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- **Traditional Medicinal Plants (Dar Es Salaam University Press - Ministry of Health - Tanzania, 1991, 391 p.)**
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  - **Introduction**
  - **OPENING SESSION: WELCOME AND OPENING ADDRESSES**
    - **Welcome address by Hon. Dr. A. D. Chiduo, Minister of Health, United Republic of Tanzania**
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  - **PART I: USE AND PROMOTION OF TRADITIONAL MEDICINAL PLANTS IN THE AFRICAN REGION**
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son valuation dans le cadre de la politique des soins de sant primaires

Chemical Evaluation of Tanzanian medicinal plants for the active constituents as a basis for the medicinal usefulness of the plants

Ethnobotany and the medicinal plants of the Korup rainforest project area, Cameroon

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Biotechnology and medicinal plants

Phytochemical investigations of four medicinal plants of Malawi: What next?

The chemistry and pharmacology of the essential oil from the leaves of Hyptis suaveolens (L) Point

Some CNS effects of Datura stramonium L (Solanaceae) in mice

Discovery and development of drugs from natural sources

A Survey of medicinal plants in Tabora region, Tanzania

Intrt pharmacognosique des plantes de la flore mdicinale Rwandaise: valeur chimiotherapeutique de quelques plantes Rwandaise

A note on the utilization and commercialisation of traditional medicine

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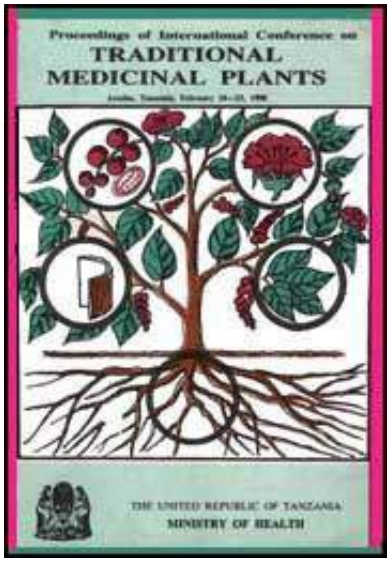

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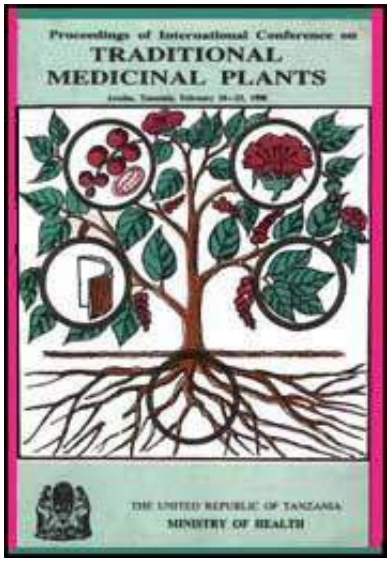
Session I



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PART IV: SESSION SUMMARIES AND DISCUSSIONS

Session I

Open Discussion

The Session Chairperson informed the Conference that the session was a general one and delegates were invited to give their views and experiences on Traditional Medicine as stipulated in the theme of the Conference.

Dr. Brancho **from Venezuela spoke on behalf of the South Commission. He pointed out that there is a growing interest and demand of Medicinal Plants in the World due to economical problems in developing countries, environmental consciousness**

and the apparent destruction of plants.

Dr. J. Koori, **the Vice-Minister for Health, Cuba, outlined policies being taken to incorporate Traditional Medicine in health care. These include the training of medical students in the field of Traditional Medicine, setting up of regional pharmacopoeia, cooperating and collaborating with other countries, and encouraging scientific research in Traditional Medicine.**

Dr. Amando Caceres, **Director of Traditional Medicine in Guatemala informed the Conference that Guatemala had established a commission to promote and evaluate the use of Traditional Medicine.**

Professor E.A. Sofowora **from Nigeria discussed the economic aspects of Medicinal plants. He recommended the formation of an International South Commission to be responsible for information and material exchange, to take care of the geographical elements, and village level plant processing and production.**

Dr. J. Arnoldo, **Ministry of Health, Venezuela, recommended collective efforts to promote traditional medicine in Latin America. He supported the Cuban idea of establishing regional Latin American pharmacopoeia so as to give the best sources of medicinal plants. He said Venezuela is in the process of introducing courses on traditional medicine for the general practitioners.**

Prof. E. Estrella, **special representative of the Ministry of health, Ecuador, said Traditional Medicine was totally outside the country's medical programme. Efforts were being made to legalise it in health care. Ecuador was in a process of taking necessary political, scientific and other actions to promote Traditional Medicine in**

the country.

Dr. K. Bhat **from Venezuela strongly supported collective effort on the promotion of Traditional Medicine in the South through international cooperation.**

Dr. W. Johnson, **Minister for Health, Sierra Leone, emphasized the need for scientists in the South to disseminate their research findings on Traditional Medicine to the general public.**

Dr. Z.R. Xiang, **Deputy Director of Science and Technology Department, State Administration of traditional Medicine of Peoples Republic of China, presented the abundant Chinese experience in research, exploitation and utilization of Traditional Medicinal plants which is now a parallel health care system in the country, citing a number of outstanding achievements in different areas including the discovery of Artemisinine, an antimalarial drug.**

Prof. ***A. Abondo*** **from Cameroon strongly advised on the need for distinguishing traditional medicine from witchcraft, and stressed the need for educating the public on the myth and reality of such medicines. He was also of the opinion that Traditional Medical practitioners should observe hygienic conditions in their course of practice.**

Finally ***Dr. Bracho*** **summarized the views expressed by the various speakers, again emphasizing the need for collaborative efforts in the evaluation of medicinal plants. He then pointed out that a report is in the course of being prepared for the South Commission on the conference's conclusions and recommendations.**

In summary all the speakers strongly stressed on the urgent need to legalize,

promote, coordinate, and accept traditional medicine as a parallel health care system in the South.

Session II

Chairman: Prof. E. A. Sofowora
Rapporteur: Prof M.H.H. Nkunya

Presentations

Prof. P.M. Sarungi **from Tanzania stressed on the need to popularize the use of Traditional Medicine in the South in order to improve health care, particularly in the rural areas where modern medicine is inadequate. He mentioned also the need to preserve and, if possible, cultivate those plant species which are threatened with extinction due to excessive commercial exploitation and villagilization schemes. He also emphasized on the need for more financial inputs to enable the collection of information on medicinal plants and their final scientific evaluation.**

Dr. Kofi - Tsekpo **from Kenya pointed out the need to identify safety, toxicity and efficacy of Traditional Medicinal Plants in the course of the scientific evaluation of these resources. This can be simplified if ethnobotanical data, methods of Traditional drug preparation and formulation and effective collaboration among botanists, phytochemists, pharmacists and pharmacologists are documented. He also commented on the recent reports of a discovery in Kenya of an anti-AIDS drug.**

Prof. Boukef **from Tunisia outlined the experience of Tunisia in scientific evaluation of Traditional Medicinal Plants. He also cited an example where**

improved agronomical methods can improve the content of active ingredients in Medicinal Plants.

Prof. Bhat **from Venezuela cautioned that no natural product should be discarded as being useless before being extensively evaluated biologically for a number of activities. He then gave eight examples where crude extracts from traditional Medicinal Plants were successfuly used to cure patients suffering from various forms of cancer, some of the patients having undergone extensive treatment with modern medicine but without success. Some had actually been considered to be terminal cases.**

Prof. Koumare **from Mali outlined the primary health care policy of his country with emphasis on the use of Traditional Medicines. The policy is based on legal, social and scientific grounds. He deplored the negative attitude of some modern medical practitioners who look upon traditional Medicine as being primitive and ineffective.**

Dr. Jonathan **from Lesotho presented her results on the phytochemical studies of a Colombian medicinal plant. Some of the compounds which she had isolated showed marked antitumour activity.**

Mr. Shauri **from Tanzania outlined efforts being made in Tanzania to incorporate Traditional Medicine in health care. He deplored the present attitude of medical personnel of referring complicated medical cases from traditional Medical practitioners to modern hospitals but not vice versa. He also deplored the present attitude of medical personnel of referring complicated medical cases from Traditional Medical practitioners to modern hospitals but not vice versa. He also**

deplored the incorporation of mythious beliefs, such as witchcraft, traditional malpractices (e.g. sacrifices, etc) and the so called godly punishment as a cause of illness.

Dr. Rwangabo **from Rwanda gave a brief description of the Centre for Traditional Medicine Research in his country (CURPHAMETRA), and its activities and achievements, citing an example of a scientific evaluation of two Rwandese medicinal plants.**

Prof. Nkunya **from Tanzania presented his results on the study of medicinal plants for their antimalarial activity, emphasizing on the need for collaborative efforts between traditional medical practitioners, botanists, pharmacologists, chemists, toxicologists, and the pharmaceutical industry. He cautioned the long term dangers of using crude plant extracts for medicinal purpose without extensive toxicological studies since quite a number of hitherto biologically active plants have also been found to be highly toxic to humans.**

Discussion

Dr. Shauri **was asked to comment on the methods of standardization and determination of the dosage of Traditional Medicines he gives to bis patients, and how he collaborates with various scientific disciplines, particularly the Traditional Medicine Research Unit.**

In reply, he admitted that standardization and determination of the dosage of traditional medical preparation, considering the diverse chemical compositions of these drugs, is difficult and challenging. However, through his collaboration with

the Traditional Medicine Research Unit and various departments at the Muhimbili Medical Centre, Dar es Salaam, he had tried to standarized the dosages for drugs used for skin diseases.

Dr. Jonathan **was asked on how she had performed the treatments, using the compounds she had isolated.**

She replied that her work had only involved laboratory experimentation and ho clinical.

Prof. Sarungi **was asked to comment on the production of *Cinchona* bark in Tanzania. In reply Prof. Sarungi, being assisted by Prof. Kilama from Tanzania outlined the history of *Cinchona* tree plantations and reported the bark is being exported for extraction of quinine.**

Dr. Fernandes **from Angola objected to all presentations, saying that African scientists are taking the wrong course in scientific evaluation and usage of Traditional Medicines. Without citing specific methods, he advised African scientists to follow Cuba's, other Latin American, and also Chinese policies.**

Dr. Kofi **was requested to comment further on the AIDS drug which is reportedly to have been discovered in Kenya, and how the plant had been chosen. In reply Dr. Kofi remarked that the drug had not been obtained from a plant, but rather it is a form of interferon, obtained through genetic engineering. He also said that the AIDS patients had been treated with the drugs are still being followed.**

Prof. Boukef **was requested to elaborate on the antihypertensive property of his drugs. Prof. Boukef elaborated on how he had carried out the antihypertensive**

tests.

Dr. Kofi **wondered about the methods used to identify the real Traditional Medicine practitioners. Do they pass any exams? Prof. Koumare replied that the real Traditional Medicine practitioners are recognized from within the village societies and are then given identity cards.**

Dr. Bhat **was requested to elaborate on how he treated his cancer patients. In reply, Dr. Bhat elaborated the methods he used to obtain his extracts and how the curative effect had been evaluated.**

Prof. Nkunya **was asked to comment on the ultimate goal of his research and what had been the dosage of his extracts and compounds. He replied that the ultimate goal of the research was to obtain chemically pure and potent antimalarial drugs which could then be utilised in malarial chemotherapy. He said that the biological tests are done by parasitologists.**

Session III

Chairpersons Dr. Dagne

Presentations

Dr. Gheyouche **gave results of studies on three plants in which aspects of microbiology, pharmacology and some phytochemistry were covered. Tests had been done on decoctions prepared as per traditional healer method.**

Prof. G.M.P. Mwaluko **presented a study on the use of *Datura stramonium,* which**

had been prompted by observation that the plant was added to local alcoholic brews. The plant was found to increase the stimulatory effects of alcohol. The study had used the open field test method. He expressed concern since the dosages used are not known.

Prof. W. Boping **presented a very detailed paper on the use of medicinal plants in China. He stated that the uses cover many diseases and the plants are well documented in the Chinese pharmacopoeia. He stressed the importance of the use of traditional approach in studying medicinal plants.**

Dr. P.C. Rwangabo **gave a report of a comprehensive study on Rwandese plants. The paper gave results on three plants where identification of chemicals responsible for the major activities was possible. Antifungal and antiviral activities were also noted.**

Discussion

Dr. Armando **wanted to know from Dr. Gheyouche whether her results were not due to a collective effect of different components. He also wanted Prof. Mwaluko to comment on the toxicity of *D. stramonium.***

Dr. Gheyouche **answered that she was only interested in establishing relationship rather than mechanisms. Prof. Mwaluko informed Dr. Annando that chronic toxicity studies have not yet been done.**

Dr. M. Cajias **wanted to know the type of animal disease treated by plants discussed by Dr. Rwangabo.**

Dr Rwangabo **replied that the plant sap is used in special quantities to treat calf intestinal parasites. Very effective and popular but scientific analysis is yet to be done. He also explained that all plants are potentially toxic. The three plants studied were not very toxic and are commonly used by traditional healers. In general, all drugs are toxic, it only depends on the dose given.**

Dr. Kofi **made a general comment to the effect that what cures also ills. In studying traditional medicine, the most important aspect is to utilise well what is active, not necessarily to isolate single entities. However, this can be necessary in establishing dosage.**

Dr. Elmi **wanted an elaboration of latest information on the drug Artemisinine.**

Dr. Boping **answered that the latest information is available in literature as studies are now also being done in Japan and USA. Information on the other plants was available in Chinese Traditional Medicine Pharmacopoeia. Participants supported that there is now a lot of literature on Artemisinine.**

Dr. Abondo **made a comment on the plant in Dr. Rwangabo's paper which he felt, was wrongly named. After a number of contributions from the floor on this possible mistake, it was agreed that all botanical names must be checked by appropriate experts and specimens be sent to herbaria for future reference. This is important because wrong names may be misleading during studies.**

Dr. Abondo **wanted to know how the traditional healer is protected should his plant prove to be commercially viable. In addition, Prof. Mwaluko wanted to know if traditional medicine needs to go through a research process as it is with the**

western medicine (Which may take 10 years).

***Dr. Duale,* the WHO representative, in answer to both questions drew attention to the objective of the conference, and urged participants to think about these issues and come out with recommendations.**

Session IV

Chairman: Dr. W. Kofi-Tsekpo
Rapporteur: Dr. M. Cajias

Presentations

***Prof. Asmoah* reported on the toxicity and pharmacology of some selected plants from Ghana. Four plants bad been studied for antimalarial and antimicrobial activity, both in *vivo* and vitro with promising results similar to tetracycline. A number of alkaloids were isolated and identified, some of them being new compounds. He recommended careful pharmacological studies.**

***Dr. J.D. Msonthi* reported that there is a good co- operation between the traditional healers and modern practitioners and chemists in Malawi. He said the major problem was lack of equipment. He reported also that the traditional medicine is now incorporated into modern medical care. He reported the isolation of compounds with anticancer activity from *Hyposis* species. The compounds also showed antimalarial activity comparable to quinine.**

***Dr. S.R. Malele* described the biotransformation of hydroxyanthroquinones glycosides from *Cassia* species. Two biogenetic pathways were given. Tissue**

cultures method with isotope labelling were described.

***Dr.* M. *Cajias* gave a general overview picture of the state of traditional medicine in Bolivia. She strongly recommended the integration and co-operation between traditional and modern medicine.**

Discussion

***Prof. Koumare* said we are trying to look into traditional medical system from scientific point of view. He generally felt that no solid ideas are precipitating out, and the whole issue is still confused. He said it was necessary for the conference to agree on what we want to do. He suggested that delegates should keep in mind the objectives of the symposium during the discussions.**

***Dr. P.C. Rwangabo* asked Dr. Msonthi to give details of antimalarial, and anticancer activities, and the model used. He also asked Dr. Malele if he did any pharmacological studies. He commented and showed satisfaction of Dr. Cajias presentation.**

***Dr. Msonthi* responded that cancer was a human colon. Dr. Malele said that glycosides and cyanocides release compounds which are active in the intestine.**

***Dr. Jonathan* strongly suggested identification of a centre with facilities to carry out research and exchange information on traditional medicines.**

***Ms Z. Nuru* (Chairperson of the Conference) responded that at the end of the day we shall streamline the strategy of the symposium.**

Dr. K. Akhiri **commented on Prof. Asmoah's paper that he would not advise patients to take the drug because it has hypoglycaemic activity, and could be dangerous to diabetic patients.**

Prof. Asmoah **responded by saying that toxicity studies should not be extra plated but they should be used as precautions.**

Prof. Dagne **told Dr. Malele that he doesn't believe chrysophanol will give emodine as the two will not have the same biogenetics. Dr. Malele replied that probably Dr. Dagne is correct.**

Dr. ***Abondo*** **commented that most of the papers presented did not address to the objectives of the conference. He raised a serious concern on Dr. Msonthi's paper on care of carcinoma without thorough scientific studies.**

Dr. Msonthi **responded by saying that he is a phytochemist and other relevant institutions with competent experts were used for the testing.**

Prof. Mwaluko **commented that Msonthi's results were from laboratory work, and were subject to further investigation.**

Dr. Fernandez **from Angolan stressed the need of mass education on all fronts.**

Dr. Bhat **commented that the papers presented were of specialised nature and not very relevant to the objectives of the conference. Traditional Medicine should be the interaction of the drugs with the patient. Drug tolerance should be considered.**

Prof. Elmi **stressed on the need of feedback of information from the scientists to**

the traditional healers.

Prof. Asmoah): **was asked if there was any abuse of the plant described with morphine type of activity? He replied that the government would will take appropriate precaution on the abuse of such plants.**

Dr. Mapunda **commented on the participants' insistence on the isolation of active ingredients followed by the synthesis, rather than adopting the position of traditional medicine in health care.**

Ms. Zahra M. Nuru **(Chairperson of the conference) noted that the participation on the first objective of the symposium had been very well covered, while other objectives were much less covered.**

Dr. Wakori **described biological and phytochemical screening leaflets of cassia didymobotrya.**

Dr. D. W. Kioy **described in detail the basic schemes of isolation and identification of natural products.**

Dr. F. Mirez **gave a general lecture which included information on his institute in Peru. He described the general procedure of the treatment, in different stages, of various diseases. The plants used for treating tuberculosis were reported.**

Dr. Thiambino **gave a general lecture on the geography population, and land statistics of her country, including government policy on traditional medicine. She also reported on the commercial production of some drugs from medicinal plants.**

Session V

Chairman: Dr. A. Caceres
Rapporteur: Dr. J. D. Msonthi

Presentations

Mr. Ventura Galegos **(Mexico) stated that man is his own victim. He becomes sick because of his own technology. Therapeutic medicine is necessary for good health. Plants are used to prevent illness and keep the body equilibrium stable.**

Mr. Wodwell Vongo **- (Zambia) gave the definition of traditional medicinal plants and traditional medicine which is holistic, covering such aspects as cultural heritage, beliefs and customs passed from one generation to another. He said he is the Secretary General of an association of traditional practitioners in Zambia, and a member of the International Centre for Traditional Medicine in Central and Southern Africa, whose headquarters are based in Bulawayo, Zimbabwe. He gave a brief history of his training as a traditional healer. He said that traditional medicine is not fully understood by medical doctors who usually condemned and rejected it. It is important that the two disciplines learn from each other. Traditional medicine is a practical science that requires sincerity and commitment. Illnesses include psychosomatic diseases, normally managed by traditional healers, while some organic illnesses are better treated by orthodox doctors. Where there is overlap, there should be proper referral systems between the two disciplines. He stated that traditional medicine, if used conjointly with modern medicine, will effectively bring good health care. Traditional healers should be helped by scientists in such areas as toxicity studies and posology, and**

governments should offer financial contributions towards training, legislation, and certification of Traditional Medicine, to reduce dependence on foreign exchange and bring about improved health.

Mr. Steven K. Makuu **(Tanzania), on behalf of the healers who attended the conference, said that they were appreciative of their being invited. They use plants, seaweeds and other items to treat such illnesses as stroke, hypertension and AIDS. He said there was a need for the formation of an association which will link them with the government. There is need to establish medicinal plant fora, which would help to popularise traditional medicine at national level, to co-operate with pharmaceutical companies, and exchange information/and statistics, through journals and meetings, in the South Commission States.**

Mrs. Hawa Nyamwicho **(Tanzania) informed the delegates that she had successfully treated AIDS patients. She said all Holy Books state that all kinds of diseases can be treated, e.g. in the Koran, honey from the bee is used to prevent illness. She gave examples of cases which were treated for cancer, oedema, hydrocephaly, sterility and AIDS. In traditional medicine, the patient is harmonised with nature. She stated that stress and worries cause body unbalance and diseases, and these can be treated.**

A request was made for scientific contribution to enhance the knowledge on medicinal plants and the introduction of large scale production of drugs from plants. The traditional healers are not all quack: they have a duty before God to help patients.

Discussion

Dr. Antonio **(Angola) and** ***George Washington (Brazil)*** **wanted to know the names of the plants in the formulation given to AIDS patients. The response given was that the concoction was made from several plants, and that a special diet which boosted the patient's immune system is also required.**

Honorable Minister of Health of Sierra Leone, Dr., Johnson. **The Minister reminded the scientists to uphold mutual respect of the two disciplines. Thus traditional healers should be treated with due respect, and it was therefore uncalled for that the Lady Traditional healer be asked to reveal the contents of her formulation.**

Dr. Kofi (Kenya) **confirmed the use of animal and plant material by a herbalist in Kenya on a patient who suffered from same ailments.**

Dr. Bacon **(Botswana) gave details of the export of root tubers of the grapple plant at a very low price and import of the same product in tablet forms at a very high price. This was in connection with Dr. Vongo's sample which was circulated.**

Dr. E. Estrella **(Ecuador) observed the fact that traditional medicine in Latin America is similar to that in Africa and is divided into two categories, country diseases which are psychosomatic and better handled by traditional healers using symptomatic diagnosis, and urban diseases, which are treated by modern doctors and traditional healers.**

Dr. P.C. Rwangabo **(Rwanda) wished the Tanzanian lady herbalist good luck in her endeavour to treat AIDS patients, and hoped she would get every help from scientific community to develop her drug.**

Dr. Jonathan **(Lesotho) suggested that traditional medicine be incorporated in**

medical school curricula if the gap between the two disciplines, is to be bridged.

Mr. Vongo **(Zambia) urged that scientists should look at traditional medicine with a critical but open mind. He also stated that discipline has limited skills, and can play a role towards health care through a referral system. He emphasized that common language is necessary for the two disciplines to understand one another.**

The Hon. Minister of Sierra Leone Dr. W. Johnson **urged that we should try to process our medicinal plant formulations first for home consumption before we think of exports. We should promote co- operation through mutual respect, since traditional medicine is also a science. There is a need to respect the Lady traditional healer (Mrs. Nyamwicho), to protect integrity, and discoveries.**

Dr. F. Mirez **(Peru) reported that there were about 16 HIV positive cases treated for AIDS in Brazil using the following herbs: *Ambrosia, Eseteria, Mentha periralis, Mintostachy, Peragonia Perezia* and *Uncaria tomentosa* He stated that the people of Peru believe disease to be caused by lack of body balance and change of life energy, and that some spiritual diseases are treated in a ritual called "passing the egg".**

Professor Koumare **(Mali) suggested that traditional healers should be encouraged to use local terms and avoid the use of medical terms when discussing their work. He emphasized that there is need a for a true exchange of understanding through respect between the two systems.**

Ms. Zahra Nuru **(Chairperson of the Conference, Tanzania), requested the delegates to digest the message from the Chairman of the South-South**

Commission, and bring up comments for a discussion on the final date of the conference.

Session VI

Chairman: Prof. Koumare
Rapporteur: Prof. A. S. Elmi

Presentations

Dr. Waane's **paper was on the cultural context of using traditional medicine. It covered such aspects as life on the planet, attitude when in trouble (turning to nature for help), and the three operational spheres of household: home, region, and wilderness. The traditional medicinal plants and other medical practices are but natural associations of the human race. He stressed on the need for total cooperation and collaboration between the two medical systems.**

Dr. E. Njau **gave the history of the development and commercialization of drugs from natural sources, e.g., morphine in the 18th century. He pointed out that the development of a modern drug, which is patented, is exceedingly costly, while, on the other hand, traditional drugs cannot be easily patented, and are less expensive in general. He stressed that our chances of protecting our traditional medicinal products with the existing legislation, are rather remote.**

Dr. E. Dagne **gave a brief account of the medicinal plant sale in the local market in Ethiopia. He argued that identification of the samples is difficult in such cases. Nevertheless pharmacological studies showed their medicinal values. For example,** ***Taverniera abyssinica,*** **was shown to be biologically active. In another study some**

anthraquinones were separated from Aloes.

Prof. A. S. Elmi **expressed that the use and acceptance of medicinal plants in Somalia is wide but varied. In 1977 Somalia started the systematic evaluation of the medicinal plants, but experience showed that it was not a very satisfactory way of carrying out the studies; so a more direct approach was applied, which was the application and use as per traditional healer methods, after the toxicity studies had been carried out. There is also a mechanism of passing on information to the healers.**

Dr. F. Mbenkum et al., **elaborated on the situation in Cameroon. He gave a detailed description of the study of traditional medicinal plants grown in Korup area, Cameroon, and described the inventory of the medicinal plants of the area. There is a Herbarium based on the medicinal plants of the Korup area and the traditional medicines of the area are equivalent to the common drugs.**

Mr. R.L.A. Mahunnah **expressed the importance of ethnobotany and conservation of medicinal plants. Ethnobotany is much more than names of the plants for it gives information about all the characteristics of the plants as far as possible.**

Prof. Kofi-Tsepo **presented Prof. Akerele's paper which stressed the importance of the following:**

(a) the need for registration and the establishment of associations;
(b) listing of the herbal remedies used in each country, and
(c) establishment of safety laws.

Prof. K. E. Mshigeni **gave a detailed account of the use of seaweeds in medicine**

and pharmacy. He elaborated on the potential of seaweeds, including the possibility of enhancing seaweed biomass production through farming. He also reported that is extensive research going on to screen seaweeds for new drugs. The Third World as a whole should look into the neglected seaweed resources.

Dr. J. Bacon **gave an account on studies of the *Lippia javanica* and *Harpogophtum procumbens,* medicinal plants of Botswana, from which a number of compounds were reported. The grapple plant is marketed in the area. He stressed on the need to produce such drugs locally, rather than to re-import the material at very high cost.**

Mr. C.K. Mutayabarwa **reported on the anti-epileptic properties of the essential oil of Hyptis suaveolens, which consisted of 60 components. The activity is due to the collective action of the oil.**

Dr. R. Tokarski **gave an elaborate video programme of the cultivation, production and final processing of medicinal plants on industrial scale in Brazil.**

Prof. M.R. Khan **reported on the testing of medicinal plants for their antibacterial properties, and also on the phytochemistry of over 200 plants used in Tanzania.**

Mrs. J.A. Aluoch **reported on the use of medicinal plants in the treatment of bronchial asthma. The work had been done by a traditional healer, and was confirmed by a modern clinician.**

Dr. N. Koita **reported on his comparative study of the medicinal plant *Cassia occidentalis* and chloroquine, on two groups of patients suffering from malaria.**

Dr. K. Ikhiri **gave a report on his country's activities in the field of traditional medicine. There were 400 medicinal plants, out of which 200 were studied. Some of the plants were used against dysentery and diabetes in Niger.**

Discussion

Dr. Rwangabo **(Rwanda) wanted to know from Dr. Koita if any other studies had been done before the clinical trials, and how ethical problems had been dealt with. He responded that no laboratory studies had been conducted. They were dependent on the traditional use. Patients had been consulted before the treatment. No placebo was used.**

Dr. Kofi **said he appreciated the work by Mr. Mutayabarwa for his antiepileptic study. He also made a general comment to the traditional healers, requesting them to inform the other participants on how they control their dosages.**

Prof. Mwaluko **directed a question to Mrs. Aluoch, asking her to elaborate on the mode of administration and efficacy of the reported remedy. This was particularly important since the disease is chronic. He also asked for an elaboration on the duration of the follow up.**

Mrs Aluoch **responded that the route of administration was through intranasal for one of the drugs, and oral for the other two. The attack on a sixteen year old patient has not recurred since 1987.**

Prof. Abondo **asked Prof. Akerele to comment why the list of countries in his paper embraced only the English speaking states. The response was that the information collected had emanated from an English speaking workshop. For the Francophone**

a similar workshop will be held in 1990.

Dr. Vongo **pointed out that scientists should exchange information with the healers on collecting the plants, and on the results of their research, e.g. toxicity.**

Mr. Twalib **asked Mr. Mutayabarwa whether any cost elements had been studied with regards to his plant. Mr. Mutayabarwa responed that the study was still continuing and that the costs would be looked into.**

Dr. Upunda **re-stressed the need for using appropriate terminology.**

Dr. Estrella **commended Dr. Koita for their paper on the treatment of malaria. He was happy that he now knew two new plants for treating malaria.**

Dr. Tokarski **stressed the importance of proper eating habits for good health, especially where traditional medicinal plants play a part. The comment was also supported by Dr. Bracho. Dr. Tokarski further explained the pricing system in Brazil and what they had done to help the local people use the home remedies.**

Dr. Caceres **made a general comment on his visit. He had no intention of insulting anyone, but his aim was to come and try to bring cultures together, share experiences, find means of joining people to have a common front, so that we have our plant resources available for everyone.**

Ms. Zahra M. Nuru **(Chairperson of the Conference) said Dr. Cacere's paper would be included in the proceedings. The Conference was designed to cover scientists, traditional healers, policy makers, and enterpreneurs, so that the gap existing between modern and traditional medicinemen could be bridged, and appropriate**

recommendations and resolutions could be made by all the participants, collectively.

Special Session of Traditional Herbs

Traditional Healers from Tanzania held a special session, discussed issues of mutual interests, and made resolutions as follows:

1. We, Tanzanian traditional healers, attending ICMP meeting, have the following views and resolutions:

(a) We, the traditional healers in Tanzania, have used plants from land and from the sea, to cure the following diseases:

- **Mental disorders**
- **Epilepsy**
- **Stomach disorders**
- **Asthma**
- **Cancer**
- **Blood pressure**
- **Diabetes**
- **Infertility**
- **Haemorrhoids**
- **Paralysis**
- **Aids (HIV)**

(b) Traditional healers should have an organization to coordinate their activities, and the same organization should serve as a link between the

Government and the traditional healers.

2. With regard to the production of medicinal plants, we recommend that:

(a) Whenever possible, special gardens should be established for the cultivation of medicinal plants.

(b) Whenever possible, special reserves (National Medicinal Reserves) should be set aside for the conservation of medicinal plants. Such reserves should be established by the healers, in collaboration with the relevant state organs (e.g. Ministry of Lands, Ministry of Agriculture, etc.).

(c) The traditional healers organization should liaise with pharmaceutical industries, which need raw materials for traditional medicine. The organization should have legal status like a cooperative union.

(d) Developing countries should form similar organizations to facilitate collection of data, and the establishment of inventories of medicines and diseases, and the sale of medicines.

(e) There should be a forum for the exchange of information, journals, research findings, and other developments in developing countries.

(f) Whenever possible, regional centres should be established to strengthen cooperation and data collection from different countries.

3. Present

N. E. N. Shauri - Chairman
S. Makuu - Secretary
M. S. Msemo
T. A. Dyakaya
H. Nyamwicho
A. M. Mapembe
H. I. Messo
J. Benda
O. B. M. Shajari
J. K. Lyamba
L. G. Ngalianguo
Dr. S. Mnaliwa - Advisor, ICMP Secretary

Closing Session

CLOSING SPEECH BY MS. ZAHRA. M. NURU
PRINCIPAL SECRETARY, MINISTRY OF HEALTH

Your Excellency,
Ladies and Gentlemen,

We have a Kiswahili adage which says, "hakuna mwanzo usiokuwa na mwisho;" which means, "there is no beginning without an end." Nevertheless, today is our last day of this busy week in our beautiful town of Arusha. It is with great pleasure then that I take this opportunity to invite those of you who attended this educational and unique conference on medicinal plants.

Distinguished participants, during the last six days we have had a rare occasion to deliberate on various issues about this virgin subject area. You have proved that research work on medicinal plants has reached an advanced stage. You have also proved beyond doubt that the research on traditional medicine has been conducted jointly and cooperatively and tests have been made on various patients.

I hope that the knowledge gained in this conference will be of greatest assistance in your future endeavours towards strengthened cooperation among countries of the South in the areas of exploration, exploitation and application of research results in the field of medicinal plants.

Let me take this opportunity to re-emphasize three points. Firstly, in the original plan you bad listed five objectives of the conference. From what I have been able to gather informally, there are clear indications that you have covered them all. Understandably, given your own training and career orientation you may have, at some point, been carried away by professional exchanges of the differing experiences in your respective regions. But that should not rule out the facts that once issues of application and acceptability emerge, your field becomes more to other dimensions and require the input of other professions. At that point, the need for helping bands from other disciplines is inevitable; hence the need to adopt a much more multidisciplinary approach. It is my sincere hope that the type of exchanges witnessed at this conference will subsequently enrich your perspectives on research on medicinal plants and in the popularization of your respective results.

Secondly, it has always been a dream of the Chairman of the South Commission, Mwalimu Julius K. Nyerere, to find an opportune time to bring together people of

your calibre and integrity to deliberate on the subject matter of this conference. Today, the dream has finally come true. If self-reliance means using our own resources to the maximum and for the benefit of our people, this conference proves quite vividly the existence of enormous resources in the form of real potential of the traditional medicine in the South.

As a means of strengthening our moves towards self-reliance in the medical field, the challenge ahead of us is to disseminate, as aggressively as possible, all that we feel is fully researched on. Therefore, closing the knowledge gap in this area represents one of the pressing challenges. The pivotal role of our traditional healers deserves closest inspection and attention.

Thirdly, I have been impressed by the contributions of Tanzanian participants. I believe that the experiences of other participants will greatly strengthen the ability of our local experts so that they could fully utilize the existing potential of medicinal plants in Tanzania. The Government of Tanzania looks forward to your recommendations which will be digested carefully to facilitate assistance to those of you who are directly involved in the country's traditional medicine scene.

Distinguished participants, let me end by thanking all those who have contributed to the success of this conference by organising and sponsoring delegates. I would tike to single out WHO's further support, to Africa through Dr. Monekosso and Dr. Bracho who assisted in coordinating the Latin American participants with UNDP and UNEP. Allow me to express our heartfelt thanks to a unique group of people without whose commitment and dedication, this conference would have foundered. I am also extending my sincere commendations to our interpreters, translators, secretaries and typists for their excellent work. I will not forget our

hosts, the AICC for their hospitality. To all, let me take this opportunity to express my sincere appreciation. My appreciation should also go to the traditional healers who participated in this conference. I request them, to pass on to their colleagues our sincerest appreciation of their useful role in our societies. I propose that consideration should be made to invite a good number of them in subsequent meetings.

Once again, I take this opportunity to propose that the knowledge gained from this conference should also guide our plans for the future. Such meetings should be set as our unity plans for the future and should act as unifying forces to try and examine all that we have discussed here. In future, the meetings could consider exchanges with a view to finding out if the objectives and recommendations reached at this conference have been met.

Let me conclude by wishing you the best in all your future endeavours. For those of you who will be leaving soon, I say ton voyage, Buen Viaje Felicidades. And for those who may have to extend their stay for various reasons, I can only say, KARIBU SANA Tanzania.

I now have the honour and privilege to close this conference.


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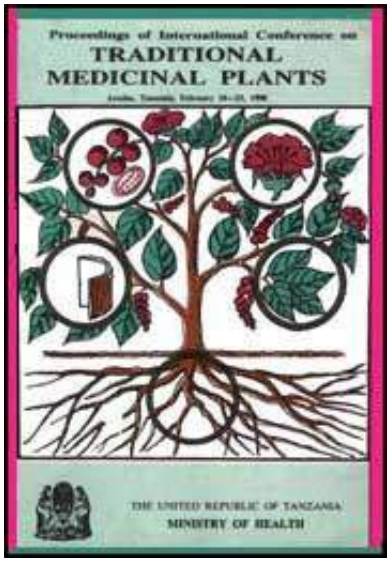
Traditional Medicinal Plants (Dar Es Salaam University Press - Ministry of Health - Tanzania, 1991, 391 p.)



Traditional Medicinal Plants (Dar Es Salaam University Press - Ministry of Health - Tanzania, 1991, 391 p.)

PART V: GENERAL SUMMARY RECOMMENDATIONS AND RESOLUTIONS

English Version

GENERAL SUMMARY RECOMMENDATIONS AND RESOLUTIONS

General Summary

1. Introduction

1.1 Traditional medicine has been always a key resource to meet the health needs of Third World peoples. In the past, it was in fact, the only way which existed in the Third World to meet such needs. But even today, in spite of the widespread

advances of the modern medicine model, according to the World Health Organization, most people of the Third World continue to rely on their traditional medicine to meet their primary health needs. This very resilience of traditional medicine in the face of advances of modern medicine says a great deal about its effectiveness since health is one vital need people cannot afford to deal with lightly or ineffectively.

1.2 Moreover, increasingly apparent shortcomings of the Western medical model to meet the health needs of people, particularly in the field of growing lifestyle-related endemic diseases such as cancer and cardiovascular ailments as well as the increasingly staggering cost of modern medical care, are creating an upsurge of interest in the benefits of the more holistic and less expensive traditional medicine to treat those health problems on which modern medicine seems to be systematically failing. Regarding the cost factor, it is necessary to add that in the case of Third World countries, the dramatic worsening of their economic situation and their almost total dependence on the importation of modern pharmaceutical drugs and technology from the North, is accelerating their renewed interest in the more indigenous-based traditional medicine as an alternative to redress the inadequacies of their modern health system and in order to be more self-reliant.

1.3 The use of traditional medicinal plants has been the basis of the practice of traditional medicine in the South. Most of the medicinal plants of the world are, by and large, located in the tropical areas of the South, which contain about two-thirds of the plant species of the world, out of which at least 35,000 are estimated to have some medicinal value. A number of these plants appear to be on the verge of extinction because of man's irresponsible destruction of their natural ecosystems, which makes such plants even more valuable.

1.4 However, the sovereign use by countries of the South of these valuable resources for the benefits of their people is threatened by the unchecked profit-making interests of the major pharmaceutical companies of the North. Indeed, the exploitation of medical plants has become a booming business to the tune of billions of dollars in terms of world production and trade. But the problem is that such companies, which have for many years held a monopolistic control on the production of synthetic chemical drugs, are now in the process of expanding that control into the field of herbal remedies, through an unscrupulous acquisition of the plant species and knowledge of the traditional peoples of the Third World. They are also restricting patenting and privatisation of the plant species and knowledge of the traditional peoples of the Third World for their monopolistic use to the detriment of the rights and interests of Third World. This disquieting situation calls for militant action on the part of the countries of the South to defend their rights, and for an international cooperative action to ensure that the precious medicinal plant resources of the Third World are protected from the monopolistic privatisation drive of the transnational pharmaceutical companies and are preserved and developed for the democratic and equitable benefits of the world's peoples.

1.5 In the light of the above situation, the countries of the South should vigorously strengthen their cooperation in the fields of drawing up inventories, nationally and collectively, of their medicinal plant resources, as well as in the cultivation, processing, marketing and in general widening the use of herbal medicine to meet the health needs of their peoples, in accordance with the objectives of self-reliance, respect of cultural heritage and of the integrity of the natural ecosystem.

2. Preamble

The overall objective of a South - South cooperation on medicinal plants should be the optimal utilisation of these plants in a standardised form by the people of the developing countries.

3. Objectives

3.1 To provide a forum for exchange of information and experience in the use of medicinal plants and related programmes in developing countries.

3.2 To discuss modalities of cooperation in drawing up of systematic inventories on the use of medicinal plants including their comparative analysis.

3.3 To review cooperation on the joint promotion of the use of medicinal plants including cultivation, processing and marketing.

3.4 To discuss issues related to ethnobotany and conservation of medicinal plants.

3.5 To review the implementation of financial, institutional, technical resources and legal requirements for promoting cooperation.

4. Exchange of Information and Experience

4.1 In order to fulfill the first objective, generation of information is required, based on research which will provide scientific back-up for the efficacy and use of medicinal plants.

4.2 The International Conference noted that:

4.2.1 There is inadequate exploitation and utilisation of the existing information that has already been generated by researchers for the benefit of the people.

4.2.2 Not all institutes of Research in Traditional Medicine have the facilities to work on medicinal plants in a multidisciplinary way involving herbalists, botanists, pharmacists, medical doctors, anthropologists, etc. collaborating together.

4.2.3 There is existing information about safe and efficacious medicinal plants in some countries of the South (especially China, Egypt, India and several other Asian countries) which could be tapped by other countries of the South.

4.2.4 There is existing expertise on modes of production of extracts, powders, tea bags and other simple dosage forms from medicinal plants in the Asian countries that can be tapped.

4.2.5 The present meeting has provided a temporary forum for exchange of information on the development of medicinal plants. On a long-term basis, the non-aligned countries have designated the Republic of Korea to see to the modalities for providing a permanent structure for such information exchange on medicinal plants.

4.2.6 Researches carried out and being carried out on medicinal plants continue to produce patentable information which should be protected on a Regional basis

5. Inventories of Medicinal Plants and their Analysis

5.1 The Conference recognised that medicinal plants are already playing a major role in the health care of the population of the South. While the efforts that have already been made in the research and development of medicinal plants are welcomed and appreciated, it is recognised that these undertakings are often uncoordinated and that results from such efforts are minimally disseminated and have limited application to the health problems of the population of the countries of the South. It is also recognised that the economic benefits that could be derived from the exportation of medicinal plants is not being realised. It is recognised that traditional medicine research in the countries of the South is in different stages of development.

6. Promotion of Use of Medicinal Plants

6.1 There are no readily accessible data banks at regional and interregional levels for traditional medicinal plants.

There is a great need to create a data bank of traditional medicine incorporating such information as:

- **local and scientific name and identity of the plant;**
- **latitude, longitude and altitude for cultivation;**
- **morphology of the part used (root, bark, flower, seed, etc.);**
- **use and form in which part is used.**

7. Ethnobotany and Conservation

7.1 Cultivation and large scale farming of traditional herbs will facilitate promotion of traditional medicine. In this regard attention should be paid to:

- **collection;**
- **drying under shade to preserve vitality;**
- **quality control to preserve somatic homogeneity;**
- **products should be given an expiry date;**
- **hygienic conditions to be used in preservation and storage; and**
- **conservation *in situ* and *ex situ* should be done with special attention to endangered species.**

8. Resources for Implementation

8.1 In order to implement the recommendations contained in the first four objectives, it is imperative that financial, institutional, technical and legal requirements to promote cooperation be established.

Recommendations

9. The conference agreed on the following recommendations:

9.1 *On exchange of information*

9.1.1 As far as possible, research centres on medical plant development should work in a multidisciplinary manner involving the traditional healers and the relevant science discipline from the countries of the South.

9.1.2 Efforts should be made to transfer existing information and expertise

on medicinal plants to the other countries of the South for immediate application as appropriate.

9.1.3 Priority should be given to research which will generate information that could provide scientific backing for the efficacy of traditional medicinal plants, their standardisation and their formulation into simple dosage forms.

9.1.4 A list should be generated of existing expertise and research and development facilities in the countries of the South for researchers, to reduce dependence on the countries of the North for assistance.

9.1.5 Information generated on medicinal plants should be diffused not only among scientists, but also among the traditional healers and the people as much as possible through newsletters, the mass media, symposia, and the recognised scientific journals.

9.1.6 Existing regional facilities protecting discoveries should be strengthened to cover new developments emanating from medicinal plant development work.

9.2 *On Inventories of Medicinal Plants and their Analysis*

9.2.1 A mechanism for every region of the South, and an interregional mechanism for the selection of research priorities should be established. It is important that regular meetings for these bodies should be held to oversee the smooth functioning of such mechanisms.

9.2.2 National research centres should be identified and linked into a regional network, with well-defined tasks to be undertaken on behalf of the countries of the South.

9.2.3 These national research centres and all other centres within the network should be strengthened to undertake the denied allocated tasks.

9.2.4 National surveys of medicinal plants should be undertaken by all countries of the South. Such surveys should identify medicinal plants that could be utilized in the health services system.

9.2.5 Because of the diversity of ethnopharmacological information that may be generated from various regions and provinces in the same country, plant surveys should be initiated at sub-national levels. Information derived from these surveys should be analysed locally as well as at national levels. Furthermore, these national surveys of medicinal plants should be geared towards solutions of the prevailing major health problems.

9.3 *On Ethnobotany and Conservation*

9.3.1 Practical exchange of ethnobotanical information should be encouraged.

9.3.2 Selection of herbs for cultivation should be geared towards solving pertinent health problems locally or regionally.

9.3.3 Harvesting and processing of medicine plants should be done so as to maintain the integrity of the ecosystem.

9.3.4 Inventories of expertise should be undertaken at local, regional and interregional levels.

9.3.5 Extension services and education which are a necessary feature in promotional use of traditional medicines should be encouraged and adequately strengthened.

9.3.6 Pricing and profit levels which ensure the widest access to herbal remedies should be established and maintained.

9.3.7 Regional laboratories should be identified which should study and analyse traditional medicinal plants of selected major therapeutic values and promulgate standards of efficacy.

9.3.8 A national list of essential traditional herbal remedies should be established which should correspond to the prevailing common diseases pattern.

9.4 On *Resources for Implementation*

9.4.1 An interregional mechanism should be established in order to:

- **keep under review the progress made in the implementation of the proposed recommendations; and**
- **undertake such new actions, as necessary, in order to strengthen cooperation among countries of the South in the field of medicinal plants.**

The interregional mechanism should aim at the holding of bi-annual meetings in order to facilitate this work.

9.4.2 Until the first biannual meeting is held, the government of the United Republic of Tanzania should act as the interim secretariat. To this end, all participants and concerned international institutions should assist the Tanzanian Government in the facilitation of this study.

9.4.3 An initial plan of action is recommended for each member country to work upon. This would be on the theme of utilization of medicinal plants in health care system.

9.4.4 Countries should be encouraged to create national bodies to handle medicinal plants research development, dissemination and utilization from a multidisciplinary and inter-institutional approach.

9.4.5 Interest should be raised to donor and cooperation agencies to make financial and technical resources available for national; regional and international levels in the field of medicinal plant research and application.

9.4.6 Each Member State of the South should endeavour to adopt at national level, the various recommendations contained in the subject one to four and earmark specific and significant resources to implement them.

9.4.7 The interim coordinating secretariat as well as Member States should liaise with existing organizations working on the development of medicinal plants in their respective regions.

9.4.8 An interim international organizing committee should be appointed by this Conference to monitor progress of implementation of the recommendations made at this meeting and prepare for the next meeting.

9.4.9 Legislation to foster the use of herbal medicine in health services should be undertaken by all the countries of the South bearing in mind the distinctive nature of herbal medicine. To this end, the experience of other countries and international organizations such as WHO and the International Drug Regulatory Authorities should be made readily available to countries in need of such information.

9.4.10 Claims of intellectual property rights such as patents on plant-derived remedies should ensure that persons and communities involved in the discovery of the drug (including traditional practitioners who supply information that may lead to new discoveries) are appropriately rewarded. Countries should have a policy on how potential income from this discovery might be distributed including ensuring popular access to such remedies at a cost the communities can afford.

9.5 Known pharmacologically active produces (for example tincture of atropine) derived from local plants as well as pharmaceutical aids (such as starch which can be locally extracted and produced) should be manufactured as import substitutes and used as part of the national essential drugs programme.

9.6 Programmes for the production of standardised and safe galenical traditional preparations for use in the health service should be established.

9.7 The recommendations of the Conference should be brought to the attention of the highest national authorities and governing bodies of relevant international agencies and non-governmental organizations.

Resolutions

10. On Recommendations 9.4.8 the following resolutions were made:

10.1 The recommendation referred to above was unanimously accepted.

10.2 The Principal Secretary, Ministry of Health, Tanzania, was appointed to serve as Interim Secretary for steering progress towards preparation for the next meeting, and also towards implementing the rest of the recommendations.

Spanish Version

CONFERENCIA INTERNACIONAL DE EXPERTOS DE LOS PAISES EN DESARROLLO SOBRE PLANTAS MEDICINALES TRADICIONALES

Introduccin

1.1 La medicina tradicional siempre ha constituido un recurso fundamental para las necesidades de salud de los pueblos del Tercer Mundo. Ella constituy en el pasado la nica forma que tenian estos pueblos para cubrir sus necesidades. No obstante, a pesar de los avences obtenidos por el modelo moderno del occidente segn la OMS muchos de los pueblos del Tercer Mundo, continan dependiendo de la medicina tradicional para cubrir sus necesidades primarias de salud. Est permanencia de la medicina tradicional ante el avance de la medicina moderna nos

demuestra en gran medida su efectividad si tenemos presente que la salud es una necesidad vita) que los pueblos no pueden darse el lujo de tratar en forma ineficaz o a la ligera.

1.2 Ademas, crecientes limitaciones obvias del modelo moderno para atender las necesidades de salud de los pueblos, particularmente en el campo de las cada vez ms frecuentes enfermedades endmicas relacionadas con el estilo de vida, tales como el cncer y transtornos cardiovasculares asi como el creciente costo de la atencin mdica moderna, estn creando un vigoroso interst en el mundo por la medicina tradicional cuyos medicamentos son ms baratos y eficaces para el tratamiento de aquellos problemas de salud en los cuales la medicina moderna parece estar fallando sistemticamente. Teniendo en cuenta el factor de costo, es necesario aadir querel caso de los pases del Tercer Mundo, la agudizacin de su situacin econmica y su casi total dependencia en la importacin de tecnologa y medicamentos modernos desde el Norte, est acelerando el inters en la medicina tradicional indigena, como una alternativa para enfrentar las limitaciones del sistema de salud occidental y para alcanzar una mayor auto-sustentacin.

1.3 La utilizacin de las plantas medicinales tradicionales ha sido esencial en la prctica de la medicina tradicional en el 3Sur. La mayora de las plantas medicinales del mundo se localizan en las reas tropicales, que albergan 2/3 de los especies de las plantas del mundo, de las cuales se estima que por lo menos 35,000 tienen valor medicinal. Algunas de estas plantas pueden estar al borde de la extincin por la irresponsabilidad del hombre en la destruccin de sus ecosistemas naturales, que le daria a esas plantas un mayor valor.

1.4 Sin embargo, la utilizacin soberana de estos valiosos recursos por loe pases

del Sur para el benefici de sus pueblos que estn amenazado por el irrestricto inters de lucro de las grandes companias farmacuticas del Norte. La explotacin de las plantas medicinales se ha convertido en trminos de produccin y comercializacin mundiales en un prspero negocio en el orden de los miles de millones de dlares. El problema radica en que tales companias, que por muchos aos han tenido el control monopolistico sobre la produccin de los medicamentos quimicos, ahora estan a punto de reeditar este control en el terreno de los medicamentos de origen vegetal, mediante la apropiacin inescrupulosa de las plantas medicinales y el conocimiento tradicional de los pueblos del Tercer Mundo a travs de una patentizacin restrictiva y una privatizacin de dichos recursos, para su aprovechamiento monopolistico y con el apoyo de los gobiernos de los pases de origen en perjuicio de los derechos e intereses de loe pueblos del Tercer Mundo. Est inquietante situacin convoca a la accin militante por parte de los pases del Sur a fin de defender sus derechos as corno una accin internacional para asegurar que los preciosos recursos de plantas medicinales del Terce Mundo sean protegidos de la privatizacin monopolistica de las compaas farmacuticas internacionales, y a fin de perservarlos y desarrollarlos para el beneficio democrtico y equitativo de los pueblos del mundo.

1.5 A la luz de toda la situacin anteriormente presentada, los pases del Sur deben fortalecer su cooperacin en el campo de la formulacin a nivel nacional y colectivo de inventarios de sus recursos de plantas medicinales, asi como en el cultivo, procesamiento, mercadeo y en general aumentar la expansin del uso de la medicina herbolaria, a fin de satisfacer necesidades en materia de salud de sus pueblos, en consonancia con sus objetivos de respeto al patrimonio cultural propio y a la integridad de los ecosistemas naturales.

2. Prembulo

El objetivo general de una cooperacin Sur-Sur en plantas medicinales debe ser la utilizacin ptima de las plantas medicinales en forma normalizada por los pueblos de los paises en desarrollo.

3. Objetivo 1

Proveer un foro para el intercambio de informacin y experiencia en la utilizacin de las plantas medinales y programas afines en los pases en desarrollo.

Introduccin

A fin de alcanzar el prembulo y el objetivo anteriormente mencionados, se requiere de la generacin de informacin basada en la investigacin que suministe un respaldo cientfico para la eficiente utilizacin de las plantas medicinales.

Observaciones

La conferencia internacional de expertos de paises en desarrollo sobre plantas medicinales observ lo siguiente:

3.1 Existe una inadeacuada explotacin/utilizacin de la informacin existente generada por los investigadores en beneficio del pueblo.

3.2 No todas las instituciones cuentan con facilidades para un trabajo multidisciplinario en plantas medicinales en el que participen herbalistas, botnicos, farmaclogos mdicos, antroplogos, etc, en cooperacin mutua.

3.3 En algunos pases de Sur (tales como Egipto, India, China y otros pases asiticos) existe informacin acerca del uso efectivo y generalizado de las plantas medicinales que podra ser utilizada por otros pases del Sur.

3.4 Los pases asiticos tienen una avanzada experiencia sobre formas econmicas para la produccin de extractos, polvos, bolsas de t y otras formas simples de prescripcin de las plantas medicinales, experiencia que podra ser de utilidad para otros pases.

3.5 La reunin actual ha brindado un foro temporal para el intercambio de informacin sobre el desarrollo de las plantas medicinales, al tiempo que los pases No. Alieneados han designado a Corea del Norte para que proponga modalidades para brindar una estructura permanente para el intercambio de informacin sobre plantas medicinales.

3.6 Las investigaciones realizadas y que an se realizan sobre plantas medicinales continan produciendo informacin patentable que debera ser protegida sobre una base internacional teniendo en cuenta los intereses de los pueblos del Sur tanto como posibles fuentes de generacin de tal informacin asi como usuarios de las plantas medicinales.

Recomendaciones

La conferencia acord las siguientes recomendaciones:

3.7 En la medida de lo posible los centro de investigacin sobre plantas medicinales debern trabajar en una forma interdisciplinaria involucrando a los curanderos-tradicionales y las disciplinas cientficas pertinentes de los

paises del Sur.

3.8 Deberan realizar esfuerzos para transferir la informacin y conocimientos existentes sobre plantas medicinales a otros pases del Sur para su aplicacin inmediata segn convenga.

3.9 Debera concederse prioridad a la investigacin que genere informacin que pueda brindar un respaldo cientfico a la eficacia de las plantas medicinales tradicionales, su normalizacin y su formulacin en formas de dosis simples. En esta tarea los cientificos deben conducir sus investigaciones con pleno respeto al conocimiento tradicional y mente abierta, teniendo en cuenta el contexto cultural del cual forma parte la medicina herbolaria asi como su milenaria eficacia.

3.10 Debera realizarse un inventario sobre el conocimiento existente y las instalaciones de investigacin y desarrollo en pases del Sur para los investigadores, a fin de reducir la dependencia de la asistencia proveniente de pases del Norte.

3.11 Difundir la informacin generada sobre plantas medicinales no slo entre cientficos sino tambin entre los curanderos tradicionales y el pueblo, en la mayor medida posible, mediante folletos, medios de difusin de masas y las publicaciones cientficas reconocidas asi como, simposios.

3.12 Las actuales instalaciones regionales que protejan los descubrimientos e innovaciones deberan ser fortalecidas, a fin de abarcar todo lo nuevo que emane del trabajo de desarrollo de las plantas

medicinales.

4. Objetivo 2

Analizar modalidades de cooperacin en la creacin de inventarios sistemticos sobre el uso de plantas medicinales incluyendo su anlisis comparativo.

Introduccin

La Conferencia reconoci que las plantas medicinales ya estan desempeando un papel importante en la atencin de la salud en la poblacin del Sur. A la vez que se reconoci los esfuerzos realizados en la investigacin y desarrollo de las plantas medicinales se seal que a menudo los mismos no son coordinados y que sus resultados tienen una pobre difusin y una limitada aplicacin a los problemas de salud de la poblacin de los pases del Sur. Tambin se reconoci que los justos beneficios econmicos que pueden derivarse para los pueblos y pases del Sur de la exportacin de las plantas medicinales no se estan logrando. Se reconoci que la investigacin sobre medicina tradicional en los pases del Sur se encuentra en diferentes etapas de desarrollo. Reconociendo la necesidad de corregir este desbalance la Conferencia recomend lo siguiente:

4.1 Establecer un mecanismo para cada Regin del Sur y un mecanismo interregional para la seleccin de las prioridades en la investigacin A travs de reuniones peridicas se asegurara el funcionamiento adecuado de dichos mecanismos.

Centros nacionales de investigaciones deben ser identificados y enlazados a travs de redes regionales con tareas bien definidas, por consiguiente la

Conferencia recomienda:

4.2 Fortalecer los centros de investigacin nacionales e internacionales con el mismo fin, para poder realizar las tareas dadas.

Deberan realizarse estudios nacionales para la identificacin de plantas medicinales que podrian ser utilizadas en los sistema funcionales de salud.

En vista de la diversidad en la informacin etnofarmacolgica que podra generarse en distintas regiones y provincias del mismo pas, la Conferencia recomienda entonces:

4.3 Loa estudios nacionales deberan iniciarse al nivel sub-nacional. La informacin derivada de dichos estudios debera ser analizada local y nacionalmente. Adems estos estudios nacionales de las plantas medicinales, deben estar en funcin de la solucin de los principales problemas de salud de la poblacin.

5. Objetivos 3 y 4

Examinar y promover la cooperacin para la accin conjunta en el campo de las plantas medicinales, incluyendo su cultivo, procesamiento y mercadeo.

Discutir asuntos relacionados con la etnobotnica y la conservacin de las plantas medicinales.

Recomendaciones

5.1 Hay una gran necesidad de crear bancos de datos sobre la medicina tradicional, incorporando informacin como la siguiente:

- **El nombre local y cientfico, y la identidad de la planta;**
- **latitud, longitud y altitud para el cultivo;**
- **morfologa de las partes utilizadas (races, cortezas, flores, semillas, etc).**
- **Forma de utilizacin y preparacin.**

5.2 Debe verse con animacin el intercambio prctico de la informacin etnobotnica.

5.3 El cultivo en gran escala de las plantas medicinales facilitar la promocin de la medicina tradicional. En este propsito debera prestarse atencin a:

- **La recoleccin**
- **El secado a la sombra para preservar la vitalidad.**
- **Un control de calidad para la preservacin de la homogeneidad somtica.**
- **Los productos debern tener fecha de vencimiento.**
- **Debe velarse por las condiciones higinicas en la conservacin y almacenamiento.**
- **La conservacin *in-situ* y *ex-situ* debe realizarse con una atencin especial para las especies en pelgro de extincin.**

5.4 la seleccin de las plantas a cultivar debe estar en funcin de la solucin de problemas de salud a nivel local y regional.

5.5 La cosecha y el procesamiento deben ser realizados manteniendo la integridad del ecosistema.

5.6 Los inventarios de conocimiento deben llevarse a cabo a niveles local, regionale interregional.

5.7 Los servicios de extensin y la educacin son importantes para la promocin de la utilizacin de la medicina tradicional, deben ser estimulados y fortalecidos adecuadamente.

5.8 Deben establecerse niveles de precio y ganancias que aseguren el mayor acceso posible a los remedios de hierbas.

5.9 Deberan identificarse laboratorios regionales que estudien y analicen las plantas medicinales de probado valor teraputico y promulguen las normas de eficacia.

5.10 Deberan establecerse lista nacionales de remedios de hierbas tradicionales esenciales, que deben corresponderse al tratamiento de las enfermedades ms comunes.

6. Objetivo 5

Examinar y proponer recursos de implementacin: requerimientos financieros, institucionales, tcnicos y legales para la promocin de la cooperacin.

Introduccin

Para poder implementar las recomendaciones contenidas en los objetivos 1-4 anteriormente tratados, es imperativo establecer los requerimientos financierors, institucionales tcnicos y legales necesarios. Por consiguiente la reunin recomend que:

6.1 Se estableciera un mecanismo inter-regional para:

- **Mantener en evaluacin el progreso logrado en la implementacin de las recomendaciones propuestas.**

- **Emprender las nuevas acciones que se requieren, para fortalecer la cooperacin entre los pases del Sur en el terreno de las plantas medicinales. Tal mecanismo inter-regional contemplara la realizacin de reuniones bi-anuales para facilitar su trabajo.**

6.2 Proponer que hasta que se realice la primera reunin bi- anual el gobierno de Tanzania debera actuar como el *Secretariado intermediario.* Con este fin todos los participantes y las instituciones internacionales respectivas debern asisitial gobierno de Tanzania en el desempeo de dicha funcin.

6.3 Cada pais debera poner en marcha un plan inicial de accin sobre el tema de la utilizacin de las plantas medicinales en el sistema de atencin a la salud.

6.4 Que los pases establezcan rganos nacionales a cargo del desarrollo de las investigaciones, desarrollo, diseminacin y utilizacin de las plantas medicinales desde un enfoque multidisciplinario e interinstitucional.

6.5 Loe organismos internacionales de ayuda y cooperacin deben intensificar su labor a fin de que se facilite el acceso a los recursos tcnicos y financieros en los niveles nacionales, regionales e internacionales en los campos de la investigacin y aplicacin.

6.6 De las plantas medicinales cada pas del Sur debe tratar de adoptar a nivel nacional las diversas recomendaciones propuestas en relacin a los objetivos 1-4, y destinar recursos especficos y significativos para su implementacin.

6.7 Que la Secretaria coordinadora at interim, as como los pases participantes deben unir esfuerzos comunes con las organizaciones en sus regiones respectivas en el desarrollo de las plantas medicinales.

6.8 Debera constituirse un Comit Organizador Internacional e interino a ser nombrado por est conferencia, para supervisar el progreso de la implementacin de las recomendaciones propuestas y para la preparacin de la siguiente reunin.

6.9 Debera darse un marco legal en cada pas del Sur para fomentar la utilizacin de la medicina herbolaria en los servicios de salud teniendo en cuenta las pecu liaridades propias de la medicina herbolaria.

6.10 A este fin la experiencia de los otros pases y organizaciones internacionales como la OMS y la Agencia internacional de la Regulacin de medicamentos debe ponerse al alcance de los pases que necesitan tal informacin.

6.11 Las pretensiones de derechos de propiedad intelectuales como las patentes, sobre los remedios derivados de plantas debe asegurar que las personas y comunidades involucrados en el descubrimiento de las drogas (incluyendo los practicantes tradicionales quienes sumistrn informaciones que pueden conducir a los descubrimientos) sean recompensados en forma apropiada. Los pases deben tener una poltica sobre como la ganancias potenciales de estos descubrimientos pueden ser distribuidas, incluyendo el aseguramiento del acceso popular de estos remedios a un costo que las comunidades puedan tolerar.

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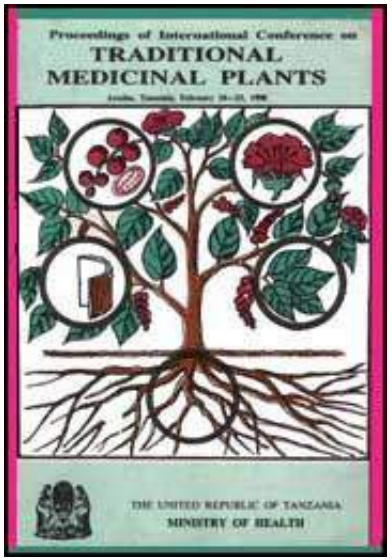

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APPENDIX I: TRANSLATED VERSIONS OF FRENCH AND SPANISH PRESENTATIONS

Contribution to a global proposal supporting the use of medicinal plants by developing countries: The case of Guatemala

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Introduction

The genetic and cultural wealth of Guatemala expresses itself on a traditional medicine based on the use of medicinal plants. The experiences of the last decade indicate that the issue of the medicinal plants is of interest from all points of view and it might contribute to the development of the people by means of its systematic study in a multidisciplinary approach. The present paper summarises the Guatemalan experiences in recognising, organizing, coordinating and implementing institutional and national projects in order to fully validate the use

of medicinal plants and to support its application by the national health systems.

Research and development strategy

The fact that Guatemala is placed in the junction of the North and the South, the Atlantic and the Pacific, brings about the result that the country has an outstanding biological diversity, in spite of the threatening decay seen in its national heritage. The cultural legacy of the Mayas' forefathers is rich in the wise use of the resources produced by nature, out of which a deeply rooted traditional medicine has been formed. However, it lacks systematization and has not achieved full acceptance as part of the national legal medical system. The social decadence and the financial "bankruptcy" generalized in many countries, to the health problems, the growing incapacity to purchase of imported drugs and the lack of supplies of pharmaceutical products in the the local markets, create the need to look into a therapeutic system which is part of the national heritage. In an effort to contribute to the reconstruction of Guatemala after the earthquake of 1976, Meso-American Centre for Studies on Appropriate Technology (CEMAT) was created as a non-governmental organization, projecting itself towards the adaptation and integration of appropriate technologies for development within the framework of the organization of rural micro-enterpreneurial groups. The areas covered have been: energy (timber, biogas, gasification); sanitation (latrines, digestors, water purification); agriculture and primary health care (phytotherapy, acupuncture promoters); building materials (puzzalana, fibercreto covers), mini-animal husbandry (bees, rabbits, fishes, swine) and information (information center with 250,000 specialized documents, bulletin in two languages sent to 76 countries, translations, organization of national and international events). With the experience attained by means of the joint research with the groups, a

methodology of workshops was developed to train and up-grade the rural personnel in construction, monitoring use of the appropriate technology introduced, as well as in the micro-enterprise organization of these community groups.

An area which received particular attention was the project under the title: "Rural Enterprise of Medicinal Plants" which carried out activities during 1979-89 in six fields, namely: ethnobotany, agronomy, pharmacology, industrialization, training and information. The findings have been published in national and international bulletins. At present the Programme of Medicinal Plants of CEMAT is financing four research projects namely: a Producers' Commodity network, Industrialization, Commercialization, and Information and Training.

The ever growing demands to work on medicinal plants on a comprehensive way led to the formation of a multi-disciplinary and inter-institutional group to coordinate the activities for the optimal use of the natural and ethnomedical resources, especially the use of medicinal plants. In 1984 a Committee, CONAPLAMED, was formed, which in 1988, was transformed into a Commission which is now awaiting legalization. CONAPLAMED is made up of 12 public and private institutions. Its organizational structure is based on three national groups: Ethnobotany-Agronomy, which deals with projects related to botanical and agronomical studies; Phytochemistry- Pharmacology whose objective is to conduct scientific studies lending to the validation of the use of medicinal plants, and Industrialization-Commercialization, which deals with industrialization and commercialization of medicinal plants and by- products. The Commission organizes annual National Seminars on Traditional Medicine in which the research information from the national groups is disseminated. In this way the research

findings have been disseminated at national level, but coordination at an international level is underway to achieve some international exchange of information. Since 1982 there is an active participation in the TRAMIL workshops for the creation of a Caribbean Pharmacopoeia under the coordination of ENDA-Caribbean in the Dominican Republic which will take place in Guatemala in November, 1990. In 1987 the First Meso-American Seminar of Ethno-Pharmacology was organized with 150 participants from 10 countries. 20 scientific papers were presented and published. The Second Meso-American Seminar of Ethno-Pharmacology took place in San Jose, Costa Rica, in December 1989.

Objectives

General

To scientifically validate the use of traditional medicine as an integral part of the national systems of health care; to strengthen the acceptance of traditional medicine by the people *as* part of their cultural heritage.

Specific

- **To compile existing ethnobotanical information according to practising ethnic groups.**
- **To encourage the cultivation of medicinal plants as part of the conservation strategy.**
- **To develop non-sophisticated technology for the utilization of indigenous**

and exotic medicinal plants.

- **To conduct chemical and pharmacological studies in order to validate the efficacy of popularly used medicinal plants.**

- **To disseminate important scientific information on medicinal plants.**

- **To compile national and regional pharmacopoeia of medicinal plants.**

- **To promote the production of plant - derived pharmaceuticals based on the available indigenous medical flora.**

- **To create an awareness at all decision making levels, on the importance of traditional medicine as a priority in formulating health policies.**

- **To provide financial support to all initiatives working towards promoting the utilization of medicinal plants and phytopharmaceutical products.**

Methodology

In order to achieve these objectives, there is a need to form a multidisciplinary and inter-institutional research team representing various research institutions to effect the following:

- **Carrying out countrywide ethnobotanical surveys to assess the medicinal potential of the indigenous flora. The collected voucher plant specimens should enrich our national herbaria for retrieval and exchange purposes.**

- **To encourage planting of the most commonly used medicinal plants by the farmers and family communities. Further the work of preserving native species would be promoted through the integration of these plants in silviculture and agroforestry programmes.**

- **To establish medicinal plant farms for those plants with known chemical composition and efficacy. However, experimentation to determine the agronomical parameters of indigenous medicinal plants should be conducted prior to large scale cultivation.**

- **To establish adequate research infrastructure, including expertise and well equipped laboratories, to conduct chemical and pharmacological studies including *in-vitro, in-vivo* studies and clinical evaluation of our medicinal plants and pharmaceutical products.**

- **To exchange research information by means of networks so as to have access to the information in research centers from other countries. Although specialized information networks on medicinal plants do exist, the researchers have a limited access to the information due to either financial or technological reasons.**

- **To compile a national pharmacopoeia. The proceedings of the TRAMIL workshop illustrates the way to attain this important objective. It is based on information obtained from regional field ethnobotanical surveys and recommendations emanating from scientific workshops.**

- **To produce laboratory or pilot-plant scale extracts of active principles or**

phytotherapeutical products at a sustainable level, with the agricultural production capacity. The goal would be to substitute a percentage of the imported drugs and to subsidize these operations until they become competitive with the market of the multinationals.

- **To promote and consolidate the use and transmission of the concepts and practices of traditional medicine, as well as to convince the modern medical system on the qualities of these traditional therapeutic practices.**

- **To establish an international network of institutions working on the validation of traditional medicine. Perhaps the identification work of the institutions and the working plan might require some time but once consolidated it could favour all the member states. The role of the modern medical system is very important but we have to acknowledge the need for a change in the mentality and policies of the entire health systems. The financial support of both the government and donor agencies should put emphasis in strengthening the local research capability to implement the required projects. Where such research capability is not sufficient, joint projects could be implemented by specialized centers in developing countries.**

Remarks

Given the political will in the developing countries, the financial backing from friendly countries, the technical cooperation of international agencies, and the commitment on the part of the national groups, then it would be possible to create working teams to achieve the following:

- **The creation of resource teams, technically skilled, which, given the proper material and financial resources, would significantly contribute to the multidisciplinary validation of traditional medicine and to its use in legal health systems, in particular, medicinal plants.**

- **The cooperation among centres from developing and developed countries to carry out joint projects which will facilitate the proper documentation of what has been done on the validation of medicinal plants, of interest to countries which might benefit from it.**

- **The production of national or regional pharmacopoeia that will facilitate the utilization of medicinal plants as safe therapeutical alternatives to modern drugs.**

- **The development of phytopharmaceutical products, which might partially substitute some of the conventional medications demanding imported raw materials, and which could be produced by pharmaceutical industries based in developing countries through joint projects.**

- **The institutionalization of traditional medicine in all those countries having the necessary conditions to incorporate these beliefs and practices to their national health systems. It is encouraging that in China, India and other countries, traditional medicine has been integrated in primary health care and at present it is in the hands of the population.**

- **The regaining of self-confidence in combating diseases, promoting the strengthening of national identity, providing alternative choices to the**

country regarding importation of medications, and comprehensively improving the doctor-patient relationship which lacks in the modern medical system.

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History and reality of medicinal plants from Ecuador

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ABSTRACT

In this paper the author gives a historical background on the documentation, and traditional medicinal uses of the vascular plants of Ecuador. The paper describes the use of medicinal plants in South America, long before the advent of colonial rule, which came with Spanish invaders into the country. Amongst the many traditional medicinal plants documented and discussed are species of Cinchona, locally known as Quinah, a plant which was subsequently developed as a source of quinine, used for the treatment of malaria. The paper calls for the need to establish national reference herbaria for medicinal plants; the need for incorporating traditional medicinal plant use in modern day national health programmes; the need for promoting the conservation of national forests. lest we lose useful species of medicinal plants; the development of documentation centres for medicinal plants and traditional medicine, etc.

Introduction

The survival and superior development of Man is due, to a great extent, to the benefits obtained in his progressive control of the plant Kingdom. Pre-history Man required several thousand years, and of great efforts, to discover the nourishing qualities of plants; to properly collect them and, later on, to freely cultivate them once agriculture was created. Alongside the acknowledgement of the nutritional value of the plants, experience permitted him to identify the plants, and to discover other qualities related to improving the health for the sick. Subsequently, it was possible to identify, in some plants, the advantages of using them for the treatment of a given disease, and, on the other hand the hazardous, and even the mortal effects, or the psychoactive ones.

The American indigenous medical knowledge is a collection of magical-religious empirical knowledge on the health/disease phenomena, and therapeutics is based on the use of plants to which preventive-curative effects have been historically attached. The Shama, the witch-priest-doctor of the primitive society, is the character who collects and transmits, through generations, the medical traditions of the community. He is the depository of the knowledge on herbal therapeutic uses, and is the selected one for using hallucinogenic drugs, which will change his appearance, and will allow him to know details about the disease, and the fate of the patients.

Pre-Spanic medicinal plants

The Andean Region is one of the most important domestication, adaptation, and diffusion centres of plants from the American continent. The Inca civilization emerged in this surrounding, and, by availing themselves from the ancient traditions of other aboriginal populations, shaped an empire whose life supported

itself in land economy. During the Pre-Columbus time, several plants were domesticated, and it was possible to attain a good knowledge on several useful plants, for either feeding purposes, timber extraction, or for the making of dyes and medicines.

In ancient Ecuador, the Cacicazgos, or primitive lords, by following a long tradition, had, at their disposal local products which resulted from wild collection, or planting, in the Amazon region. Added to this knowledge, we see the influence of the Incas, which by the end of the 15 Century, started to go into the North. This mixture was what both the Conquistadors and the historians found. Some of them referred to the presence of these plants. According to their information, during the pre-Spanish era, at least 40 different species of medicinal plants were known. We need to say that almost all the plants used as food, had their use in the aboriginal pharmacopoeia.

Three medicinal plants had a peculiar importance in medical matters in ancient Ecuador, and they were soon incorporated into the European pharmacopoeia: the Zarzaparrilla (*Smilax zarzaparilla* L.); the Palo Santo or Guayaco (*Guayacum officinalis*) and the Cascarilla or Quinah (*Cinchona* sp.). The first two were applied in the treatment of buboes, the French disease, or syphilis, creating great expectations during the 16th and 17 Centuries, thus achieving great commercialization in Europe. It was later seen that their effects were either limited or nil, for the efficient treatment of this infection. At present they are still used by traditional healers, but with a different purpose. The Quinah or Cascarilla, was incorporated into the European pharmacopoeia at the beginning of the 17th Century, creating a real revolution, since it was found to be the first medicine of plant origin, having real curative effects against tercianas, malaria or paludism.

The Quinah is the biggest contribution America has done to universal pharmacopoeia, thus saving millions of lives.

Starting with the Spanish conquest, a group of alien plants were added to the native ones, which soon got their naturalization documents, and which were included in the national folklore. Under the influence of Spanish popular medicine, primitive medicine reorganized its knowledge, transforming itself into a practice aimed at the treatment of health problems of the aboriginal population, as well as of the lowest urban strata. Scientific medicine, which came together with the Spaniards, had a slow progress, alongside the three centuries of colonial domination, which based its therapeutics in plant applications. This situation did not change until mid-19th Century, already the Republican Period of the history of Ecuador.

Tradition in the study of medicinal plants

The concern over the study of medicinal plants from different perspectives, has a long tradition in our country. The historical and geographical documents, written by the Spanish authorities, have a vast information on the use of the plants by our native population. Regrettably, there is no systematic work of the ethnic-historical knowledge, which is to be fundamental to the assessment of the evolution of the application of each plant that is useful for medicine. Also, as we have noted, during the 16th Century, new species of plants were introduced, which needed to be differentiated from the native ones, and which had to be studied also, taking into consideration their impact on the therapeutics, and their incorporation into traditional medicine. We must stress that in this century, two native plants have rapidly been incorporated into European pharmacopoeia, by virtue of their

curative potency for the treatment of syphilis, rheumatism, and fever in general. Here we are referring to "guayacan" or "palo santo" (*Guyacum officinialis*) and "zarzaparrilla" (*Smilax* sp.). In the 17th Century, Quinah (*Cinchona* sp.) was introduced into the therapeutics, of paludism, this being a major contribution to universal pharmacopoeia. During this time, several historians and some colonial officials, wrote valuable reports on common plants used for food and medicinal practices by the aborigines. Alongside, 18th century scientific studies were started on the American plants. In Ecuador, the arrival of a French geodesy mission, was witnessed in 1735. The historian, Juan de Velasco, wrote a book at the end of that century, titled "The History of the Quito Kingdom". The document contained the first list of medicinal plants.

The arrival of the French geodesy mission, whose task was to measure a section of the Earth meridian, set, as of 1736, an important landmark on the development of knowledge on the botany of Ecuador. La Condomine, and the botanist Jussieau, wrote the first scientific memoirs on Cascarilla, or Quinah de Loja, which later on were used by Linnaeus to establish the genus *Cinchona* in 1742. All along the 18th Century, the Spanish Crown was very much concerned with the extraction, the transportation, and commercialization of this plant.

At the end of the 18th Century, the historian, Juan de Velasco, in his work, the "History of the Kingdom of Quito", presented a list of 60 medicinal plants from the country, giving their uses and modes of application. Also at that time, the natural sciences flourished in America, with the sending, from Spain, of three botanical expeditions: one to Peru (1777-1788), the second one to Nueva Granada (1783-1816), and the third to Nueva Espana (Mexico), from 1737 to 1803. These expeditions introduced the Linnaean system of naming the medicinal plants.

Regarding Ecuador, the botanists Juan Tafalla and Juan Augstin Manzanilla, members of the botanical expedition to Peru, studied, for nine years the tropical and Andean flora, and carried out (in Loja) the most important research work on Quinas, describing 32 different species. These works were incorporated in one book, "Flora Huayaquilensis", which remained unpublished until 1989. Several medicinal plants are part of this "Flora". Francisco Jose de Caldas, a member of the botanical expedition to Nueva Granada, visited the country between 1801 and 1805, and also discovered several species of medicinal plants. Humboldt and Bonpland, who arrived in the country in 1802, also carried out outstanding studies on the natural history of Eduardor. Finally, the native botanist, Jose Mejia Laquerica, between 1802 and 1806, wrote the first Ecuadorian botanical study, "Plantas Quitenas", in which he listed several species used in biomedicine.

During the 19th Century, botanists Jameson and Sodiro, developed their botanical research work to such a significant level that this period is known in history as, "the golden age of Ecuadorian botany".

Jameson, a German national, lived in Ecuador from 1822 until 1873, and published his book, "Synopsis Plantarum Aequatoriensium", in which he cited medicinal applications of plants. Sodiro, an Italian botanist, arrived in the country in 1870, and carried out several valuable taxonomic studies on the plants of the country, and also initiated the development of the first national herbarium. He published several books.

Luis Cordero, a distinguished researcher in botany, sent in 1889, a collection of medicinal plants to the Universal Exhibit in Paris, obtaining a silver medal for that. In 1890, this study was published, and in it, indications are given on the uses and

effects of the plants. Later on he published his great work, "Enumeracion Botanica", a reference book, which is a must for those working on Ecuadorian plants. Also around those same years, a physician from Quito, Jose Maria Troya, published his work "Vocabulario de Medicina Domestica", which is the first book giving medical information, published in the country, with a scientific perspective. In it, formulae and techniques in the handling of the remedies which are of plant origin are presented.

At the First Medical Congress held in Guayaquil in 1915, Dr. Marco Tulio Varea pre sented a paper under the title "Botanica Medica Nacional, published in 1922 as a book, which later on, became the most valuable piece of work done in this field. During the last decades, valuable botanical, anthropological, phytochemical, and pharmacological research was carried out. Miguel Acosta Solis, Alfredo Paredes, and Plutarco Naranjo merit to be named in these areas due to their valuable contributions.

Medicinal plants and the present medical practice in Ecuador

At present Ecuadorian medical practice might be classified into two big categories: (a) official or scientific practice, and (b) traditional practice. Regarding the latter, some research has been done lately, which Justifies its recognition as "knowledge", widely used by the population. Traditional medicine represents an ideological and empirical answer on the part of the population to its own health needs. It has been preserved, thanks to tradition, and it is used by the vast majority of the population in the rural areas (50 per cent of the 10,000,000 inhabitants), especially by indigenous peasants. It is also used in the urban-marginal neighborhoods of the cities. The concepts and practices used by this

medicine, are rational, and are in accordance with the definitions of nature, Man and the society of which the peasant population is a part. These definitions are determined by the functions implemented by this social group in the production process of the country, thus explaining the degree of acquisition of a dominant ideology, especially of the schemes of the catholic religion, and of the survival of ancient ideas and beliefs. There are theoretical as well as empirical elements of great importance regarding traditional medicine we could name: the broad concept of health and disease; the systematization or classification of diseases and their treatment according to the concept of chance, the therapeutic use of the values of the community, the successful application of several psychological resources, the empirical treatment based on the knowledge of medicinal properties of the different plants, animal and mineral products, learning through practice, and the acceptance of tradition. The healers of the aboriginal medical practices are classified as follows: (a) the witchdoctor, (b) the healer by horror, (c) the herbalist, (d) the masseur and (e) the midwife.

Traditional medicine is a lively element in the Ecuadorian medical practice. It is true that in recent years the rendering of medical care by the state medical services, has increased outstandingly, both in the urban as well as in the rural areas. Nevertheless, due to the communication problems derived from the unavoidable cultural problems and the high price of the drugs, a large part of the population still use exclusively or perhaps in combination with the drugs from the Western medicine, medicinal plants. On the other hand, the mobility structures felt by the population, basically composed of temporary small ailments, always offers possibilities to simplify the therapies.

Lately, the historical continuity of the use of plants has come to being part and

parcel of the self-identity of the Ecuadorean citizen, thus requiring a study, recuperation and diffusion process of the value of medicinal plants, so as to prevent its disappearance in the hard struggle witnessed in our countries, between what is modern and tradition.

Justification for the development of studies on medicinal plants

As we have been stating, there have been, in the country, an important concern for the study of medicinal plants. But these works have not been systematized and most of them are not known at all. Any research work which will allow the systematization of ethnobotanical, and historical information, and which places in time and space the importance of each plant, would undoubtedly represent a contribution to the knowledge of the important field of medicine. On the other hand, if these investigations would concentrate themselves in the phytochemical and pharmacological studies developed in recent decades, they would provide for objective and scientific backing to the popular knowledge, regarding the beneficial effects of the plants. Finally, if these research scientists were able to collect, by means of epidemiological and anthropological methods, data on the prevalence of the present use of medicinal plants, we would obtain extraordinarily useful information.

Given the situation of national medical practice and the need for training health professionals, it is necessary to start implementing the useful national information on medicinal plants. The professionals graduating from the Faculties of medicine, and who have to complete a year learning about rural medicine, face a serious problem of communication with the population in the countryside, and they are not able to handle situations related to traditional medicinal practice. A technically

drafted manual, giving an elaboration on herbal medicine, will be of tremendous help in solving these problems. Also, by doing so, we will start a real process of integrating medical practice.

The population needs to have at its disposal a serious scientific information on the value of medicinal plants, because if, it does not, the people will continue to base their beliefs on information permeated with magic and witchcraft. It is also possible that a more scientifically based application of the plants, might help in solving the health problems of the population.

The Amazon Region is one of the few regions in the world which still holds an extraordinarily rich botanical heritage, which has not been fully studied. The phenomena derived from the impact of modern agro-industry are fostering a speedy deforestation of the virgin vegetation of the Amazon, and it is necessary to take proper measures to ensure its protection; and the country's researchers should undertake botanical, anthropological, clinical, and phytochemical studies, in order to determine the nutritional and medicinal values of the plants in this region.

The conservation of the culture of Third World countries can be effected in several fields. One of these is the recognition and evaluation of all that the population has been able to accumulate as knowledge on the use of the elements of nature, in order to satisfy their needs, and for the solution of their problems. This necessitates that we involve politicians and administrators in the execution of research and the dissemination of information regarding medicinal plants.

Summary and conclusion

The information presented above indicates the following areas of priority with respect to the medicinal plants of Ecuador:

- **Ethnohistorical studies on medicinal plants which will allow one to systematize and objectively place, in time and space, information compiled by scientists to date.**

- **Epidemiological studies on the use of medicinal plants in different ecological and socio-cultural strata.**

- **Botanical, anthropological, and biochemical research on the plants from the Amazon Region.**

- **Systematization of the information on the biochemical, pharmacological, and clinical studies undertaken in the country.**

- **Diffusion of the results of whatever is known, up until now.**

- **Drafting of manuals, catalogues, brochures, videos, etc.**

- **Promotion of conservationist policies.**

- **Incorporation of traditional medicine and medicinal plants in the National Health Programme.**

- **Development of herbaria of medicinal plants.**

- **Development of a Documentation Center on Traditional Medicine and**

Medicine Plants.

- **Development of joint regional programmes amongst the countries from the Andean Region.**

- **Exchange of information and documentation.**

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African indigenous medicine: Its standardization and evaluation within the policy of primary health care

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ABSTRACT

The indigenous African remedy obeys some rules of preparation which respect and allow the obtention of acceptably standardized products, qualitatively and quantitatively.

The study of therapeutic dosages used by traditional health practitioners shows that these dosages are also acceptable.

The effectiveness of therapy studied by clinical tests as well as the importance of the accomplishment of indigenous remedy, both constitute the elements for their evaluation.

The rules of this evaluation are expected to take account of the concept of African indigenty.

Introduction

There is no doubt today that Primary Health Care (PHC) offers one of the most viable approaches for attaining accessibility to health for all. In fact, this approach takes into account all appropriate resources available, including the practices and remedies in the indigenous system of care. The pharmaceutical component of this policy of Primary Health Care, requires the provision of appropriate medicines to the populations, taking into account both geographical and economical factors.

In spite of the popularity of the African indigenous medicine, its acceptability is still viewed with certain distrust. Hence the necessity of its evaluation and its standardization in order to enable it to be confirmed and to be registered on the list of essential medicines.

Although everybody is unanimous on the necessity of an evaluation, not everybody is in favour of the conditions which are currently applied in putting new medicines on the market. Our purpose is not really to bid acceptance of whatever medicine for Primary Health Care, nor again to match the African indigenous

medicine with the European medicine; but rather to present an experience, whose aim is to dispel the distrust that has been caused by negative prejudices and to assist in solving the problem of public health, which is the regular destination of sanitary training programmes in medicine.

Although there is an apparent analogy in the medicinal conceptions of the two systems of health care, namely, the African indigenous and the European exotic system, it is also true that the philosophy that underlies them is different. One is a result of an analytical method of reasoning and of experimentation; and the other is a result of a systematic method of intuition and empiricism.

At first, one could think that the medicines of the European exotic system treat the causes of illness and that those of the African indigenous system deal with the symptoms. We would like to state that it is not just to say that the African indigenous medicines are only used to treat the symptoms.

As we have already stated orally and in writing, each of these systems of treatment has "etiological medicines" as well as "symptomatic medicines" whose application depends on given rules. It has become both necessary and urgent that we should discuss these rules, so as to know the degree to which they are reliable and to allow better standardization of the African indigenous treatment. As such, we have tried to follow the procedures of its elaboration and its administration.

The elaboration of the African indigenous medicine

The distrust, leave alone fear, that we have described above still persists within the African indigenous medicine, in spite of the great involvement of the

populations. One cannot deny the fact that this distrust is justified; but, unfortunately, too often and even improperly, we tend to accuse the therapeutical quality and doses of the indigenous medicines. "The false healers" are, unfortunately, too many and it is not possible to guarantee their skills and competence. In fact, we are not denying the insufficiency of the African traditional pharmaceutical art; but it appears to us unjust not to recognize that there exist rules for the preparation and the administration of indigenous medicines well adapted to the system.

In order to be truly convinced, it is sufficient to note that in certain countries, it has been possible to codify the rules of the indigenous medicine in general and that of the indigenous treatment in particular.

Raw materials

We shall limit ourselves, in this study, to medicinal plants which form the major part of the raw materials and whose techniques for collection seem to be well respected, if not standardized.

The strict respect of the rules for collection, arises from the fear that the phytotherapeutist derives his experience from the transgression of these rules. Each gesture is taken into account. We do not share the view of those who always see in its implementation nothing but superstition. Moreover, even if there was an element of superstition, it would be desirable not to be opposed to it before knowing its origin or making its complete evaluation. In the same way, it is important to preserve all the necessary conditions during the collection phase and to *obtain average samples of the raw materials that would be easy to test and to*

confirm. **In our opinion, the presentation under the form of bundles easily draws one's attention. We have tried to find out the approximate weight by vegetable species. This homologation, from our modest experience, is more convenient for the phytotherapists than for the herbalists who are much worried about the sales of their products, even when there is an apparent homogeneity of all the bundles.**

The identification of plants is not only morphological; it is a real diagnosis which is practised by the phytotherapist from the organoleptic characteristics. Moreover, he knows the period and the place of collection, and the part of the plant which will ensure constant results. Unfortunately, many researchers do not involve themselves with the terrain and do not ask questions sufficiently. ***It is rare that the phytotherapist will preserve raw materials for a whole year.*** **While for herbalists this is a usual practice.**

In our opinion, with the identification made by the phytotherapists, the knowledge of the useful part of the plant, the techniques, period and the favourable place for the collection - ***all this makes it possible to establish the basis for an acceptable homologation from the average samples.***

It is certain that, it *is* necessary for the institutions which are responsible for the study of medicinal plants, to gradually improve this knowledge by supplementing it with other elements which are normally not part of the traditional health practitioners. It is the method of approach which make us determine the best period for collection, the major chemical groups, the water content, ashes and essential oils, etc. If the traditional medical ethics require the phytotherapist to observe strict respect of some definite rules of collection, it would be advisable to make an adaptation of the preparation and of the treatment of the patient. This

practice makes it very difficult to have standardization in any industrial manufacturing of the medicine.

Composition of the medicine

The qualitative and quantitative standardization of the composition of the African indigenous medicine, will prove necessary when it starts being manufactured industrially or even semi-industrially, for, the rules of individual preparations advocated by the traditional therapists might be difficult to apply. It is, however, important that one should not make too many modifications without making a prior indepth analysis as it was recommended when we discussed the techniques for collection.

With regard to the qualitative aspect, it would not be wrong to say that *some African indigenous medicines contain more than ten ingredients.* Only medicines in the group "excipient" which are normally registered in a special inventory, such as, the "vidal", would contain as many ingredients. This is why it is important, as we have already stated, that we should never consider anything as useless. It is, however, possible, after discussions with the traditional therapist and conducting some chemical, pharmacological and/or clinical tests, to eliminate certain drugs which would not change the acceptability, the harmlessness or the effectiveness of the medicine. This is the essence of our approach.

As far as quantity is concerned, it is sufficient to be guided by the traditional therapist in *taking the right measures* of each ingredient. These measures, could easily be reproduced later from average quantities which could be established after several measurements.

In order to facilitate the methods of preparation, we started by adopting kitchenware methods which are used by the traditional therapist. Then, gradually as we established the specific values of certain elements, we replaced the kitchenware, with the appropriate pharmacotechnical apparatus. Thus, we ended up by establishing a certain equivalence between the two devices and to facilitate communication and dialogue between health care systems.

States caused by medicine and how these happen

Although it was relatively simple to compare the tenuity of the powder obtained from local kitchen sieves and the powder obtained from our Forplex grinder, it was not the same thing for the other forms of galena. We can, however, state that the strict observance of the methods of operation guarantees, to a certain extent, the reproduceability of the characteristics of preparations and as a result, that of the doses. That is why in the case of a decoction, for example, the traditional therapist will normally put into account the following:

From the qualitative aspect:

- **the colour of the decoction**
- **if no special colour, its viscosity, and**
- **how it tastes (astringency).**

From the quantitative aspect:

- **the number of bundles found in the plant, and**
- **water volume at the beginning and at the end of the operation, often determined by the immersion or non-immersion of the bundles of plants,**

and state the time taken for boiling up.

The monitoring of this reproduceability could be done by the extraction of dry decocta by denning, both qualitatively and quantitatively, certain properties and characteristics.

With regard to one of the most frequent criticisms, namely, that concerning the hygienic conditions, again we think that it is not just to say that the traditional therapist is not concerned about it. The methods of nitration or decantation, the use of new containers which have never been used, the taking into account of the pharmaceutical forms (especially orally or externally) explain in part the situation.

We are going to provide one of the fundamental principles of the African indigenous medicines for your consideration:

- **The human organism needs a symbiotic equilibrium and cannot subsist in an absolute sterility.**
- **The administration of the African indigenous medicine: the posology**

The existence of doses in the African traditional medication has often been questioned. In our opinion, we have sometimes wrongly attributed to medication accidents caused by the imprudence of the victims themselves. The purpose of our discussion here is more to affirm the existence of acceptable therapeutical doses, rather than to deny the insufficiency of precision of the measurement units.

One of our objectives is to have a better knowledge of the rules which determine the dosage so as to improve such rules.

As we have already said, the strict observance of the methods of preparation makes it possible to obtain relatively good quality medicines that are highly appreciated by the traditional therapist and which, in spite of such a moderately equipped institution, are determined with reasonable precision. Thus, without involving ourselves in the active principle, we shall study both qualitatively and quantitatively, certain ingredients (at least two) and certain characteristics (physicochemical and/or organoleptical) in order to prove that the preparations are of good quality.

The existence of non-unitary pharmaceutical forms makes it imperative to know the rules of the measurements used in collecting the medicine as well as the methods used in doing it. It is not sufficient, for example, to use the same spoon and the same product in order to believe that the quantities of the measured powder are the same. In fact, in order to have the same quantity, it is necessary to respect the rule of the base measurement. Moreover, the use of a spoon requires certain precision, such as, whether it is a tea-spoon, a table-spoon or a spoon used for dessert. Also, in traditional practices, it is necessary to know that the pinch by fingers is done vertically and is limited to the first phalanx. It is necessary to indicate the number of fingers to be used or, at least, which of the two fingers will retain the pinch of the medicine.

A well-balanced study of fresh plant material gave us a variation from simple to triple (1:3 to 3:1). The ones of pinches showed a variation of 1 to 2.5 (see Annex).

By way of mouth, the quantity of decocta absorbed by the sick persons, are functional to the capacity of their stomach whose variation limits (1 to 1.5 litres for an adult) enable the traditional therapists to advocate a drink of a certain

infusion of herbs.

In taking again the example of the vidal catalogue, we notice that the usual dose for the day for an adult can vary often from 1 to 3 tablets. In other words, the variation is from a single to a triple dose.

A comparison from these various figures, enables us to state, in our opinion, that the variations of the therapeutical doses advocated by the traditional therapist are acceptable.

We think that the decision as to the dose to be administered depends also on the competence of the practitioner; and this is true of both medical systems. It is up to the doctor to adapt this ordinary dose, taken throughout the day, to different cases. It is only his experience which will enable him to avoid the errors of estimation and accident. The attitude of the traditional therapist, as that of a doctor, is determined by the general state of the sick person, as well as other factors such as, sex, age and bodybuild (for the traditional therapist especially), or weight (for the doctor), and the seriousness of the disease.

Evaluation of the African indigenous medicine

Elements of evaluation

The therapeutical efficiency and the importance of the use of the African indigenous medicine constitute, undoubtedly, the elements of its evaluation:

- **In fact, there is no need to recall here, the good results of some of the traditional preparations which are based on the discovery of pure**

crystalline products and the synthesis of similar substances.

- **The acquired popularity since decades of use "(estimated pharmacovigilance)" and the high consumption of indigenous medicine, which enable us to establish its importance for pharmaceutical use and to determine whether it should be registered on the list of essential drugs.**

The evaluation method, in our opinion, should be to make comparisons (through clinical tests) with an already existing medicine on the market and which enjoys a very good acceptability in all respects, namely, its cost, its effectiveness and its availability.

Prior conditions in the evaluation of the African indigenous medicine

The marketing of any medicine today depends on a number of strict conditions, which, although necessary and indispensable for new molecules, do not seem to us to be justifiable for the indigenous medicine which has successfully undergone the tests of time after its administration on the human species. This means, in fact, that the pharmacovigilance, that is the supervision of the medicinal results in their usual conditions of use, has not been favourable to it. We cannot deny the possibility of teratogenic toxicity of these medicines; but we think also that it is not just to underestimate the fact that they have gone through the test of time after they were administered on people and not on animals in a laboratory. This is why we are advocating that we should adapt administrative and legislative conditions of marketing so as to ensure that they are appropriate and that they facilitate innovation rather than block it. We think that this adaptation should take place by allowing comparative clinical tests to be carried out sooner than it is the

case now, at least legally and officially. The issue involved is more ethical than scientific. This is why the solution should be in line with the ethics of our socio-cultural environment.

Conclusion

At the end of this paper, we think that we have succeeded in discussing very clearly our approach, our results and our conclusions, with regard to the standardization and evaluation of the African indigenous medicine. We have shown how it is important to understand the attitudes and concepts, which are the causes of the shortcomings in the practices, in order to find ways of making them reproducible.

We would like to add that this approach is not opposed to any other earlier approach which may have been used in more indepth studies on, for example, the active principle (if this exists at all), its toxicity and its mechanism of action.

Without denying the importance of these studies, our priority was not to look for an active principle or to determine an LD_{50} value, or a plan of action. But, our priority was rather to ensure that the reproduceability and the stability of the preparations was carried out within certain norms of specifications. For, we are dealing with medicines for which the pharmacovigilance test has not been unfavourable. As such, we think that the establishment of average samples over a given period of collection, and the strict observance of certain rules suffice.

The improved indigenous medicine, **as we have called it, can be accepted and produced, at least semi-industrially, so as to respond to the problem of public**

health which requires the supply of medicines through health education. This can be effected by an adaptation of conditions of marketing that would be in line with the ethics of our socio-cultural environment.

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APPENDICES

1. Evaluation of Fresh Plant Bundles (in grams)

No. d'odre	Guiera senegalensis	Diospyros mespiliformis	Saba senegalensis	Opilia celtidifolia	Bridelia ferruginea (saguan)	Parkia biglobosa (nere)
1	110,2	185,5	182	51,5	232,2	181,5
2	140,4	191,8	177,5	130,2	226,1	220,9
3	116,1	224,4	166,4	164	257,2	169,8
4	122,8	149,4	190,9	142,7	194,9	252
5	161,9	184,3	155,1	105,8	206,4	184,2
6	130,7	230,3	138,8	115,8	184	179,2

7	167,6	191,8	177,5	130,4	190,6	136,5
8	113,5	212,5	113,2	140,2	215,7	153,2
9	147,9	212,3	192	136,5	187,6	104,7
10	122	207,9	189,8	94,6	194,1	193,3
11	1333,1	1990,2	1683,2	1211,7	2088,8	1775,3
Average	133,31	199,02	168,32	121,17	208,88	177,53

2. Calculus of the Variations of the Pinch Measurements of Asthmagardenia Powder

Dsignation des sries de mesures	Mesure extra infrieure (Mi)	Mesure extreme suprieure (Ms)	Report Ms Mi
1	0,2073	0,5278	2,5
2	0,1976	0,3212	1,6
3	0,1966	0,3282	1,6
4	0,2310	0,3443	1,5
5	0,2542	0,3600	1,4

3. Calculus of the Variations of the Fresh Bundle Measurements

Dsignation des plantes	Mesure extreme infrieure (mi)	Mesure extreme suprieure (me)	Rapport Ms
Guiera senegalensis	110,2	167,6	1,5

Diospyros mespiliformis	149,4	230	31,5
Saba senegalensis	113,2	192	1,6
Opilia celtidifolia	51,5	164	3,1
Bridelia ferruginea	184	257	21,3
Parkia biglobosa	104,7	252	2,4

4. Evaluation of the Pinch of Asthmagardenia Powder

No. d'odre	Tare Tare + Poudre		Poudre (g)
1	5,9558	6,2604	0,3046
2	6,2375	6,5157	0,2782
3	6,4909	6,6982	0,2073
4	5,8706	6,3035	0,4329
5	6,3572	6,7570	0,3998
6	5,7518	6,2796	0,5278
7	6,3614	6,7975	0,4361
8	6,1505	6,5910	0,4405
9	6,1310	6,4805	0,3495
10	6,0659	6,4950	0,4291

My = 0,3805 gm

5. Evaluation of the Pinch of Asthmagardenia Powder

No. d'odre	Tare Tare + Poudre		Poudre (g)
1	6,2980	6,5042	0,2062
2	6,1622	6,4777	0,3155
3	6,7003	6,9084	0,2081
4	6,2670	6,4646	0,1976
5	6,6130	6,9342	0,3212
6	6,1116	6,3390	0,2274
7	6,6522	6,9386	0,2864
8	6,2492	6,5276	0,2784
9	6,2055	6,4426	0,2371
10	5,6594	5,9298	0,2704

My = 0,2548 g

6. Evaluation of the Pinch of Asthmagardenia Powder

No. d'odre	Tare Tare + Poudre		Poudre(g)
1	6,2980	6,5032	0,2052
2	6,1620	6,3862	0,2242
3	6,7005	7,0287	0,3282
4	6,2672	6,5349	0,2677

5	6,6130	6,8559	0,2429
6	6,1113	6,3628	0,2515
7	6,6522	6,8795	0,2273
8	6,2489	6,4455	0,1966
9	6,2058	6,4220	0,2162
10	5,6593	5,8643	0,2050

My = 0,2364 g

7. Evaluation of the Pinch of Asthmagardenia Powder

No. d'ordre	Tare Tare + Poudre		Poudre (g)
1	6,5,9559	6,2130	0,2571
2	6,2381	6,5824	0,3443
3	6,4914	6,7793	0,2879
4	5,8704	6,1430	0,2726
5	6,3573	6,6548	0,2975
6	5,7522	6,0433	0,2911
7	6,3616	6,6746	0,3130
8	6,1508	6,3818	0,2310
9	6,1312	6,4310	0,2998
10	6,0663	6,3322	0,2659

My = 2860 g

8. Evaluation of the Pinch of Asthmagardenia Powder

No. d'odre	Tare Tare + Poudre		Poudre(g)
1	8,8108	9,1197	0,3089
2	6,1620	6,4421	0,2081
3	6,7005	6,9547	0,2542
4	6,2673	6,5570	0,2897
5	6,6130	6,9702	0,3572
6	6,1112	6,4504	0.3392
7	6,6524	6,0124	0,3600
8	6,2493	6,5490	0,2997
9	6,2057	6,5402	0,3345
10	5,6595	5,9712	0,3117

My = 3135 g

Pharmacological value of plants of Rwandese traditional medicine: chemotherapeutic value of some Rwandese plants

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Introduction

A detailed study of Rwandese plants was done in order to enhance the knowledge of traditional Rwandese therapy and that of biological activity in medical flora. This study, like many others done in Rwanda and elsewhere, aims at discovering new or better medicines from plants. It also justifies the therapeutic use of certain plants by traditional Rwandese healers. This paper summarises the methodology used and describes the major results of the study.

The study involves some plants widely used in traditional Rwandese medicine. These are *Rubus rigidus* Sm. ("Umukeri") from the Rosaceae family; *Lantana trifolia* L. ("Mugengeri") of the Verbenaceae family and *Vernonia amygdalina* Del. (UMUBILIZI) which belongs to the Asteraceae family.

The paper presents in a condensed form the results obtained up to now from a systematic study seeking to show the pharmacological value and/or chemotherapeutic value of these plants. In order to prove the therapeutic use of these plants, we started with the following general hypothesis: in addition to its psycho-socio-cultural value acknowledged by everybody, traditional medicine also uses plants which have a biological effect that can be demonstrated by using scientific models employed in biomedical research. For one plant species studied, results of which indicated the possibility of its clinical use, toxicological aspects were also examined. The results are promising.

While pursuing research on the therapeutic activity of plants, the isolation and

identification of chemical molecules make it possible to have a more complete phytochemical knowledge of the plants being studied for the first time and also to obtain toxicological information which is often inaccessible when working with raw extracts,. The isolation of chemical molecules is important in writing pharmacopoeia of these plants and the identification of chemical molecules is very useful not only in the production of medicines, but also allows the researchers to give useful advice to traditional practitioners who use these species.

A description of the general methodology is given, followed by a detailed study of every species. This study focuses on the chemical molecules that have been identified and their biological activity. Since a tentative conclusion is given during the study of each species, a brief discussion is provided to summarise the importance of the plants studied in the development of a national medico-pharmaceutical sector.

General methodology

The plants studied were selected from the whole range of Rwandese medicinal flora, using in particular the information provided by the traditional practitioners on the ethnopharmacological activity of the species.

For each species, research was done using a methodology that can be summarised by the following seven major elements:

(a) a botanical description and the geographical distribution of selected plants;
(b) an inventory of the uses of plants in Rwandese and central African

traditional therapy;
(c) preliminary biological screening of the whole extract of the plant;
(d) phytochemical screening and detailed bibliographical study of the whole extract of the plants;
(e) chromatographic fractionation of extracts as well as investigating the previously identified activity;
(f) isolation, purification and identification of the products responsible for the activity;
(g) detailed study of the therapeutic effect and possible toxicity of active products compared with products already known in therapy.

The botanical study was done at CURPHAMETRA where specimens of the plants can be found. The study of the geographical distribution of the plants was done using specimens at CURPHAMETRA and the Herbarium of the National Botanical Garden of Belgium.

The phytochemical methods of extraction, isolation and identification of plant products have been described in many books. Some particular aspects of this research have been presented in detail in the cited references. A summary of some techniques used in the research on biological activity is presented in this paper, giving the specific character of some of them. Dilution and diffusion were used to demonstrate the antibacterial and antifungal chemotherapeutical activity. Each time we tested the microorganisms that represent major groups recognised as the main pathogenic agents. For purified active products, we investigated the minimum inhibitory concentration (MIC) according to the standard method. Whenever possible, the activity of a product was compared to a known control product used in therapy.

The antiviral activity of plant extracts and of pure products was studied using a more complex technique which necessitates culture and maintenance of cellular tissues, growth of virus on those cells and testing of the antiviral activity by observing the absence or persistence of the cytopathogenic effect of virus according to whether the tested product has any antiviral effect or not. We mainly used dilution of virus in plates of microtitration. The selection of the virus was done in such a way as to include representatives of different classes. Thus the Adenovirus was selected to represent the ADV virus without coating, the Poliovirus and the Coxsachievirus represent the ARN virus without coating, while the measles virus at the Semliki Forest represent the ARN with a coating. Cardiovascular activity was demonstrated using the following experiment models: blood platelets of rabbits, the right and left auricles of guinea - pigs, the central artery of the rabbit's ear, and microsomes of the sheep's seminal vesicle. Some of these experiments were done at the University of Anvers (UIA), in Belgium.

Toxicological studies on 3-methoxyquercetine (3-MQ) isolated from *Vernonia amygdalina* were done at Butare, at the CURPHAMETRA on experimental models described below.

1. Toxicity of 3-MQ in internal usage (9)

Preparation and administration of the product

The 3-MQ was extracted from the flowers of *Vernonia amygdalina* (omubilizi). An aqueous suspension was prepared by grinding the powder in a mortar; the suspension was added to a concentration of 15 mg to 20 ml of distilled water and was administered to mice in ratios of 30 mg per kg of the animal's body weight.

This translates into 0.8 ml of the suspension for a mouse weighing 20 g. The suspension was administered using a plastic syringe with an unoxidable tip and unlikely to cause trauma in the animal.

Handling and observation of mice

Ten white mice (colony OFI) of both sexes, of more or less identical age and of average weight of 22.4 g were divided into two groups of 5. The general condition and temperature of each animal were observed and noted the day before the administration of the product. The following day, one of the two groups was given a suspension of 3-MQ proportional to the weight of the animals while the other group received an equal amount of distilled water. The weight and temperature of the animals were noted everyday at the same hour and focused on:

- **the general condition of every animal**
- **nervousness and any sign of drowsiness**
- **temperature**
- **the condition and form of coat/fur**
- **the body weight of every animal**

The animals were kept in groups of 2 in rectangular plastic cages.

The product was administered for 10 consecutive days and the above- mentioned aspects were initially observed for 44 days.

The animals were given food, water, and libitum. On same dates, the 1st, 9th, 11th, 22nd, 29th, 36th and 44th days, every mice was weighed from the 2 groups and the average weight on those dates was calculated. The comparison of these

average weights and initial weight allowed us to evaluate the effect of the treatment on weight evolution and consequently on growth of animals in the experiment.

We used the following procedure to investigate the influence of the product on reproduction: a group of 10 female mice of the same colony were given an aqueous suspension for 10 days. Another group of female mice was given distilled water in the same way like in the previous experiment. On the 11th day, the mice from the 2 groups were mated and kept in pairs in groups of different cages for each lot where they were given normal food, drink and libitum.

The number of new-born mice in each lot was counted and compared.

2. Toxic manifestation of *V. amygdalina* in UE (10)

The experiment involved 10 adult rabbits with weights between 2.8 and 4 kg; they were divided into 2 groups of 5. After weighing them and observing carefully the general condition of the animals, every rabbit was shaved over an area of 4x4 cm on the back. They were kept in individual cages, fed and given libitum. An ointment of 5% of aqueous-methanolic fraction made from the fruits of the plant was applied in the shaved area of the first lot of rabbits. The ointment had a vaseline base.

The second control group was treated with vaseline only. A small amount of ointment or the vaseline were accordingly applied once a day in the same way by rubbing lightly in order to cover uniformly the bare area.

The experiment lasted a month (from 4th December 1987 to 4th January 1988).

On the 18th day the administering of the medicine was stopped. The two groups were observed daily and compared on the following aspects: the general condition of the animals, weight, growth of hairs and especially any manifestation of irritation on the treated surface.

Detailed study of the plants and results

1. Rubus rigidus

The species is widely found in Rwanda and neighbouring countries. The Rwandese traditional practitioners use it mainly to treat bacterial and fungal diseases but it is also used in other areas of pathology such as poisoning, snakebites, etc.

A preliminary study showed an antibacterial and antifungal activity in the whole extract of the plant. Phytochemical studies made possible the isolation and identification of pygallic acid, commonly known as pyrogallol.

The antibacterial and antifungal activity of the product already shown in literature was confirmed by this study with a minimum inhibitory concentration (MIC) of nearly 250 micrograms per ml. The microbes most sensitive to this product are *Staphylococcus aureus, Pseudomonas aeruginosa, Microsporum canis, Trichophytom mentagrophytes* and *Candida albicans.*

No other activity, antiviral or pharmacological (cardio-vascular), was noted in this plant during our study. However, bibliographical research has shown that pyrogallol has a hepatoprotective activity which is observable when the same amount of doses are used as those showing antibacterial effect. This triphenol shares that action with other phenols of similar structure, catechins and tannins.

To conclude, we established that the chemotherapeutic activity of *Rubus rigidus* used by Rwandese traditional practitioners is mainly due to the presence of pyrogallol. From the medico - pharmaceutical point of view, pyrogallol already has several uses especially in external usage. References which we consulted mention also antibacterial ointments with doses of 2 to 10%. However, it is known that the plant has some toxic effect when used internally. We therefore advised traditional practitioners to put more emphasis on its external uses.

2. Lantana trifolia L.

It is a verbenaceous plant widely found in Rwanda where it is known as "umuhengeri". This plant had previously shown an antibacterial activity especially in its leaves. Traditional practitioners use it to treat many syndromes.

It is the antibacterial activity that gives promising results while other biological activities investigated do not give any results that can justify further investigation in other areas.

The chemotherapeutic antibacterial study on the active fraction made it possible to isolate and identify a series of products which have promising activities. These products are: two saturated chains aliphatic hydrocarbons ($C_{33}H_{68}$ and $C_{35}H_{72}$), saccharose, two pentacyclic triterpenes of the ursane group (alpha-amyrine, urs-12-ene-3-one), a new polymethoxy flavonoid (5-hydroxy-6,7,3',4',5'-pentamethoxynavone) that we named "umuhengerine" following the Kinyarwanda, name and finally diospyrin which is a binaphtoquinone related to juglone. "Umuhengerine" was isolated from these plants for the first time whereas diospyrin had only been identified in the different genera of *Diosypros*

(Ebenaceae).

Among the products isolated, only the last two showed any antibacterial activity worth investigating. Umungerine has a small antibacterial and antifungal spectrum at concentrations of 300 micrograms. Diospyrin has a wide spectrum on gram positive and gram negative bacteria and some fungi, with a predilection against *Mycobacteria* (for example the causal agents of leprosy and tuberculosis) whose representatives show sensitivity to an MIC of nearly 2.5 micrograms per ml.

As far as this plant is concerned, even if the comparison of MIC is not the only parameter taken into consideration, diospyrin is active in a similar concentration (perhaps even better) compared with many antibacterial products used in therapy; such is the case for its action against *M. fortritum* (MIC = 2.5 μg ml) compared to the control, Neomycin, which is only active with a MIC of 32 micrograms/ml. Umuhengeri has a weaker antibacterial spectrum but according to its chemical structure, it could be more active at the level of lipophile balance, a factor presently recognised as determining the activity of chemical molecules against gram negative and gram positive bacteria. In addition, its identification clearly contributes to the chemical knowledge of this species.

According to the literature on *Lantana camara,* another Verbenaceous plants which resembles very much the preceding plant, *Lantana camara* has toxic products especially against the liver and the skin, such as those which show some photosensitization. An example of these structures is lantadene A.

We did not isolate these products in the active fraction of *L. trifolia.* However, we cannot conclude that they are absent in all parts of the plant. It is probable that

these toxic products can be demonstrated by other chemical methods which do not take the biological activity as a major indicator. Bibliographic research on the genus *Lantana* advises some caution in the use of this plant.

3. Vernonia amygdalina Del.

It is an Asteraceous plant belonging to the subfamily of Vernonieae, which is very common in tropical and subtropical Africa. It is called "Umubilizi" in Rwanda and in some neighbouring countries like Uganda and Burundi. Its use in traditional medicine ranges from treating hepatitis, cardiac ailments, poisoning, malaria, stomach pains, snakebites and eczema. The authors of the "Communautes Africaines" journal have confirmed recently the use of *V. amygdalina* as food for humans in Cameroon. We had earlier on stated this use of the plant in East and Southern Africa.

Concerning the biological activity, especially of the antitumour and cytotoxic nature already identified in this plant, this study identified other structures that had never been stated before and demonstrated other therapeutic activities such as antiviral, and the pharmacological effect at the level of platelet aggregation and cardiac ailments.

The study was done on extracts of dried flowers of the plant prepared and fractioned according to procedures. Given its importance in chemotherapy, the antiviral activity guided the separation and purification of active molecules. Some chemical structures were isolated and identified, for example:

- **11 saturated aliphatic C_{22} to C_{32} fatty acids;**

- **5 esters of fatty acids derived from glycerol;**
- **a sesquiterpene lactone known as vernolide;**
- **a series of flavonoids, that is:**

quercetine (3,5,7,3',4'-pentahydoxyflovone), 3-methoxyquercetine (3-MQ), 3,3'-dimethoxyquercetine (3,3'-DMQ), rutine, quercetine - 3-0-1-beta-D-glucose-6-1-alpha-L-rhamnose) and kaempherol (3,5,7,7,4'-tetrahydroxyflavone (K).

3-MQ was isolated with a yield close to 1% compared with the powder of dried flowers at ambient temperature.

A detailed study of therapeutic activity of isolated products showed that flavonoids and vernolides are the active principles, while the fatty acids and esters are aliphatic products which are associated with these active principles. Four groups of biological activities were studied. These are the cardiovascular activity, antiparasitic activity, antiviral activity as well as the verification of some lexicological aspects of products that can be clinically used.

1. Cardiovascular activity

1. *Effect on platelet aggregation.* All technical details of the procedure for demonstrating this activity have been described elsewhere especially in "Revue Medicale Rwandaise" in 1986.

The technique used demonstrated that quercetine flavonoids, 3-methylaquercetine and rutine, to a small degree inhibit platelet aggregation, lipoxygenase activity, and cyclooxygenase, at a concentration of 100 micrograms (110 M) per ml. This

concentration is 1,000 times higher than that which shows an important antiviral effect.

Vernolide also shows a completely reversible inhibition of platelet aggregation induced by arachidonic acid, but this activity is very small.

2. Other cardiovascular activities.

At doses of 10 micrograms per millilitre, 3-methoxyquertine shows a positive chronotropic effect on the right auricle and an antiarythinic activity on the left auricle of the isolated guinea-pig's heart.

3. Antiparasitic activity

This was indirectly demonstrated, especially by vernolide. In fact during our research, another group working independently isolated the same product from *Vernonia colorata* and showed that the product has an antiparasitic action especially against *Entamoeba histolitica* at nearly the same level as antiparasitics used clinically, such as metronidazole. By demonstrating this product in *V. amygdalina* we were justifying, at the same time, the use of this plant against intestinal parasites.

4. Antiviral activity

3MQ and 3,3'-DMQ have an important antiviral activity which was shown even at concentrations as low as 10 nanograms. These products have a selective effect since they prevent the formation of ARN and viral proteins without interfering with the metabolism of the host cell. They are especially active against the virus of

poliomyelitis, the coxcachie virus, the vesicular stomatitis virus (VSV), the Rhino virus, and against other virus of African origin like Bangin and Bunyamwera.

The importance of this plant in antiviral chemotherapy is thus obvious, especially since even in more developed European medicine, there is no medicine in this area. Fortunately, the family of products isolated from this plant allows us to foresee further research with some hope of success in treating other groups of virus, such as retrovirus. Proof exists some of which is very recent. For example in 1979 Mr. Apple and his colleagues demonstrated inhibition of reverse transcriptase of encornavirus by some flavonols of vegetable origin.

In May of the same year the Japanese group ONO Katsuhiko with French researchers reexamined the action of some flavones related to quercetine as inhibitors of reverse trascriptase, enzymes that were associated with human immuno-deficiency syndrome.

Even if further research was to demonstrate the absence of any important activity in this area, the importance of *Vernonia amygdalina* in semi-purified extracts as well as pure products is obvious given the low level of toxicity in the plant. One can foresee the therapeutic use of this species in future. Before this stage of the study, we explored some toxicological aspects of the main active principle.

5. Preliminary toxicological study of 3-MQ in internal usage

As described above, we tried to establish the importance of toxic manifestations that can occur when using the plant as an ointment in treating dermatological diseases such as eczema. The study shows that the application of an ointment

with 5% of a semi- purified extract of *V. amygdalina* does not produce any detectable irritation among rabbits in the laboratory treated with it. The same applies to rabbits that only get the expient.

General conclusion and discussion

In reporting the results of this research we have underscored, once again, that the value of African medicinal plants in general, and Rwandese plants in particular, in the treatment of all kinds of diseases does not need to be demonstrated any more. The use in traditional therapy of plants that are the focus of this paper is justified by the demonstrated biological activity of their products. There are plants which have activities already known but of which we did not know the presence in the plant under study, for example pyrogallol. There are products which were very well-known in chemistry as being inactive or nearly so. However the research showed us that they had a very useful activity which was sometimes unknown elsewhere in the medico-pharmaceutical sector. An example of this group is 3-methoxyquercetine isolated from *V. amygdalina.* Finally we found toxic or inactive products in relation to the activity under investigation. The demonstration of these products contributes very much in toxicological or phytochemical knowledge of plants under study.

As expected, the plants under investigation do not have the same importance in developing further the socio-sanitary sector. The activity of *R. rigidus* is very low. Its main importance is mostly in justifying its use in traditional therapy. *Lantana trifolia,* however, has activities similar to those of the most active antibiotics but because the plant is very toxic, the products could be purified and then used in new medicines in bacterial chemotherapy. *Vernonia amygdalina* is hardly toxic and

grows spontaneously in many of our regions. Its varied activity, very obvious in antiviral chemotherapy and as an anthelmintic, suggests that we should develop quickly research on its use, even without isolating active molecules. One could use its semi-purified extract.

The experience of Burkina Faso in the area of traditional pharmacopoeia

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Introduction

Geographical Information

Situated in the heart of West Africa, Burkina Faso is a country which is completely landlocked . It borders on the Republic of Niger to the East, on Ivory Coast to the West, on Ghana, Togo and Benin to the South, and on Mali to the North-West. The country covers an area of 274,000 square kilometers with an estimated population of 8,600,000 inhabitants in 1988.

Demographic characteristics

The population density is 31 persons per square kilometre. The urban population is low, only 12%. Thus 88% of the Burkinabe live in the rural zone. The population is mainly that of young people. 42.2% of the population is made up of young

people of less than 15 years. The birth rate is at 49.9% and the infant mortality rate is high: 134% while the gross mortality rate is 24%. The annual population growth rate is 2.68%.

Administrative structure

The country is divided in 30 provinces, 300 districts and 7,285 villages. This administrative structure is under the Ministry of Territorial Administration.

Overview of the sanitary situation

The sanitary situation is affected by the following:

- **problems of drainage and the provision of drinking water;**
- **the quantitative and qualitative insufficiency of the sanitary services;**
- **the persistence of epidemo-endemic diseases due to a low socio-economic level of the population. These diseases remain the main cause of the high mortality rate, especially among children (134%).**

In order to rectify the situation, the Burkinabe State has carried out a number of vaccination campaigns, some of which are:

- **the operation "Commando vaccination" of 1984;**
- **the operation "Doors Open on Vaccination" of 1988;**
- **the operation "Daily Vaccination" of 1989.**

These operations enabled the vaccination, during a very short time, of an important number of children. The state also carried out other more permanent

actions such as the establishment of fixed vaccination stations and the creation of primary Health Stations (PSP) in the villages. All this has helped to improve the sanitary situation.

The National sanitary policy

Objectives

The sanitary policy is based on the primary health care. Its objective is to ensure "Health for All by the year 2000". As such, a sanitary scheme for the decade 1980 - 1990 has been worked out, and this scheme is meant to deal with the major community health problems. In order to achieve this, it is essential that the state should establish actions of curative care promotion and re- adaptation, in the functional infrastructure, with the necessary equipment and personnel.

Given certain realities, namely the fact that this project was not in line with the financial realities of the country, it became necessary to revise it so as to put into account the sanitary priorities at the national level. The main components of the project centered on the following points:

- **the implementation and the working out of programmes for the control of endemo-epidemically transmissible diseases;**
- **the creation of basic sanitary services, especially maternal and infant health care;**
- **the training and in-service training of the paramedical personnel in the domain of public health and the control of endemo- epidemics.**

(epidemiology?)

Institutional Device

In order to meet the objectives of the national sanitary policy, a pyramidal system of Health was recommended. Its structure is as follows:

Starting from the base to the top, we have the following structure:

- **ESSA: Institute of Health Science;**
- **MS-AS: Ministry Of Health and Social Welfare;**
- **H.N: National Hospital;**
- **CHR: Regional Hospital Centre;**
- **C.M: Medical Centre;**
- **CSPs: health and Social Promotion centre; and**
- **PSP:Primary Health Station.**

The national pharmaceutical policy

The inability to cover the whole national territory with medicines is one of the major handicaps in making an effective implementation of primary health care in Burkina Faso. Thus, the national pharmaceutical policy has instituted the following objectives:

General objectives

- **To provide the population with essential medicines at a reasonable price and as permanently as possible.**

- **To improve the management of medicines in all the sanitary structures in order to make a rational use of the resources which are supplied for sanitary use.**

- **To institute and develop the natural product by integrating into it the medical returns and the traditional pharmacopoeia.**

Specific objectives

- **To assess and strive to satisfy the needs for public sanitary education in essential medicines and technical materials.**

- **To select the medicines which are considered essential in Burkina Faso.**

- **To monitor the effects of medicines on the market with the help of national and international experts.**

- **To contribute to the fight against the abuse and illegal traffic of drugs.**

- **To exploit and to avail to the users all information or documentation relative to pharmaceutical products.**

- **To promote traditional pharmacopoeia and medicine.**

Methods

In order to attain these objectives, a number of measures were considered, namely:

- **The establishment of a Directorate for Pharmaceutical Services (DSPH) consisting of a department for pharmacopoeia and traditional medicine. This Directorate is expected to monitor the application of the national pharmaceutical policy.**

- **The establishment of a national corporation responsible for pharmaceutical supplies (SONAPHARM) in 1985, which played the role of a state whosaler and which enabled customers to buy their medicines at a reasonable price.**

- **The creation of a medical laboratory for the country (MEDIFA) in 1989 whose role was to study soluble materials (salty and sweet serum). A similar institution had been created in 1978.**

This is called IRSN (Research Institute of Natural Substances). It is under the Ministry of Higher Education and it contributes, to some extent, to the local production and to the promotion of medicine and traditional pharmacopoeia.

Burkina Faso's policy in the sphere of traditional pharmacopoeia

Justifications

In spite of the establishment of the SONAPHARM in 1985, which helped to lower the prices of certain medicines, the national budget has problems in meeting the demand for primary medicines in sanitary education. Also, the new medicine supply policy is only confined to emergency medicines.

The cost of the other medicines has to be entirely met by the people. And, in spite

of the efforts made by the State, the price of medicines remains always high especially given the very low gross national product. Also the majority of the Burkinabe people have a very low income and therefore turn to the traditional medicineman.

Historical account

In Burkina Faso, both medicine and traditional pharmacopoeia have gone through four major historical periods:

- **The precolonial period**
- **The colonial period**
- **The revolutionary period**

The precolonial period

During this period, traditional medicine was totally under the jurisdiction of traditional practitioners who were scattered in all villages. These were both general practitioners as well as specialists (bone setters, gyneoco-obstricians e.t.c.). Their activities were practically secret and entirely private. Their services were based on humanism and were offered free of charge.

The colonial period

During this period, there was a brutal interruption of the medicinal evolution due to the coming of the colonial power which forbade this practice on the ground that the "civilised" medicine from the metropole was much more superior. But this act was futile since, rather than disappear, this traditional medicine started being

practiced secretly.

The neo-colonial period

Since the time of independence in 1960, this period has been marked by an attempt of codification. A number of very general and limited texts were worked out with the intention of legally permitting the traditional healers to practice their art. However, at this period, the traditional healers had not been accorded real freedom by the local authorities.

Revolutionary period

After the advent of the revolution in August 1983, Burkinabe traditional medicine came out from its lethargy. The authorities were openly in favour of having the traditional practitioners participate in the resolution of health problems experienced by the people in order to attain the objective "Health for All by Year 2000". But in order to participate effectively in this challenge, traditional medicine has to adapt itself with time and knowledge. Thus, the minister for Health and Social Welfare, at the opening of the 1st National Seminar on Medicine and Traditional Pharmacopoeia on 16th November 1987, declared:

The fight which we have started in order to restore the confidence of our people in matters of public health, should not only be confined to things to do with our past experiences, but also we should work hard in order to render to this medical wealth a confirmed scientific value.

Medicinal plants: Their production, phytotherapeuticity, uses and propagation

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Introduction

In Brazil phytotherapy is a non-conventional therapy that has received great attention from the Government in the past five years, having proved to be useful for the treatment of many ailments. A large part of the population has access to it, not only due to its low cost, but also because of our Brazilian habit resulting in 90% of the population using tea as a medicine.

We are heading towards a stage in which a medicinal plant is seen as medicine deserving all care and attention. The latter has been shown in the fact that several universities and research centres have acknowledged medicinal plants as auxiliaries in the treatment of, and curing several diseases, and as a solution to many other ailments afflicting the Brazillian community. We see medicinal plants as resources able to produce medicated principles.

It is worthwhile to mention the great transformation seen in the panorama of the infectious diseases after Alexander Flemming discovered a substance produced by a fungus *Penicillum notatum* which is able to kill bacteria. This substance, known as Penicillin, represented a real progress in therapeutics.

Superior plants which, due to their metabolic activity are able to produce antibiotics, and which are found in Brazil include, among others, *Capraria bioflora* from which biflorine which is a polycyclic orthoquinone, was isolated. The compound shows an anti-*Canadida albicans* activity.

Considering that the plant synthesizes its active principles starting from the nutrients in the soil and basic elements, such as carbon dioxide, solar energy and water, we then went into the cultivation of plants which we considered as being important phytotherapeutics and which did not exhibit the required qualities which are necessary for medicines.

In the course of cultivation, the plants were provided with all favourable conditions for their development, thus obtaining as a result, a population of uniform plants regarding the external characters as well as their chemical composition which would guarantee a production of active pharmaceutics.

The following plants have been investigated for their phytotherapeutic properties.

Stevia (Steviare rebaudiance)

The leaves of this plant contain the deterpenic glycosides, stevioside and rebaudioside -A as the main components. These glycosides have found their importance as sweeteners. Thus stevioside and rebaudioside - A are 300 and 400 times as sweet as sucrose, respectively. Presently, the two compounds are widely used in Brazil as non-calorific sweeteners in foodstuffs and medicines. The compounds also posses non-cryogenic activities and are known to be harmless to humans.

Stevia reaudiance

The leaves of this plant contain stevioside and rebaudoside - A, which are diterpenic glycosides as main components. The importance of these glycines were given by the fact that they were sweeteners. Stevioside has up to 300 times the sweetening power of saccharose, and Rebaudoside-A has 400 times the sweetening power of saccharose.

At present there is a great interest in Brazil in the use of these glycines as non-calorific sweeteners, both in foodstuffs and medicine. They also present non-caryogenic activities and are harmless to health.

By using almost 10 kg of good quality dry leaves, we can extract 1 kg of stevioside. This sweetener is recommended to people suffering from diabetes, obesity and those under a hypocalorific regime.

We cultivated this plant in our farms. It can also be found under cultivation in Mato Grosso do Sul, Parana, Santa Catarina and Sao Paulo states.

Besides this sweetener being recommended for hypocalorific regimes we also have in our pharmacies a compound tea in which *Stevia* is the main plant ingredient and this is also recommended for the same purpose.

Other components of this tea include:

(a) Carqueja Amarga (*Baccharis trimera* Less), with bitter properties and thus favouring and stimulating digestion.

(b) Chapeu de Cauro (*Echinodorus macrophyllus* Kunt), from which alkaloids, and other substances have been detected. The plant shows diuretic properties.

(c) Jurubeba (*Solanum paniculatum L*.), whose active principles are found in the whole plant. It is used for the treatment of jaundice and in maintaining a good functioning of the liver.

Another group of plants are those which are rich in essential oils. One of the representatives of this group is Camomila (Matricaria *chamomilla*), which is also known as matricaria, margaca das boticas and camomila dos alemaes. Its extract is a blueish liquid which, when exposed to light, first turn green and later on brownish. The essential oil content of the extract varies from 0.15 to 1.35%. Azulene constitutes 0.062 to 0.16% of the crude extract occurring as procamazulene-A (matricina), which during the distillation process successively transforms itself into camazulenogen, and ultimately into camazulene. The amount of azulene in the essential oil fluctuates between 1 and 15%.

The pharmacological activity of Camomila is attributed to remarkable anticongestion properties of the extract, which are due to the camazulene and alpha-bisabolol present in it.

The Camomila extract also contains a bicyclic acetylenic ether which causes some toxicity as a result of its spasmolitic properties. Its anticongestion action is superior to that of guaiazulene.

Camomila is used as an internal medicine in the form of an infusion, as a digestive

bitter tonic and also as an antispasmodic agent. Externally it is used as an anticongestion drug in erythemas created by sunlight, locally applied as a mask.

In cosmetics the extract is used to increase the flaxen, golden, light auburn, or pale yellowish brown colour of hair.

***Barbatimao (Straphnodendron barbatimam* Martius)**

This is a leguminous Brazilian plant which is rich in tannins. Its thick bark contains 18 to 27%, sometimes up to 40% tannin. The high tannin content gives this plant a pharmacological astringent, energetic, healing, hemostatic and antiseptic action, due to the phenolic nature of the tannin.

Barbatimao tea is prepared under a boiling process, and it is used for cleansing and in baths when treating leucorrea, ulcers, wounds and uterine hemorrhage. Manoel da Silva *et al.*, used it at the Assistencial-Brasilia-DF-Brazil teaching hospital to cure proctitis actinic. This non-comparative work was done on 16 patients with 11 of them having an unspecified proctosigmoiditis and 5 patients with actinic proctosigmoiditcs. Those patients, who were diagnosed by means of a biopsy were given a retention enema with Barbatimao tea, without any other additional oral medication. All patients showed a full recovery. Nine of them had lesions limited only to the rectum and seven to the rectum-sigmoide flexure. The patients selected in this study were those who did not respond to the topical treatment with 5-ASB corticoid or those who could not afford to purchase the conventional medicines. The minimum time for the use of the medicine was one month and the maximum 30 months. Two of the patients had to suspend the medication because they developed abdominal colics. There was clinical and

endoscopic recision in 50% of the cases; in 6% there was clinical recision and endoscopic improvement and in 19% there was clinical and endoscopic improvement. The unaltered patients consisted of 25% of all those studied.

Given the initial clinical data, there is the possibility to use this new medicine for the treatment of these ailments, the medicine being easy to purchase and it is cheap.

Conditioning of the soil

We should stress the fact that during the conditioning of the soil when cultivating medicinal plants, several measures were taken that increased the productivity of the crop. Thus the following factors have now been established:

- **Calcium favours the growing of *Alfazema* and *Aleerim.***
- **An acidic soil is ideal for the development of *Camomila.***
- **Nitrogenous compounds guarantee the production of alkaloids in the plant.**

Collection

We have some basic procedures for the collection of different parts of the plant:

- **Roots, stems and tubercle: collected during the autumn, when the plant is adult.**

- **Bark: collected from the branches during spring, before blossoming.**

- **Leaves: when the plant is developing the reproduction organs; preference is given to fully developed leaves.**

- **Flowers: when the floral buds are opening.**

Drying

Regarding drying, we were able to verify that the amount of water present in the plants varied according to the tissue and organs, but in general it reached high volumes, as shown below:

Roots - 70 to 75%
Leaves - 60 to 90%
Flowers - over 90%

We were able to reduce these volumes to a percentage close to 5%, thus avoiding undesirable enzymatic reactions and the proliferation of fungi and bacteria, which endanger the stability of the active principles produced by the plant.

Phytotherapeutic forms

In our pharmacies, the pharmaceutical forms we indicate and prepare for the use of medicinal plants ranges from the simple one, a tea, to the one in which we use a fluid extract and dry plant, microcrushed in capsules. We attach importance to the information given to our clients on the fact that when plants are used as medicine, besides containing a large amount of active principles, they should be prepared in

the right way, so as not to alter the composition and damage the medicinal fractions. When used as a tea, we stress on the way to prepare it, either by infusion or by boiling, and how to use it.

In obtaining fluid extracts and dyes for pharmaceutical preparations for topical and oral therapy we use suitable extracting solvents which dissolve and carry in them the active principles of the plants. At present consumers prefer the phytotherapeutic which are in the form of capsules. We either put the whole plant or part of it to a microcrushing process, thus obtaining a product which liberates easily its active principles to be absorbed by the body. Capsules are then made from this material.

Plants also used in Brazilian traditional medicine

***1. Guarana* (*Paullinia cupana* Kunts)**

A native plant from the Amazon region that sometimes might reach ten meters high. Its principal constituent is caffeine and the average content in its seeds is 3 to 5%. This phytotherapeutic plant has several pharmacological actions:

- **It stimulates the central nervous system.**
- **It stimulates the cardiac muscle.**
- **It relaxes the lean muscle, in particular the bronchial muscles.**
- **It acts on the kidneys, determining diuresis.**

It is indicated to maintain the person awake, to restore mental lucidity in exhausted patients and to increase the respiratory capacity.

2. Espinheria Santa (Maytenus ilicifolia)

The plant is used for patients with high dyspepsia or peptic ulcers.

Trial uses for the protecting effect of the lyophilized extract of the *Maytenus licifolia* tea against gastric ulcer on mice, which was induced by indometnacine or by the stress obtained when immobilizing mice at a low temperature were carried out. The protecting effect was found to be dose-dependent and the results revealed an antigastric ulcer action.

Doses up to 360 times larger than the ones commonly used by human beings did not bring about any alteration in either biochemical serum or hematologic parameters.

Mice which were treated for as long as two months did not show a reduction in the reproduction capacity and the offsprings developed normally. The reproducing capacity and the offsprings born from females which received the treatment during pregnancy did not show any alteration when compared to the control group.

The clinical toxicology in healthy volunteers that drank *Espinheira Santa* during 14 days of a double dose of the posology was negative, indicating that the plant is non-toxic to humans. 23 patients who showed a diagnosis of a non-ulcer high dyspepsia, received during 28 days, two capsules of 200 mg each of lyophilized *Espinheria Santa* tea, equivalent to 2.4 g of dry pulverized plant material per day. As a result the group which took *Espinheira santa* showed significant improvement in relation to the placebo group, regarding the symptomatology of

global dyspepsia and, in particular, of the burning symptoms and pain.

There were no complaints of side-effects produced by *Espinhearia Santa.*

3. Mentrasto (Ageratum conyzoides L.)

The plant is used for the treatment of arthritis.

In the research programme on medicinal plants, the authors studied the analgesic action of Mentrasto tea in fifty patients with clinical and radiological arthrosis of the knee, the femur, the hands and cervix. A study was undertaken on the daily and nightly spontaneous pain for a whole week.

Regarding pain, there was an improvement in 66% of the patients after the second week. The mobility of the joints improved only in 12% and probably it was a secondary effect in the absence of pain.

The absence of collateral effects, as well as from my personal impression led to the recommendation of Mentrasto as an alternative treatment for pain in arthritis, mainly for people who are financially unable to buy common anti-inflammatory medicines.

4. Quebra Pedra

To show the interest and depth of the study on medicinal plants as phytopharmaceutics, we tested, by means of this work, a new alkaloid obtained from *Phylanthus sellowianus,* commonly known as Quebra Pedra, used in the treatment of kidney stones.

Alkaloid fractions extracted from the leaves and branches of this plant presented anti-spasmodic effects in different pharmacological models and one of the alkaloid component was found to have formula $C_{15}H_{20}N_2O_2$.

5. Ricinus communis

The crude seed extract of this plant showed antineoplastic action. The non-oily fraction of the acetone extract of the seeds of *R. comunis* showed activity on the Walker carcinoma 256 in mice, with a daily dose of 0.3 mg/Kg for 8 days. A significant tumoral inhibition of 65% was seen in relation to the control group.

6. Alipina nutans

The aqueous alcoholic extract of this plant has shown a prolonged hypertensive effect in dogs.

This plant, commonly known as "colonia", is widely used in popular medicines both in the North and North-Eastern parts of Brazil to control hypertension in a form of tea.

With the objectives of verifying the possible hypotensive effect of these concoctions, male does put under anaesthesia by using Sodium pentobarbital (30 mg/kg) were injected with the extract from the leaves of the plant, to which alcohol had been previously eliminated. A decrease in the mean blood pressure was observed, thus showing that the preparation is less powerful than the aqueous alcoholic extract.

With these data we reached the conclusion that scientific experiments cannot only

prove the popular use of a plant, but can also identify the more active forms from it, to be used as a phytotherapeutic. Due to the fact that the interest shown by research centres on medicinal plants is recent, we find that *most* of the medicinal plants have not been scientifically studied, even though they have been widely used by the people for a long period.

Table 1: Examples of medicinal plants available in pharmacies in Brazil

Botanical name	Common name	medicinal use
Cynra scolymus L.	Alcachofra	Hepatic diseases
Caiaponia tayuya	Caiapo	Rheumatism
Lippia alba HBK	Erva Cidreira	Analgesic
Chenopodium ambrosioides L.	Erva de Santa Maria	Vermifuge
Mikania sp.	Guaco	bronchal dilator
Mentha sp.	Hortela	Vermifuge and carminative
Bauhinia fortificata	Pata de Vaca	Diabetes
Bidens pilosu L.	Picao	Jaundice
Mentha pulegium L.	Poejo	Bronchal dilator & caominative
Sambucus nigra L.	Sabugueiro	Measles
Boudichia major Mart	Sucupira	Throat infections

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attend this conference. To the organizers of the conference, I express my gratitude for the successful meeting.

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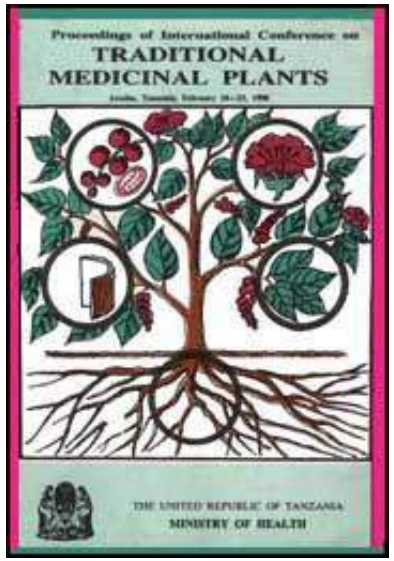

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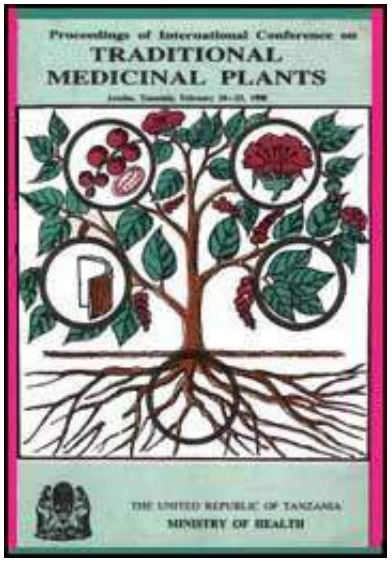

Foreword

Long before Buddha, long before the advent of Jesus Christ, long before Mohammed, Marco Polo, Christopher Columbus, Vasco da Gama, and Captain James Cook..., the aboriginal people in Africa, Asia, North and South America, and the Central Pacific Islands, used concoctions prepared from a wide range of medicinal plants for treating their sick. In most cases, the information on what plant and what part of the plant cures what disease, in which precise locality it grows, when its curative potency is maximal, how it is prepared, and what dosage should be administered..., was passed on from father to son, and mother to daughter, by word of mouth and by practical field experience, from generation to

generation.

But following the "discovery" of North and South America, Asia, Africa, Australia and New Zealand, and the slicing of Third World countries into fragmented pockets with European spheres of influence, the rich heritage of traditional medicinal practices was looked down upon, and branded as primitive. Yet, even in the North, and the West, many pharmaceutical drugs and medicinal syrups administered to patients in modern hospitals, are of plant origin. Indeed, in the Middle Ages (about 500 A.D. to 1450 A.D.), and also following the Renaissance, botany was a mandatory core subject studied by all those aspiring to study human and veterinary medicine.

It has been estimated that over 7000 medicinal compounds in the modern western Pharmacopoeia are derived from plants, and that over 100 pure chemical substances extracted from the higher vascular plants, are used in medicine throughout the world.

It is well established that the majority of the medicinal substances used to-day are extracted from vascular plants occurring in tropical rain forests, where over 50% of the world's vascular plant species are found. Unfortunately, however, the tropical forests, which cover less than 10% of the earth's land surface, are disappearing at an alarming rate, as Man cuts down trees from the forests to provide timber for housing and construction industry, to give room for more land for agriculture, to provide domestic fuel in the form of firewood and charcoal..., and other products whose shortage is caused by the human population explosion. The rapidly vanishing forests are disappearing with many species, some of which have unique curative potency for a wide range of human and livestock diseases.

Some of the endangered vascular plant species in Africa, Asia and Latin America may not possess known curative medicinal value now, but their loss means that our biosphere is being subjected to genetic and chemical impoverishment, since each species has its unique genome and chemistry, which may be useful for solving Man's medical problems of tomorrow. The need for a serious campaign towards the conservation and re-establishment of tropical rainforests, and other endangered ecosystems in Africa, Asia and Latin America, is certainly a must of the day.

But that is not all. The rich ethnobotanical and ethnomedical information in the Third World, which was passed on to us by the ancients, from father-to-son and mother-to-daughter, prior to the advent of European culture, is also vanishing fast. The traditional medicinemen and medicinewomen, like all of us, are given a life span of only three score years and ten. And, since the youths of to-day have a tendency to consider traditional medicinal practice as primitive and unfashionable, few opt to enter into apprenticeship with the practising and experienced healers, whom we are still fortunate to have to-day. Thus when the traditional medicineman or medicinewoman dies, he or she is gone with the rich invaluable information unrecorded. As Mark Plotkin of the World Wildlife Fund has put it, it is as if a library were burned down, and he adds that the situation is actually worse than that (i.e, the burning down of a library) because, if a library is burnt, most of the information can be retrived from other libraries. However, when a traditional healer dies, his or her knowledge is lost, and is lost forever. The need for establishing a close working relationship with the experienced traditional healers, and documenting their medicinal practices before it is too late, is thus one of most urgent, top priority, and critical activities which we must embark upon to-day.

The international conference on traditional medicinal plants, whose proceedings are described in this document, was organised by the Ministry of Health, United Republic of Tanzania, with a view to facilitating the exchange of information between experts on traditional medicinal plants, working in various countries in Africa, Asia and Latin America, and also with traditional healers from some countries in the Third World, and to come with definite recommendations, which are likely to lead to a better and complementary working relationship between experts in traditional medicine and modern medicine.

In this historic conference of its kind, which took place in Arusha, Tanzania, many papers were presented by scientists of widely varied backgrounds: botanists, medical doctors, pharmacists, pharmacologists, chemists, traditional medicine practitioners, sociologists, etc. Poster presentations, and demonstrations of the medicinal plants used for the treatment of various ailments, were also arranged.

Amongst the scientific papers which were presented, some papers, for example indicated that there are good possibilities of developing new pharmaceutics, which are as effective for the cure of malaria as (if not better than) chloroquine. These are extracted from local plants which the village communities use for the treatment of malaria.

Some papers indicated that there are possibilities for developing medicinal substances which are effective for the treatment of asthma, using traditional medicinal herbs. One paper indicated good possibilities for developing the grapple plant, currently exported from Botswana, for the local production of tablets which are effective for the treatment of arthritis. All the participants asserted that traditional medicines should be promoted because of the following reasons:

First, modern medicinal drugs and syrups are becoming increasingly expensive and unaffordable. Indeed, in most cases many Third World countries are unable to meet the high medical bills involved in the importation of the medicines from the North. The countries of the North feel that they must keep the prices of their medicines high because of the exorbitant costs involved in research towards the development of new medicinal drugs, before the drugs are marketed to the international community. It has been estimated that, on the average, the development of a new medicinal drug takes about ten years of research, and costs about U.S $ 40.0 to U.S $ 200.0 million before the marketing stage. A proportion of the prices for the imported drugs apparently goes into the recovery of the initial monetary investments. But this is not always the case. I shall elaborate.

In Botswana, the root tubers of the grapple plant, *Hypogophytum procumbens,* are sold at 2.0 *pula* per kilogramme (Botswana currency). The dried tubers are exported to the North, where they are processed into tablets, presumably with no additional ingredients. But when the tablets from the plant are imported back into the country for use as a cure for arthritis, and other ailments they are sold at 213.25 *pula* per kilogramme. That is, indeed, the pattern throughout the Third World: exporting the dried medicinal plants at an exceptionally low price, and importing the packaged and coated processed medicine at an outrageously high and unaffordable price.

Secondly, it was pointed out that the modern medical facilities in the Third World are inadequate, or totally lacking, in the remote villages, far inland. In most cases, therefore, some 60% - 80% of the inhabitants of rural areas rely on traditional medicinal practices. It is thus important for the respective Governments of Third World countries to recognise this fact, and to come out with solutions on how the

traditional medicinemen could be assisted towards administering their medicines at appropriate dosages, and how the scientists in our Universities and various research institutes could collaborate with the traditional medicinemen, and to assist them towards extracting the potent curative substances, with the use of appropriate solvents, where water alone will not do.

Thirdly, many examples are known whereby patients could not be cured with modern medicines, prescribed by some of the best trained modern physicians, and whereby the patients regained vitality, and were completely cured, after being referred to the traditional healers. There is thus a big scope for modern Western-trained health practitioners to learn from the traditional medicinal practices. The cure of malaria by using quinine was, for example, developed from traditional medicinal practices, as will be highlighted in one of the papers included in the proceedings.

We hope the reader will find the information in this document enriching, both culturally and scientifically. We believe also he/she will be interested in making direct contacts with the authors of the various papers, and seek for more information on the various ideas expressed. We believe the reader will particularly be enriched by the messages from the Chairman of the South Commission, His Excellency, Mwalimu Julius K. Nyerere; the President of the United Republic of Tanzania, His Excellency, President Ali Hassan Mwinyi; the then Minister of Health, Honourable Dr. Aaron Chiduo, M.P.; the Director of the World Health Organization (Regional Office for Africa), Dr. G.L. Monekosso; and the then Principal Secretary in the Ministry of Health, Ms Zahra Nuru. The resolutions and recommendations which emanated from the conference, are also likely to be of interest to many. We hope the reader will support all the efforts aimed at developing sustainable

programmes which will promote the conservation of our valuable tropical plant heritage, through intensified afforestation, the establishment of gene banks for the endangered species, and initiating stern control measures against indiscriminate exploitation of medicinal plants for export to the North.

Finally, we hope that through the new contacts that have been established between scientists from Africa, Asia, and Latin America, comprehensive collaborative programmes on the utilization, chemical extraction, identification, characterisation and pharmacological testing of medicinal substances from various medicinal plants found in the Third World, will be established, and that these will yield fruitful results.

Keto E. Mshigeni
Editor-in-Chief


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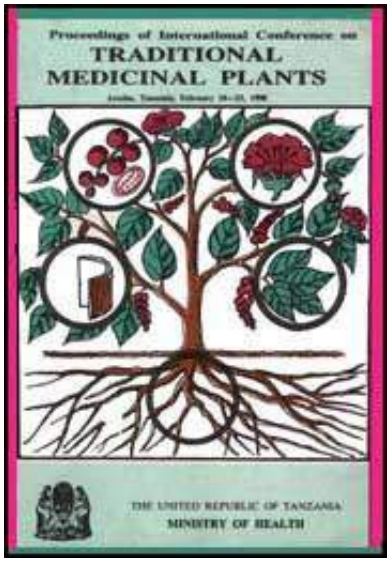

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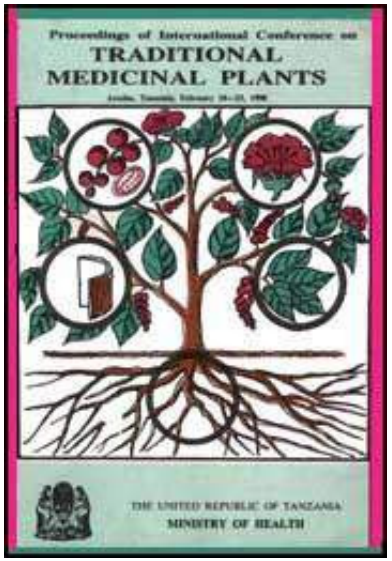

Acknowledgements

Very many individuals made the international conference, whose proceedings are reported in this publication a reality. Many others made the synthesis of the various papers that were presented at the conference into this volume possible. To all these, we wish to express our most profound acknowledgement and gratitude.

More specifically, we wish to acknowledge the encouragement rendered by His Excellency Mwalimu Julius K. Nyerere, Chairman of the South Commission. Indeed, it was Mwalimu's personal interest and initiative that set the ball rolling.

We would also like to take this opportunity to express our deep appreciation and gratitude for the support and encouragement accorded by Mr. Frank Brancho, Executive Assistant to the Commissioner of the South Commission; to Dr. J. Lozoya of the Institute of Traditional Medicine, Mexico; and also to Prof. W. Makene, formerly Dean of the Faculty of Medicine, University of Dar es Salaam and Personal Physician to the Chairman of the South Commission, who (together with Mr. Brancho and Dr. Luzoya) drafted the original objectives of the International Conference whose proceedings are presented in this book.

We wish also to express our deep appreciation and acknowledgement to His Excellency Ali Hassan Mwinyi, President of the United Republic of Tanzania; to Hon. Or. A.D. Chiduo, then Minister of Health, United Republic of Tanzania; H.E. A. Jamal, Tanzania Ambassador in Geneva, whose collective personal interests and commitments, enabled the conference to be successfully executed in Tanzania.

The contributions made by Hon. Dr. W. Johnson, Minister of Health, Sierra Leone; Hon. Professor J.B. Kouri, Deputy Minister of Health, Republic of Cuba; and Ms. Zahra Nuru, then Principal Secretary, Ministry of Health, Tanzania, who graced the

conference with their presence and useful inputs, are also deeply acknowledged.

Furthermore, we would wish to express our deep gratitude to all the members of the international and national organising committees, and especially to Hon. Prof. P.M. Sarungi, then Director General of the Muhimbili Medical Centre, Tanzania, and currently Minister of Health, United Republic of Tanzania; Prof. G.M.P. Mwaluko, then Dean of the Faculty of Medicine (incorporating the Muhimbili Medical Centre), and currently the Director General of the Centre; Mr. E.N. Mshiu, Director of the Traditional Medicine Research Unit, Muhimbili Medical Centre; Dr. S.P. Dyauli, Assistant Chief Medical Officer, Ministry of Health, Tanzania; to all the authors of the various papers presented at the conference; to all the interpreters and translators; to all the members of the editorial committee; and to all the other silent and unseen hands, who contributed to the success of the workshop in one way or the other.

Lastly, but perhaps most importantly, we wish to take this opportunity to acknowledge financial support from the UNDP and the World Health Organisation, who provided the financial fuel that set everything in motion. More specifically, we wish to acknowledge the personal interest of Dr. H. Nakajima, Director General of WHO, Geneva; Prof. G. Monekosso, African Region Director, WHO, Brazzaville; Dr. E.A Duale, WHO representative, Tanzania and the Seychelles; Dr. O. Akerele, WHO, Traditional Medicine Programme, Geneva; and Dr. W. M. Mtenga, WHO Office, Dar es Salaam, Tanzania.

To all the others, who deserved to be mentioned by name, and who, indeed, played significant roles towards the success of the conference, but whose names are not included above, we submit our sincere apologies. The full list would have

filled many pages.

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Introduction

The promotion and integration of traditional medicines in health care programmes invariably involves people of various disciplines: botanists (contemporary and ethnobotanists), pharmacists, pharmacologists, chemists, traditional healers, physicians, sociologists, policy makers, etc. Experts in all these disciplines, drawn from Africa, Asia, and Latin America, were represented at the International Conference on Medicinal Plants (ICMP). Amongst the three regions of the South, Africa drew the highest representation: there were twenty two countries on the continent represented, with delegates from fifteen countries presenting papers. Second in rank was Latin America, which was represented by eight countries. Asia was represented by only two countries: China and India. Nonetheless, there was a lot to be learnt from them also especially with respect to the conservation of traditional medicinal plants today, and ancient uses of the plants.

The diverse nature of the topics in the many papers presented in the conference sessions did not warrant the arrangement of the papers according to the sessions. Instead, the papers in the proceedings are arranged according to the three geographical regions of the South, i.e., Africa, Asia and Latin America, respectively. The countries in each region and the first authors of each article are, accordingly, arranged alphabetically. It is hoped that this arrangement will assist the reader to quickly find out specific information about a specific region.

In these proceedings the first section comprises the opening session . Here the

full texts of the opening speeches, addresses and messages are presented.

Parts One, Two and Three of the proceedings encompass presentations by participants from the African, Asian, and Latin American regions, respectively. Full texts of the papers (in the original languages) are presented in alphabetical order of surnames of the authors of the papers. The Editorial Committee of the conference proceedings was of the opinion that since the majority of the participants were from English-speaking countries, at least the key issues contained in the papers, which had been written in French and Spanish languages, should be translated into English. The translations are presented in Appendix I of the proceedings.

Part Four presents the key issues raised and the summaries of the discussions held in the individual sessions. Part Five presents a General Summary, Recommendations and Resolutions which had emanated from the conference as a whole.

For the benefit of non-English speaking participants, a Spanish text of the key issues presented in the General Summary and Recommendations section was also prepared. This is presented in Appendix I. A list of all the participants from each region is included at the end of the text as Appendix II.

The Editorial Committee thanks the readers in advance, for tolerating any inadequacies of editorial nature which they may find in this volume. It is hoped, nevertheless, that the information contained in the proceedings will be found to be invaluable, and of interest to many.

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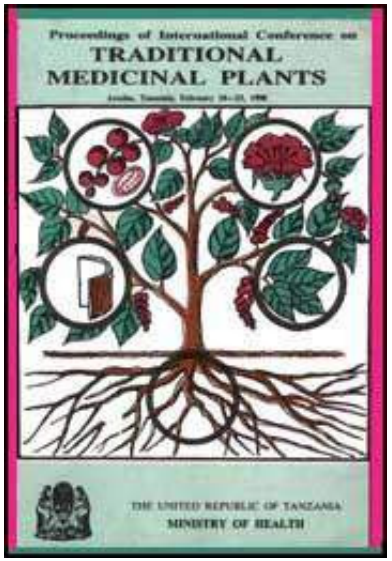

Traditional Medicinal Plants (Dar Es Salaam University Press - Ministry of Health - Tanzania, 1991, 391 p.)

OPENING SESSION: WELCOME AND OPENING ADDRESSES

Welcome address by Hon. Dr. A. D. Chiduo, Minister of Health, United Republic of Tanzania

Your Excellency, the President of the United Republic of Tanzania, Hon. Ali Hassan Mwinyi,

Mr. Chairman,
Distinguished Guests
Ladies and Gentlemen.

The purpose of my brief address to you this morning is to welcome all of you to Arusha. It gives us great pleasure that persons of your high academic and social standing, have responded so well to our call to attend this conference. The distances you had to travel are long: some of you have come all the way from Latin America, Asia and from within the expansive continent of Africa. For this effort, from your side, we say Thank you

We are in Arusha, a town which ranks third among our major municipalities. It is situated in the northern part of Tanzania, near the border with the Republic of Kenya, our good neighbours. This town is exactly midway between Capetown and Cairo, the two Southern and Northern tips of Africa, ft is situated at the foot of Mount Meru and only 50 km from the well known Mount Kilimanjaro, the highest mountain in Africa. The famous Ngorongoro Crater and Serengeti National Parks, known for their high concentration of wildlife, are within a few hours of driving. The indigenous people of the Arusha region are unique, linguistically, and culturally. Within this Region, we have the Khoisan speaking Hadza, who are hunters and gatherers; the Cushitic speaking agricultural Iraqw; the graceful pure pastoralists, the Maasai; the mixed farming Bantu, the Meru, and its town is characteristically cosmopolitan.

This rich variety of geophysical endowments is well repeated when the plant Kingdom is analysed. Our people have a long tradition and experience in dealing with their health problems, by using naturally occurring substances, including

medicinal plants. Before the colonial era, these were the only remedies, and were adequate. The colonial period was not only a wasted one for development of traditional medicine, but was also a serious set bade. There is a need to bring back the development of traditional medicine to its original track, and to utilize modern advances alongside it, in order to achieve maximum benefit for our communities.

Tanzania has been striving to move in that direction, with moderate success due to various factors, including economic ones. Our Traditional .Medicine Research Unit is constrained by shortage of qualified personnel and equipment. We still have to develop a clear - cut policy, and implementation strategies. The existing legislation needs revision, but revision must be followed by an informed and committed staff.

It is due to these circumstance that we have found it necessary to pool ideas, and even the meagre resources, with other developing countries, in this common course. I repeat, again, a word of welcome to each one of you, and request you to kindly bear with us, if you will find any inadequacies.

After these brief remarks, may I now invite the Guest of Honour, His Excellency, the President of the United Republic of Tanzania, Hon. Ali Hassan Mwinyi, to give the Opening Address.

Opening statement by H.E. President Ali Hassan Mwinyi

Mr. Chairman,
Honourable Ministers,
Distinguished Participants,

Ladies and Gentlemen.

Allow me, first of all, to express Tanzania's pleasure and gratitude for the honour and privilege to host this international conference on traditional medicinal plants. It is also a great honour for me personally to be invited to open this important conference.

Before I do so, I wish to take this opportunity to extend a very warm welcome to all our distinguished guests who have travelled a long way to come and share their knowledge and experience with us. We in Tanzania are very happy to have you in our midst. We wish you a happy and successful visit to our country. Please feel at home. KARIBU SANA.

I would also like to express my deep appreciation to the World Health Organization (WHO), the United Nations Development Programme (UNDP) and the South Commission for organizing this conference on a subject which is of great interest and importance to all of us in the South. The presence of so many eminent experts and other dignitaries at this conference is a clear testimony of the continued importance of traditional medicine in the South.

As we all know, traditional medicine has for many years, been the main form of treatment of several maladies in many developing countries. But as more and more countries achieved their independence, several governments including that of Tanzania embarked on ambitious programmes to expand modern health services as part of their efforts to improve the quality of life of their people. Those programmes included the expansion and construction of hospitals, health centres, dispensaries and clinics. Efforts to train doctors, nurses and other health service

staff were also intensified.

Remarkable progress has been recorded in many developing countries. But the task of providing modern health services in the South is far from being accomplished. Its accomplishment wilt take longer than most of us had expected because the demand for modern health services continues to expand, especially as the population in many of our countries also continues to grow. It will be recalled, for example, that at the time of independence, Tanzania had a population of about 9 million people. Today we are more than 23 million.

But the task of providing modern health services in the South has been made even more difficult by the severe economic crisis which has affected many developing countries. The crisis has greatly undermined the ability of many governments to sustain existing health services, let alone to expand them. As a result of that crisis many hospitals in some of our countries lack essential drugs and equipment, whose prices are rising sharply.

There is a more fundamental factor which needs our close attention. I am sure you know better than I do that modern or allopathic medicine has proved ineffective in the treatment of such maladies as asthma, cancer, heart problems, mental diseases, and now AIDS. Yet evidence does exist that traditional medicine and some medicinal plants do provide hope for the treatment of several maladies, where allopathic medicine has failed. We also know very well that some of the pharmaceutical used in hospitals originate from those medicinal plants which have been traditionally applied by our communities for many years.

All that evidence points to the need for the intensification of research on the

exploitation and scientific application of those plants for the benefit of our people. I believe that such research would benefit immensely from the knowledge and practice of those who have been applying the medicinal plants to their patients. It is my sincere hope, therefore, that these engaged in the research on medicinal plants will strive to work in close collaboration and cooperation with prominent traditional medicinemen.

I am confident that the results of the research will not only expand our scientific knowledge of the medicinal plants, but also lead to their optimal utilization in the treatment of many diseases. That will greatly complement the role played by allopathic medicine in the South and reduce the costs of health services, since there is an abundance of medicinal plants in many developing countries. Those important natural resources should be fully exploited for the benefit of the people of the South.

I fully recognize that cooperation among developing countries is essential to ensure the maximum exploitation and utilization of the medicinal plants, abundantly available in the South. Such cooperation is especially important because scientific research on medicinal plants has been going on for a long time in some developing countries. Some have even developed the scientific and technological capacity for the exploitation and utilization of some of those plants.

Cooperation among developing countries in this important field will enhance our collective capacity to identify the most useful medicinal plants available in our respective countries. It will also greatly facilitate an exchange of information and knowledge on their cultivation, processing, distribution and application. Time has, therefore, come for developing countries to establish an organ which wilt bring

together the best expertise, which will be charged with the responsibility of coordinating research, monitoring technological developments in the processing of medicinal plants and facilitating the scientific application of traditional medicine. The organ should also look into various legislation which inhibit a broader application of traditional medicine in our societies and recommend measures for correcting them.

South-South Cooperation in the exploitation and application of medicinal plants will also ensure that those natural resources are used for the maximum benefit of the people of the South. As we are all aware the countries of the North have also intensified their search for healing substances from plants which naturally grow in the South. Those countries have the capacity to siphon our natural raw materials at a very low cost and then sell to us the processed products at very high prices.

That is what is happening to our copper, cotton, sisal and other raw materials, which we export to the North at cheap prices. The main cause of our current economic problems is that we have been placed in the perpetual position of exporting cheap raw materials and importing expensive industrial goods from the North. So as the world commodity prices continue to decline, our economic situation also deteriorates.

That could also happen to our medicinal plants. The countries of the North will make every effort to get those plants at very cheap prices and process them in their industries. We will then be placed in the same situation of importing expensive drugs from the developed countries. I call upon the countries of the South to resist those attempts by pooling together their resources and technology in order to strengthen their collective capacity to produce their own drugs from

their own plants. That will greatly reduce our independence on the imports of expensive medicine from the developed countries.

By doing so, we will have made a practical contribution to the implementation of our broader objectives for collective self- reliance in the South. Collective self-reliance will not only strengthen our efforts to improve the living conditions of our people, but it will also improve our bargaining power, as we strive to establish more mutually beneficial relationships between the North and the South.

It is my sincere hope, therefore, that this workshop will discuss, among other things, ways and means of strengthening South-South Cooperation in the utilisation of the wide variety of medicinal plants, abundantly available in our countries. I am confident that the recommendations of this workshop will help us move a step forward towards collective self-reliance in this vital sector of health.

I therefore wish you great success in your deliberations.

Message from the Chairman South Commission Mwl. J.K. Nyerere

Dear Friends,

The South Commission has been working since October 1987 and expects to issue its final Report about the middle of this year. The members are now engaged in working on the wording of that Report. It is because of an important meeting in that connection that I am unable to come personally to your Workshop, to say bow important we regard your undertaking to be.

The South Commission's basic message to the countries of the South is this: Build

Self-Reliance, nationally and collectively. The present widespread dependence on the developed countries of the world is inimical to our national independence, and reduces our capacity to fight against our underdevelopment and poverty. It is prejudicial to the right of our peoples to improve their own living standards while developing their own roots and preserving their own culture. We must adopt policies and act in such a manner that we Build Self-Reliance.

National Self-Reliance means using your own resources of people, of natural resources, and of knowledge - to the very maximum, before looking elsewhere for these essential components of development. Collective Self-Reliance means cooperation among the countries of the South on a bilateral, sub- Regional, Regional and Global basis, so that the capacities and resources of the South increase the strength of the South and all its members, and enable it to play its necessary and more equal role in the international economy.

Among the resources which we have is the traditional medicine of the countries of the South. Millions of our people still depend on it. They have insufficient access to what is called 'modern medicine', or they have more faith in the healing methods of their parents and grandparents. It is too often scorned or denigrated. Its practitioners are regarded by the elites as ignorant and dangerous - at least in public, for many of those who most denigrate them consult them in private. And the practitioners of traditional medicine do in fact have considerable botanical knowledge; they are in general aware of the link between the mind and the body.

Of course there are incompetents and con-men active in the field of traditional medicine; the best of practitioners rarely understand the scientific background to the herbs which they use, and usually do not realise the dangers which go along

with their cures. The importance of hygiene, and the place which prevention can play in maintaining people's health is rarely part of their expertise. And there are many things which modern medicine can now do which rely upon the capacities of high-technology and advanced scientific research, and which are beyond the capacity of even the wisest traditional practitioner. Finally, there is the reality that to such people the use of their knowledge is their livelihood; they guard that knowledge as a great secret and are often reluctant to share it - especially if they have no security or reward in compensation.

But the reality is that people of my generation are alive today because of traditional medical knowledge. So are millions of people much younger than me. The task is not to ignore or overthrow - much less to denigrate - traditional medicine, but to recognise and develop its potently, and help its practitioners to expand their own knowledge. Our scientists have to get the cooperation of traditional practitioners and of elders in our different areas, so as to combine traditional medicine with modern scientific knowledge and techniques. This can be done: it is being done. Many of those present at this Workshop are doing such work.

If we in the South are to become self-reliant nations and if we are to give good and universal health service to our peoples, we must expand this work and give more emphasis to it. That must be part of our health policy. We must not leave this valuable national resource to be developed only by the great international pharmaceutical companies, who will later charge us large royalties for developments based on our plants and minerals.

On behalf of the South Commission I wish to convey our very good wishes for the

success of this International Workshop. May you succeed in sharing knowledge about how to modernise traditional medicine so that it gives the maximum service to our people everywhere, and in promoting it as a vital, large, and respected part of Health for All by the year 2000.

Speech by Dr. G. L. Monekosso, World Health Organisation

Mr. President of the United Republic of Tanzania,
Honourable Ministers,
Your Excellencies,
Representatives of International Organizations,
Distinguished Delegates,
Ladies and Gentlemen

May I first of all, Mr. President, thank you most sincerely for the great honour you have done us by gracing, with your presence, the formal opening of this International Conference of the Countries of the South on Medicinal Plants, so generously hosted in Arusha, following the kind invitation of your government. We are well aware of the great efforts that you, as President of the United Republic of Tanzania, and the Director-General of the World Health Organization have made to ensure the success of this historic meeting of donor and recipient countries.

We are, therefore, happy to voice to your government, in the presence of this august Assembly, our thanks and deep gratitude for all that you have done to achieve health for all Tanzanians by the year 2000, which is our common social objective. Similarly, we salute the decisive action taken by your government, and especially by the Ministry of Health and Tanzanian communities to control disease,

postpone death, promote health, and reserve our common community health.

Finally, Mr. President, may I assure you that I am extremely happy to be here, once again, in the United Republic of Tanzania, to which I consider home and which harbours many happy memories; and I would like also to express to you my deep satisfaction at the excellent cooperative relations that exist between the United Republic of Tanzania and the World Health Organization.

Honourable Ministers,
Your Excellencies,
Representatives of International Organizations,

Your presence today at this ceremonial opening is particularly comforting, since it shows very clearly as we are all now aware, in these difficult times, that the effective solution of problems of international cooperation can only be achieved through concerted approaches to socioeconomic development. That progress and development can only result from a collective will to make positive changes in mental attitudes and living conditions. That is why it is desirable, despite significant improvements in coordination in recent years, that additional efforts must be made to clear away the final obstacles to progress in international health cooperation in traditional medicinal plants.

Our organization has already charted our course, the path to our common objectives. This may be found in the resolutions of the World Health Assembly adopted during the past three years (WHA 40th, 33, WHA 41th, 19th and WHA 42nd, 43). In the African Region Assembly, Resolution AFR/RC28/R3 invited member states of the region "to take appropriate steps to ensure the use of

essential drugs and traditional medicinal plants so as to meet the basic needs of communities and promote the development of African pharmaceutical industry", while Resolution AFR/RC34TH/R8 1984 invited member states to "prepare specific legislation governing the practice of traditional medicine within the framework of national health legislation and ensure an adequate budget appropriation to allow the effective launching or development of a programme of traditional medicine". I also recall that in February 1976 my predecessor convened the experts of the region to consider the following terms of reference:

(i) To assess the present situation of traditional medicine in the region.

(ii) To identify ways and means of fostering collaboration between traditional and modern medicine.

(iii) To propose material for the working paper of the technical discussions of the twenty sixth session of the regional committee for Africa of WHO.

In November 1979 we organized a workshop in Bamako, Mali, for French-speaking countries on "The Role of Traditional Medicine in the Development of Health Services". In August 1980 a similar workshop was held at Accra, Ghana, for English-speaking countries. The objectives of those two workshops were:

(i) To analyse the experiences of collaboration between practitioners of the two systems of medicine in some African countries.

(ii) To formulate a realistic approach for collaboration between the two systems in order to improve health coverage of the population.

Between 1981 and 1985 five collaborative centres were set up: one in Ghana, another in Mali and two in Nigeria. Their number was increased to five in 1985 with the one in Madagascar. The main responsibilities are:

(i) To compile an inventory of medicinal plants with recommended uses.

(ii) To verify the therapeutic actions attributed to the listed plants, together with their possible undesirable or toxic effects.

(iii) To carry out studies with a view to improving and standardizing of the form and presentation of traditional medicines.

(iv) To collaborate in training research workers desiring to study traditional medicine and in the improvement of the practices of traditional practitioners.

(v) To carry out studies on the rote of traditional practitioners in primary health care.

In July 1984, we organized a consultation on the coordination of activities relating to traditional medicine in the African region, with the various international and regional organizations and agencies concerned. The objectives of that consultation were:

(i) To evaluate activities related to traditional medicine in the African region.

(ii) To propose mechanisms for coordinating work in traditional medicine

in the African region, bearing in mind the allocation of responsibilities to the various agencies.

In 1987 the Regional programme created a unit for traditional medicine in Africa. In February 1989, the first meeting of WHO collaborating centres for traditional medicine in the African region was held in Niamey, Niger, with the following objectives:

(i) To identify the priorities of the African region after assessing the current situation in various countries.

(ii) To establish guiding principles of a regional strategy for the use of traditional health technologies in the national primary health care policy.

Finally, it is planned this year to examine the programme on traditional medicine in the course of the fortieth session of the regional committee for Africa.

It may be said that this conference comes at the right time, when we are putting all our strength into the battle to promote primary health care. Our meeting today is a clear indication of our determination to make better use of local resources and recover our freedom and identity through self- sufficiency in matters of health. It is also a way of reaffirming our cultural values. I believe very sincerely in international cooperation, but it has its limits. We should, in future, make use of our own raw materials and our capacities, for local production. But we should also be aware that realism requires us to keep a proper balance between folklore and scientism. Folklore, far from serving the objective that we are pursuing, will give the sceptics a pretext for continuing to doubt the values of our civilization.

Scientism has far too long been used as a comforting alibi for a stagnation.

The scenario for African health development adopted by the ministers of health, provides a dynamic framework for the rapid and effective implementation of the primary health care approach, especially two of its components: traditional medicine and medicinal plants. The aim in regard to these plants is not to seek systematically to replace all modern drugs, and still less to bring two types of therapy into opposition, but rather to avoid duplication of efforts in order to make optimal use of available resources, and thus meet the need for accessibility of pharmaceuticals, both from the geographical and financial point of view.

To that end the following themes have been chosen:

> ***(i) Ways and means of cooperation to establish a systematic inventory of plants with their uses and comparative analyses.***
>
> ***(ii) Promotion of plant culture and processing with a view to obtaining stable and standardized galenical preparations that are recognised to be harmless yet effective, while not overlooking the marketing aspects.***
>
> ***(iii) Problems related to ethnobotany and conservation of medicinal plants.***
>
> ***(iv) Resources for implementation, financing, technical and institutional structures and an appropriate legal framework. That is the arsenal without which nothing cam be done.***

These are issues that reflect our concerns at the regional office.

This means that you have our full encouragement and support in your difficult but noble duty. I have no doubt of the results of this forum and I am sure that with the cooperation of so many experts we shall be able to meet the challenge.

We are putting our trust in your skills, your devotion to duty and above all your commitment to work for our common objective: "The achievement of health for all by the year 2000".

Your Excellency, Mr. President, I have taken up much of your valuable time in this somewhat extended address, because great things are at stake, and because I know that your hearts lie in self-reliance development. Our approach to health development in the African region follows the same path, and that is what I have tried to show.

I wish the conference on medicinal plants every success. Thank you for your kind attention.


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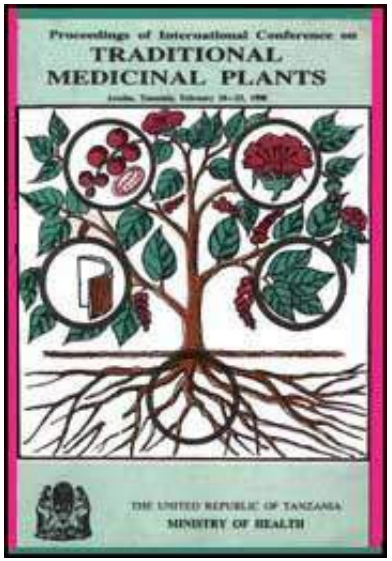
PART I: USE AND PROMOTION OF TRADITIONAL MEDICINAL PLANTS IN THE AFRICAN REGION

Registration and utilization of herbal remedies in some countries of Eastearn, Central and Southern Africa



- **A report on the development of a traditional medicine for bronchial asthma**
- **Resume of current research in medicinal plants in Botswana**
- **The use of data from traditional medicine: Tunisian experience**
- **Chemical and pharmacological studies of marketed traditional drugs**
- **Research into medicinal plants: The Somali experience**
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- **Chemical characterization of pharmacologically active compounds from Synadenium pereskiifolium**
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- **Antimicrobial activity of Tanzanian traditional medicinal plants**
- **Identification of clovanediol: A rare sesquiterpene from the stem bark of canella winterana L. (Canellaceae), using spectrophotometric methods**

- **A comparative study of the traditional remedy ''Suma-kala'' and chloroquine as treatment for malaria in the rural areas**
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- **Chemical Evaluation of Tanzanian medicinal plants for the active constituents as a basis for the medicinal usefulness of the plants**
- **Ethnobotany and the medicinal plants of the Korup rainforest project area, Cameroon**
- **Seaweeds in medicine and pharmacy: A global perspective**
- **Biotechnology and medicinal plants**
- **Phytochemical investigations of four medicinal plants of Malawi: What next?**
- **The chemistry and pharmacology of the essential oil from the leaves of Hyptis suaveolens (L) Point**
- **Some CNS effects of Datura stramonium L (Solanaceae) in mice**
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- **A Survey of medicinal plants in Tabora region, Tanzania**
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Traditional Medicinal Plants (Dar Es Salaam University Press - Ministry of Health - Tanzania, 1991, 391 p.)

PART I: USE AND PROMOTION OF TRADITIONAL MEDICINAL PLANTS IN THE AFRICAN REGION

Registration and utilization of herbal remedies in some countries of Eastearn, Central and Southern Africa

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Introduction

Traditional medicine has been practised for the last several thousand years, although it found a place in the WHO programme only twelve years ago.

Traditional medicine is widespread throughout the world in a variety of forms. Its practices are based on beliefs that were in existence, often for hundreds of years, before the development and spread of modern scientific medicine, and that are still prevalent to day.

The recent development and resurgence of traditional medicine activities in the African Region grew out of the political events of the 1960s. With the advent of political independence, Africans felt the need to rediscover their sociocultural identity, and traditional medicine, an integral part of their heritage, and benefited from this return to the fountain-head. In reality, the masses had never stopped making use of traditional medicine, despite the imposition of modern medicine by the colonial powers. Moreover, economic circumstances were making imported techniques and drugs less and less accessible, forcing the authorities to take a fresh look at the problem and study the possibility of using traditional medicine to improve the health of their populations.

In most cases, however, it was necessary to convince the political decision-makers that traditional medicine had something to offer. To this end, the World Health Assembly and the Executive Board passed a number of resolutions in support of traditional medicine globally. In addition, the Regional Committee for

Africa passed a number of resolutions reflecting this political will.

Three periods which correspond to very definite political and economic development stages can be distinguished in the development of traditional medicine in the African countries. These are, first, the pre-colonial period, when traditional medicine reigned supreme. Unfortunately, there was no record of traditional practices and *materia medica,* even though these have contributed to the modern-day therapeutic arsenal. The examples of physostigmine from the Calabar bean and the life-saving vincristine from the African periwinkle, illustrate past and present contributions. The colonial period was marked by the introduction of modern medicine and the suppression of Africa's traditional systems of medicine. Finally, the post-colonial period is represented by a renewed cultural awareness of, and pride in, traditional medicine and its values.

Primary health care has been adopted by all WHO member states, including those on the African continent, as the appropriate strategy, for developing national health systems. This approach has become imperative for technologically less advanced countries, given their present economic crisis. However, even the primary care demands the use of therapeutic preparations, and in the face of declining foreign exchange earnings, governments are finding it increasingly difficult to make essential drugs available to their rapidly growing populations. The use of medicinal plants in traditional medicine thus Finds its natural expression, and further development in primary health care, where in many cases they bridge the gap between the availability of and the demand for essential drugs. It is, however, at this level that the transition from traditional practice to medical care can most readily be made.

In our common efforts to extend coverage of the health services to improve medical care and to control major endemic and epidemic diseases we have often not fully recognized just how important a role medicinal plants play in the health of the peoples of the world. In developing countries, about three-quarters of the population rely on medicinal plants for their primary health care. In technologically advanced societies, consumers preference is shifting from synthetic to natural products and this is dictating the pace of the resurgence and expansion of the use of medicinal plants in therapy in industrialized countries. It is only logical for WHO to collaborate with others to develop activities in this exciting area of manufacture and promotion of the use of new drugs of plant origin by encouraging countries to make fuller use of the natural wealth of medicinal plants, which most of them possess. Some of the currently known herbal medicinal products could substitute imported drugs, which currently require foreign exchange for their purchase. In addition, plants used in traditional medicine hold a great, but still largely unexplored potential, for the development of new drugs against major diseases, such as AIDS, for which no safe, effective treatment is as yet available.

As part of those efforts by WHO, a workshop was organized by the Organization's Programme for Traditional Medicine, in collaboration with the Danish International Development Agency (DANIDA) and hosted by the Ministry of health of Zimbabwe. It was held from 26 June to 6 July 1989 at Kadoma, Zimbabwe.

The workshop was attended by participants from East, Central and Southern Africa and included scientists from Botswana, Kenya, Lesotho, Malawi, Swaziland, United Republic of Tanzania, Zambia and Zimbabwe, representing a variety of disciplines that are crucial to initiating multidisciplinary research in drug development from

herbal remedies. These include: pharmacy, pharmacology, phytochemistry, health administration, and clinical sciences.

The workshop was the first of a series for the African Region and was intended to address issues hindering the introduction of traditional remedies into national health systems. Key issues discussed included ensuring safety and efficacy of traditional remedies, as well as associated problems of standards, stability, and dosage formulation. Safety is, indeed, a crucial issue. It is often erroneously believed that products that are natural carry no risk to the consumer. Nothing could be further from the truth. Much of our present-day powerful therapeutic arsenal is derived from plants and plant products.

This workshop was designed to establish a logical "thought process" for decision-making that is related to the utilization of herbal preparations as drugs. The workshop began with presentations from each participating country on the use of traditional medicine. A summary of the current situation with regard to traditional practitioners and the registration of herbal remedies is given below: a series of formal lectures followed, addressing areas such as the importance of medicinal plants in therapy; development of a traditional medicine pharmacopoeia; types and sources of information available on medicinal plants and their chemical constituents; how the information can be evaluated; safety and toxicological testing procedures; and the planning of clinical studies. All participants were then provided with copies of original articles on commonly used plants and challenged to decide whether each could be introduced into their national health system. Using a well-defined decision-making process, the participants answered questions about the safety and efficacy of the plants and categorized them as meriting acceptance without further study, requiring further work, or meriting

outright rejection on grounds of toxicity.

It is widely believed that the use of medicinal plants in health care is increasing in the African region, and that trade in these substances is on the rise. However, no valid data are currently available on utilization and trade patterns. Plant-derived remedies currently in use range from traditional preparations such as decoctions to locally manufactured modern formulations in the form of syrups, tablets and capsules, as well as products imported from Asia. This increase in intercontinental trade in plant- derived substances has triggered concern for regulation in countries of East, Central and southern Africa. No regulations related to the use of plant-derived remedies currently exist in these countries. However, national drug legislation to cover manufacture of herbal remedies is being contemplated in all the countries. The necessary registration process should be contingent upon review of available sources of information, quality control of raw material, modern toxicology testing, and good manufacturing practices. In addition, one of the chief contributions that traditional medicine has made and continues to make to health, is the discovery of plants of medical value. "Save Plants that Save Lives" is a call to safeguard this heritage, and regulations should therefore cover conservation measures.

Country presentations at the Workshop described the current regulatory status of traditional medicine and practitioners. This information is summarized below.

Current regulatory status in some countries of East, Central and Southern Africa

Botswana

No regulation related to the use and practice of traditional medicine exists. A provisional council has been appointed to decide what to do, and will probably propose some draft legislation regarding traditional medicine. Modern medicine must be registered in the country of origin.

Kenya

There is no regulation regarding the practice of traditional medicine. The Ministry of Culture and Social Services issues certificates to traditional practitioners, but they must also obtain the permission of the area chief to practise. There is no regulation concerning the manufacture and or use of traditional remedies.

Lesotho

National drug legislation is being formulated and will create some controls for traditional remedies. The proposed regulation will lead to the registration of traditional medicines for an initial period of 8-10 years, based on safety as the sole criterion. Subsequently, registration of traditional remedies will have to be based on efficacy as well as safety.

Malawi

The Pharmacy Medicine and Poisons Act of 1988 does not have any provision regarding the use of traditional medicinal remedies. Since traditional practitioners are not used in the health services, the need to register them has never arisen. Some other provisions of the Act are related to the exclusion of traditional practitioners from practice. For example, "no person shall sell by retail, or supply in circumstances corresponding to retail sale or administer, other than to himself,

a medicinal product of a description or a class specified by Order made by the Minister and published in a Gazette except in accordance with prescription given by an appropriate practitioner," which excludes traditional practitioners.

Similarly, Section 17(1)(b) of the Act indicates that "except as is provided by this Act, no person other than a person registered as a pharmacist under this part shall in the course of any trade or business prepare, mix compounds, or dispense any medicinal product or poison except under the supervision of a registered pharmacist". Thus, it can be deduced from this provision that traditional healers should not practice their trade. In practice, however, people are not imprisoned for administering traditional remedies.

According to section 42(2)(a) of the Act, no one is allowed to "sell or supply any product for the purpose of a clinical trial unless that person has a product licence and a clinical trial certificate". This makes it very difficult to assess the efficacy of traditional remedies without following the standard procedures. However, a number of modern medical practitioners have tested the efficacy of some traditional remedies used in Malawi.

Swaziland

There is no government regulation on the use and manufacture of traditional remedies. Modern drugs require registration. Traditional practitioners have been registered since 1974. A list of traditional practitioners is kept by the Swazi National Council, a traditional executive body under the King. In 1981 a Commission for Traditional Medicine was formed by the Minister of Health. The Commission was to recommend ways of organizing the regulation of traditional

practitioners and their work as well as to act as a body through which their views are communicated to the government and to the general public.

Tanzania

The legal status of traditional medicine in Tanzania is governed by two statutes namely:

(i) Medical Practitioners and Dentist Ordinance Act, caption 409, section 37, and

(ii) Pharmaceutical and Poisons Act 1978, stipulating that substances used in local systems of therapeutics should be utilized in the communities where "the traditional practitioners belong, provided they are not detrimental to the people's lives and health".

The traditional practitioner is registered by a regional or district cultural officer and his drugs are only known to him or herself. The drugs are not registered. Modern drugs are regulated by law.

Zambia

There are no laws prohibiting the practice and use of traditional medicine. However, traditional practitioners must be registered at provincial level and must adhere to laws governing the practice of modern medicines. There is no regulation in respect of the use of traditional remedies.

Zimbabwe

The government has instituted controls over the practice of traditional medicine through the Traditional Medical Practitioners Act 1981. This made provisions for the formation of a Traditional Medical Practitioners Council and the registration of practitioners. An Association of Traditional Practitioners was formed in 1980. It promotes professionalization and gives direction and support to member practitioners.

There is no drug regulation specifically applicable to traditional remedies. Modern drugs circulating in the country must be registered under the Drugs and Allied Substances Control Act (Chapter 320) 1949.

Conclusion

In all of the participating countries, the general feeling is that the future of traditional medicine is bright, because it is widely used and respected, especially by the rural population that constitute the majority. Although no specific studies have been made, costs are considered to be low.

Legislation is needed in all of the countries to recognize and legitimize traditional practitioners. The traditional practitioners should group themselves into associations through which they could interface with the formal system, whether or not they are formally part of it. An association of this nature could be a regulatory body in relation to ethical and professional matters. Without this formal structure, the chaos that exists now is likely to continue.

Steps need to be taken to list the herbal remedies used in each country and their medical indications and properties. This needs to be done before the

disappearance of indigenous people, who hold the key to identifying medicinal plants that may result in new drugs of inestimable benefit to the global community. The establishment of their safety, based on published data and/or preclinical scientific studies, should precede the use of manufactured medicinal plants for both self-medication and in national health services. When quality control has been assured, studies for efficacy may then be initiated.

While these are not unrealizable goals, their attainment will require the establishment of an organizational structure that is coupled with dedication and rational analysis of the situation in each country.

Many African countries are focusing on actions at national level that seek to obtain maximum benefit from their natural plant resources. However, medicinal plants should not be valued solely because of the possibility that they offer from import substitution, but because traditional medicine is an avenue to greater self-reliance, based on appropriate technology in accordance with a country's cultural heritage and national resources. As African countries attempt to revitalize and rationalize this heritage, they can look for support from the World Health Organization in their endeavours.

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A report on the development of a traditional medicine for bronchial asthma

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ABSTRACT

A traditional medicine for bronchial asthma was identified through interaction with a traditional healer, Mr. Charles Obuya of Rangwe, South Nyanza. The traditional medicine regimen consists of three different liquid preparations:

(1) A cold aqueous root-bark extract used for diagnosing the disease.

(2) An oral liquid medicine for regular treatment, prepared by boiling plant roots in water.

(3) An oral liquid medicine for regular treatment, prepared by boiling plant stem and leaves in raw ghee.

This traditional medicine regimen is said to produce curative effects in very few weeks. Basic ethnomedical information indicated a high potential in this medicine and this led us to take more interest in the investigation. Phytochemical screening of the drug plant materials, revealed the presence of flavonoids, terpenoids, alkaloids and glycosides. Preliminary animal toxicity studies indicate that the medicine is reasonably safe. There is abundant evidence that the medication has a promising therapeutic effect in man and a clinical study is being planned. The steps taken so tar in the development of this traditional medicine for bronchial asthma will be discussed.

Introduction

Since traditional medicine has been shown to have intrinsic utility, it should be promoted and its potential developed for wider use and benefit to mankind (WHO, 1978). In view of this, the Traditional Medicines and Drugs Research Centre of the Kenya Medical Research Institute, has been able to establish some form of dialogue with the traditional healers on an interactive basis. This has enhanced research on traditional medicines to establish their efficacy and safety.

Asthma is a common and important disease, characterized by widespread bronchial obstruction that is reversible either spontaneously or with therapy. Its principal causes seem to be allergy, infectious, irritants and psychological reactions (Heiner, *et al* 1973). The large number of conventional medicines currently in use for the treatment of bronchial asthma, are only able to control the disease but do not provide a complete cure. It has therefore been found necessary to develop an asthma traditional medicine prepared by Mr. Charles Obuya, which appears to be of very high potential.

The steps taken so far in the development of this traditional medicine for bronchial asthma are discussed below.

Ethnomedical investigations

The traditional medicine for bronchial asthma was identified through interaction with a medicineman, Mr. Charles Obuya during field research. Several visits were made to his clinic to observe the treatment procedures, and the patients treated with the medicine.

The preparation and formulation of the medicines were observed. The traditional

medicine regimen consisting of three different liquid preparations was noted to be prepared from three different plant materials. A medicine for diagnosing the disease is prepared by extracting a root bark in cold water. The cold extract is then administered intranasally at a single dose of 5 ml into each nostril. This results in profuse mucous secretion from the lungs. An oral liquid medicine is prepared by boiling plant roots in water, and the extract is administered at a dose of 200 ml twice a day for two months. A second oral medicine is prepared by boiling plant stem and leaves in water and raw ghee. This is also administered at a dose of 200 ml twice a day for two months or more, according to the severity of the disease.

The medicinal plants used to prepare the medicines were collected, and correct botanical information was obtained with the assistance of the botanists at the herbarium of the National Museums, Nairobi.

The research activities in the Institute have created interest in over 100 asthma patients, who have sought assistance from the Institute in order to use this traditional medicine for asthma. Our laboratories, on the other hand took this opportunity to monitor the conditions of these patients and found that all have responded to this treatment regime. The high potential observed with this medication has led us to take more interest in the investigations .

Phytochemistry

Phytochemical investigations of the plant materials carried out using thin layer chromatography revealed the presence of flavonoids, terpenoids, alkaloids and glycosides.

Pharmacology and toxicology

Preliminary animal toxicity studies were carried out in mice, and the results obtained indicated that the medicine is reasonably safe.

Isolated tissue experiments carried out using guinea pig tracheal rings revealed some antagonistic effects of one of the asthma preparations on the contractions caused by PGF2X.

Clinical perspectives

The therapeutic claims of this medicine were first evaluated by observing the patients under treatment by Mr. Charles Obuya. The medicineman was then invited to our laboratories to carry out a clinical demonstration under the supervision of two physicians among members of the research team. Long function tests were carried out on the patients before and during treatment with the traditional medicine. A reversal of bronchoconstriction was noted on administration of the traditional medicine (Aluoch *et al,* 1987), indicating a reasonable level of efficacy. Thus there is abundant evidence that this medication is good and a clinical study is being planned.

Discussion and conclusion

In the context of cultural evolution, traditional medicine has always developed and preserved its role of providing care in all communities (WHO, 1978). Thus even if the active principles have not yet been identified in the plants used in traditional medicine, historical evidence of the value of such plants could result in useful preparations provided they are safe (Farnsworth, *et al.* 1985). The evaluation of

chronic toxicity based on the ethnomedical information obtained from the traditional healer and acute toxicity investigated using laboratory mice, suggested that this asthma medication is reasonably safe. The only side effect observed so far is diarrhoea obtained with the use of the oral preparation boiled in raw ghee and water, but this is eliminated by reducing the dose of this medicine.

There are several possible mechanisms which might account for the anti-asthma effect of this traditional medicine. The presence of terpenoids as revealed by the phytochemical screening, may suggest corticosteroid-like mechanisms, e.g., inhibition of histamine formation or storage and the direct smooth muscle effect of steroids. The pharmacological experiments carried out on guinea pig tracheal ring, seems to suggest a prostaglandin pathway as another possible mechanism of action. Further evaluations of these medicines are in progress.

Special tribute

We pay a special tribute to the medicineman, Mr. Charles Obuya for his interest in our collaboration.

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Resume of current research in medicinal plants in Botswana

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ABSTRACT

The potential for the economic development of medicinal plants use in Botswana has been shown to be very great. Experience gained during the last decade shows the necessity for proper management of resources, and a coherent unified strategy for research to reduce the possibility of exploitation of resources by external concerns. The grapple plant, Harpogophytum procumbens, serves as **an** ***excellent example of economic exploitation which has necessitated nationwide cooperation of research and government bodies. Following the lessons learned from the grapple plant, traditional remedies are now being closely examined with a more unified approach. Initially, only medicinal plants that have an immediate economic potential are being studied.***

Introduction

In common with all African countries, Botswana has a strong tradition in the use of herbal remedies. As is frequently the case, it is difficult to separate traditional religion from therapeutic properties of administered medicines. The value of any drug is greatly enhanced by the power of suggestion, with the conclusion that any innocuous substance administered under the right conditions of suggestion and belief, can have dramatic healing effects. Belief in the power of a drug is not however, limited to traditional medicine. Clinical trials using placebos will always result in a percentage of cases responding to the "drug". For this reason, it is extremely difficult to study possible medicinal properties of plant species and correlate findings with traditional uses. This is clearly exemplified by the "grapple plant" *(Harpogophytum procumbens),* which, in recent years, has become Botswana's pre-eminent medicinal plant, known in Europe and the USA as "Devils Claw".

In this paper, the author describes the status of the art with respect to the exploitation of the grapple plant and the herbal tea plant (lippia) in Botswana, for medicinal applications.

The grapple plant

The grapple plant grows only under the semi-arid conditions, and is indigenous in the Kalahari desert and parts of Namibia and Angola. It is a typical desert plant in that it shows adaptation to restricted and sporadic rainfall. Much of the plant mass lies below ground level in the form of a parent tuber, storage tubers and roots. The leaf system is highly susceptible to available water, and in times of drought (which is frequent in the Kalahari) may be inconspicuous, making the plant very difficult to identify or collect. The fruiting body has an endocarp which resembles

a grappling hook, from which the plant takes its common name. The storage tubers of the grapple plant have been known in Botswana traditional medicine for generations. However, in Namibia, the plant has almost become extinct, due to systematic destruction by the Namibian farmers. The fruiting body can inflict serious damage to animals, and farmers in Namibia regarded it a menace. Its survival in Botswana is probably explained by its use in traditional medicine, and hence its destruction a taboo.

Studies conducted in 1986 by Kgathi, confirm that the grapple was used in small amounts in traditional medicine. Producers of grapple for the European trade, confirmed that it could be used for stomach disorders in man and to heal wounds in animals. However, according to Taylor (1982), clinical trials in Germany indicated that 60% of arthritis cases can be healed by an extract of the grapple storage tubers, with no observable side effects, apart from the purgative effect. It therefore seems apparent, that traditional medicine has utilized the grapple for its purgative effect rather than for its proven anti-arthritic properties. One reason for this may be that the purgative effect is almost spontaneous, whereas the anti-arthritic properties are discerned over a much longer period of time. If this is indeed the case, then the converse must also be true, i.e., detrimental effects of medicinal plants may not be immediately obvious, such that physiological damage may occur days, weeks, or months after receiving treatment. Western medicine has of course learnt this the hard way as in the case of the drug "Thalidomide".

Although the exact mechanism of the therapeutic action of grapple on arthritic cases is not known, the active components of the storage tubers were identified as far back as 1962, by Lux and Tinmann, who identified iridoid glucosides. Bendul *et al.,* (1979) modified the structure to produce an improved form, procumbide. In

1981, Vanhelen *et al.,* proposed a mechanism for the anti-arthritic properties in which they suggested a conversion from harpogoside to harpagogenine. Research is still continuing in Germany as to the exact mechanism involved with these substances.

The case history of the economical development of the grapple plant serves as an excellent example of beneficial exploitation of natural resources and also possible detrimental exploitation of human resources. During the early 1980's 15-20 tones of dried grapple storage tubers were exported yearly from Botswana to Europe, mainly by Namibian and South African traders.

Iridoid glucosides

In 1987, the National Institute of Research (NIR), concluded that in general, producers of grapple are poor people, and in the Kgalagadi district, only those who desperately needed cash were involved in grapple production, because they needed the cash to purchase their basic needs. However, the report also concluded that although the grapple was being produced as a cash crop, it appeared not to have a detrimental effect on production of subsistence crops and the farming activities. The main reason for this seems to be that harvesting of the grapple takes place during the dry season when subsistence crop production has virtually ceased. It is however, interesting to note that the report found that the majority of grapple producers were women, the socio-economic implications of which need to be examined.

In 1981/1982, the average income earned by a grapple producer in the Kgalagadi District was 97 *pula.* Even allowing for inflation, this sum is small, but the report

concluded that it was significant, particularly if it was used for purchasing such basic needs as food and health care.

The economics involved in the grapple trade, are, at best bewildering, and show the need for legislation. It has been calculated (Kgathi, 1987) that one harvester can collect kilogramme of dry grapple in 6.5 hours for which he receives 2 *pula,* which, although very small, is comparable with the rate for farm workers. It is nevertheless below the minimum wage for manual workers. Both collectors and traders in grapple require permits, and to ensure sustained yields, a quota system is in operation. In order to sell the grapple to foreign traders, the local traders must have an export permit. On the export permit, the amount and value of the grapple is recorded. However, serious discrepancies between the amount bought from producers and the amount exported have occurred in recent years.

The 1987 NIR report notes that although the export prices are recorded in the export permit, they do not make sense, since they are almost equivalent to the prices at which the trader buys from the producers. The report concluded that the correct prices are not actually declared. According to Taylor (1982), a South African company was prepared to pay 4.50 *pula* per kg for dried grapple storage tubers. Allowing for inflation, this price can now be expected to be much higher.

In 1982 grapple tablets were on sale in U.S.A. and South Africa, at an average price of 5.60 *pula* per kg (Taylor, 1982). In 1987 grapple tablets manufactured in Europe were on sale, in Botswana, at 148.25 *pula* per kg. (Kgathi, 1987). In February 1990, the price is 213.25 *pula* per kg. There is no evidence to suggest that other ingredients are added to the tablets, suggesting that the dried tubers are simply sterilized and compressed into tablet form. Kgathi (1987) concludes

that the difference between trader prices and producer prices is just too wide, even if one allows for transport costs. The report recommends that the government should look into this matter and work out possibilities for increasing the producer prices of grapple. It is also apparent that strategies should be developed to lessen the difference between the trader prices and the tablet manufacturers prices.

In 1989, a non-profit making organization for rural development (Thusano Lefatsheng) approached the Ministry of Agriculture for funds to develop marketing and sustained production of grapple in Botswana. Thusano is a commercial concern, involved in the development of Botswana's natural products. Profits from the company are ploughed back into rural development. Research within Thusano liaises closely with many institutions, including NIR/Agricultural Research Institutions and the University of Botswana, Chemistry Department. Thusano's involvement with the grapple plant has so far been restricted to research on sustained yields and some sale of the product to European markets.

Following discussions with representatives from the Ministry of Agriculture, an advisory committee has been set up by the Ministry, with representatives from various institutions involved in natural product research, parastatals and Ministry of finance. In principle, it has been concluded that the research operations of the various institutions should be coordinated by Thusano, with financial support from the government for the development of veld products.

The immediate aim of Thusano is to start the manufacture of grapple tablets for export. If this can be achieved, Thusano will be able to pay the producers competitive prices for their labour and profits can be re-invested into rural

development projects. The primary aim is to remove the control of the marketing of grapple from individuals who do not re-invest in rural development.

The formation of the advisory committee for the development of natural products in Botswana is certainly a step in the right direction. If environmental/economical chemical/agricultural research bodies can coordinate their activities, then repetitions of the abuse of the grapple plant can be avoided. There is no doubt that a coherent research programme coordinated by Thusano will undoubtedly serve rural development far better than ad hoc research in the Chemistry Department of the University of Botswana. Thusano currently has a number of projects under development, and the Chemistry Department of the University of Botswana is actively engaged in research of some of these products.

Lipia javanica

A **herbal tea, marketed by Thusano is made from the dried leaves of *Lippia javanica.* The taste is variously described as that of 'mint' or 'vanilla'. In traditional medicine, the plant has a variety of recorded uses throughout the Southern Africa area. The reported uses of *Lippia javanica* according to Watt *et.al.* (1962), are as follows:**

Xhosa: infusion of leaf and stem for coughs/colds and bronchial infections: disinfecting anthrax infected meal

Kwema: cough/cold remedy

Tswana: cough/cold remedy

Zulu: "gangergous rectis" measles, urticaria and rashes.

Zimbabwe: blackwater fever, malaria, dysentery.

Masai: red ointment for body decoration.

Lobedu: colds/nasal haemorrhage.

Shangana: cough remedy

Swati: influenza/colds

Nunguoi Bushmen: Malaria

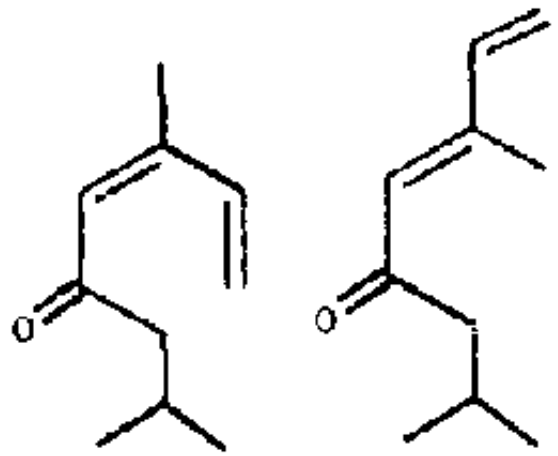
Tswana: Insect repellent/insecticide

Early research concluded that flowering tops from Tanzania contained 0.4% of an oil rich in ocimene. The leaves contain an oil that yields 65 - 70% of a liquid of molecular formula $C_{10}H_{16}O$, which has an odour of lemons.

Research within the Department of Chemistry, University of Botswana, in conjunction with the Analytical Chemistry Laboratory of Utrecht University in The Netherlands, has shown that the essential oil yields a liquid of formula $C_{10}H_{16}O$. However, detailed analysis using various separation techniques and hyphenated techniques such as $C_{10}H_{16}O$ and GC-F.T. etc., show the presence of three compounds of formula $C_{10}H_{16}O$.

The major component is 3,7-dimethyl-1,3-octadien-5-one, which is a monoterpene

with two geometrical isomers as shown:



cis trans

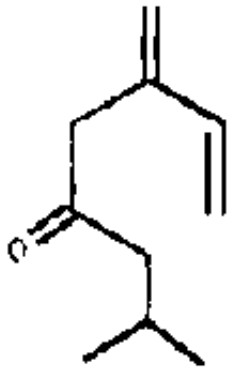
3,7-dimethyl-1,3-octadien-5-one

Figure

These compounds have previously been identified in *Tagetes* species, specifically, in *Tagetes minuta,* from which they take their trivial name Tagetones. The antimicrobial action is being studied by Hethely.

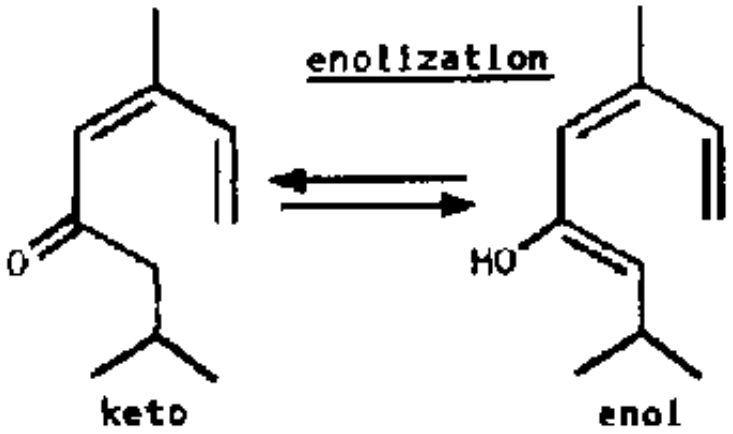
The other compound is also a highly unsaturated ketone with a proposed structure as shown below:

7-methyl-3-methylene-1-octen-5-one



Figure

The decongestant effect of ketonic terpenes is well known (c.f. menthone, etc.) and so it is not surprising that these compounds have a calming effect on respiratory conditions. Similarly, the insect repellant properties of cyclic and acyclic monoterpenes has recently been reported (Wang *et al* 1985). The anti-microbial properties, however, are rather more difficult to explain on the basis of ketonic structures. However, tagetone exists in equilibrium with the enolic form. This can easily be shown by the temperature dependence of the infrared spectrum. At high temperatures, the carbonyl stretching vibration disappears and a hydroxyl stretching absorption appears instead.

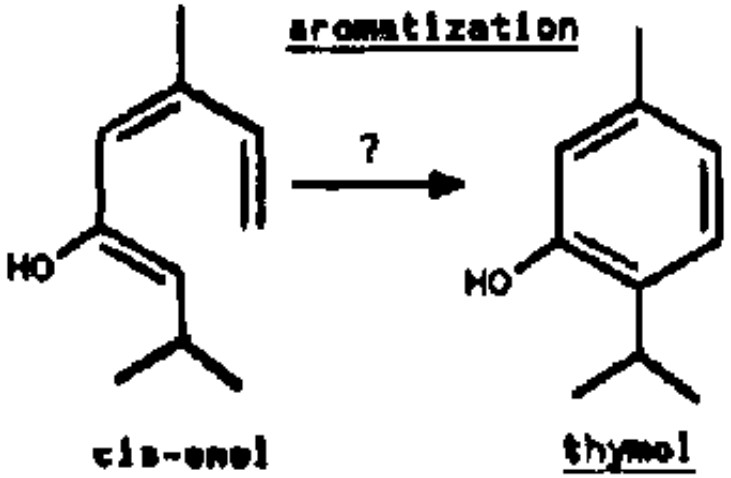


Figure

The formation of an enol may explain the anti-microbial properties since enols are known to show disinfectant properties.

When heated, the above compounds readily polymerize by opening of the double bonds. However, it is suspected that in the case of cis-tagetone, the molecule may also aromatize. This reaction is also possible in the presence of ultra violet light.

The product, thymol, is of course a well known natural product (Thyme oil) and its phenolic nature gives it disinfecting properties.



Figure

The potential use of this plant is very promising. However, we feel sure that much of the chemical analysis may be a replication of work that has already been done and unpublished and/or is under investigation in other regional laboratories since there is insufficient liaison between the various groups undertaking research in the field of medicinal plants. Effective research to aid development can only be achieved by a coordinated approach, both nationally and internationally. For this reason, current research into medicinal plants is being restricted to plants which have an 'immediate' commercial potential.

Acknowledgements

I am indebted to the fullest cooperation of the following,: Dr. T. Tietema, National Institute of Research, Gaborone; F. Taylor, Veld Products, Gaborone; Thusano Lefatsheng, Gaborone; Prof. J. H. van der Maas, University of Utrecht, The Netherlands and Phillips Laboratories, The Netherlands.

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The use of data from traditional medicine: Tunisian experience

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ABSTRACT

The industrial, technological and social developments in the world have significantly contributed to a situation whereby man has neglected the development of expanded uses of traditional medicines. However, our knowledge on the adverse side effects of some of the modern medicines, the emergence of diseases which are incurable with modern medicines, and adverse economic conditions particularly in the Third World countries, have re-activated interest on the development of traditional medicines for use in health care systems, all over

the world. This trend has called for scientific verification of the efficacy and toxity of these medicines. The new advances require thorough ethnobotanical investigations on medicinal plants; on the traditional uses of the plants; and the mode of preparation of the medicines by the traditional healers. This paper discusses the Tunisian experience on the ethnobotanical survey of medicinal plants. The data obtained in these investigations, are compared with those reported in countries neighbouring Tunisia.

Introduction

During the second half of the twentieth century, there has been rapid technological development in the search for new drugs. Third World laboratories have been "invaded" by newer and more efficient equipment to handle the isolation and identification of the active principles of plants. During the same period, computers have radically transformed, not only our working and living habits, but also our way of thinking.

Despite the above changes, it has been noted that there is paradoxically a trend to return to nature, and to "soft" medicine. Currently research is being carried out almost everywhere in the world, to try to rehabilitate traditional medicine.

In the developed countries, research to rehabilitate traditional medicine has mainly been a result of industrial development, which was geared towards production and consumption, but overlooked the dangers of such consumption. An awareness of the fact that the use of some drugs is dangerous, has led to a scenario whereby people want to go back to the roots, or to the use of medicinal plants.

In the Third World, economic factors have had a role to play in the use of medicinal plants. Due to the economic crisis, some countries are trying very hard to reduce the health budget, particularly the cost of drugs, by advocating the use of medicinal plants and other natural resources.

How can the resources of traditional medicine be used in a rational way? To answer this question, five steps must be followed: (a) taking stock of the resources of traditional medicine; (b) studying similarities in neighbouring countries; (c) modernizing the farming techniques of medicinal plants; (d) establishing procedures for the processing, quality control and standards of plant-derived products; and (e) testing the inocuity and efficiency of plant-derived products, including toxicological tests.

We now turn to a more detailed description of the above steps, with special reference to the experience obtained in Tunisia.

Stock-taking of the resources of traditional medicine

A research was carried out using a questionnaire which was distributed to primary and secondary school teachers all over the country. The research enabled the establishment of an inventory of about 1250 plants used in traditional medicine in Tunisia. Further field research was carried out in most of the regions in the country, and this helped to add 191 more plants to the inventory.

Similarities with neighbouring countries

The neighbouring countries selected for the study were Algeria and Morocco. In Algeria, Merabet carried out research in 1982, and in Morocco, Bellakdar edited a

book on traditional medicine in Western Sahara in 1978. He came out with a list, of 250 species.

The study by the current author has managed to establish a list of 24 species which are used in the same way in the three countries, and 41 species which have; the same indications in at least two countries. The traditional use of 18 of the species in the inventory corresponds to characteristics which are already known, or which can be shown scientifically.

The second step described above is necessary, as it adds to the field research, and enables the researcher to sort out the plants listed in the inventory.

Modernization of the farming techniques of medicinal plants

The percentage of active principles found in the plant itself can be improved by genetic engineering and agricultural production of the plants. We will quote here an example of the results obtained with *Solanum sodomeum* L., a source of solasodine, a raw material which can be used for the semisynthesis of steroid hormones. The species was improved through farming techniques, and the percentage of solasodine was increased from 2.2% to 4.2%.

Establishing procedures for the processing, quality control and standards of plant-derived products

In order to maintain quality, rigid standards have to be set for plant-derived products. A law was passed in 1985 to govern the pharmaceutical industry and the different articles relating to the execution of the law are being worked out.

Testing the inocuity and efficiency of plant-derived products, including toxicological tests

Although an inventory of at least 18 plants (whose activity was demonstrated scientifically) was made, this is not always done for most of the plants used in traditional medicine. This motivated the author and his associates to undertake research aiming at testing the activity of some plants.

(a) Anti-bacterial and anti-fungal activity

16 plants were tested against 4 bacteria and 6 fungi species by using the technique of dilution, in a freezing solid environment. Six plants revealed an activity estimated at 5mg/ml, which can compare with the antibiotic, streptomycin, and the antifungal agent, griseofulvin. The six plants were: *Pistacia lentiscus, Peganum harmala, Agave americana, Anonis natrix, rubus discolor* and *Ruta montana.*

(b) Plants with cytotoxic activity

22 extracts were tested for their cytotoxic activity. The tests used were those which have been recognized by the C.C.N.S.C., using human cancerous cells (KB), and murine cells. The extract from *Pergularia tomentosa* was the only one which revealed an activity estimated at DI_{50} = 20 mg/ml.

(c) Algae used as vermifuge

***Alsidium coralinum* was tested by HPLC, and kainic acid was found to be**

present. This acid was isolated by Fuhrman in 1981 from another alga, *Digenia simplex,* and its vermifuge activity has been demonstrated.

(d) Plants with anti-inflammation activity

***Calendula arvensis* is used in traditional medicine in Tunisia to treat rheumatism. Several components were isolated and identified, such as amino acids, phenol acids, flavonoids and particularly saponosides. The study on anti-inflammation was carried out using the carragenine test. By measuring levels of hormones such as cortisone and haptoglobin, it was possible to isolate and identify a saponoside, arvensoside "A", which could be the source of this activity.**

Discussion and conclusions

The testing of the above activities, and the search for new active principles need great human and material resources. However, we are of the opinion that the best way to carry out and implement successfully a programme which aims at studying the use of traditional cures derived from plants, is to work in an environment which has the following combination of factors:

(a) the use of plant-derived cures must be socially acceptable;

(b) there must be expertise in the agricultural and pharmaceutical fields; and

(c) there must be an industrial infrastructure, which deals with the transformation of traditional collections into scientific formulae, which can

be prescribed and administered, according to recognized professional medical practice.

Chemical and pharmacological studies of marketed traditional drugs

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Introduction

Most of the medicaments used in the traditional medicine of Ethiopia, as indeed in many other countries, are of plant origin. These traditional medicines are obtained in most cases from healers. However, the very common medicaments are obtainable from vendors.

In most markets one does not fail to find a corner which could be considered as an "open pharmacy" and where medicinal plant preparations are spread out to attract the attention of customers. Vendors do not usually prescribe as the customers are quite knowledgeable about the type of drug they wish to purchase.

A survey of 19 medicinal plant markets of Central Ethiopia (Kloos *et al.* 1978) identified over 40 common medicinal plants sold routinely. This survey showed that Ethiopia has a rich medicinal plant resource. The interdisciplinary studies of clinicians, chemists, pharmacists, botanists agronomists and anthropologists is necessary to develop more efficient uses for these potential resources. Table 1 summarises the results of the survey of Kloos *et al.*

The proper authentication of medicinal plants and identification of the active ingredients, is invaluable in the assessment of the pharmaceutical value of the traditional medicines. Although the usage of most of the marketed traditional drugs does not require special knowledge, there are instances where overdosage leads to toxic effects, particularly in the use of anthelmintics. Pharmacological studies, therefore, help not only to determine efficacy of these traditional preparations, but also to establish required dosages.

In this paper, we report the results of a study on one of the marketed drugs of Ethiopia. In the indigenous system of medicine in Central Ethiopia, the roots of *Taverniera abyssinica* (Leguminosae) are known in the Amharic language as 'Dingetegna' signifying "medicine for sudden illness'. The roots are chewed to alleviate severe stomach pain and fever.

***T. abyssinica* is an endemic species occurring in Ethiopia and grows up to 2 m high in bushland or on limestone, at altitudes between 1700 and 2200 m. *Taverniera* belongs to a relatively small genus containing only 15 species found in arid regions, from Egypt to India (Thulin, 1983). Three other species are also known to occur in Ethiopia.**

Phytochemical investigations of the roots have revealed the presence of a number of compounds including the isoflavonoids formononetin, afrormosin and the pterocarpans medicarpin and 4-hydroxymedicarpin (Duddeck *et at.,* 1987). It has also recently been shown that extracts of the roots of this plant exhibit antipyretic and analgesic properties (Dagne *et al,* 1990).

The present investigation has been undertaken to evaluate the spasmolytic and other pharmacological activities of the extract of this plant, in order to establish an ethnopharmacological basis for its use in traditional medicine.

Materials and methods

Plant material

The plant material used in this study was purchased from the main market in Addis Ababa from traditional medicine vendors. For botanical authentication of the plant material as *T. abyssinica* and for voucher specimens see Duddeck *et al.* (1987).

Extraction

The powdered root (100 g) of *T. abyssinica* was soaked in 75% ethanol in water for 24 hrs. The concentrated extract was further extracted with butanol. The butanol extract was successively refluxed for 20 min. each with ethyl acetate, acetone and ethanol. The ethanol portion was used to test on the different models. The other extracts were devoid of pharmacological activity.

Pharmacological tests

Four experimental models were employed to investigate the effects of the extract: anti-ulcer, antiasthmatic (*in vivo*), oxytocic (both in *vivo* and in *vitro*) and the isolated guinea-pig ileum. The extract was found to have an effect only on the isolated guinea pig ileum.

Isolated guinea-pig ileum

Adult guinea-pigs weighing 250-350 g were used. Heal segments (ca. 2-3 cm long) were taken from the caecal end. The muscle was suspended in warm (37° C) Tyrodes solution aerated with atmospheric air in a 20-ml organ bath. Contractions of the smooth muscle were monitored by means of the Ugo Basile isotonic transducer with 1 g tension and recorded on the Ugo Basile Gemini 7070 two-channel recorder at a chart speed of 5-mm/min. The tissue was allowed to equilibrate in Tyrode's solution for 30 min. Control contractile response were obtained for acetylcholine. A contact time of 30 sec. and time cycle of 3 min. was maintained. The extract was then introduced into 500 ml of Tyrode's solution in different concentrations. Using this solution acetylcholine-induced contractile responses were again elicited after giving 20 min. for the tissue to equilibrate every time a fresh solution containing a higher concentration of the extract was used.

In another set of experiments, the effects of the extract of the contractile response of the ileum to histamine were similarly investigated.

Statistical analysis

The given data represent mean ± S.E.M. and the statistical significance was

evaluated by the Student t-test.

Results

The extract produced no changes on the resting tone of the isolated guinea-pig ileum, i.e. neither a spasmogenic action nor a relaxation of smooth muscle was observed at any of the concentrations tested. Acetylcholine at concentrations of 5, 10 and 20 ng/ml produced concentration- dependent contractions of the ileum. The acetylcholine-induced contractions were significantly ($p < 0.001$) antagonized by the extract at 500 and 800 ng/ml. Fig. 1 illustrates a typical effect of the extract on the ileal response to acetylcholine and the results are presented in Table 1.

In the presence of the extract, maximal responses to acetylcholine could not be reestablished by increasing the concentrations of acetylcholine. Histamine at 10, 20 and 40 ng/ml also contracted the guinea-pig ileum in a concentration-dependent manner. The inhibitory effects of the extract on the isolated guinea-pig ileum contractions to histamine are illustrated in Fig. 2 and the results are presented in Table 2. As was observed for acetylcholine, in the presence of the extract, maximal responses to higher histamine concentrations were also not attained.

Discussion

Spasms of the gastrointestinal tract and gastric hyperacidity contribute to the symptoms of stomachache. In orthodox pharmaceutical preparations, such as, belladonna extracts, containing alkaloids of the atropine type, are often included

in formulations for stomach ailments, because of their spasmolytic actions against acetylcholine-induced spasms (Weimer, 1980). Histamine mediates gastric acid secretion, acting through the H receptors and has been shown to be responsible for gastric pain, particularly in ulcers. To antagonize the histamine, gastric activity H receptor antagonist drugs like cimetidine, have been designed (Douglas, 1980).

Our present preliminary pharmacological investigations of *T. abyssinica* have illustrated the ability of the extract to antagonize the smooth muscle spasmogenic actions of both acetylcholine and histamine, two of the most important spasmagens responsible for hyperactivity of the gastrointestinal tract. The non-attainment of the maximum control response of acetylcholine and histamine in the presence of the extract suggests the non-competitive nature of the antagonism.

The above findings show that the extract of this plant possesses analgesic and antipyretic properties, confirming the significance of this traditional drug in ethno-medicine.

Acknowledgements

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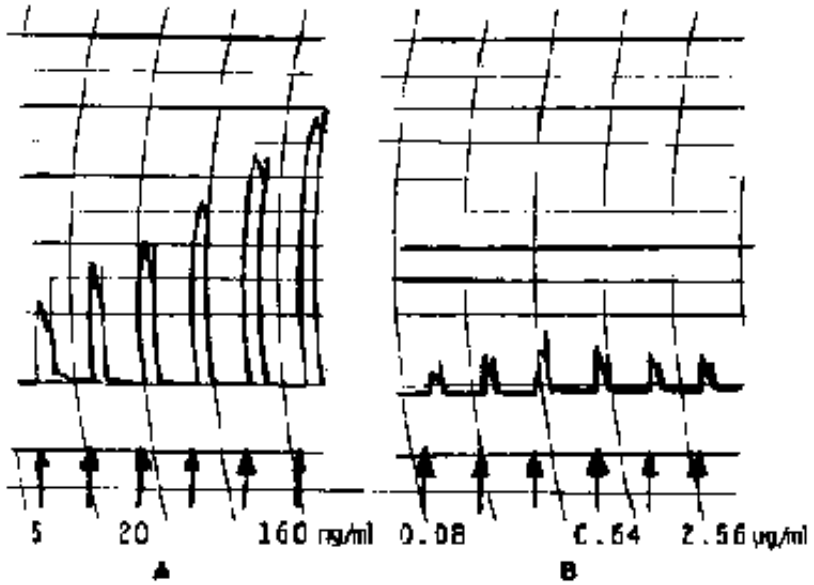

Fig.1. Typical trace showing the contractile responses of the guinea-pig ileum. 'A' shows control responses induced by ACh 5, 10, 20, 40, 80 and 160 ng/ml and 'B'

shows responses of the ileum for ACh 0.08, 0.16, 0.32, 0.64, 1.28 and 2.56 ug/ml in the presence of 500 ug/ml of the extract.

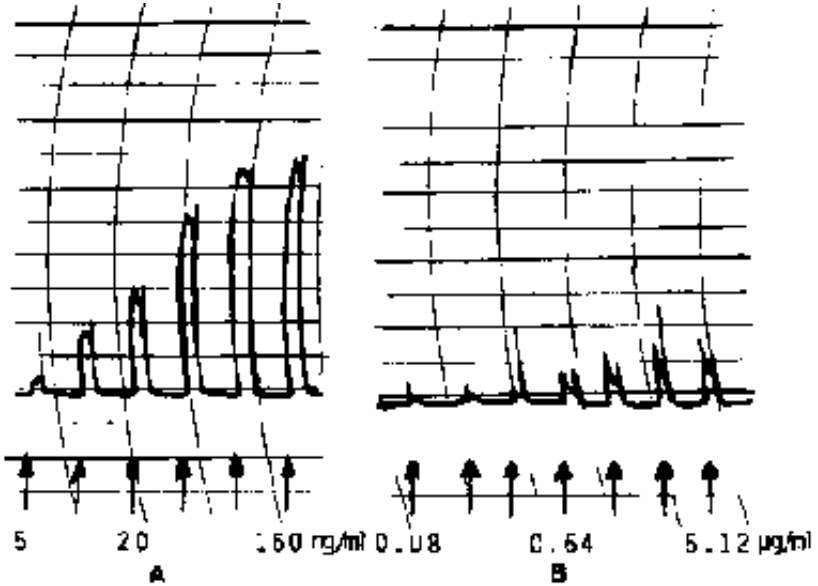

Fig.2. Typical trace showing the contractile responses of the guinea-pig ileum. 'A' shows control responses induced by histamine 5, 10, 20, 40, 80 and 160 ng/ml and 'B' shows responses of the ileum for histamine 0.08, 0.16, 0.32, 0.64, 1.28, 2.56 and 5.12 ug/ml in the presence of 500 ug/ml of the extract.

Table 1: Some traditional medicinal plants marketed in Ethiopia

Plant species	Vernacular name	Plant part	Major use
Hagenia abyssinica	Kosso	Flowers	Taenicide
Embelia schimperi	Enkoko	Fruits	Taenicide
Glinus lotoides	Metere	Seeds	Taenicide
Croton macrostachys	Bisana	Bark	Taenicide

Croton macrostachys	Bisana	Bark	Taenicide
Myrisine africana	Kechemo	Seeds	Taenicide
Cucurbita pepo	Dubba	Seeds	Taenicide
	Arusi kosso	Root	Taenicide
Silen macroselen	Wogert	Root	General Medicine
Echinops sp.	Kabaricho	Root	General Medicine
Ajuga remota	Armagusa		General Medicine
Withania somnifera	Gizawa	Stem	General Medicine
T. abyssinica	Dingetegna	Root	General Medicine
Ruta chalepensis	Tena adam	Leaves/fruit	General Medicine
	Altit	Resin	General Medicine
Leonotis velutina	Ras-kimir	Leaves	General Medicine
Lepidium sativum	Feto	Seeds	General Medicine
Pychnostachys sp.	Famfa	Leaves	General Medicine
Phytolacca dodecandra	Endod	Fruit	General Medicine
Cucumis prophetarum	Yemeder-embway	Hoot	General Medicine
Artemisia afra	Chukun	Stem/leaves	General Medicine
Vernonia amygdalina	Grawa	leaves	General Medicine
Aloe sp	Setret	Leaves	General Medicine
Thymus serrulatus	Tosin	Leaves	Expectorant
Rubus sp.	Enjore	Leaves	Expectorant
Lantana trifolia	Kase	Leaves	Expectorant

Rubia discolor	Encheber	Roots	Expectorant
Ocimum sp.	Dama-Kasseh	Leaves/Stems	Expectorant
	Taibedle	Leaves	Tonic
	Ofgahng	Leaves	Tonic
Myrtus communis	Addes	Leaves	Tonic
Coriandrum sativum	Dembelal	Leaves	Tonic
Cymbopogon citratus	Tej-sar	Leaves	Tonic
Rutex abyssinicus	Mekmeko	Root	Tonic
Foenicalum vulgare	Ariti	Leaves/Stem	Tonic
S. longipendunculata	Etsemenahe	Root	Medicomagical
Lagenaria spp.	Kel	Fruit	Medicomagical
Commiphora sp.	Karbe	Resin	Vulneraries
	Dechemarech	Root	Vulneraries
Verbena officinale	Attuch	Leaves	Digestant
Laggare sp.	Kaskase	Leaves	Digestant

Table 2: Traditional medicinal drugs available at the market of Addis Ababa according to a cursory survey conducted in February 1990.

Plant species	Vernacular name	Plant part	Major use
Cymbopogon citratus	Tej-sar	Leaves	Buda-besheta
Achyranthes aspera	Attuch	Roots	Dysentery
Mytrus communis	Addes	Leaves	Dysentery

Allium cepa	Nech-shenkurt	Bulb	General Medicine
Echinops sp.	Kabaricho	Roots	General Medicine
Lepidium sativum	Fetto	Seeds	General Medicine
Ocimum lamiifolium	Dama-kasseh	Leaves	General Medicine
Silen macrosilen	Wogert	Roots	General Medicine
Withania somnifera	Gizawa	Stem	General Medicine
Impatients tinctoria	Ensosela	Leaves	Rheumatism
Ajuga remota	Armagusa	Leaves	Stomach
Artemisia afra	Chukun	Seeds	Stomach
Artemisia rehan	Arriti	Leaves	Stomach
Ruta chalepensis	Tena-adam	Leaves	Stomach
			seeds
Taverniera abyssinica	Dingetegna	Roots	seeds
Embelia schimperi	Enkoko	Fruit	Taenicide
Ghinus lotoides	Metere	Seeds	Taenicide
Cucurbita pepo	Duba	Seeds	
Hagenia abyssinica	Kosso	Flowers	Taenicide
Dovyalis abyssinica	Koshim	----	Wounds
	Senafech	Seeds	---
	Kosseret	---	---
Osyris abyssinica	Kerett	Roots	---

Research into medicinal plants: The Somali experience

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Introduction

Herbal drugs have a considerable use throughout the World. In the past centuries, such use was understandably more extensive when related to the density of the populations. Treatment with herbal drugs seemed to be destined to vanish with the development of biomedicine. Instead, what actually happened is that despite the expeditious and impressive progress of "modern medicine" in the course of this century, ethnomedicine has remained the chief therapeutic reliance for hundreds of millions of people.

People have recourse to herbal drugs for a variety of reasons. A large number of persons depend on medicinal plants, mainly because they have no access to modern medicine. These people mostly live in rural areas, or in peripheral slums of big cities. For some people, especially in economically developed countries, plant-derived drugs are associated with memories of good old days. Nostalgia for grandmother's remedies are an inducement for many to try such remedies. Certain people believe that natural products have great efficacy while being devoid of toxic effects. Some people rely on modern medicine for certain diseases, while for others they resort to traditional medicine.

The use of herbal drugs by many is the result of balanced judgement based upon personal experiences, or acquired through reliable scientific sources. Whatever the reasons behind the utilization of herbal drugs, the merits of this system of treatment is unquestionable. It is unfortunate that some people associate it with the nostalgia of the past or link it with poverty. Herbal drugs are neither the medicines of the poor alone nor the remedies for nostalgic people; they are not merely a great potential for delivering health care for all in the future; they are actually an important tool for treatment of millions of people of different culture, social class and status throughout the world.

In today's world therapeutic year of armamentarium, plant products are well represented. Farnsworth points out that one quarter of the total prescription drugs in industrialized countries contain one or more components derived from plants.

Furthermore, scientific research has very often shown that in spite of being based on empirical systems, traditional herbal remedies are the result of long standing positive experience.

It is time that the experience of so many generations be placed at the service of modern man without loosing time or necessarily making use of expensive and sophisticated methods. The goal of improving and exploiting the use of medicinal plants in health care can be achieved with relatively easy means and in reasonable time.

Herbal drugs in Somalia

Traditional medicine uses different methods for curing diseases. The Somali traditional medicine could be divided into: (a) ceremonial healing and (b) practical treatments and herbalism.

Ceremonial healing:

This system is based on the celebration of specific rites. Some of these are purely religious. Others are located in the sphere of the magical and others are a mixture of both. The magic rites deal often with spirits and the treatments are mainly for mental or psychosomatic disorders. Famous among these rites are: the *saar, hayaat, mingis, nuumbi,* etc.. The religious treatments are based on the islamic teaching, that is the Koran, and give health to the true Muslim believers. Religious healing is for both organic and psychic diseases.

Practical treatments and herbalism:

These systems deal more properly with *organic* disorders. Most common among these are: (i) cauterization, (ii) scarification and blood letting, (iii) bone-setting, (iv) surgery, and (v) use of herbs. Traditional medical treatments are well approved and widely used by the Somali population. Surveys on traditional medical practices carried out by the Division of Pharmacology of the Faculty of Medicine in different times, showed very high prevalence of this type of medicine within both the rural and the urban communities. Among other information, one survey indicated that in the male population, the administration of herbs reached 73%. Several hundred plants are used in Somali traditional medicine. The confidence of the population to the ability of traditional herbalists is great. The use of plants is not devoid of spiritual rites. In the Somali traditional medicine,

there is a great respect for the plant. Eradication of the whole plant is avoided, even if the used part is the root. This shows also a respect to the environment. Healers of the inter-riverine area do not consider the plant as a simple physical entity. Greater part of herbalists feel that the effect of a plant depends not only on its power, but also on the relationship between the collector and the plant itself. Usually, a healer avoids his shadow on the plant while collecting it. He says prayers or recites formulas before cutting the plant. The recited words or formulas may be words from the Koran or prayers to ancestors. It is important that the rules laid down by the ancestors be strictly followed.

Most herbalists make use of no more than 30-40 different plants. Nevertheless, the average number of plants known to the majority of healers is far greater than that. Many herbalists could easily list over 100 plants, indicating the purpose they are used for in traditional medicine. In this they are like the modern physicians, who in spite of the great armamentarium of drugs at their disposal, feel more convenient to prescribe few dozens of drugs during their lifetime. The average inventory of kinds of leaves, stem barks and roots in Mogadishu traditional herbalists' dispensaries do not exceed the number of 35-40 for each. While in the rural areas healers very often go out into the bush in order to collect their own herbs such is not the case in the cities. The herbalists who are also dispensary owners would employ an apprentice, or younger herbalist for this job. They also buy herbs by occasional suppliers. By doing so, much of the magical aureola is neglected. They prefer to pretend that their suppliers have complied to all traditional plant collecting regulations. Many herbalists of the cities probably do not give great importance to the "rules of the ancestors".

Herbalists of big centres may act as healers or simply as dispensers. In fact they

may dispense herbs on simple request by the patient or according to another healer's prescription. This is quite a difference compared to their rural counterparts, who gather herbs upon clients needs. Traditional herbalists are allowed to practice their profession without restrictions. On the other hand, the law is not clear on whether clinical trials with plants could be performed.

Research experience

A programme of research into medicinal plants was established by the Somali National University in 1978. Investigation on plants used in traditional medicine is also one of the main lines of research of the Somali Academy of Sciences and Arts. The aims of the research that started in 1978 are:

(a) to foster the accomplishment of better use of medicinal plants lending to the necessary scientific support;

(b) to examine the credits of traditional use of medicinal plants in the light of modern science so as to encourage the use of therapeutically effective plants and discourage harmful ones;

(c) to promote the integration of proven valuable knowledge in herbal and modern medicine;

(d) to stimulate and cooperate in the realization of Somali traditional pharmacopoeia;

(e) to reduce the country's drug bill;

(f) to help in creating a national pharmaceutical industry;

(g) to aid in the therapeutic, economic and commercial exploitation of medicinal plants, by promoting their use, culture and exportation.

The research is a multi-disciplinary enterprise requiring the contributions of botanists, chemists, pharmacologists, and clinicians. At the Somali national University, the research on medicinal plants involves the Division of Pharmacology, Faculty of Medicine, the Section of Organic Chemistry, Department of Chemistry, and the Division of Botany at the Faculty of Agriculture.

At the very beginning, in 1978, we designed our programme just following the classical approach for drug research. Great importance was given to the isolation and structure elucidation of active compounds and pharmacological screening on them. After sometime, the team of research realized that the system chosen for the research was not the most appropriate to attain the aims of the programme at reasonable time. Further discussions brought about some changes and a decision was made that the research phases be as follows:

(a) Inventory of botanical identification of plants used in traditional medicine.
(b) Literature survey of the identified plants.
(c) Verification of efficacy of selected plants.
(d) Safety and toxicity assessment of active plants.
(e) Isolation, identification or structure alienation of active principles.
(f) In-depth pharmacological and toxicological evaluation of isolated active substances; and

(g) Production of drugs based on plants containing therapeutically valuable substances.

Extensive work has been accomplished on each of the above phases. The plants to be investigated upon are not chosen at random, but according to clearly set priorities. These priorities are linked to:

(i) the prevalence of the use of the plant among the population;
(ii) the prevalence of the disease for which the plant is used. Additionally, plants used for diseases which have no good cures in modern medicine, are given due consideration.

Regarding the inventory and botanical identification, information on the use of hundreds of plants has been collected by interviewing traditional herbalists. Many plant collecting expeditions have been carried out. All the collected plants have been identified. Samples of collected plants have been sent to internationally important herbaria.

Literature information has been collected for a relevant number of plants. This was partially carried out in Somalia. Lists of names (with synonyms) of identified plants were sent to the WHO collaborating Centre for Traditional Medicine at the University of Illinois, Chicago, USA, for search, through the NAPRALERT computer file. Literature printouts for most of the identified plant species have been obtained from the above Centre. The Medicinal Plants News-letter published by OAUSTRC, also reports literature information on medicinal plants.

Following the above system, extensive experimental research through the use of

in *vivo* and *in vitro* pharmacological methods has been carried out. The performed activities include: isolated organ tests, antimicrobial and antiparasitic activity, anti-inflammatory activity, anti-ulcer activity and several others. Toxicological studies have been performed on a number of plants.

The isolation and identification of active principles has led to the elucidation of the structure of a number of compounds. Some of these compounds, such as, two 1,3-diarylpropan-2-ol derivatives, called quracol A and quracol B, are new compounds hitherto not found in plants. One of the positive results of this chemical research was the identification of a cocancerigenic compound (a phorbol diester) in a plant species, the oil of which was commercially exploited by a Government agency for use as a purgative.

The last step is the clinical evaluation of efficacy and safety. This is the most difficult phase, especially because of the ethical implications and the long time required for carrying out appropriately controlled clinical trials. We elaborated a strategy that would allow us to monitor some clinical effects before starting with controlled clinical trials. Since the traditional medical practitioners are allowed to practice their profession, we decided to assign a physician to a qualified and licenced healer. The healer's job was mainly observation of the healer while he practises. This arrangement was not difficult, because a practicing healer was in fact among the staff of the Division of Pharmacology. The observations yielded valuable information on several plants.

The research programme has given a lot of interesting and useful results. The new approach has shown to be better suited for the aims of the programme. Nonetheless, it has many shortcomings.

The experience has shown that it still neglects the most important and immediate objective of medicinal plants research in a developing country: the early utilization of these plants in Primary Health Care. Most of the research programmes in developing countries share these drawbacks.

More appropriate method for applicable research

The research into herbal drugs usually makes use of dried plants, while we know that such plants are normally administered by traditional medical practitioners in the fresh state. Moreover, the solvent used by the practitioners is water.

The classical method for research is to dry the plant, store it for some time and then subject it to extractions with different types of solvents. Thus the approach of the researcher is quite different from that of the operators of the type of medicine which is under evaluation. It is clear that the researcher directs the work in a way more compatible with the setup of the research facilities and methodologies. The latter are established according to drug research of pure chemical compounds. In fact the rest of the research sequence is testing on laboratory animals and later on clinical trials as is classically done with synthetic drugs.

Is this method appropriate for plant material? Many plants undeniably lose totally or partially their activity during the drying and storing process. Therefore biological as well as chemical studies must be performed on fresh plants. The use of solvents and fractionation may result in greater concentrations of active compounds and stronger activity. But this is not always the case. In fact, sometimes total activity decreases with fractionation.

The classical method gives undue importance to the isolation of pure active compounds from medicinal plants. While isolation and identification of single active compounds is interesting for studies of structure-activity relationships and may be stimulating for the scientist, it will not contribute to any significant extent to the solution of health problems of developing countries. It is imperative that research methodologies be made more respondent to the principles of traditional medicine and to improved objectives. We must consider that traditional medicine has, in many countries, greater prevalence and accessibility than modern medicine. There is no doubt that the trend will remain the same for many years to come.

For the hundreds of millions of people who live in rural areas, changes of attitude and the established use and acceptance of modern health care facilities will be very gradual. Therefore, the immediate useful arid most important contribution of scientists in this field is how to make the traditional curing systems safer and confirm or disprove the efficacy of the preparations which so many people make use of.

If research into medicinal plants is oriented to reach this very important goal, it can be carried out in an easier, quicker and cheaper way, than the methods which are normally applied in most research centres of developing countries. People in our countries are using herbal remedies although for most of them the toxicity has not been studied. It is the duty of scientists to investigate the toxicity of every product which is consumed by humans. One of the first investigations on all medicinal plants, regardless of their efficacy is, therefore, the study of their toxicity.

The second step is the evaluation of the activity for which the plant, or combination of plants, is used. If for nothing else, it is very unwise and wasteful to use something when it does not serve the purpose for which it is used.

Once enough information has been acquired on the safety and efficacy of a certain traditional remedy, this knowledge must be transferred to those who prescribe the treatments and, possibly, to the clients who make use of such treatments. Normally, the results on the investigations of plants remain in the drawers of the laboratories or in libraries as printed materials and they will never reach the user of the plants.

The method that we deem best respondent to the needs of our communities is as follows:

> **(a) toxicological study in two species of animals for acute and subacute toxicity;**
>
> **(b) experimental evaluation of the activity for which the supposed remedy is used; and**
>
> **(c) clinical evaluation for efficacy in humans (where possible this must be preceded by observation of the healer while using the remedy).**

The fact that the plant is already used by healers on humans should not, by any means, save it from the necessary ethical obligations during clinical trials.

The advantage of this model is that the costly, sophisticated and time-consuming chemical studies of separation, subsequent fractionations and structure

elucidation is avoided. These steps, in fact, are not necessary for the needed progress towards a better use of medicinal plants in health care. This approach takes into account the concepts of traditional and folklore medicine. We cannot expect that traditional medical practitioners make use of pure extracts, or fractions of the plants they use,

The organization of training courses and workshops with the participation of healers would contribute to the improvement of their knowledge and skills and to the consolidation of a safer and more effective community health care system. Healers trained and left to operate in their communities would be the best fabric for Primary Health Care.

The achievement of this goal would be the greatest satisfaction and victory for scientists engaged in research into medicinal plants.

Effect of nitrogen and phosphorus on the essential oil yield and quality of chamomile (Matricaria chamomilla L.) flowers

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ABSTRACT

Field experiments were carried out to determine the effect of nitrogen (0, 50, 100, and 150kg N/ha) and phosphorus (0, 17.47, 34.93, and 52.41 kg P/ha) and their interactions on the essential oil yield and composition of chamomile. Nitrogen significantly increased essential oil yield and influenced its composition. Phosphorus did not significantly influence essential oil yield and composition, but low phosphorus rates (17.47 kg P/ha) tended to increase essential oil yield. High phosphorus rates decreased essential oil yield. Application of 17.47 kg P/ha at transplanting and top-dressing later with 50 kg N/ha gave the best results.

Introduction

Chamomile flowers contain an essential oil which is used in the manufacture of drugs for the treatment of such diseases as convulsions in children, diarrhoea, colic and acidity, hysteria, allergy, inflammation of body tissues, sleeplessness and stomach ulcers induced by chemical stress or heat coagulation (Martindale, 1977; Sticher, 1977 and Isaac, 1980). The essential oil also promotes epithelization and granulation, and shows antibacterial and antimycotic effects, through the activity of (-)-α-bisabolol and chamazulene (Isaac, 1979). The oil can also be used for flavouring liquors, colouring foods and making cosmetics (Bailey, 1949 and Kirk and Othmer, 1952). The essential oil content of chamomile flowers is in the range of 0.2-2.0% per unit dry flower weight (Martindale, 1977 and Franz, 1980). The composition and yield of essential oil may be affected by many factors, including plant nutrition (Franz *et al.,* 1978 and Franz. 1982).

Work done elsewhere, and not in Kenya, has shown that nitrogen and phosphorus fertilization increases the yield and essential oil content of the flowers (El-Hamidi *et al.,* 1965; Franz 1981; Singh, 1977 and Meawad *et al.* 1984). The authors further

reported that nitrogen and phosphorus influenced oil composition. Although nitrogen and phosphorus increased chamazulene content in the essential oil, excess nitrogen decreased it. Franz (1983) reported that nitrogen increased the concentration of (-)-α-bisabolol but decreased that of bisabololoxide B. No work on chamomile has been conducted in Kenya.

The importance and usefulness of chamomile essential oil in the pharmaceutical, food, and cosmetics industries and the fact that Kenya is importing a lot of the essential oil, has led to the initiation of studies on chamomile. The objective of this study was to show the effect of nitrogen and phosphorus and their interactions on the essential oil yield and composition of chamomile flowers.

Materials and methods

Field experiments were carried out between August, 1985 and March, 1987 at the Field Station, Faculty of Agriculture, University of Nairobi. Chamomile seeds (variety *max et oljea*) were sown in the nursery and seedlings were transplanted four weeks after germination, when they had attained 6-7 true leaves. The treatments consisted of 4 levels each of phosphorus (0, 17, 47, 34.93 and 52.41 kg P/ha) and nitrogen (0, 50, 100, and 150 kg N/ha). These were combined factorially to give 16 treatment combinations which were laid down in a split-plot design with three replicates. Phosphorus and nitrogen treatments were allocated to main plots and sub-plots, respectively. Phosphorus and nitrogen were applied at transplanting time and two weeks after transplanting, respectively.

Harvesting of flowers started when 50% of the plants had flowered and continued for 98 days. At every harvest, only flower heads with more than 40% open tubular

florets were harvested. The fresh flowers were dried to constant weight in an air-ventilated oven, at 35° C for 5 days and their dry weights were then determined and cumulated. The cumulated dry flowers were then used for extraction in order to determine the quantity and quality of the essential oil.

Determination of the quantity of the essential oil in the dried flowers was based on steam distillation. Clevinger apparatus were used for the extraction using the method described by Trease and Evans (1978) and Kornhauser (1986).

The qualitative analysis of the essential oil was done using gas liquid chromatography (GLC) as outlined by Kirk and Othmer (1952), Trease and Evans (1978) and Kornhauser (1986), with slight modifications on the conditions of the GLC. The conditions of the GLC used were as follows: Apparatus: Gow-mac series 69-750; column: 2.5 m long, 0.25 cm internal diameter; Packing: OV-1 on chromosorb W/HP (100-120); Temperature linear programming, 85- 175°C, 2.5°C per minute; Detector: Flame ionization; Injector temperature: 220°C; Detector temperature: 220°C; Column temperature: 170°C; Carrier gas: Nitrogen (flow rate 25 cm^3 per minute); Attenuation: 16; Chart speed: 1 cm per minute; and Range: 10^{-11}. The results presented are means of two trials.

Results discussions

Essential oil yield

Nitrogen fertilization significantly increased essential oil yield per both unit dry flower weight and hectare (Table 1). Increasing nitrogen from 0 to 100 kg N/ha increased essential oil yield per both unit dry flower weight and hectare from

0.627 to 1.036% (65% increase), and 5.85 to 16.64 kg (184% increase), respectively. Nitrogen rate above 100 kg N/ha decreased oil yield. Similar results were reported by El-Hamidi *et at.,* (1965), Franz (1981), Agena (1974), Meawad, (1981) and Meawad *et al.* (1984); that is nitrogen increased chamomile essential oil content and yield. The increase of essential oil yield due to nitrogen fertilization could be accounted for by the fact that nitrogen played an active role in the development and division of new essential oil cells, cavities, secretory ducts and glandular hairs (Meawad 1981; Meawad *et al,* 1984 and Agena, 1974). Nitrogen may have increased the essential oil yield because of increased carbohydrate accumulation, gibberellins and auxins concentration in chamomile plants. These were then utilised in the formation of more essential oil cells in the secretory ducts, cavities or glandular hairs (Sacks and Kofranek, 1963; Moore, 1979; Agena, 1974 and Abou-Zeid and El-Sherbeeny, 1974).

Table 1: Effect of nitrogen on essential oil yield of chamomile plants

N rates kg N/ha	Essential oil yield per unit dry flower weight*	Essential oil yield per plant (Kg/ha)
0	0.627^{a}	5.85^{a}
50	0.869^{c}	13.08^{b}
100	1.036^{d}	16.64^{b}
150	0.811^{b}	13.16^{b}

*** These values are ratios and hence they have no units**

Effects of phosphorus and nitrogen and phosphorus interactions on essential oil yield per both unit dry flower weight and hectare were not significant.

Essential oil composition

Nitrogen fertilization significantly increased chamazulene, (-)-α-bisabolol and farnesene concentrations in the essential oil of the flowers (Table 2). Increasing nitrogen from 0 to 50 kg N/ha increased chamazulene, bisabolol, farnesene and cis-spiroether contents by 25, 13, 11 and 15%, respectively. Application of nitrogen above 50 kg N/ha led to a decrease in the contents of these constituents. However, bisabolol content increased throughout with increase in nitrogen. Similar results have been reported by Agena (1974), Franz (1981) and Franz (1983). The increase of chamazulene (matricine), bisabolol, farnesene, and cis-spiroether concentrations in the essential oil of chamomile flowers with increase in nitrogen application could be due to the decrease in the contents of bisabololoxides A and B with increasing nitrogen application. Amino acid metabolism in nitrogen-rich chamomile plants leads to the biosynthesis of chamazulene (matricine), bisabolol, farnesene and cis-spiroether at the expense of bisabololoxides A and B and vice versa (Franz, 1981 and 1983). This implies that the biosynthesis of basic hydrocarbon terpenes (matricine, farnesene and bisabolol) of chamomile are antagonistic to that of the oxygenated terpenes (bisabololoxides and bisabolonoxides).

Nitrogen application significantly decreased the concentrations of both bisabololoxides A and B in the essential oil of the flower (Table 2). Increasing nitrogen from 0 to 150 kg N/ha resulted in a decrease of 27 and 39% in bisabololoxides A and B concentrations, respectively. Franz (1981 and 1983)

reported similar results.

Bisabololoxides (A + B) were predominant in the essential oil of the flowers, as they constituted on the average, 54.21% of the total constituents. Other constituents included bisabolol 6.02%, chamazulene 7.76% farnesene, 13.65% and cis-spiroether 7.97%. Mr-lianova and Felklova (1983) reported similar results. They reported that bisabololoxides (A + B) contents in essential oil of chamomile flowers were over 50%. This can be attributed to the fact that the biosynthesis of bisabololoxide A and B, and bisabolol are controlled by dominant and recessive genes, respectively (Franz, 1982).

Phosphorus application and the interaction between nitrogen and phosphorus did not significantly influence essential oil composition of chamomile flowers.

Table 2: Effect of nitrogen on essential oil composition of chamomile flowers

N rates kg N/ha	% chamazulene	% bisabolol	% farnesene	% *cis*-spiro ether	% bisabololoxide A	% bisabololoxide B
0	6.89^{a}	5.17^{a}	12.93^{a}	7.38^{a}	43.55^{d}	22.69^{d}
50	8.60^{c}	5.84^{b}	14.31^{b}	8.46^{a}	38.68^{c}	18.11^{c}
100	8.02^{bc}	6.51^{c}	13.84^{ab}	8.13^{a}	34.82^{b}	15.09^{b}
150	7.45^{ab}	6.54^{c}	13.90^{ab}	7.90^{a}	31.58^{a}	13.20^{a}

Figures followed by same letter(s) down the columns are not significantly different according to Duncan's multiple range test at 5% probability level.

Conclusion and recommendation

The study showed that application of 17.47 kg P/ha (40 Kg phosphorus pentoxide, P_2O_5/ha) during transplanting and two weeks later top-dressing with 50 kg N/ha, would ensure high essential oil yield which has good quality. The study also showed that nitrogen was important in the biosynthesis of essential oil and its components. However, it is recommended that more research should be done in the field of plant breeding, agronomy (varietal evaluation, plant nutrition, ecological zones), plant biochemistry and economic evaluation of chamomile growing in Kenya.

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Chemical characterization of pharmacologically active compounds from Synadenium pereskiifolium

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ABSTRACT

Synadenium pereskiifolium (Baill.) Guill (Euphorbiaceae) is the key plant among the six plants which are used in the preparation of an anti- asthmatic drug

regimen by traditional doctors. Although this plant belongs to the family of poisonous plants, traditional doctors have used it effectively in the treatment of asthma for decades with no adverse effects. Phytochemical screening of the aqueous extract of this plant revealed the presence of glycosides, terpenoids, flavonoids and other phenolic compounds. In order to characterize the pharmacologically active compounds from the aqueous extract of S. pereskiifolium, a method was adopted that was based on ion exchange, gel nitration on sephadex and extraction with organic solvents.

Introduction

Synadenium pereskiifolium **(Baill.) Guill, belongs to the family Euphorbiaceae. The plant is used in the preparation of various traditional medicines, the most important preparations being an asthma remedy.** ***S. pereskiifolium*** **has been reported in the literature (Verdicourt and Trump, 1969; Watt and Breyer-Brandwijk, 1962) as a poisonous plant and no therapeutic value has to-date been ascribed to it. There are several publications which have mentioned other plants used traditionally for the treatment of asthma (Adjanohoun, 1983; Oliver, 1960; Nad Karni, 1976; Kokwaro, 1976; Watt and Breyer-Brandwijk, 1962). None of the publications have mentioned** ***S. pereskiifolium*** **as a drug plant for asthma. Yet in the preliminary study in our laboratories, medicines prepared from this plant by a traditional medicineman have shown very promising therapeutic effects on man. Preliminary phytochemical screening revealed that the leaves and stems of the plant contained glycosides, flavonoids and terpenoids.**

An aqueous extract of the stems and leaves of ***S. pereskiifolium*** **showed both contracting and inhibition activity of the isolated Guinea pig ileum. The aqueous**

extract was thus subjected to a bioassay-guided fractionation according to the scheme for preliminary chemical characterization of pharmacologically active compounds in aqueous plant extracts (Samuelsson *et al.,* 1985).

Experimental

Solutions were concentrated under reduced pressure at temperatures not exceeding 40°C. Proton nuclear magnetic resonance (^{1}H-NMR) spectra were obtained at 270 MHz, and Carbon-13 nuclear magnetic resonance (^{13}C-NMR) spectra were taken at 67.8 MHz on a JOEL GSX-270 spectrometer using sodium 3-trimethysilyl-propanoate-d_4 i (TSP, ^{1}H-NMR, D_2O) and 1, 4-dioxane (^{13}C-NMR, D_2O; 67.40) as internal references. Spectra were obtained at 70°C. Separation of 2-butyl glucosides was performed on Hp-54 fused-silica capillary columns (30 m × 0.3 mm) at 190-250°C, 3°/min. A Hewlett Packard 5970 MSD gas chromatograph - mass spectrometer (GC-MS) was used for GC-MS analysis. Positive FAB-MS spectra were obtained on a JEOL Dx-303 spectrometer.

Plant material

Fresh aerial parts of *S. pereskiifolium* were collected from South Nyanza, Kenya and transported to Sweden by airfreight. The identity of the plant was established by Dr. Mats Thulin, Department of Systematic Botany, University of Uppsala, Sweden.

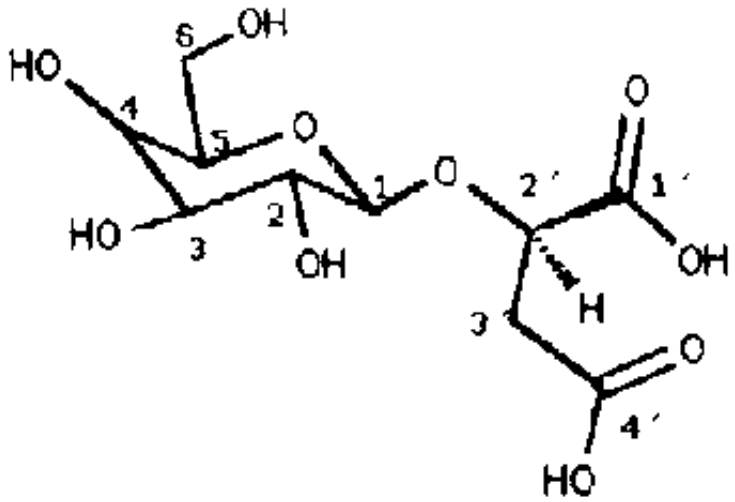
Extraction

The fresh material (1.2 kg) was cut to small pieces in a blender with rotating knives and extracted in water (81) by stirring at room temperature overnight. The extract was filtered, concentrated in *vacuo* in a cyclone evaporator and lyophilized, yielding crude material (41.9 g).

Isolation of glucosides

Crude extract (10 g) was dissolved in water (100 ml) and acetone (1 l) was added with stirring. The precipitate which formed was recovered and lyophilized, yielding 8.0 g of material. An aqueous solution of this material was applied on Dowex 50 (H^+) (160 ml) and eluted with water until the effluent was colourless. The eluate was neutralized with ammonia, concentrated in vacuo and lyophilized, yielding 5.0 g of material. The water eluate was partitioned between water (300 ml) and n-butanol (5x200 ml). The aqueous phase was concentrated in vacuo and lyophilized, yielding 4.8g of material. Part of this material (2.5g) was subjected to flash chromatography on silica gel (180 g) eluating with methanol: acetic acid: chloroform (85:10:5v/v). The separation was monitored by thin layer chromatography (TLC) using ethanol: acetic acid: propanol (50:30:10 v/v) and the compounds were visualized by spraying with anisaldehyde-sulphuric acid. One fraction contained a component which gave a green spot on TLC. The solvent from this fraction was evaporated and the material was lyophilized (0.9 g). Further purification of the material (100 g) was performed on Sephadex LH 20. Eluation was performed with water and the separation was monitored by TLC. Fractions containing the compound giving a green spot were combined and lyophilized (56 mg). The yield corresponded to 8.9% of the original aqueous extract of the plant and 0.3% of the fresh plant material. Part of the material was transformed to the

acid form by passing it through Dowex 50 (H^+). The sodium salt was obtained by evaporating part of the material with sodium bicarbonate followed by purification on a column of Bio-gel P-2. The material was analysed by MS and NMR spectroscopy.



Figure

Acid hydrolysis of the glucoside

The glucoside (43 mg) was treated with 2M trifluoroacetic acid for two hours at 120°C. The reaction mixture was purified over Bio-Gel P-2, eluted with water. A fraction containing pure aglycone was obtained and the latter was shown to be malic acid by NMR and MS spectroscopy and comparison with authentic L-malic acid. Glucose was also isolated from the reaction mixture and identified by sugar analysis and ^{1}H-NMR spectoscopy.

Determination of the absolute configuration

The glucose (2.7 mg) was treated with 2M hydrochloric acid in (+)- 2- butanol (0.2 ml) at 80° for eight hours in a sealed tube (Gerwig, *et al,* 1978). The mixture was neutralized with silver carbonate and then evaporated to dryness over phosphorus pentoxide. Part of the material was analysed by GC-MS and another part was silylated with a mixture of trimethylchlorosilane-hexamethydisilane (1:3) in pyridine at 22° for thirty minutes, concentrated to dryness, dissolved in ethyl acetate and then analysed by GC-MS. Authentic D-glucose and L-malic acid were treated with racemic and (+)-2-butanol in the same way and injected as references.

Results and discussion

The compound giving green colour with anisaldehyde-sulphuric acid was isolated from *S. pereskiifolium* as described in the experimental section. Analysis of the ^{1}H and ^{13}C-NMR spectra (Table 1 and 2) showed that the substance consisted of one sugar residue and an aglycone which had one CH_2 group, one CH group and two carbonyl carbons. ^{1}H-NMR chemical shifts and coupling constants of the signal from the sugar residue indicated a D- glucopyranoside. The ^{1}H- and ^{13}C-NMR chemical shifts of the CH-signal indicated the presence of a CH-O group (Table 1). Positive FAB-MS produced an ion at m/z 319 ($M+Na^{+}$) which corresponds to a molecular weight of 296 for the compound. These data, together with the sugar analysis and the determination of the absolute configuration, demonstrated that the substance consists of a β-D-glucopyranosyl group, linked to a hydroxylated dicarboxylic acid. The latter was isolated after acid hydrolysis of the glucoside and separation of the products by chromatography on Bio-Gel P-2.

The ^{1}H-and ^{13}C-NMR spectra of the dicarboxylic acid were compared and found to be identical with spectra of malic acid.

Determination of the absolute configuration of the acid by GC-MS after reaction with 2-(+)-butanol demonstrated it to be L-malic acid. No separation of the D-and L- forms of malic acid could be obtained after the hydroxyl group of the butyl ester was silylated. On the basis of these results, structure 1(2-O-β-D-glucopyranosyl-l-malic acid) was proposed for the isolated compound. This compound inhibited electrically stimulated contractions of the Guinea pig ileum eight times more than the original total aqueous extract. To our knowledge this compound has never been found in higher plants, but itself and the similar D-tartaric acid glucoside have been synthesized by Helferich and Arndt (1965).

Acknowledgements

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Table 1: ^{1}H-NMR. Chemical shifts (δ values) of 1 isolated from *Synadenium pereskiifolium* and of L-malic acid (coupling constants Hz in parentheses)

Compound	H-1	H-2	H-3	H-4	H-5	H-6a	H-6b	H-2	H-3a	H-3b
Glucoside (H^+)	4.58	3.34	3.50	3.41	3.43	3.88	3.72	4.78	2.99	2.99

Glucoside (H^+)	(7.9)	(9.1)	(9.2)	(9)2		(1.6,5.1)	(12.3)	(5.7)	2.99	2.99
Glucoside (Na^+)	4.47 (7.9)	3.36 (9.2)	3.50 (9.2)	3.40 (9)2	3.41	3.89 (1.8,5.5)	3.70 (12.5)	4.55 (9.5,3.3)	2.66	2.49 (-14.7)
L-malic acid (H^+)								4.61 (6.8,5.0)	2.93	2.84 (-16.5)
L-malic acid (Na^+)								4.28 (9.3,3.5)	2.67	2.40 (-15.6)

Notes

1. The coupling constant could not be obtained from the spectrum. 9 Hz gave the best result in spin simulation experiments.

2. Unresolved signals.

Table 2: 13C-NMR Chemical Shifts (δ values) of 1 isolated from *Synadenium pereskiifolium* and L-malic acid

Compound	**C-1**	**C-2**	**C-3**	**C-4**	**C-5**	**C-6**	**C-1**	**C-2**	**C-3**	**C-4**
Glucoside (H^+)	102.87	73.97	76.55	70.41	76.87	61.63	174.92	74.47	38.62	174.54
Glucoside (Na^+)	102.50	74.14	76.99	70.58	76.98	61.81	179.98	79.12	42.92	179.60
L-malic acid (H^+)							176.60	67.07	38.98	174.62
L-malic acid (Na^+)							177.71	63.53	39.65	176.66

L-malic acid (Na+)

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Abietane diterpene quinones from lepechinia bullata

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ABSTRACT

Three cytotoxic abietane diterpene quinones, horminone, 7-O-methylhorminone and 6,7-dehydroroyleanone have been isolated for the first time from a methanol (MeOH) extract of Lepechinia bullata (Kunth) Epling (Labiatae). 7-O-methylhorminone is a new natural product, whose structure was unambiguously determined through ^{1}H-^{13}C long range homonuclear correlation (COSY) and heteronuclear correlation (HECTOR) experiments. To date, only a few diterpene quinones have been found to display antitumor activity. In the present study, the three isolates were found to inhibit the growth of P-388 cells although horminone and 7-O-methylhorminone were only marginally active, according to the guidelines of the National Cancer Institute. The compounds did not however, exhibit any significant cytotoxity against KB cells. They represent the first examples of diterpene quinones of the royleanone type to be found cytotoxic against mammalian tumor cells, although horminone has previously been reported to inhibit the growth of Trypanosoma cruzi.

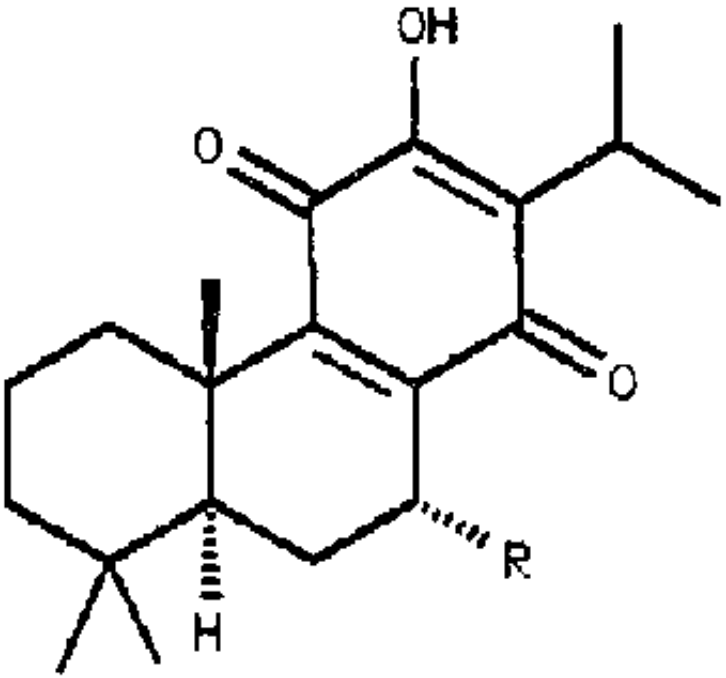
Introduction

Lepechinia bullata **(Kunth) Epling (Labiatae), a medicinal plant growing in**

Colombia, South America, was investigated for antitumour activity. A methanol (MeOH) extract of the above ground parts of the plant was found to be active against P-388 (murine leukaemia) cells (ED_{50}=14.5 μg/ml), but far less sensitive in KB (nasopharyngeal carcinoma) cells (ED_{50} 40.5 μg/ml).

Phytochemical screening of the bioactive MeOH extract afforded three cytotoxic diterpene quinones, viz., horminone (Fester *et al.,* 1956), 7-O-Methylhorminone (Montes, 1969) and 6,7- dehydroroyleanone (Alpandes *et al.,* 1972). 7-O-methylhorminone is a new natural product whose spectroscopic properties were very similar to those of horminone, thus justifying the royleanone type structure (See also Silver, 1968; Delgado *et al.,* 1986):

***Lepechinia bullata* has not previously been investigated. Other *Lepechinia* species such as *Lepechinia chalepensia* (Fester *et al.,* 1956), *Lepechinia floribunda* (Montes, 1969), *Lepechinia speciosa* (Alpandes *et al,* 1972), *Lepechinia salviae* (Montes *et al.,* 1983), and *Lepechinia graveolens* (Riscale and Retamar, 1973) have been analysed for their essential oil content. Diterpenes and triterpenes have also been isolated from *Lepechinia chamaedryoides* (Silva, 1968) and *Lepechinia glomerata* (Delgado *et al.,* 1986). The isolation and biological screening of the three abietane diterpene quinones from *Lepechinia bullata* is reported in this paper.**



Figure

Materials and methods

Plant material

The aerial parts of *Lepechinia bullata* were collected in Colombia in May 1976, by a USDA team. Voucher specimens have been deposited at the National Herbarium, Washington D.C., U.S.A.

Isolation and identification

The crude methanol extract, after being washed with petroleum ether, was partitioned between chloroform ($CHCl_3$) and aqueous MeOH. The $CHCl_3$ fraction

was chromatographed over silica gel, using $CHCl_3$ as eluting agent. Fractions (500ml) were collected and combined on the basis of thin layer chromatography (tlc) analysis (see fractionation scheme). Fractions 6-19, on standing in the cold room overnight, deposited an orange precipitate, which was purified by preparative tic and recrystallised from $CHCl_3$ to give fraction 3 (see Fig. 1). Fractions 47-48, when left overnight in the cold room, deposited a light-green substance which, on repeated chromatography and recrystallisation, gave Fraction 1. Complete spectral analysis (UV, IR, MS ^{1}H- and ^{13}C-NMR) of Fractions 1 and 3, gave data which were in close agreement with those previously reported for horminone (Hensch *et al.,* 1975) and 6,7-dehydroroyleanone (Hensch *et al.,* 1975), respectively.

Flash chromatography, followed by preparative tic of the yellowish- brown solid obtained by evaporation of fractions 31-42, gave the new compound 2 as yellow needles, mp 126-128°C. It was assigned the structure 7-O-methylhorminone, based on its spectroscopic properties. Its mass spectrum displayed a molecular ion at m/z 346, 14 amu higher than that of horminone (m/z 332), shown by the presence of the methoxyl signal, in both the ^{1}H- and ^{13}C-NMR spectra (δ3.45 and 57.3 ppm, respectively). The compound was, therefore, most likely a derivative of horminone, with a methoxyl group at either C-7 or C-12. 12-O-methylhorminone has been synthesised and characterised by Hensch *et al.* (1975). The 7-O-methyl analogue is hitherto unknown.

Further comparison of the ^{1}H and ^{13}C-NMR spectra of 1 and 2 (Table 2 and 3) showed that the most significant difference between them lies in the chemical shift values for H7 and C7. The methoxyl group in 2 caused the H7 signal to move

upfield to δ4.32, from δ4.73 in 1, and concurrently, C7 absorbed downfield at δ0.8 from δ63.2. The results are consistent with a methoxyl substituent at C7 and not C12 of horminone.

The *uv* spectra of 2 provides further evidence for a methoxyl substituent at C7. The absorption at 411 nm exhibited a significant bathochromic shift to 524 *nm* on addition of NaOH, indicating the presence of a quinonoid hydroxyl group at C12. Similar *uv* shifts have been reported in diterpene quinones bearing a quinonoid hydroxyl function (Lin *et al,* 1989).

The stereochemistry at C7 was determined from the ^{1}H-NMR spectrum. Kupchan *et al.* (1968, 1969) have compared the H-7βH signal of horminone with the H-7αh of taxoquinone, its 7-epimer. They found that at 60 MHz, the H-7βH appeared as a multiplet with W1/2 = 20 Hz, whereas the H-7βH signal was a broad singlet, with W1/2 == 8Hz. In our work, the H7 of 2, measured at 300MHz, was observed as a doublet of doublets with J = 2 and 4Hz, consistent with a β orientation of H7. Compound 2 was, therefore assigned the structure 7-O-methylhorminone.

Biological screening

The MeOH extract and the three isolates were tested for antitumour activity in KB and P-388 cell cultures, according to standard procedures as described previously (Pezzuto *et al.,* 1983, and Arisawa *et al,* 1984). The results are shown in Table 1. All isolates inhibited the growth of P-388 cells, although 1 and 2 were only marginally active, according to the guidelines of the National Cancer Institute (Geran *et al.,* 1972). They did not, however, show any significant cytotoxicity against KB cells. The three compounds represent the first examples of diterpene

quinones of the royleanone type, to be found cytotoxic against mammalian tumour cells. It is worth noting that in both KB and P-388 systems, the unsaturated 6,7-dehydro compound (3) is more active than the 6, 7- saturated structures, leading to speculation that the antitumour activity of these compounds depends on the substitution pattern at the C6-C7 position of these molecules.

Acknowledgements

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Table 1. Data obtained from pharmacological testing of KB cells (nasopharyngeal carcinoma) and P-388 cells (murine leukemia) with *Lepechinia bullata* plant extracts and pure compounds

Compounds		**ED_{50}**
	KB cells	**P-388 cells**
Crude MeOH extract	40.5 μg/ml	15.5 μg/ml
Horminone	20.2 μg/ml	4.6 μg/ml
7-O-methylhorminone	13.0 μg/ml	4.8 μg/ml
6,7-dehydroyleanone	5.7 μg/ml	1.6 μg/ml

Table 2. Summary of 1H-NMR of Extracts 1 and 2 (300 MHz, $CDCI_3$)

	δ (ppm)	
Proton	**Horminone**	**7-O-methylhormine**
H - *7β*	4.73 (d)	4.31 (dd)
H - 15	3.16 (septet)	3.18 (septet)
H - *1β*	2.16 (ddd)	2.68 (ddd)
H - 6α	1.96 (d)	2.04 (d)
H - 2β	1.72 (m)	1.70 (m)
H - 5	1.55 (hidden)	1.57 (hidden)
H - 3α,β	1.5 - 2.7 (m)	1.4 - 1.6 (m)
H - 6α	1.4 - 1.5 (m)	1.35 (ddd)
H - 2	1.2-1.3 (hidden)	1.2- 1.3 (m)
Me - 16	1.21 (d)	1.19 (d)
Me - 17	1.22 (d)	1.22 (d)
Me - 20	1.22 (s)	1.22 (d)
H - 1α	1.1 - 1.2 (m)	1.1- 1.2 (m)
Me - *1δ*	0.98 (s)	0.95 (s)
Me - 19	0.90 (s)	0.91 (s)
7 - Ome	-	3.45 (s)

Table 3. Summary of data of C-13-NMR of Compunds 1 and 2 (90.8 MHz, $CDC1_3$)

	δ(ppm)	
Carbon	**Horminone (1)**	**7-O-methyl-horminone (2)**
C - 14	189.0	186.4
C - 11	183.8	184.1
C - 12	151.1	150.6
C - 9	147.8	147.8
C - 8	143.1	141.4
C - 13	124.1	124.7
C - 7	63.2	70.7
C - 5	45.7	45.5
C - 3	41.0	41.0
C - 4	39.1	39.2
C - 1	35.7	35.7
C - 18	33.1	33.0
C - 10	33.0	33.0
C - 6	25.7	22.1
C - 15	23.9	24.2
C - 19	21.7	21.9
C - 17	19.8	19.9
C - 16	19.7	19.7
C - 2	18.8	18.8
C - 20	18.3	18.5

C - Ome	-	57.3

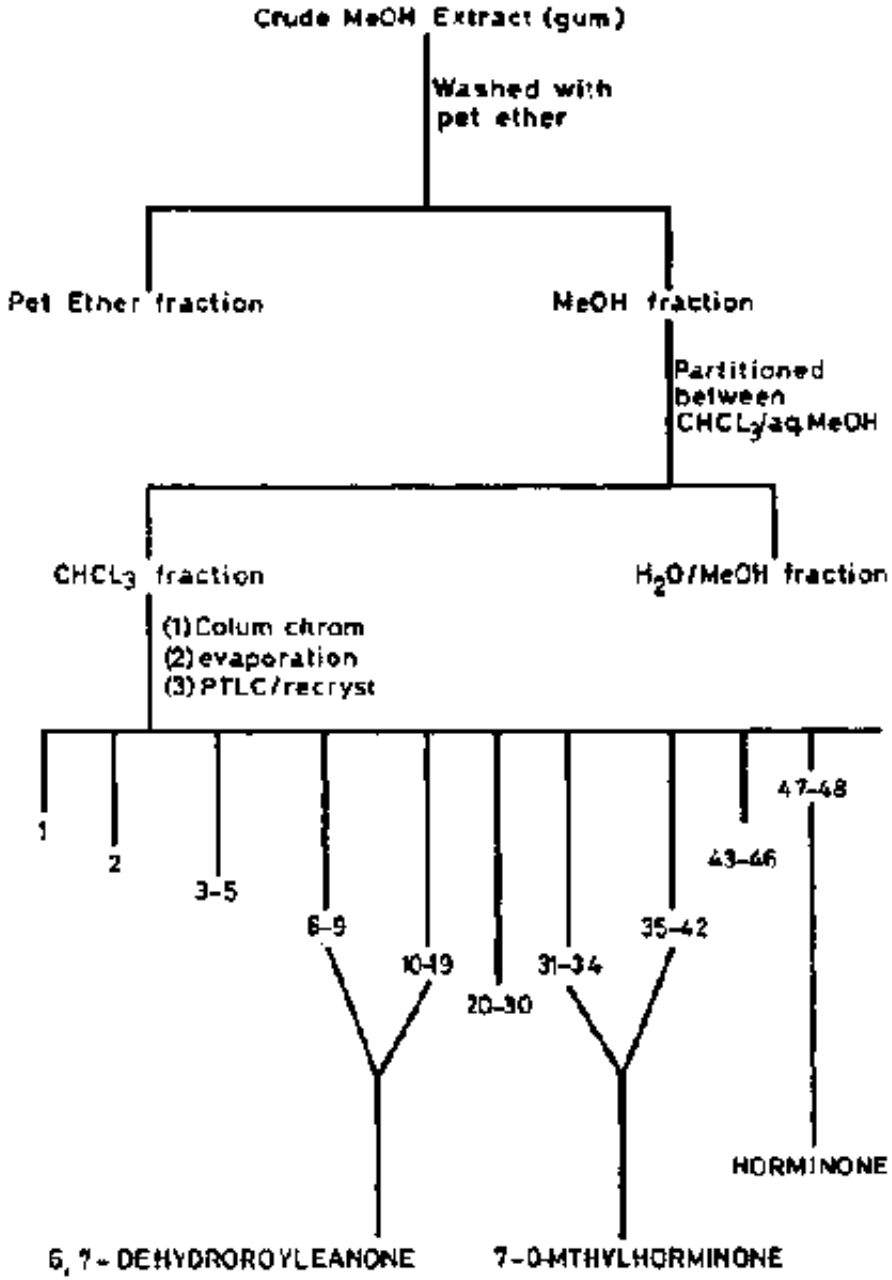
Crude MeOH Extract (gum)
Washed with pet ether
Pet Ether fraction
MeOH fraction
Partitioned between CHCl3/aq.MeOH
CHCl3 fraction
H2O/MeOH fraction
(1) Colum chrom
(2) evaporation
(3) PTLC/recryst
1
2
3-5
6-9
10-19
20-30
31-34
35-42
43-46
47-48
HORMINONE
6, 7 - DEHYDROROYLEANONE
7-O-METHYLHORMINONE

Figure 1: Fractionation scheme for the extracts from Lepechinia bullata

Antimicrobial activity of Tanzanian traditional medicinal plants

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ABSTRACT

A large number of plants used in traditional medicine were screened for antimicrobial activity. In the preliminary screening, Staphylococcus aureus (gram positive bacteria) and Escherichia coli (gram negative bacteria) were used to differentiate between active and non-active plant extracts. The extracts which showed activity were then screened for their antigonococcal and also for antifungal activity. A number of active plants were then phytochemically investigated to isolate the active components. A large number of different types of non-active compounds were also isolated and identified. There is some correlation between the activities and the traditional medicinal uses of the plants studied. Some of the compounds isolated could be responsible for the activity and use of the plants. This paper gives only the in-vitro screening and the results should be used with caution when applied to in-vivo effectiveness in humans. Screening needs to be done in-vivo and the toxicity aspect has to be studied very thoroughly before such crude plant extracts could be given as safe treatment with no serious consequences.

Introduction

In African and most developing countries traditional medicine still forms the backbone of rural medical practice. Medicinal herbs are extensively used for various ailments in these countries. This indicates that some of these medicines, if scientifically evaluated and standardized, could make very valuable medicaments. However, although a number of American (Lucas *et al.,* 1951) and Australian (Atkinson *et al.,* 1955) medicinal herbs have been screened for their medicinal properties, up to now there seem to be no serious attempts to evaluate African medicinal plants in a collective form for their biological activities and medicinal usefulness. However, there are scattered reports of such evaluations for individual or small groups of plants, as it will be noted in various presentations in this conference.

In the literature, it can be noted that Nickell (1959) is among the first researchers to compile an extensive review on biological (antibacterial) activity of vascular plants. Nickell's list of plants included only a few of Tanzanian medicinal plants. We therefore considered it worthwhile to investigate the in vitro antibacterial and antifungal activities of some of the Tanzanian medicinal plants, and ultimately to isolate and identify the active constituents (Sawhney *et al.,* 1978a; Sawhney *et al.,* 1978b: Khan *et al.,* 1979).

We chose to screen the medicinal plants for antifungal activity because, of all human microbial infections, fungal diseases are the most difficult to modify in their course, or to prevent (Lucas *et al.,* 1973; Taylor *et al.,* 1961). It is now becoming more evident that the incidence of such diseases is increasingly becoming prominent.

From the literature (Kokwaro, 1976; Watt *et al.,* 1962) and personal

communications with Tanzanian traditional medical practitioners, we established that a number of herbs are used for the treatment of skin diseases, and many of them are said to be very effective. Thus the fruits of *Solanum incanum,* a weed which is widely distributed in East Africa, are extensively used for the treatment of cutaneous mycotic infections and other pathological conditions. The therapeutic action of the fruits has been attributed to solanine and related glycoalkaloids (Beaman-Mbaya *et al.,* 1976). Similarly, the juice of *Emilia sagittata* is used for ring worms and athletic's foot. Although no chemical work is reported on this plant, a very potent antimicrobial and pharmacological agent, emiline (1), has been obtained from another plant of the same genus, *E. flammea* (Tomczyk *et al.,* 1971).

Apart from using *Staphylococcus aureus* and *Escherichia coli* as test bacteria, we also included the essay of the crude plant extracts for their antigonococcal activity. This is because gonorrhoea is among the most common venereal diseases, both in rural and urban populations in Africa (Becker, 1973). Despite the introduction of sulphonamides and antibiotics, a large proportion of rural populations in developing countries still rely on local herbs for the treatment of gonorrhoea. Thus, in West Africa for example, cottonwood tree (*Bombax* sp.), *Alchronea cordifolia, A. floribunda, Mussaenda elegans, Craterspermum laurinum* and *Aframomum baumannii* are commonly used (Harley, 1970). There are also similar example in East Africa (Kokwaro, 1976).

In this paper we will give an overview of the results on the screening of crude plant extracts for their antibacterial, antigonococcal and antifungal activity and the phyto-chemical investigations on some of the most active plants.

Antibacterial activity

In all, 134 plant extracts were tested for their activity against *S. aureus* and *E. coli in vitro.* An extract which failed to inhibit the growth of the test bacteria was regarded as being inactive. Results are summarized in Table 1, in which the inactive extracts are not shown.

Phytochemical investigations on some of the most active extracts have revealed the active constituents of the plants. Thus the activity of *Euclea natalensis* can be attributed to 7- methyljuglone (2), mamegakinone (3) and diospyrin (4). These compounds, which were isolated from the plant, have been found to be active against *S. aureus* and a few other bacteria (Table 2).

The antibacterial activity of *Harrisonia abyssinica* root bark, which showed an activity against *S. aureus*, comparable to 5 units of penicillin G, has been traced to be due to the limonoid harrisonin (5) (Kubo *et al.,* 1976). The latter compound, which was the only active component of this plant, showed a minimum inhibitory concentration of 5 μg/ml (Mosile, 1980).

Another most active plant is *Acacia nilotica.* This plant is known to contain phenylethyl alkaloids and flavonoids. Although these compounds have not been tested, we found the activity to be concentrated in the acidic fraction of the extract, which contains the flavonoids.

Active compounds which have been isolated from some of the most active plant extracts are shown in Chart 1.

Antigonococcal activity

In this category of assay, extracts from 88 Tanzanian medicinal plants were tested for their *in vitro* activity against *Neisseria gonorrhoea* isolates from clinical cases, which were isolated and maintained at the Department of Microbiology and Immunology, Faculty of Medicine, University of Dar es Salaam (Sawhney *et al,* 1978a). Results are shown in Table 3. It is interesting to note that some of the plants used locally for the treatment of gonorrhoea are very active against the pathogenic bacteria. Furthermore, 82% of the plants listed in Table 4 were also active against *S. aureus.* More than 40% of the plant extracts without antigonococcal activity showed various levels of inhibition of *S. aureus.* This, in a way, ruled out the effect of nonspecific factors, such as acidity, on the observed activity.

Antifungal activity

In all, 124 plants were screened for activity against the common dermatophyte, *Trichophyton mentagrophytes,* as well as *Candida albicans.* Results are summarized in Table 4.

As it can be noted in Table 4, the highest level of antifungal activity was exhibited by extracts of *Emillia sagittata, Securrinega virosa* (pulp) and *Sida serratifolia* (roots) (Sawhney *et al.,* 1978b). Apparently, none of these plants is used to treat dermatomycoses in East Africa. Instead these plants are used for miscellaneous ailments, such as eye inflammation, topical dressing for wounds and contusions, diarrhoea, gonorrhoea, pneumonia, pulmonary tuberculosis and dysentery, most of which are bacterial diseases (Kokwaro, 1976; Watt *et al,* 1962). Incidentally, among the above plants only *S. serratifolia* showed antibacterial activity *in vitro* (Table 1). Such results may suggest that either the antibacterial activity is

exhibited only *in vivo,* in patients, or the plants are used just as a matter of tradition. Again, the observed antifungal activity, despite the plants not being used traditionally for fungal related diseases, gives us a good indication that a lot is yet to be discovered regarding the diverse usefulness of medicinal plants.

Phytochemical investigations

We have carried out extensive phytochemical investigations on some of the most active plants shown in Tables 1, 4 and 5, with the aim of isolating the active constituents. Thus from *Euclea natalensis* we isolated several naphthaquinones, among which the active ones are listed in Table 2 (Khan *et al.,* 1979).

Several triterpenoids and naphthaquinones have been isolated from various *Diospyros* species (Ebenaceae), but only 7-methyljuglone, diospyrin and mamegakenone were the active compounds in this series. Eleven *Cassia* species have been analysed for their constituents, and in addition to emodine (6), aloe-emodine (7) and barakol (8), several other anthraquinones have been isolated, some of which were obtained for the first time (Mutasa, *et al.,* 1990).

***Maerua angolensis* (Capparidaceae) is among the plants which exhibited a high antifungal activity. We have isolated several C_{12}, C_{14} and C_{18} fatty acids and esters from this plant, and most of these compounds showed antifungal activity (Nkunya, 1985).**

Among the plants of the family Annonaceae, which were included in the screening tests, were those belonging to the genus *Uvaria.* In the literature some of these plants are reported to possess a wide range of biological activities. Furthermore,

these plants have been found to contain compounds with interesting chemical structures, some of which are also the active components of the plant extracts. These findings prompted us to carry out extensive phytochemical investigations of these plants. In the course of these investigations, we have isolated more than forty compounds from nine *Uvaria* species found in Tanzania. An account of these compounds, regarding their biological activities, has been given by Nkunya (1990, this conference), in a paper on the antimalarial activity of the compounds. Apart from this, the compounds have shown activity against some bacteria and tumour cells. Among the active compounds are (+)-β-senepoxide (9), (+)-pandoxide (10) and (-)-pipoxide (11) (Nkunya *et al,* 1986). Results on the antibacterial activity are shown in Table 5.

Conclusion

The results discussed in this paper do not claim that the plants we have investigated and the pure compounds therefrom are safe medicines. Their efficacy and safety can only be established by very careful toxicity and pharmacological studies, followed by clinical trials using usual protocols. Our results definitely have provided a basis for further investigations on similar lines, as well as on the toxicity and pharmacological aspects of the extracts, and pure compounds. We hope that the leads presented here will be pursued exhaustively by the scientific community.

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Table 1: Susceptibility of *Staphylococcus aureus* and *Escherichia coli* to various plant extracts

				Antibacterial activity	
Name of the plant	Family	Part	Traditional uses	*Staphylococcus aureus*	*Escherichia coli*
Anona senegalensis Pers.	Annonaceae	Bark	Intestinal worms, guinea worms, dysentery	+	0
Uvaria acuminata Oliv.	Annonaceae	Roots	Epilepsy, sunstroke, tonsillitis, lunasy	+	0
Uvaria acuminata Oliv.	Annonaceae	Leaves	Epilepsy	+	0
Dictyophleba lucida	Apocynaceae	leaves	No known use	++	++
Pierre *Plumeria rubra* L.	Apocynaceae	Bark	Itching, diarrhoea gonorrhoea, dropsy, purgative, skin diseases, syphilis	++	0
Kigelia africana	Bignoniaceae	Bark	Wounds, sores,	++	0

Kigelia africana (Lam.).) Berth	Bignoniaceae	Bark	Wounds, sores, gynaecological conditions, ulcers, abscesses, dysentery	+	0
Tecomaria capensiss Spach.	Bignoniaceae	Leaves	Pneumonia, bleeding gums, diarrhoea, enteritis	+++	++
Ehretia amoena Klotzch	Boraginaceae	Root-bark	For pains about the waist (stitch)	++	+
Boscia salicifolia O.	Capparidaceae	Bark	Chiufa, various women's diseases	++	0
Boscia salicifolia O.	Capparidaceae	Leaves	Chiufa, remedy for fever in cattle	++	+
Maerus angolensis D.C.	Capparidaceae	Bark	Roots used for homocidal purposes, treatment of lupus, influenza, toothache	+ +	0 0
Carica papaya L.	Caricaceae	Roots	Venereal diseases, anti-helmintic, akin	0	+
Elaeodendron	Celastraceae	Roots	*Elaeodendron* sp.	++	0

schlechteranum (L.)			to abscesses and carbuncles		
Vernonia hildebrandtii V.	Compositae	Leaves stem	Cough, strangulated hernia, stomach troubles	+++	0
Cyperus rotundus L.	Cyperaceae	Tuber	Diuretic, emmenagogue, liver and heart desease remedy, headache cure, carminative	+++	0
Tetracera boiviniana B.	Dilleniceae	Root-bark	No known use	++	0
Diospyros mespiliformis Hoechst ex DC	Ebenaceae	Leaves	Anthelmintic, wounds & sores, leprosy, dysentery, coughs	+	0
Euclea natalensis A.DC.	Ebenaceae	Root-bark	Gonorrhoea, syphilis, hookworm, relief of toothache, ulcers	++	0
Acalypha fruticosa	Euphorbiaceae	Leaves	Cholera, stomach	++	0

F.			ache coughs, chest pains		
Euphorbia hirta L.	Euphorbiaceae	Plant	Gonorrhoea, dysentery, boils, coughs, ophtholmic, wounds.	+++	++
Phyllanthus niruri L.	Euphorbiaceae	Plant	Gonorrhoea, ulcers jaundice, sores urino-genital diseases.	++	++
Phyllanthus reticulatus P.	Euphorbiaceae	Leaves	Gonorrhoea, venereal sores, hookworms, anaemia.	++	0
Pseudolachmaestylis maprouneaefolia Pax	Euphorbiaceae	Bark	Stomachache, cathartic	++	0
Ricinus communis L.	Euphorbiaceae	Plant	Venereal diseases, ulcers diarrhoea, fungicidal, eardrop	++	0
Seccurinega virosa B.	Euphorbiaceae	Roots	Gonorrhoea	+	++

Hoslundia opposita Vahl	Labiatae	Plant	Gonorrhoea, cystitis, coughs, wounds, liver disease, blennorrhoea, hookworms.	+++	0
Cassytha filiformis L.	Lauraceae	Plant	For vermin, gonorrhoea dysentery, syphilis, snake bite wounds	++	0
Acacia mellifera Vahl	Leguminosae	Bark	Syphilis, pneumonia, malaria, sterility, stomachache	+	0
Acacia nilotica Del.	Leguminosae	Plant	Tuberculosis, pneumonia, gonorrhoea, diarrhoea, smallpox	+++	++
Acacia robusta Burch.	Leguminosae	Root-bark	No known use	++++	++
Acacia sieberiana DC.	Leguminosae	Bark	Gonorrhoea, stomachache,	+++	0

			diarrhoea, haemorrhage.		
Bauhinia reticulata DC.	Leguminosae	Plant	Dysentery, leprosy, roundworms, anthrax, malaria, cough	++	0
Caesalpinia pulcherrimai Swartz	Leguminosae	Flowers	Lung disease, fever, skin diseases	+	0
Caesalpinia pulcherrima Swartz	Leguminosae	Bark	Lung disease, fever skin disease	++	0
Caesalpinia pulcherrima Swartz	Leguminosae	Root-bark	Lung disease, fever skin diseases	++	0
Cassia abbreviata Oliv.	Leguminosae	Dry - roots	Gonorrhoea, syphilis, diarrhoea, dysentery pneumonia, malaria	++	0
Cassia fistala L.	Leguminosae	Bark	Dysentery, blackwater fever, anthrax, malaria	+++	0
Cassia obtusifolia L.	Leguminosae	Whole	Stomach troubles	++	+

		plant			
Dichrostachys cinerea W.	Leguminosae	Stem & branches	Gonorrhoea, syphilis, skin diseases	+++	+
Lonchocarpus bussei Harms.	Leguminosae	Bark	Gonorrhoea, cough	++	0
Peltophorum petocarpum (DC.) K.	Leguminosae	Bark	Dysentery, diarrhoea, colic, sore eyes	++	0
Pongania pinnata (L.)P.	Leguminosae	Leaves Root-bark	Scabies, cutaneous infection	++	0
Pongania. Pinnata (L.)P.	Leguminosae	Seeds	Scabies, cutaneous infection	++	0
Asparagus falcatus L.	Liliaceae	Leaves	Syphilis	++	0
Sida serratifolia L.	Malvaceae	Leaves	Gonorrhoea	+++	0
Sida serratifolia L.	Malvaceae	Roots	Gonorrhoea	+++	0
Psidium guajava L.	Myrtaceae	Leaves	Diarrhoea, skin diseases	++	0
Brackenridgea zanguebarica Oliv.	Ochnaceae	Root-bark	Wounds, snakebites	+	0
Ziziphus pubescens	Rhamnaceae	Leaves	Pneumonia,	+++	0

Oliv.			diarrhoea dysentery, wounds, skin diseases		
Lamprothamnus zanguebaricus Hiern.	Rubiaceae	Leaves	No known use	++	0
Fagara chalybaea Engl.	Rutaceae	Root-bark	Diarrhoea, coughs, malaria, toothache	++	0
Allophylus rubifolius (A.Rich.)	Sapindaceae	Roots	Diarrhoea, toothache	+	0
Solanum incanum L.	Solanaceae	Plant	Pneumonia, ringworms, liver disease, gonorrhoea, syphilis, ear ache	+	0
Solanum incanum L.	Solanaceae	Fruits	Dandruff, skin diseases, sores and wounds	++	0
Harrisonia abyssinica Oliv.	Simaroubaceae	Root-bark & twig	Skin diseases, haemorrhoids	++++	0
Grewia forbesii Harv. ex *Mast.*	Tiliaceae	Bark & roots	Rheumatism, lumbago, stiff	+++	0

			neck		
Lantana camara L.	Verbenaceae	Leaves	Coughs, sore throat, colds, conjunctivitis, toothache	+	0
Premna chrysoclada G.	Verbenaceae	Leaves	Ulcers, venereal diseases	++	0
Vitex fischeri. G	Verbenaceae	Leaves	Chronic venereal diseases, epilepsy as sedative, skin diseases.	++	0
Rhoicissus rovoilii P.	Vitaceae	Roots	Wounds, optholmic remedy	+	0

Table 1a: Sensitivity of test organisms against a number of standard antibiotics

Standard Antibiotics	**diameter of Zones of inhibition (mm)**				
	+ 10-15	**++ 15-20**	**+++ 20-25**	**++++ above 25**	**Test Organisms**
Penicillin G. (Units)	2	3	4	5	
Septrin (SXT) (μg)	15	20	25	30	

Tetracycline (μg)	25	32	42	60	*Staphylococcus aureus* (Oxford)
Streptomycin (μg)	7	9	12	15	
Sulphathiamoxazole (μg)	12	18	24	30	
Nalidixic acid (μg)	15	24	30	35	
Furadantoin (μg)	75	100	125	130	*Escherichia coli* (055)
Gentamycin (μg)	23	30	36	43	

Table 2: Susceptibility of some microorganisms to some naphthoquinones

Bacteria	**Zones of inhibition (mm)**		
	7-Methyl-juglone	**Diospyrin**	**Mamegakinone**
Klobsiella aeroganesae (from urine)	11	9	11
Shigella dysenteriae	14	14	9
Shigella flexnerii	12	11	0
Corynebacterium diphtheriae	13	14	-
Bacillus anthracis	17	13	-
Bacillus cereus	9	10	0
Salmonella hidelberg	8	8	8
Hamophilus influenzae	11	12	10
Pseudomonas aureginosae	0	0	0
Escherichia coli	0	0	0
Clostridium wolchii	8	0	0

Staphylococcus aureus	11	0	22
Neisseria gonorrhoeae	24	0	14

The 10 - 15mm zone of inhibition is comparable to the one caused by 25 μg of tetracycline

Table 3: In vitro antigonococcal activity of some Tanzanian medicinal plants

Plant	Family	Part	Traditional uses	Antigonococcal activity
Sclerocarya caffra Sond.	Anacardiaceae	Bark	Dysentery, diarrhoea, gangrenus, rectitis, insecticide	+
Uvaria acuminata Oliv.	Annonaceae	Leaves	Epilepsy	++
Kigelia africana (Lam.) Benth.	Bignoniaceae	Bark	Wounds, sores, for gynaecological conditions, ulcers, abscesses, dysentery	++
Tecomaria capensis Spach.	Bignoniaceae	Leaves	Pneumonia, bleeding gums, diarrhoea, enteritis	++
Tetracera boiviniana Baill.	Dileniceae	Roots	No known use	+
Euclea natalensis A.DC.	Ebanaceae	Root-bark	Gonorrhoea, diarrhoea, dysentery, bleeding gums	+

Phyllanthus reticulatus P.	Euphorbiaceae	Leaves	Gonorrhoea, venereal sores, hookworms, anaemia	++
Ricinus communis L.	Euphorbiaceae	Plant	Venereal diseases, ulcers, diarrhoea, fungicidal, eardrop	+++
Acacia nilotica Del.	Leguminosae	Bark	Tuberculosis, pneumonia, gonorrhoea, diarrhoea, smallpox	++++
Albezia harveyi Fcurn	Leguminosae	Roots	Any intestinal troubles	+
Bauhinia reticulatus DC.	Leguminosae	Plant	Dysentery, leprosy, roundworms, anthrax, malaria, cough	+
Caesalpinia pulcherrima Swartz.	Leguminosae	Flowers	Lung diseases, fever, skin disease	+
Cassia abbreviata Oliv.	Leguminosae	Dry roots	Gonorrhoea, syphilis diarrhoea, dysentery pneumonia, malaria	+
Cassia obtusifolia L.	Leguminosae	Whole plant	Stomach troubles	+++
Lonchocarpus bussei Harms.	Leguminosae	Leaves, roots & bark	Gonorrhoea, cough	+
Malvastrum coramandelianum	Malvaceae	Plant	Wounds, diaphoretic, sores	+

(L) Garcke.				
Sida serratifolia L.	Malvaceae	leaves	Pulmonary tuberculosis, diarrhoea	+++
Sida *serratifolia* L.	Malvaceae	Roots	Gonorrhoea	++
Psidium guajava L.	Myrtaceae	Leaves	Diarrhoea, skin diseases	+
Ziziphus pubescens Oliv.	Rhamnaceae	Stern	Measles, gonorrhoea	+
Fagara chalybaea Engl.	Rutaceae	Root-bark	Diarrhoea, coughs, malaria, toothache	+++
Harrisonia abyssinica, O.	Simarubaceae	Twig & rootbark	Skin diseases, haemorrhoids	+++
Premna chrysoclada G.	Verbenaceae	Leaves	Ulcers, venereal diseases.	+

The following plants did not show any antigonococcal activity:

Acanthaceae: *Barleria prionitis* L. (roots, leaves and bark); *Amaranthes aspera* L. (plant);

Anacardiaceae: *Rhus natalensis* Bernh. (leaves), *Lannea stuhlmannii Engl.* (leaves);

Annonaceae: *Anona senegalensis* Pers (bark), *Uvaria acuminata* Oliv. (roots);

Apocynaceae: *Calotropis gigantea* Ait. f. (leaves), *Dictyophleba lucida* Pierre. (leaves, trunk), *Nerium oleander* L. (leaves), *Plumeria rubra* L. (bark);

Araceae: *Stylochiton hennigii* Engl. (roots and leaves);

Boraginaceae: *Ehretia amoena* Klotzch. (root bark);

Capparidaceae: *Boscia salifolia* Oliv. (bark, leaves), *Maerua angolensis* DC. (bark); *Carica papaya* L. (leaves, roots, (bark);

Celastraceae: *Elaeodendron schlechteranum* Loes. (roots);

Combretaceae: *Combretum zeyheri* Sond. (fruits, plant), *Terminalia catappa* L. (leaves); Compositae: *Aspilia natalensis* Willd. (roots), *Emilia sagittata* D.C. (plant);

Convolvulaceae: *Bonamia mossambicensis* Hall. f. (roots);

Cyperaceae: *Cyperus rotundus* L. (tuber);

Ebenaceae: *Diospyros mespiliformis* Hochst ex DC (leaves);

Euphorbiaceae: *Acalypha fruticosa* Forsk, (roots), *Fluggea virosa* Baill. (bark), *Phylanthus niruri* L. (plant), *Pseudolachmaestylis maprouncaefolia* Pax. (bark), *Securinega virosa* Baill, (bark, pulp);

Icacinaceae: *Pyrenacantha kaurabassana* Baill (tuber, green fruits); Labiatae: *Hoslundia opposita* Vahl. (leaves), *Leonotis nepetaefolia* R. Br. (plant);

Lauraceae: *Cassytha filiformis* L. (plant);

Leguminosae: *Acacia robusta* Burch (rootbark), *A. Senegal* Wild. (roots),

Adenanthera pavonina L. (seeds), _Caesalpinia pulcherrina_ Swartz (bark), _Cassia fistula_ L. (bark), _C. amiculata_ L. (seeds and bark), _Desmodium_ sp. (plant), _Dichrostachys cinerea_ Wight. Am. (roots), _Peltophorum petocarpum_ K. (roots, bark), _Pongania pinnata_ L. (leaves, rootbark, seeds), _Pterocarpus angolensis_ DC (bark), _Stylosanthes fruticosa_ Alston. (plant), _Xeroderris stuhlmannii_ Taub. (plant);

Liliaceae: _Asparagus falcatus_ L. (plant);

Malvaceae: _Sida spinosa_ L. (leaves);

Rhamnaceae: _Ziziphus pubescens_ Oliv (leaves);

Rubiaceae: _Lamprathamnus zanguebaricus_ Hiern. (leaves);

Rutaceae: _Citrus aurantifolia_ Swingle. (roots);

Sapindaceae: _Allophylus rubifolius_ Engl. (stem);

Solanaceae: _Withania somnifera_ Dun (plant);

Sterculiaceae: _Dombeya shupangae_ K. Schum (leaves), _Melhania velutina_ Forsk. (leaves), _Waltheria indica_ L. (flowers, leaves);

Tiliaceae: _Corchorus olitorius_ L. (fruits and seeds), _Grewia forbesii_ Hary ex Mast. (bark and roots), _G. Stuhlmannii_ K. Schum (roots), _Trimimfetta rhomboidea_ Jacq. (bark and roots);

Verbenaceae: *Lantania camara* L. (leaves), *Vitex fischeri* Guerke. (leaves), *Vitex* sp. (roots);

Vitaceae: *Cissus integrifolia* Manch. (stem), *Rhoicissus rovoilii* Planch (roots).

Table 4: Susceptibility of fungi to various plant extracts

Plant	Family	Part	Traditional uses	Antifungal activity
Group A				
Plumeria rubra L.	Apocynaceae	Bark	Itching, diarrhoea, gonorrhoea, dropsy, purgative, skin disease, warts, syphilis	++
Zizyphus pubescens Oliv.	Rhamnaceae	Leaves	Pneumonia, diarrhoea dysentery, wounds, skin diseases	++
Solanum incanum L.	Solanaceae	Plant	Pneumonia, ringworms, liver disease, gonorrhoea, syphilis, earache	++
Solanum incanum L.	Solanaceae	Fruits	Dandruff, skin diseases, sores, & wounds	++
Harrisonia abyssinica Oliv.	Simaroubaceae	Root-bark & twig	Skin diseases, haemorrhoids.	+++
Waltheria indica L.	Sterculiaceae	Flowers	Skin diseases, syphilis,	+

			cleansing wounds, coughs, sores.	
Vitex fischeri Guerke.	Verbenaceae	Leaves	Chronic venereal disease, epilepsy, as sedative, skin diseases.	+
Group B				
Dictyophleba lucida (K. Schum.) Pierre.	Apocynaceae	Leaves	No known use	+++
Dictyophleba lucida (K. Schum.) Pierre.	Apocynaceae	Trunk	No known use	+++
Holarrhena febrifuga Klotzsch.	Apocynaceae	Leaves	Snake bite, venereal diseases, dysentery	++
Ceiba pentandra Gaertn.	Bombacaceae	Leaves	Gonorrhoea and as dressings for wounds	+
Boscia salicifolia Oliv.	Capparidaceae	Bark	Rectal infections	++
Combretum zeyheri Sond.	Combretaceae	Whole plant	Diarrhoea	+++
*Emilia sagittat*a DC.	Composite	Whole plant	For inflammation of eyes, contusion, ulcerative processes, nasal disease syphilis	++++
Bonamia mossammbicensis (Klotzsch.) Hall. f.	Convolvulaceae	Leaves	Wounds	++++
Bonamia	Convolvulaceae	Roots	Wounds	+++

messambicensis (Klotzsch.) Hall. f.				
Bridelia cathartica B.	Euphorbiaceae	Stem	Purgative, stomach ache	+
Phyllanthus reticulatus P.	Euphorbiaceae	Plant	Gonorrhoea, ulcers, jaundice sores, urogenital diseases	+
Pseudolachnostylis maprouneaefolia Pax.	Euphorbiaceae	Bark	Stomach ache, cathartic	++
Securinega virosa (Wind.) Baill.	Euphorbiaceae	Pulp	Diarrhoea, gonorrhoea, pneumonia	++++
Cassia amiculata L.	Leguminosae	Bark	Headache, toothache	++
Xeroderris stuhlmanii T.-	Leguminosae	Plant	Colds, chest troubles, elephantisis	+
Asparagus falcatus L.	Liliaceae	leaves	Syphilis	+
Hibiscus micranthus L.	Malvaceae	Plant	Earache, bronchitis, renal remedy	++
Sida serratifolia L.	Malvaceae	Leaves	Pulmonary tuberculosis, diarrhoea	+++
Sida serratifolia L.	Malvaceae	Roots	Gonorrhoea	++++
Citrus aurantifolia Swingle.	Rutaceae	Roots	Gonorrhoea, dysentery	++++
Fagara chalybea Engl.	Rutaceae	Root-bark	Diarrhoea, coughs, malaria, toothhache	++
Deinbollia borbonica	Sapindaceae	Roots	Chest troubles, abdominal pains	+

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

nica R.

Plant extracts which did not show any *in vitro* antifungal activity:

Acanthaceae: *Barleria prionitis* L. (roots, leaves and bark);

Amaranthaceae: *Achyranthes aspera* L. (plant);

Anacardiaceae: *Rhus natalensis* Bernh. (leaves), *Lannea stuhlmannii* Engl. (leaves);

Annonaceae: *Anona senegalensis* Pers. (bark), *Uvaria acuminata* Oliv. (leaves, roots);

Apocynaceae: *Calotropis gigantea* Ait. F. (leaves), *Nerium oleander* L. (leaves); *Stylochiton hennigii.* (roots and leaves);

Bignoniaceae: *Kigelia africana* Benth. (bark), *Tecomaria capensis* Spach. (leaves);

Boraginaceae: *Ehretia amoena* Klotzch. (root bark);

Capparidaceae: *Boscia salicifolia* Oliv. (leaves), *Maerua angolensis* DC. (bark, leaves);

Caricaceae: *Carica papaya* L. (green fruits, bark);

Celastraceae: *Elaeodendron schlechteranum* Loes. (roots, leaves);

Combretaceae: *Combretum zeyheri* Sond: (fruits), *Terminalia catappa* L. (leaves);

Compositae: *Vernonia hildebranditii* Vatke, (leaves and stem), *V. cinerea* Less. (plant);

Connaraceae: *Byrsocarpus orientalis* Bak. (plant);

Dilleniceae: *Tetracera boiviniana* Baill. (rootbark);

Ebenaceae: *Diospyros mespiliformis* Hochst. ex. DC (leaves);

Euphorbiaceae: *Acalypha fruticosa* Forsh (leaves, roots), *Antidesma venosum* E. May. (root bark), *Bridelia cathartica* Bertol. f. (leaves), *Euphorbia hirta* L. (plant), *Fluggea virosa* Baill, (bark), *Phyllanthus reticulatus* Poir. (leaves), *Securinega virusa* Baill (roots);

Icacinaceae: *Pyrenacantha caurabassana* Baill (tuber, green fruits); Labiatae: *Hoslundia opposita* Vahl (leaves), *Leonotis nepetaefolia* R. Br. (plant);

Lauraceae: *Cassytha piliformis* L. (plant);

Leguminosae: *Acacia mellifera* Vehl. (bark), *A. robusta* Burch. (root bark), *A. senegal* Willd. (roots), *Adenanthera pavonina* L. (seeds, leaves), *Bauhinia reticulata* DC. (plant), *Caesalpinia pulcherrina* Swartz. (flowers, rootbark), *Cassia fistula* L. (bark), *C. obtusifolia* L. (plant), *C. occidentalis* L. (plant), *Desmodium* sp. (plant), *Dichrostachys cenerea* Wight. Arn.(stem), *Peltophorum petocarpum* K. (roots, bark), *Pongamia pinnata* P. (leaves and rootbark), *Pterocarpus angolensis* DC. (bark), *Stylosanthes fruticosa* Alston. (plant);

Liliaceae: *Asparagus* sp. (plant);

Loganiaceae: *Strychnos madagascarensis* Poir. (root bark);

Malvaceae: *Malvastrum coromandelianum* Garcke. (plant), *Sida cordifolia* L. (roots), *S. serratifolia* L. (plant), *S. spinosa* L. (roots, leaves);

Ochnaceae: *Brackenridgea Zanguebarica* Oliv. (root bark);

Rhamnaceae: *Zizyphus pubescens* Oliv. (stem);

Solanaceae: *Withania somnifera* Dun. (plant),

Sterculiaceae: *Dombeya shupangae* K. Schum. (bark, leaves), *Melhania velutina* Forsk. (leaves), *Waltheria indica* L. (leaves);

Tiliaceae: *Corchorus olitorius* L. (fruits and seeds), *Grewia stuhlmannii* K. Schum. (roots), *Triumfetia rhomboidea* jacq. (bark and roots);

Verbenaceae: *Lantana camara* L. (leaves), *Vitex* sp. (plant, roots);

Vitaceae: *Cissus rotundifolia* Vahl. (leaves),

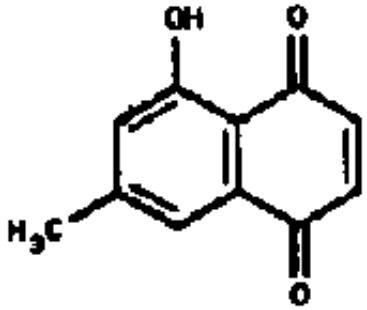
Table 5: Zones of inhibition of bacterial growth (nun) by (+)-β-senepoxide and (+)-pandoxide

Bacteria	Zones of inhibition (diameter)	
	(+)-β-senepoxide	(+)-pandoxide
Escherichia coli	29	20
Staphylococcus aureus	20	16

Klebsiella pneumoniae	23	15.5
Pseudomonas aeroginosa	20	20
Bacillus subtilis	22	22
Salmonella typhi	21	19

Both the compounds showed bacteristatic activity and no bactericidal properties. (+)-β-Senepoxide showed a minimum inhibitory concentration (MIC) of 62.5 μg/ml.

Chart 1: Some antibacterial compounds from Tanzanian medicinal plants.



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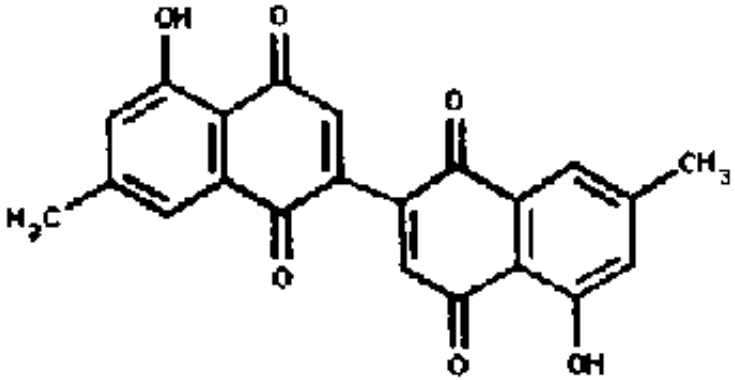

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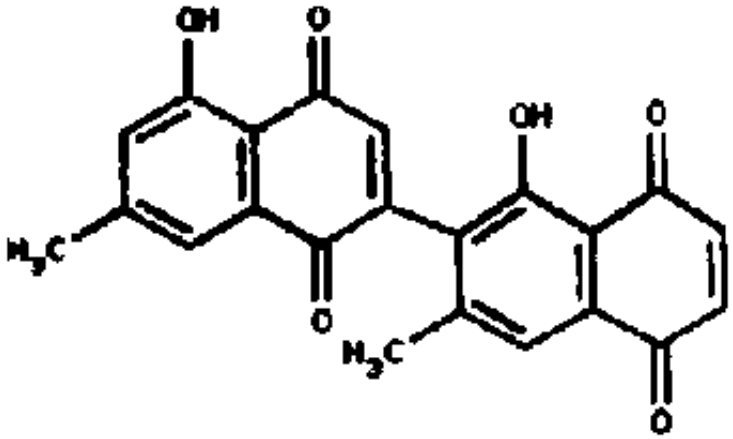

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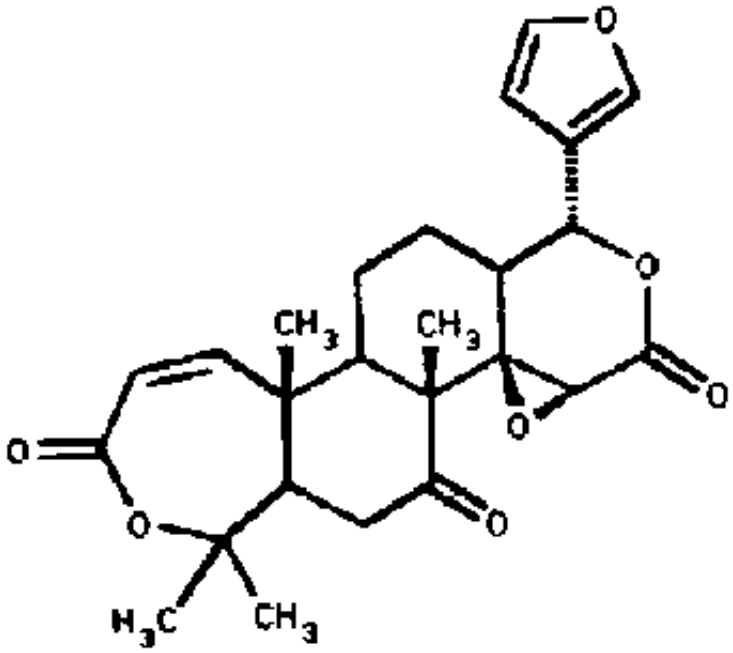

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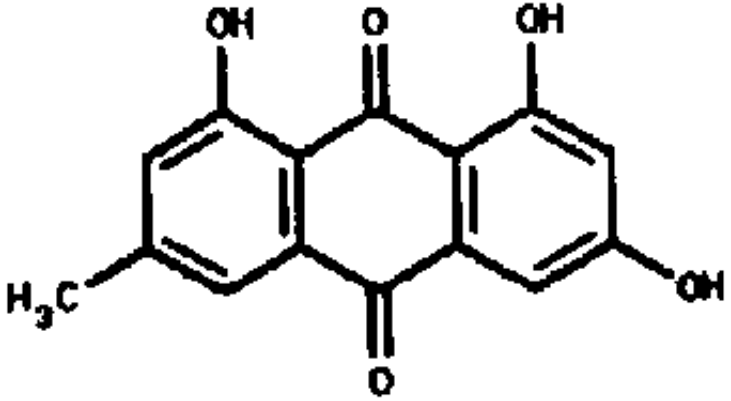

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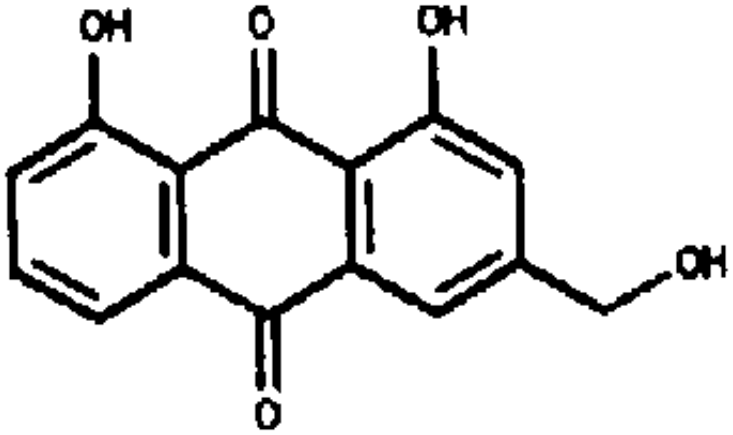

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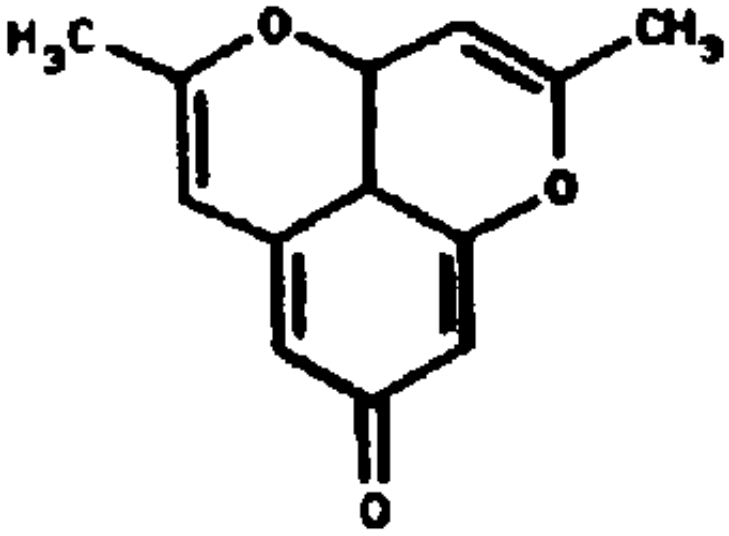

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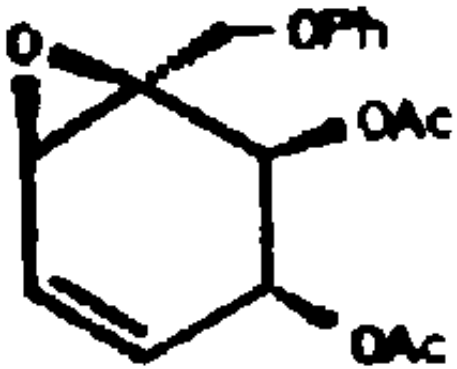

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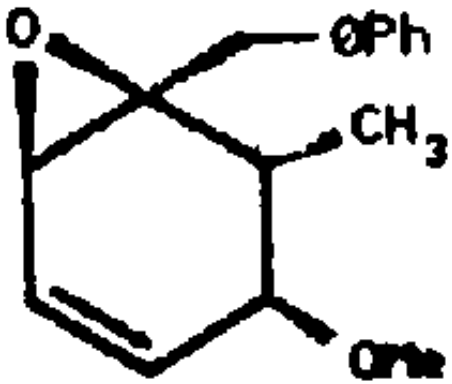

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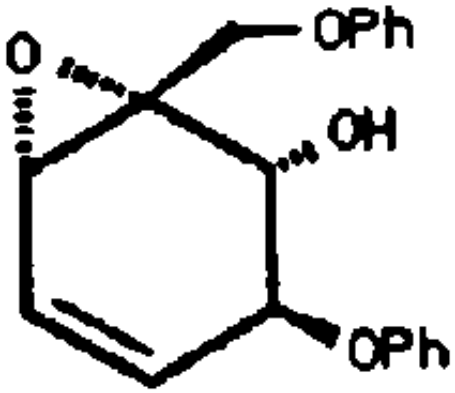

11

Identification of clovanediol: A rare sesquiterpene from the stem bark of canella winterana L. (Canellaceae), using spectrophotometric methods

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ABSTRACT

The Canellaceae is a small plant family found in continental Africa, Madagascar and America. In Kenya the two species (Warburgia ugandensis and W. stuhlmannii) that belong to this family are used traditionally as medicines against many aliments. Canella winterana are trees with an aromatic and pungent bark, found in Florida and the West Indies. Its stem bark has been used as a flavouring agent, as spices and as medicine. Previous investigations of the plant have reported the occurrence of monoterpenes, sesquiterpenes, phenylpropanoids and mannitol in the plant. In a re-investigation of the plant, ground stem bark was macerated with petrol, ethyl acetate and methanol. The separation of the extracts chromatographically, that is, column chromatography, vacuum liquid chromatography and high performance liquid chromatography (HPLC) etc., yielded a number of compounds. Of these compounds, one was identified as clovanediol, with the help of nuclear magnetic resonance (NMR), infrared (IR), ultraviolet (UV).

Introduction

The Canellaceae is a small plant family of glabrous, aromatic trees and has been described (Good, 1971 and 1974) as a discontinuous family occurring in America, Africa and Madagascar. The *Warburgia* species are found in East and Central Africa, and are used traditionally *as* medicines and spices (Kokwaro, 1976; Watt and Breyer-Brandwijk, 1962; Dale and Greenway, 1961). *Canella* is a genus

consisting of one species, *C. winterana* and is found in Southern Florida, through the Caribbean, and in Colombia (Hutchinson, 1964). It has been used traditionally as a spice and as medicine (BPC, 1934).

Earlier investigations of the stem bark of *Canella* reported the occurrence of monoterpenes, eugenol and mannitol (Claus, 1956 and Gibbs, 1974), drimane sesquiterpenes [canellal = muzigadial], 3-methoxy-4, 5-methylenedioxycinnamolide (El-Feraly, 1978 and 1979), and 4, 13-α-epoxymuzigadial (Al-Said *et al.,* 1989). During our re-investigation of the stem bark, we reported on the isolation and identification of myristicin, eugenol, warburganal, mukaadial and 9α-hydroxycinnamolide (Kioy *et al.,* 1989). We now report on the further identification of a tricyclic sesquiterpene, clovanediol (Aebi *et al.,* 1953), using spectroscopic methods.

Materials and method

Plant material

The stem bark of *Canella winterana* was collected from the coastal bluffs at East End Grand Cayman (Kenya) in August 1981.

Extraction and isolation

Ground stem bark (85 g) was macerated in the cold using petroleum ether (boiling range 40-60°), ethyl acetate, and methanol, in succession. Comparative thin layer chromatography (TLC) of ethyl acetate and methanol extracts showed similar chromatogams, and they were mixed together and separated by means of Vacuum Liquid Chromatography (VLC). Silica gel (Merck, 60 G) chromatography

(chloroform, and then a gradient of chloroform and methanol) gave a fraction which contained one major compound. This was purified by HPLC eluting with methanol/chloroform (2:100 v/v) and then by preparative HPLC to yield 18 mg of pure clovanediol.

Physio-chemical measurements

Melting points were determined using a Reichert sub-stage microscope melting point apparatus, and are uncorrected. Specific rotations, $[\alpha]_D$ were measured using a Perkin-Elmer model 241 polarimeter. The infra-red (IR) spectrum was recorded as a KBr disc on a Perkin-Elmer model 781 infra-red spectrophotometer. The Proton Nuclear Magnetic Resonance (^{1}H-NMR) spectrum was recorded on a Bruker WH-360 operating at 360 MHz instrument, and the carbon-13 nuclear magnetic resonance (^{13}C-NMR) spectrum was recorded on a Bruker WH-360 instrument operating at 90.56 MHz. High resolution electron impact mass spectral data were obtained on an AEI-MS 902 double focussing instrument by direct probe insertion.

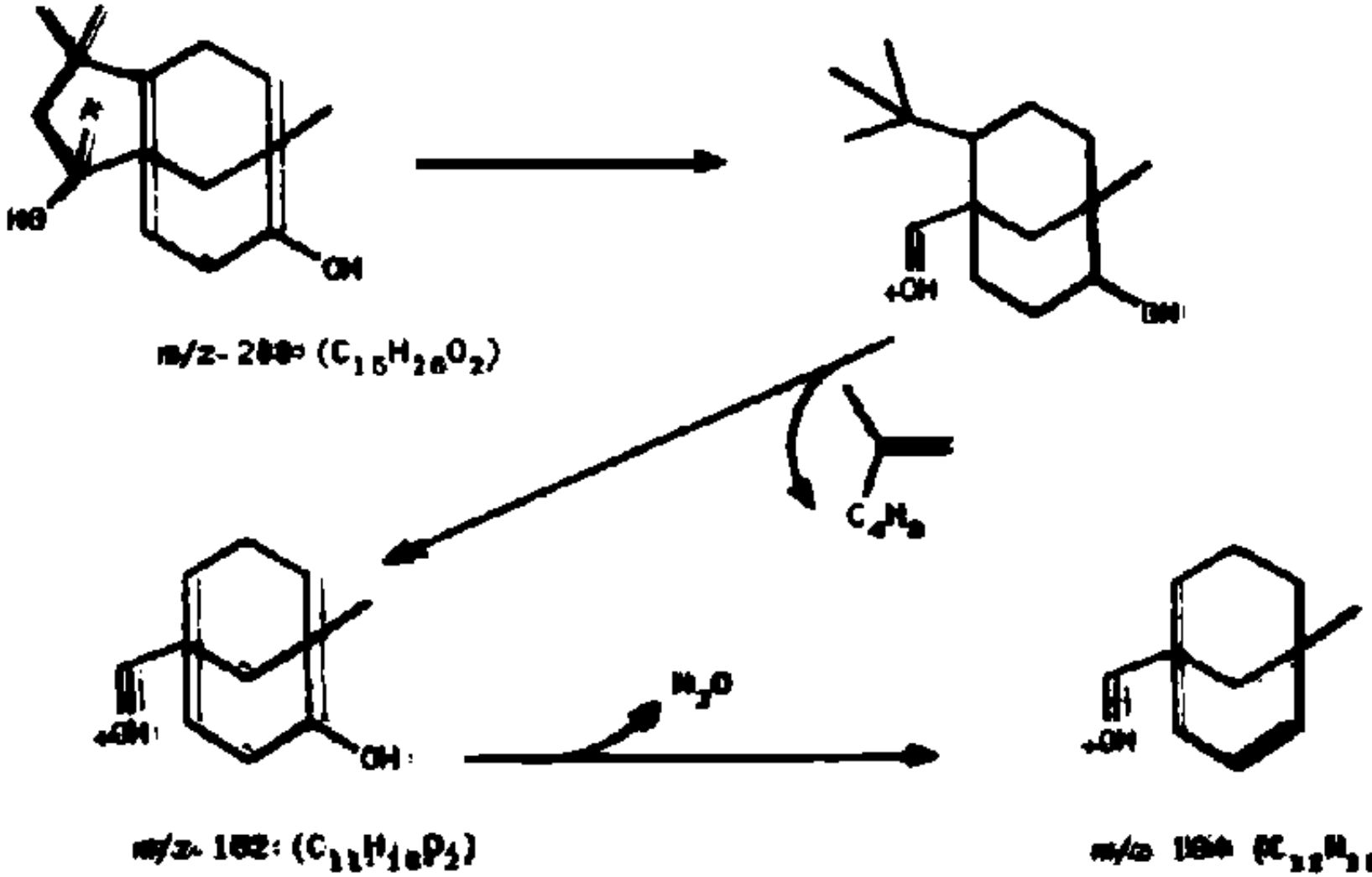
Discussion

The structure of clovanediol was established on the basis of the spectral data, and eventual comparison with literature information. Accurate mass measurements gave the molecular ion at m/z 238, which is consistent with formula $C_{15}H_{26}O_2$. The (^{13}C-NMR) spectrum contained 15 carbon resonances, while Distortionless Enhancement by Polarisation Transfer (DEPT) experiments revealed that these consisted of three methyl, six methylene, three methine and three quaternary

carbons.

Combined spectroscopic analysis and extensive single frequency irradiations and nuclear overhauser enhancement (NOE) experiments ultimately established that the isolated compound was clovanediol.

The relative stereochemistry was established by considering the magnitudes of the coupling constants, and by NOE experiments. The melting point was in agreement with the previously reported value of 152-153° (Aebi *et al.,* 1953). This, together with the specific rotation of +6° [reported: +5° (Aedi *et al.,* 1953)], confirmed the structure of clovanediol.



Scheme 2.4b: Proposed fragmentation pattern for clovanediol (Gupta and Dev. 1971)

Conclusion

The most logical approach towards the discovery of new drugs is through investigation of medicinal plants. This paper discusses an example on how

compounds isolated from medicinal plants are identified. Although different physical-chemical methods may be used, the steps outlined in this paper are essential. In some plants, the active compounds are present in very small amounts which would otherwise be difficult to be investigated using other methods. But the use of modern spectroscopic methods has made it possible to carry out complete identification of compounds, even when they are in minute amounts.

The biological activity of clovanediol has not been investigated. However, it would be interesting to see if this compound has any activity.

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A comparative study of the traditional remedy ''Suma-kala'' and chloroquine as treatment for malaria in the rural areas

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Introduction

Traditional medicine has been utilised by the majority of the World population for thousands of years. Until the beginning of the 19th century, all medicine was traditional (Jellife, 1977). Yet in many developing countries it is true that for the majority of the rural population traditional medicine is the only primary or any other kind of health care available (Heggenhougen *et al.,* 1988). For more than 70% of the population in Africa, traditional medicine is the first, if not the only health care system available in the poor rural and urban areas. In recognition of this fact, the World Health Organization underlined the potential role that traditional medicine may play in reinforcing the health care system through the primary health care approach in developing countries (W.H.O., 1978). The value of traditional medicine may be relative to both its pharmacological and/or biomedical value, as well as its psychological and social values (Heggenhougen *et al.,* 1988).

Medicinal plants and their products have been used in the treatment of malaria throughout the tropics and subtropics. Such experience is not to be ignored.

Instead, it should be actively investigated so that basic information can be made available for the preparation of standardized, effective and non-toxic remedies. Quinine, from the bark of *Cinchona,* whose legend dates from the 17th century (Bruce-Chawatt, 1985; Phillipson, *et al.,* 1986) is an outstanding example of a plant product which has been used for centuries in the treatment of malaria. The Chinese antimalarial, quinghaosu, is another example of this kind. The Ministry of Health in Mali has been trying to study the resources of Malian traditional medicine, with emphasis on the evaluation of the effectiveness of its medicinal plants.

The main purpose of this paper is to analyse and discuss the results of a clinical trial which compares a Malian traditional remedy called "Suma-Kala", with chloroquine, as a treatment for malaria in the rural areas of Mali.

Materials and Methods

A randomized controlled trial of "Suma-Kala" in the treatment of malaria was carried out at the Selingue Health Center, from July to September, 1987.

Preceding the main study, a two weeks training and pilot study took place in the Selingue Health Centre, attended by all personnel involved in the study. The aims of these were to review and standardize the clinical and laboratory techniques and also to test and correct the material and methodology. The ethical problems of the study were discussed. Any complicated case was to be admitted immediately to the health centre for proper management.

Preparatory visits were paid to the local authorities by the doctor of Selingue

Health Centre and his team, to explain the objectives of the study, and to ask for their approval and cooperation.

Objectives of the study

The objectives of the study were:

(a) to confirm the antimalarial property of the "Suma- Kala";
(b) to assess the acceptability and tolerance of the "Suma- Kala"; and
(c) to compare its activity with that of a well established standard antimalarial, which, in our case, was chloroquine.

Study area

The study was conducted in four villages in the Selingue area during the rainy season, from July to September in 1987 (Figure 1). Selingue is the National Institute of Public Health Research's rural health centre, in a dam area which deals with water-related diseases. Selingue is 135 km from Bamako. The background information about Selingue area is adapted from Traore (1986).

Human population and randomization

The method used consisted of a randomized control, and partially blind clinical trial. The four villages closest (from 3 to 10 km) to the health centre were chosen for a good follow up and case management in the event of complications. The chief and the health committee of each village chose the place (rooms) where the examination of the patients took place. All patients who thought had "sumaya" (malaria fever) were invited to attend the clinical examination.

All the patients were randomized on their arrival on day 0 and treated. The patients were randomly allocated to the "treatment" group ("Suma-Kala") or the "control" group (chloroquine) alternatively in a group of 10 on arrival. The method of "tossing a coin" was used to decide the order of allocation For the purpose of this study, the patients were told that they were receiving traditional remedies made by the Traditional Medicine Division of their own country by their own countrymen. The treatment was administered on an outpatient, basis. Neither the patient nor the medical team was blind to the treatment since the chloroquine was administered in capsules while the "Suma-Kala" was given as a decoction.

The patients were also questioned on the first day (day 0) about the recent prophylaxis and treatment and their urine was tested for presence of detectable concentration of chloroquine, amodiaquine, quinine, quinidine or mefloquine using the Dill-Glasko test.

A positive result of the Dill-Glasko test excluded the patient from the study. Any patient younger than 5 years and any pregnant woman was excluded.

The following conditions also excluded patients from the study:

(a) parasitaemia less than 5000 malaria parasites per cubic mm of finger blood smears;

(b) serious illness conditions such as, liver and kidney failures, acute or chronic pneumonia, hepatitis, and allergy;

(c) presence of serious digestive troubles such as, diarrhoea, intensive vomiting; and

(d) signs of dehydration.

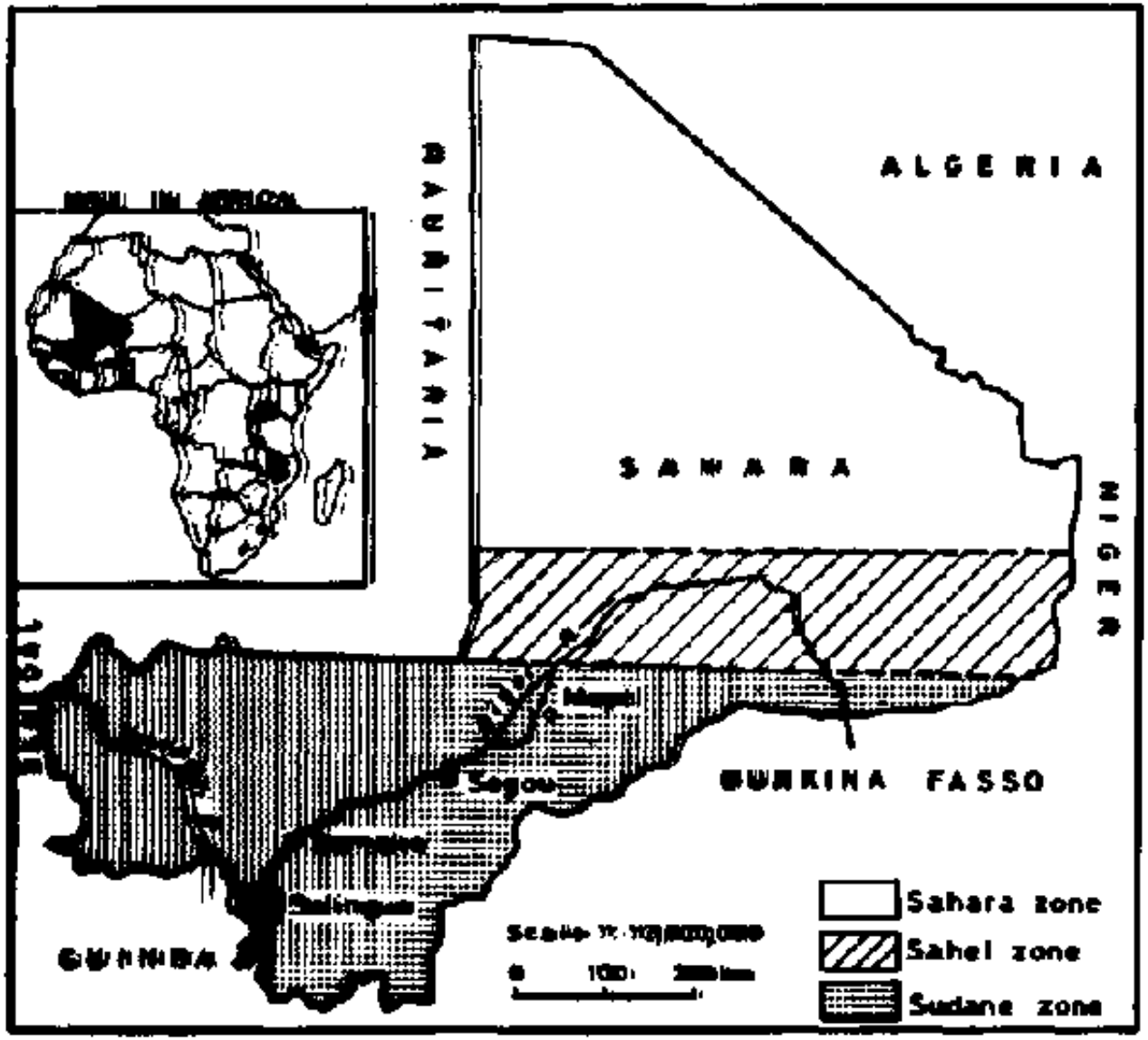

Fig. 1: Map of Mali

Two teams were responsible for the study: one team in the field was in charge of

the clinical examination and the blood film preparation without knowing the parasitaemia progress; and the second examined parasitaemia in the laboratory in Selingue Health Centre, without knowing which drug the patient had received. Only the result of the first blood smear (day 0) was communicated the following day (on day 1) to the clinical examination team for exclusion from the study of any patient with a parasitaemia less than 5000 of parasites per cubic mm on the first day (day 0). The other results of parasite count (days 1,3,5,7,14 and 21) were kept secret by the head of the laboratory team until the end of the study. On the other hand, the laboratory team members could not distinguish whether a slide they were examining belonged to a patient under the new drug or not.

Preparation of the drug

Both treatments were administered orally and were continued for seven consecutive days. The chloroquine diphosphate was made by our partners in France for the purpose of the study and presented in 100 milligramme and 300 milligramme capsules. Empty placebo capsules similar to those of chloroquine were made in France and sent to us by "CREDES, Terre des Hommes".

"Suma-Kala" was analysed botanically, chemically and pharmacologically. The detail on its botanical, chemical and pharmacological preliminary studies are available elsewhere in the Traditional Medicine Division in Bamako, Mali (Study of "Suma-Kala" presented to the 1988 meeting of the Scientific Committee of the National Institute of Public Health Research in Bamako).

The "Suma-Kala" is composed of three medicinal plants including *Cassia occidentalis* L. (locally known as: *Mbala mbala), Lippia chevalieri* Moldenke

(locally known as: *Kaniba djan*); and *Silanthus oleraceae* Jacq. (locally known as : *Mame - Farimani*) (Figures 2, 3 and 4).

"Suma-Kala" was prepared by the galenic section of the Traditional Medicine Division in its laboratory in Bamako, Mali. It was a mixed powder of the leaves of *Cassia occidentalis L.* and *Lippia chevalieri M.* and of the flowers of *Spilanthus oleracea* J. It was presented in a small plastic bag each containing 10 grams of this mixture of powder with the following proportions:

***Cassia occidentalis* L. 64%**
***Lippia chevalieri* M. 32%**
***Spilanthus oleraceae* J. 4%**

Although the population in rural areas in Mali are used to decoction preparation, the patients randomised to "Suma- Kala" were shown on the first day (day 0) how to prepare the decoction. Subsequently they were required to prepare the decoction for themselves daily at home. The decoction was prepared by boiling a bag of 10 grams of "Suma-Kala" in a half litre (500 ml) of water for about 15 minutes. Sugar can be added to sweeten its taste.

Dosage

The treatment was administered to the patients at home (outpatient). The chloroquine treatment was standardized and consisted of swallowing 10 milligrammes per kilogramme body weight during three consecutive days. For the remaining four days of the week, the empty placebo capsules were given so that the duration of the treatment for both drugs lasted for seven consecutive days.

The treatment with "Suma-Kala" consisted of drinking the decoction made from "Suma-Kala", twice a day, for four days, and then once a day for three days. The quantity of "Suma kala" bags and chloroquine capsules for the daily treatment were given to the patients each day after the clinical examination and the making of the blood film for parasitaemia count.

Clinical parameters

A form was used to record each patient's identity and the clinical parameters each day of examination. The biological parameter (parasitaemia) was recorded separately in the laboratory record. In addition to the identity (name, sex, age, village, date of examination, and the observer's name), the clinical record included the follow up of auxiliary temperature, headache, vomiting, shivering, nausea, and the side effects such as allergy and digestive troubles (see copy of the form in annex). These clinical parameters were recorded every day from day 0 (first day of examination) to day 7 (eighth day of examination) for assessing the curative effect of the drugs; and also on days 14 and 21 for assessing the eventual residual protective effect of the drugs.

Figure 2: Habit drawing of Cassia occidentalis

Figure 3 : Habit drawing of Spilanthus oleracea

FIgure 4: Habit drawing of lippia chevalieri

Laboratory methods

The laboratory method used was the malarial parasite count from finger thick and thin blood smears, using the W.H.O. standard techniques (W.H.O., 1984).

The labelling of the slides was carried out with a diamond pencil. The finger of the patient was cleaned with 70% ethanol. Staining of blood was done using Giemsa stain. The films for malaria parasites were collected in the field during the clinical examination on days 0, 1, 3, 5, 7, 14 and 21. All blood films collected were read in the first instance in the laboratory of Selingue Health Centre and cross checked after one month in the parasitology Department of the Medical School in Bamako. The laboratory observer teams were composed in Selingue by the two laboratory technicians under the supervision of the parasitologist head of the laboratory, and in Bamako by one laboratory technician and the physician parasitologist, head of the Parasitology Department of the Medical School.

The thick films were examined using the "farmer ploughing his field" technique: across the film to the opposite edge, and a slight lateral move, then back across the film, a slight lateral move. The process was repeated. For the thin films a "battlement" technique was used traversing the edge of the tail in short vertical and horizontal tracks. The number of parasites per 200 White Blood Cells were counted and parasite density was calculated taking 8,000 WBC per cubic mm as an average WBC count. A simple mathematical formula was used to convert the counts into the number of parasites per cubic mm of blood. For the minimum threshold, W.H.O. suggests 1000 parasites per cubic mm (W.H.O., 1984), but we decided to use 5000 parasites which is according to findings in Africa (Trape, 1985), a useful discriminant for separating children in whom malaria was thought to be the cause of their illness, from those in whom it probably was not. This was because of the fact that most patients in endemic areas of malaria like Selingue, could have a parasitaemia up to 1000 per cubic mm without showing the clinical signs of malaria. Therefore, any patient with a parasite density less than 5000 per cubic mm was excluded from the study.

Data analysis and reports

It was planned to carry out a computer analysis of the data and also at the Statistics Unit, the National Institute of Public Health Research in Bamako, using appropriate statistical tests (Z-test or t-test or Mantel-Haenszel test) to compare the effects of the two drugs. The results were supposed to be diffused at the different levels of utilisation.

Results of the clinical trial

About 3000 people presented with "sumaya" were included in the study. All were randomised on their arrival, then examined and their complaints were examined and treated if necessary. However, according to the criteria for inclusion in the study, only 53 of these patients were eligible for comparing "Suma-Kala" and chloroquine from July to September 1987 in Selingue. Thirty-six of the patients belonged to the "Suma-Kala" treated group and 17 belonged to the chloroquine treated group.

Age and sex distribution

The age and sex distribution is shown in Table 1. The study population was very young: 70% of the 53 patients were under 10 years. Only one patient was older than 25 years (she was 45 years old). Fourty-five percent of the patients were males and 55% were females. The results of the Mantel-Haenszel test have shown that the sex difference between the two groups after allowing for age group was not statistically significant (χ^2 = 0.030, with a degree of freedom = 1 and p > 0.05). On the other hand, the age group difference between the "Suma-Kala"

treated group and the chloroquine treated group controlling for the sex was not significant (Mantel Haenszel χ^2 = 0.030 with *df* = 1 and p > 0.05).

Table 1: Age and sex distribution of the study population per treatment

Age group	Suma-Kala			Chloroquine		
(years)	Males	Females	Total	Males	Females	Total
5-9	13	11	24	5	8	13
10-14	2	4	6	1	2	3
15-49	2	4	6	1	0	1
TOTAL	17	19	36	7	10	17

Follow-up of the study population

Table 2 shows the follow up of the study population per day and age group. The overall proportions of drop-out before the end of the study were similar among the two groups and concerned mainly the first age group (5-9 years). Eighty-six percent of the patients in the "Suma-Kala" group completed the treatment, while 71% in the chloroquine group completed the treatment. Therefore, the follow up was 15% better in the "Summa-Kala" group on day 7. However, this difference between the proportion of patients who completed both treatments was not statistically significant (Z = 0.064, p = 0.95).

Table 2: Follow up of the treatment by the patients per day and per age group

"Suma-Kala" treated group	Chloroquine group

Days	5-9	10-14	15-19	24-25	45-49	Total	5-9	10-14	15-19	Total
0	24	6	3	2	1	36	13	3	1	17
1	24	6	3	2	1	36	13	3	1	17
3	23	6	3	2	1	35	10	3	1	14
5	20	6	3	2	1	32	8	3	1	12
7	19	6	3	2	1	31*	8	3	1	12*
14	18	5	3	2	1	29	8	3	1	12
21	17	4	3	2	1	27	6	3	1	10

Clinical parameters

Figures 5 and 6 show the proportions of patients who became free of the clinical parameters per treatment and per day of treatment. The comparison of the effects of the two drugs on the clinical parameters show that "Suma-Kala" was as effective as chloroquine, if not better.

We considered an auxiliary temperature of 37.5°C or higher as fever according to findings in Africa (Greenwood *et al,* 1987; Delfini, 1968; Cobban, 1960). The proportions of patients who had fever, headache, shivering, nausea and vomiting at the start (on day 0) and became free of these clinical parameters after 7 days of "Suma-Kala'' treatment were respectively 59.3 %, 76%, 62.5 %, 93.3%, and 79%, while the proportions of patients free of clinical parameters under chloroquine treatment were respectively 50%, 47%, 80%, 75%% and 68%. The general trend was suggesting a better improvement under "Suma-Kala". However, the difference of the effects of the two drugs against fever, headache, shivering, nausea and

vomiting was not statistically significant (all $p > 0.05$). The same trend of better improvement of the clinical parameters on days 14 and 21 was noticed, but the difference was not statistically significant ($p > 0.05$).

Side effects

No clinical complication was noticed during the follow up of the patients in spite of the high parasitaemia at the start of the treatment. Few side effects were noticed. Three cases of allergy to chloroquine causing the treatment to be abandoned on day 3 were noticed among the chloroquine group, while none was reported among the "Suma-Kala" group. One case of constipation was declared among the "Suma-Kala" group, and none among the chloroquine group.

The "Suma-Kala" was very well tolerated by the patients. Table 3 shows the proportion of patients developing clinical parameters later, on days 3, 5 or 7, without having them at start. The differences between these proportions using Fisher's exact test were not statistically significant for all ($p > 0.05$), except for the allergy in which case "Suma-Kala" was better than chloroquine ($p < 0.05$).

Table 3: Proportion of patients developing clinical parameters later on days 3, 5 or 7 without having them at start

Parameters	"Suma-Kala" group	Chloroquine group
Fever	2/9 (22.2%)	1/7 (14.3%)
Headache	1/3 (33.3%)	1/2 (50%)
Shivering	1/4 (25%)	2/5 (40%)
Nausea	0/5 (0%)	0/13 (0%)

Nausea	0/3 (0%)	0/13 (0%)
Vomiting	0/22 (0%)	0/14 (0%)
Allergy	0/36 (0%)*	3/17 (18%)*
Indigestion	1/36 (3%)	0/17 (0%)

*** *p* < 0.05 using Fisher's exact test.**

Biological parameters

***Plasmodium falciparum* was the only type responsible for the malaria infection in our study. The results of the biological parameters are shown in Tables 4 and 5 and in figure 7. These results suggested that chloroquine was more effective than "Suma-Kala" in cleaning the parasites of malaria from the finger blood smears.**

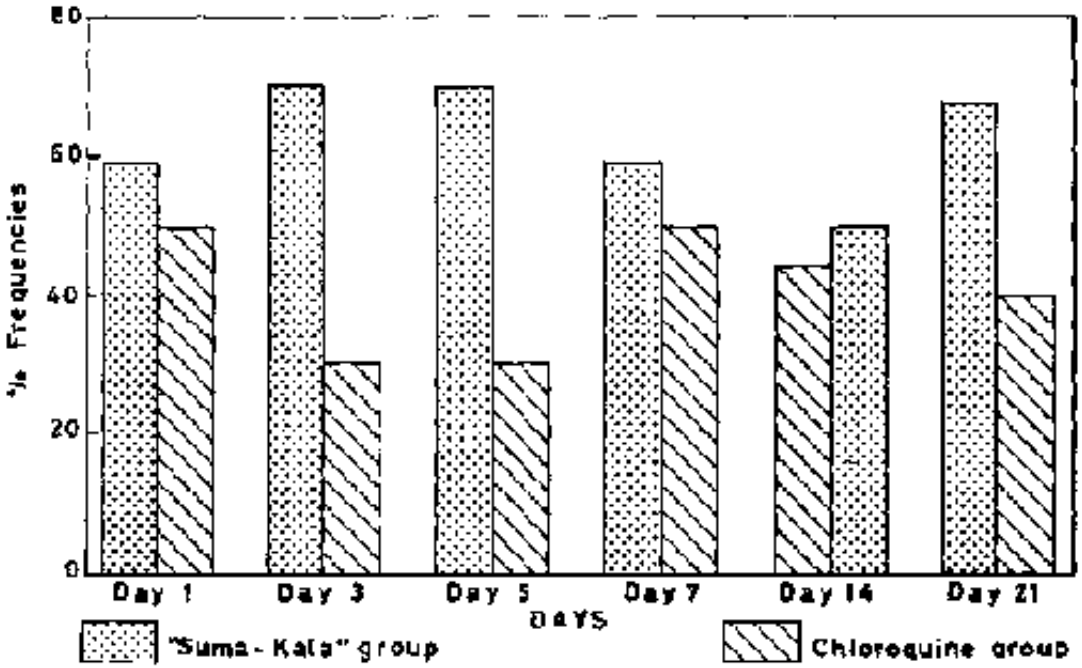

Figure 5: Proportion of patients who had fever on day 0 and became free from it later per day and treatment

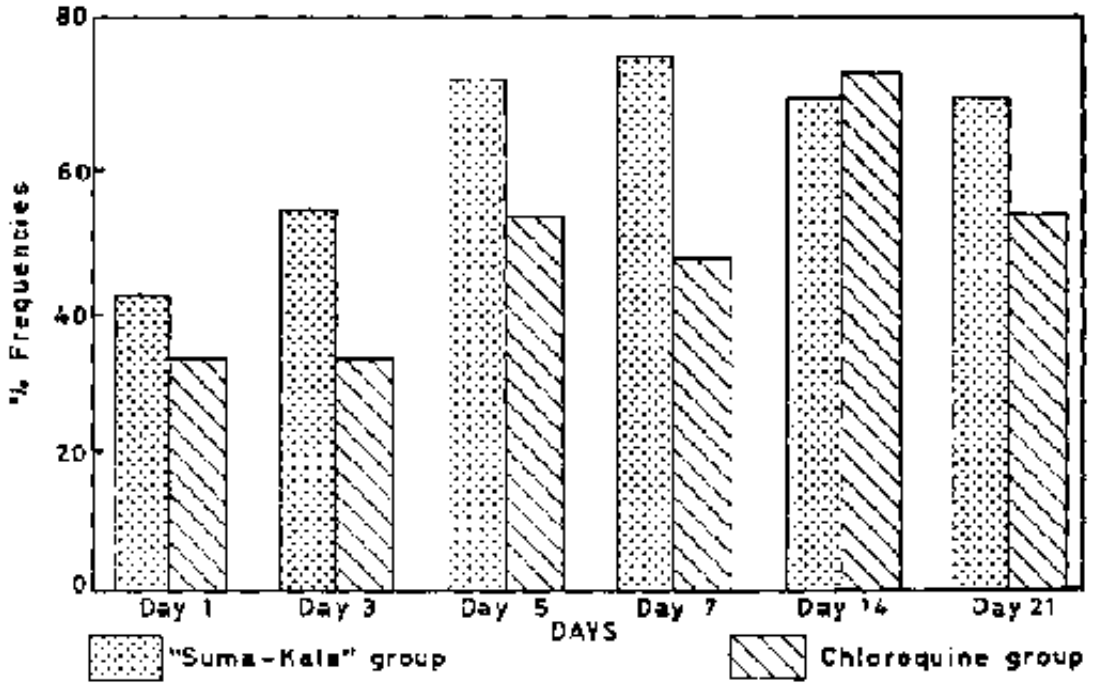

Figure 6: Proportion of patients with headache on day 0 but none later on per day and per treatment

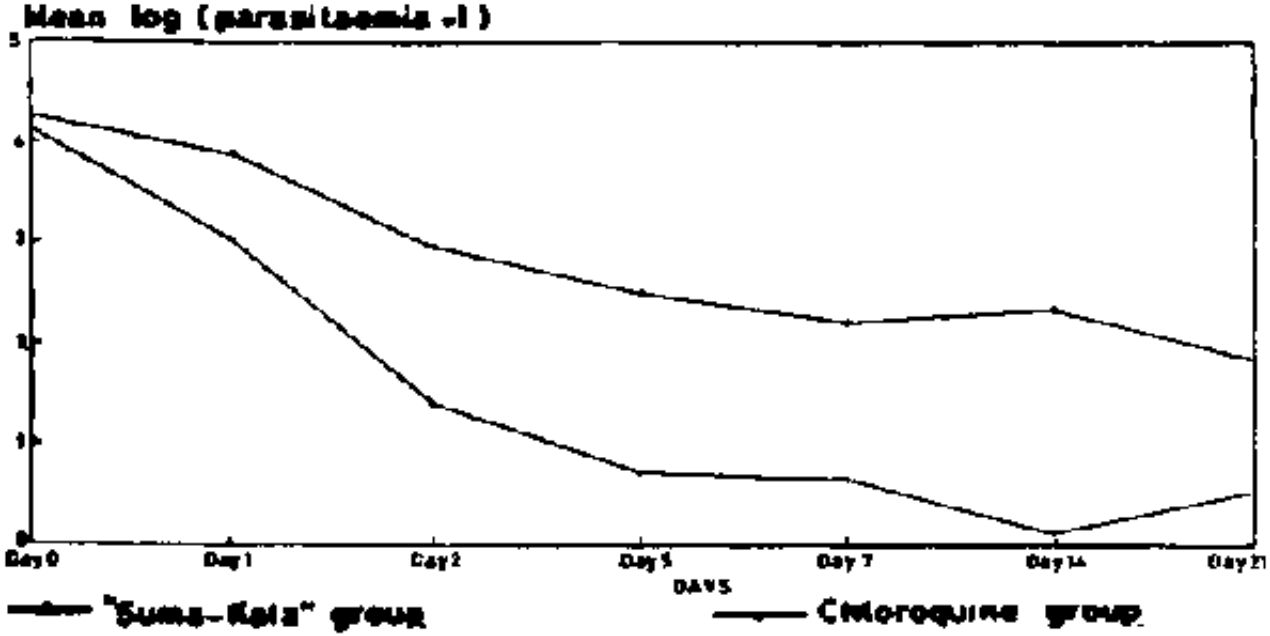

Figure 7: MEAN LOG (PARASITAEMIA .1) PER DAY AND PER TREATMENT

Before the treatment started (on day 0), the overall geometric mean of parasite count was 17975.3 among the "Suma-Kala" group for a population of 36 patients, while among the chloroquine group it was 13414.3 for a population of 17 patients. The difference between the parasitaemia of the two groups using mean log (parasitaemia count + 1) was not statistically significant (t-test = 1.37, df = 51, and $p > 0.05$).

At the end of the 7 days treatment, the geometric mean of parasitaemia count became 153.8 among the "Suma-Kala" group for 31 patients, while in the chloroquine group it became 3.4 for 12 patients. The difference between the means of parasitaemia using the mean log (parasitaemia count +1) became statistically significant (t = 2.98, df = 41 and $p < 0.05$) (Table 4). These figures in Table 4 were suggesting that chloroquine was better than "Suma-Kala" in cleaning

the malaria parasitaemia at the end of both treatments.

Table 4: Mean log (parasitaemia count + 1) and geometric means per day and per treatment

	"Suma-Kala" group			Chloroquine group		
Days	**log(cnt+1)N**	**SD**	**Geom. mean**	**log(cnt+1) N**	**SD**	**Geom. mean**
0	4.2547 36	.3079	1795.3	4.1276 17	.3274	13414.3
1	3.8774 36	.6282	7539.5	3.0301 17	.9380	1046.4
3	2.9449 36	1.4131	880.0	1.3995 13	.9204	24.1
5	2.4817 32	1.4201	302.2	.7175 12	.8457	4.2
7	2.1898* 31	1.6239	153.8	.6417* 12	1.2096	3.4
14	2.3245 28	1.6530	219.1	.1165 12	.4036	3.0
21	1.8449 26	1.6094	69.0	.5454 10	.8921	2.5

*** $p > 0.05$**

Residual effect of the drugs

We expected the protective ("prophylactic" or residual) effect of "Suma-Kala" to be continued one or two weeks after the treatment like the way it usually happens with chloroquine. The data on days 14 and 21 (Tables 4 and 5) were for the study of these eventual residual effects.

The residual effects of "Suma-Kala" against the clinical symptoms of malaria were

similar with those of chloroquine. However, the parasitaemia of 5 among the 18 patients of the "Suma-Kala" group with low parasitaemia (less than 1000 parasites per cubic mm) on day 7 (end of both treatments), became high (greater than 1000 parasites per cubic mm) on days 14 and 21, while the patients of the chloroquine group with low parasitaemia on day 7 remained with a low parasitaemia. The difference between these proportions (13/18 and 12/12 or 10/10) was statistically significant (using Fisher's exact test $p < 0.05$). Although the sample size was small, this result was suggesting that the residual protective effect of "Suma-Kala" was less than that of chloroquine on days 14 and 21.

Table 5 shows the proportions of patients with parasitaemia less than 100 per cubic mm per day and per treatment. At the end of the treatment (day 7), the difference between these proportions (58.1 % versus 92%) was not statistically significant ($Z = 1.72$ and $p = 0.085 > 0.05$).

On day 21 also, the proportions of patients with a parasitaemia less than 100 per cubic mm (63 % versus 100%) were not statistically significant ($Z = 1.81$, $p = 0.07 > 0.05$).

Table 5: Proportions of patients with parasitaemia less than 1000 per cubic mm per day and per treatment

Days	"Suma-Kala" group	Chloroquine group
0	0/36 (0%)	0/17 (0%)
1	3/36 (8.3%	10/17 (59%)
3	15/35 (43 %	13/13 (100 %)

5	17/32 (53.1 %	12/12 (100 %)
7	18/31 (58.1 %)	11/12 (92%)*
14	16/29 (55.2 %)	12/12 (100 %)
21	17/27 (63 %)*	10/10 (100 %)*

*** p > 0.05**

Discussion of study design and results

A good study design should be made in such a way that any observed difference between the treatment and the control group can be attributed to the real effect of the treatment.

We thought of using the randomized double blind placebo control trial but unfortunately, the drug section could not make placebo for the "Suma-Kala", and it was impossible to make the leaves composing "Suma-Kala" unrecognizable. On the other hand, because of ethical consideration, a control group receiving no treatment or placebo was not thinkable. We finally ended up with a randomized control blind method.

Whenever possible, it is preferable that neither the participant nor the investigator knows which treatment has been received until after the end of the trial.

For future trial if the drug section is able to make a placebo preparation indistinguishable to "Suma-Kala", then we can achieve a double blind method by giving to the control group chloroquine capsules plus a placebo decoction and to

the treatment group "Suma-Kala" decoction plus placebo capsules. We randomized alternatively by group of 10, the patients declaring having "Suma-Kala" (malaria) on their arrival to the control and the treatment group. The method of "tossing a coin" was used to decide the order of allocation. The patients were unknown by the examiners and therefore this limited the selection bias. However, the randomization method we used could be improved for instance by randomizing only the eligible patients and by using random number tables with odd numbers (1,3,5,7,9, etc.) corresponding to the chloroquine treated group and even numbers (0,2,4,6,8, etc.) to the "Suma-Kala" treated group (or vice versa).

Instead of numbers, different combinations of letters could also be used to randomize the patients (i.e., AABB, ABBA, ABAB, BBAA, etc., where A is for the control group and B for the treatment group, or vice versa). The order of allocation should be preferably decided before the start of the trial. It is sometimes also desirable to arrange the allocation so that equal numbers of participants will be entered into each group. That is what (Kirkwood (1988) called "restricted randomization" or "randomization with balance."

We had a lot of trust on the patients for following correctly the instruction for the preparation of "Suma-Kala."

The urine of the patient became positive to the Dill- Glasko test, like it happened with chloroquine. Therefore Dill-Glasko test was not performed after day 0 to check whether patients on "Suma-Kala" also gave themselves chloroquine. This could perhaps be avoided by doing the study on patients basis in which case one would have to think about selection biases. For future trials we should find a way to perform spot check.

There is no perfect approach and the field conditions are such that compromise between theory and reality is obligatory. What is essential is to be as close as possible to the ideal as the conditions permit it. The fact that our population was very young, may be due to the high level of our threshold of 5000 parasites per cubic mm, which is easier to get among the young people because the older people in a high endemic area may have already developed their semi-immunity to malarial infection (Bruce-chawatt, 1985; Trape, 1985).

Because of the conditions required for the inclusion in the study, our sample collected during three months seems small. Most of the people of Selingue very often take chloroquine in all cases of fever or for prophylactic purpose. Therefore, the urine in most of the people was positive for the Dill-Glasko test. In these conditions, a reasonable sample size was difficult to obtain in three months and the resources available could not permit a longer stay.

The results so far of the study are interesting for several reasons. To our knowledge this study is perhaps one of the first (if not the first) clinical trials comparing African traditional antimalarial medicinal plants and allopathic antimalarial drugs.

Some preliminary work has been done in some countries but not published (Bray, personal communication). Most of the studies published referred to *in vivo* experiments on mice infected *berghei* (Makinde and Obih, 1984; Peter, 1970) or *in vitro* (Phillipson *et al.,* 1986).

The plants which composed "Suma-Kala" were known in West Africa and used in traditional medicine against several diseases.

Cassia occidentalis L. **was the most popular, and the most used by the traditional practitioners mainly against malaria fevers, headache and skin diseases (Kheraro, 1974; Ayensu, 1978; Rozat, 1979; Oliver, 1986, Sofowara, 1982).**

The findings have shown that *C. occidentalis* has antiparasitic and antibacterial activities (Oliver, 1986). ***Spilanthus oleraceae*** **J. was known too, and used as a medicinal plant in West Africa (Kheraro, 1974; Rozat, 1979). The extracts of its flower-heads killed *Anopheles* larvae and the whole plant has shown insecticidal properties (Oliver, 1986).**

Lippia chevalieri M. **was the least popular among the plants which composed "Suma-Kala." However, it was also used as a medicinal plant in West Africa (Kheraro, 1974; Rozat, 1979).**

The results of the study have shown that "Suma-Kala" is as effective as chloroquine against the symptomatic signs of malaria. Therefore, the traditional practitioners are quite right in using these medicinal plants against malaria because their diagnosis and prognosis of the disease are mainly based on clinical symptoms.

The current dosage of "Suma-Kala" was less fast than that of chloroquine in suppressing the malaria parasitaemia. The difference between the proportion of patients with parastitaemia less than 1000 parasites per cubic mm, was not statistically significant at the end of the treatment (day 7). However, the difference between the mean log (parasitaemia count + 1) of the two groups was statistically significant. Therefore, chloroquine was more effective than "Suma-Kala" in clearing the parasitaemia.

A parasitaemia of 1000 per cubic mm of finger blood smears is common among the people living in endemic areas like Selingue, and is well tolerated. That is why WHO suggested it as a cut off point (WHO, 1984) and (Trape 1985) suggested a higher level of minimum threshold of 5000. If we consider a parasitaemia of 1000 per cubic mm as "normal" in endemic areas during a period of high infection (raining season) as suggested by many authors (W.H.O., 1984; Trape, 1985; Greenwood *et al.,* 1987), "Suma-Kala" and chloroquine could be considered as having similar effects against malaria, because the difference between the proportion of patients among the two groups having a parasitaemia less than 1000 parasites per cubic mm was not significant at the end of treatment.

It could be interesting to compare the effect of "Suma- Kala" to that of a placebo. But for ethical reasons, a placebo group was not used in our study, and in the literature we did not see any publication referring to placebo effect on malaria. Nevertheless, no case of complication was noticed among our patients in spite of very high parasitaemia cases (some were as high as 80,000 parasites per cubic mm). Furthermore, the difference between the biological parameters (proportion of patients with a parasitaemia less than 1000) on one hand, and between the clinical parameters (proportion of patients with fever, headache, vomiting, nausea, shivering) on the other hand, were not statistically significant. And also, the likely pattern of high parasitaemia in untreated malaria would be the occurrence of clinical malaria with a certain number of complications (for instance convulsions in children) and probably some cases of deafness. Therefore, we were convinced that the effect of "Suma-Kala" was far more than that of a placebo.

The two drugs were well tolerated, but "Suma-Kala" was better tolerated than chloroquine. This was illustrated by three facts. Firstly, the study did not show any

side effect from "Suma-Kala", while 3 patients among the chloroquine treated group abandoned the treatment on the third day because of the allergy to chloroquine that they developed. Secondly, the difference between the proportions of patients who have developed later on clinical parameters without having them at start was not statistically significant, except for the allergy to chloroquine noticed among the chloroquine group. Thirdly, the follow-up of the treatment by the patients was 15 % higher among the "Suma-Kala" group.

An attempt was made to measure the protective (residual or "prophylactic") effect of the drug by looking at the clinical and biological (parasitaemia) parameters on days 14 and 21. The interpretation of the data on days 14 and 21 was difficult, because of the size of the sample becoming smaller on one hand, and on the other hand, these data are rather related to the eventual residual protective effect than to the prophylactic effect. Nevertheless, the two drugs seemed to have the same residual protective effect against the clinical parameters, but concerning the biological parameter, "Suma-Kala" seemed to have a less protective effect against malaria reinfection than chloroquine.

Conclusion

Research into medicinal plants should not stop because the herbal medicine still has an immense potentiality to enrich the universal pharmacopoeia.

Although the cooperation between allopathic and traditional medicine is not easy to build, it is necessary because it represents a valuable national resource for many developing countries. Therefore, it should be taken into account for the achievement of the World Health Organization goal of an ideal health for all. In

Mali, as elsewhere, the research into traditional medicine should be extended beyond the focus on phytotherapy, and efforts should be made to do more research in the other aspects of traditional medicine because they heal people, even though they may not cure disease. The Malian traditional antimalarial remedy, "Suma-Kala", is working. The study showed that it is as efficient as chloroquine against the clinical symptoms such as fever, headache shivering, vomiting, and nausea, and also that it was better tolerated. However, "Suma-Kala" was not as fast as chloroquine in clearing malaria parasitaemia.

More research should be done in order to improve the mode of administration of "Suma-Kala", and to increase its speed of clearance of malaria parasitaemia. For instance, more research on its dosage and galenic presentation could improve its effects. Although the study has shown interesting results, its design, particularly the sampling method and the 'blindness', could be improved for future clinical trials. A randomised blind control trial could be applied, provided that a placebo for the "Suma-Kala" is available, so that the "control group" will receive chloroquine capsules (or the standard treatment) plus placebo (decoction), and the "treatment group" will receive "Suma-Kala" (or the new drug), plus placebo (capsules).

Meanwhile, the production and commercial exploitation of "Suma-Kala" in Mali should not be delayed. The plants which compose "Suma-Kala" are locally available and could also be locally cultivated. Therefore, the production of "Suma-Kala" should be regarded in the perspective of reducing the burden of drug importation, and also as a potential alternative source of income for the peasants.

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Ethnobotany and conservation of medicinal plants

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ABSTRACT

Plants are indispensable to man for his livelihood. This paper presents the value of ethnobotany to the search for new biomedical compounds in the tropics. The general values of the rich tropical vascular plant flora as sources of direct therapeutic agents, as sources of starting points for the elaboration of more complex semisynthetic compounds, as sources of substances that can be used as models for new synthetic compounds, and as taxonomic markers for the discovery of new compounds, are highlighted. A case is made for continued research in ethnobotany, since it is estimated that 80% of the people in the Third World rely on traditional medicine for primary health care needs, most of which is plant-derived.

The whole question is addressed from socio-economic perspectives. Of all the plant-derived compounds that are used in the prescription drugs, about 50% originate from the tropics; yet it is here where the greatest threats to plant biodiversity occur. Therefore, concerted ethnobotanical research is directly linked to the urgent need for sustainable conservation programmes. It is proposed that conservation programmes for developing countries take into account both conservation of maximum plant biodiversity and focused approach aimed at individual medicinal plants.

The results should facilitate better management of our medicinal plant genetic resources for sustainable economic harvesting in both in-situ and ex-situ conservation -areas.

Introduction

Our purpose here is to urge that ethnobotanical prospecting, the exploratory process by which new useful plants are discovered, be substantially intensified. However, plant species are being lost at an ever-increasing rate, faster by orders of magnitude than rates of evolutionary replacement. Therefore intensification of ethnobotanical exploration should, of necessity, be linked to the urgent need for sustainable conservation strategies for medicinal plants since human expansionist demands can be expected to wreak environmental deterioration and biotic destruction well into the next century.

This paper specifically urges for an Increased involvement of developing nations in the exploratory and conservatory process, an involvement which, in our view, is warranted on scientific, economic and cultural grounds.

Traditional Therapy

Traditional medicine is a priceless heritage which was created in the historical course of prevention and treatment of diseases over a long period. Today, traditional systems of medicine, which utilize mostly plant-derived prescriptions, remain the source of primary health care for more than 3/4 of the Third World population. It is estimated that a third of all world pharmaceuticals are of plant origin, or if algae, fungi and bacteria are included, then two thirds of all

pharmaceuticals are plant based. Therefore, traditional medicine and medicinal plants are indispensable in practice. The rich traditional ethnopharmacopoeia of the Third World's tropical flora is, indeed, indicative of the high utility of indigenous medicinal plants.

Proper development and utilization of traditional medicinal plants, is of great significance in the development of health services and provides for proper take-over of national cultures for developing countries. The merit of traditional therapeutics cannot be over-emphasized. It is easily acceptable to the community, manageable and is of low cost. With the rich traditional medicinal plant resources, efficacy of prevention and treatment of disease can be ensured by appropriate, but comparatively non-sophisticated technology and with minimal side effects. Therefore proper utilization of the traditional medicinal systems by developing nations can make significant contributions towards the implementation of the programme of Health For All by the year 2000.

Drugs from nature

Through most of man's history, botany and medicine were, for all practical purposes, synonymous fields of knowledge. Therefore, the traditional healer, usually an accomplished traditional botanist, represents, probably, the oldest professional man in the evolution of human culture. However, the advent of modern technology and synthetic chemistry has been able to reduce our almost total dependency on the plant kingdom as a source of medicine. Nonetheless, plants have traditionally served as man's most important weapon against pathogens. In fact, it seems that even the Neanderthal man knew and made use of medicinal plants.

What, then, is the value of ethnobotany to the search for new biomedical compounds? Of the hundreds of thousands of species of living plants, only a fraction have been investigated in the laboratory. This poor understanding of plants is particularly acute in the tropics. Consequently, this calls for the urgent need for continued ethnobotanical research. The importance of ethnobotanical enquiry as a cost-effective means of locating new and useful tropical plant compounds, cannot be over-emphasized. Most of the secondary plant compounds employed in modern medicine were first 'discovered' through such investigation. Some 119 pure chemical substances extracted from higher plants, are used in medicines throughout the world, and 74% of these compounds have the same or related use as the plants from which they were derived. The rosy periwinkle, *Catharanthus roseus* (synonymous to *Vinca rosea*), represents a classic example of the importance of plants used traditionally by man. This herbaceous plant, native to South-eastern Madagascar, is a source of over 75 alkaloids, two of which, vincristine and vinblastine, are used to treat childhood leukemia and Hodgkin's disease, with a significant success rate. The use of quinine from *Cinchona* bark to cure clinical malaria, today owes its use by Peruvian Indians in the 17th Century, who employed crude extracts from the *Cinchona* trees to cure malarial fevers. These are but only a few of what modern medicine owe to ethnobotanical treasures.

There are four basic ways in which plants that are used by tribal peoples are valuable to modern medicine. First, some plants from the tropics are used as sources of direct therapeutic agents. For example, the alkaloid D - tubocurarine, extracted from a liane, *Chondradendron tomentosum,* is widely used as a muscle relaxant in surgery.

Secondly, tropical plants provide sources of starting points for the elaboration of more complex semi-synthetic compounds. For example, saponin, an extract from *Dioscorea,* is chemically altered to produce sapogenins, necessary for the manufacture of steroidal drugs. Thirdly tropical flora can serve as sources of substances that can be used as models for new synthetic compounds. Cocaine from the plant *Erythroxylum coca,* has served as a model for the synthesis of a number of local anesthetics, such as procaine. Lastly, plants can also be used as taxonomic markers for the discovery of new compounds. For example, although little was known of the chemistry of the Orchidaceae, plants of this family were investigated because of its close systematic relationship to the Liliaceae. The research demonstrated that not only was the Orchidaceae rich in alkaloids, but many of these alkaloids were unique and thought to be of extreme interest for the future. This rich natural economic resource needs urgent appraisal to coincide with the current "green wave" of lay interest in herbs and natural plant medicines, which is unparalleled in modern history.

We must consider seriously the importance of medicinal plants in the developing countries. The World Health Organization estimated that 80% of the Third World population rely on traditional medicine for primary health care needs. In many cases, these countries simply cannot afford to spend millions of dollars on imported medicines which they could produce or extract from their tropical forest plants. Indigenous medicines are relatively inexpensive; they are locally available and are usually readily accepted by the people. The ideal situation would be the establishment of local pharmaceutical firms that would create jobs, reduce unemployment, reduce import expenditures, generate foreign exchange, encourage documentation of traditional ethnomedical lore, and be based on the conservation and sustainable use of the tropical forests.

Conservation

What can the medical community do to aid both the struggle to conserve tropical forests and the search for new plant medicines? Many reasons have been presented to the general public: aesthetic, ethical and the like. But the most relevant to the medical profession is the utilitarian, that is, species are of direct benefit to us. The few examples that are given above (drugs from nature), are indicative of the kinds of undiscovered compounds that are undoubtedly there to be discovered.

Tropical forests are complex chemical storehouses that contain many undiscovered biomedical compounds with unrealized potential for use in modern medicine. We can gain access to these materials only if we study and conserve the plant species that contain them. The point that cannot be over-emphasized, and which is at the core of our argument here, is that biotic impoverishment is tantamount to chemical impoverishment. Loss of a species means loss of chemicals of possible use, chemicals potentially unique in nature, not likely to be invented independently in the laboratory.

Clearly, the most urgent conservation problems are occurring in the tropics. While the tropical forests cover less than 10% of the earth's surface, they are believed to contain over 50% of the world's species, and the majority of the endangered species. Extinction is a natural process, yet to view these recent extinctions as natural, is to misinterpret the geological record.

Parallel to this, is the urgent need to document and conserve ethnomedical plant lore, since indigenous knowledge is essential for use, identification and

cataloguing of the (tropical) biota. As tribal groups disappear, their knowledge vanishes with them. Thus, the preservation of these groups is not a luxury, but a significant economic opportunity for the developing countries. Failure to document, this lore would represent a tremendous economic and scientific loss to humanity.

Action plan

To achieve these objectives ultimately, some practical issues need to be addressed to. These include:

(a) Formulating clear policies on the practice of traditional medicine. The policies should promote, *inter alia*, the organization of traditional healers, and realistic integration of traditional and modern medical practices.

(b) Promoting the volarization of medicinal and aromatic plants growing in the spontaneous flora, by setting up specialized units in agrobiological, pharmaceutical industrial and quality control aspects.

(c) Promoting the strengthening of research capability in the field of traditional medicinal plants.

(d) Promoting research in the economic mapping of the indigenous vascular plant flora, to identify the qualitative and quantitative natural resources, in medicinal and aromatic plants, in order to render the economic potential profitable.

(e) Promoting ethnobotanical studies to retrieve the vanishing

ethnomedicinal information from remote village communities especially the traditional healers.

(f) Promoting the conservation of medicinal and aromatic plants, based on realistic *in situ* and *ex-situ* sustainable programmes, i.e., conservation of maximum plant biodiversity and individual plant species, respectively.

(g) Promoting meaningful infra-regional, regional and international cooperation that will enhance the exchange of information and technology of medicinal and aromatic plant genetic resources, without jeopardizing the genetic germ plasm.

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Biotransformation of hydroxyanthraquinone glycosides in Cassia species

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ABSTRACT

The development and application of tissue cultures in the production, biosynthesis and biotransformation of secondary metabolites is presented. Specific consideration is given to 1, 8 - dihydroxyanthraquinone derivatives of Cassia senna and Cassia artemisiodes. Plant Tissue Cultures, both static (solid) and in suspension (liquid) were established from seeds of same. Conditions for culture

growth were investigated and optimised and cultures were maintained by sub-culturing for up to 32 passages.

Qualitative and quantitative analysis of hydroxyanthraquinone derivatives was investigated with emphasis on the application of HPLC. Total content and variation of these compounds in the species was carried out. Five compounds were identified and assayed, namely aloe-emodin, chrysophanol, emodin, physcion and rhein.

Incorporation of radio-active precursors (U-^{14}C-acetate and (2-^{14}C- malonate) were studied in cultures of the species, and their conversion into hydroxyanthraquinone derivatives has been instigated. Cultures were harvested at regular intervals, extracted and the hydroxyanthraquinones separated by HPLC before measurement of incorporated radioactivity.

Fluctuation of the radioactivity in the anthraquinone constituents occurred throughout the passage suggesting that biosynthesis and biotransformation were occurring simultaneously.

Plants of the same species were injected with (2-^{14}C)-malonate, anthraquinones extracted at regular intervals and separated by HPLC prior to measurement of radioactivity.

Introduction

Anthraquinones are the largest group of natural quinones and historically the most important which for a long time have been used as dyes. The derivatives have

cathartic activity and are used as purgatives and are widely employed in geriatric and pediatric medicine (Rada *et al.,* 1974). Plant families which are the richest sources of this class of compounds (including important genera) are Polygonaceae (*Rheum, Rumex* and *Polygonum),* Rhamnaceae (*Rhamaus* and *Zizyphus*), Leguminoceae (*Cassia*), Rubiaceae (*Morinda, Rubia* and *Galium,* and Liliaceae (Threase and Evans, 1983).

Species such as *Rheum palmatum* (rhubarb), *Aloe ferox, Cassia senna,* and *Rhamnus alnus* have long been used as laxative drugs. They contain the anthraquinone derivatives, mainly as glycosides, which on hydrolysis yield aglycones which are hydroxyanthraquinone derivatives. The common polyhydroxyanthraquinone derivatives present in laxative drugs are 1,8 - dihydroxyanthraquinones (1,8 - DHAQ) and typical structures are given in Figure 1.

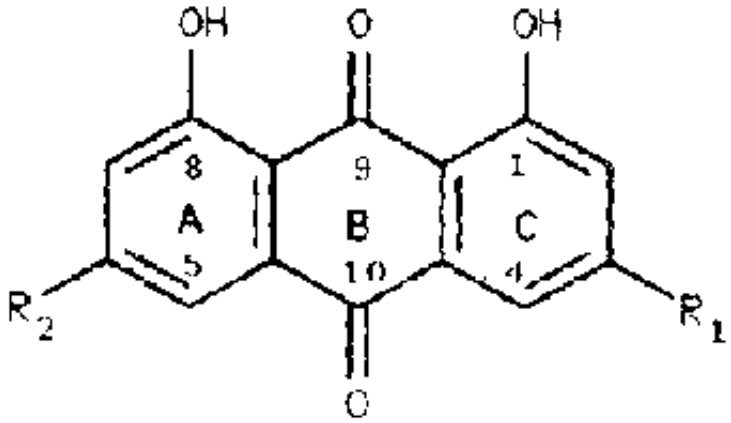


Fig. 1: Typical polyhydroxyanthraquinones

	R_1	R_2
Chrysophanol	Me	H

Emodin	Me	OH
Physcion	Me	OMe
Aloe-emodin	EtOH	H
Rhein	CO_2H	H

Biosynthesis of anthraquinones

Leristner *et al.,* (1969) and Fairbairn *et al.* (1972) established that naturally occurring anthraquinones are synthesized by two completely separate pathways. Thus those of the emodin type (with substituents in both terminal rings A and C) are usually derived through the acetatemalonate (polyketide) pathway in both higher and lower plants, while the alizarin (without substituents in ring A) type of anthraquinones are derived through the shikimic acid pathway.

Pharmacology and mode of action

Sennosides have the highest purgative activity, followed by rhein monoglcosides, whereas the anthraquinone glycosides are less active and the aglycones have the least activity (Fairbairn *et al.,* 1949, 1965, 1970).

The mechanism of action of anthraquinone glycosides involves the systematic deposition of these compounds to the site of action in the intestine, enzymatic cleavage of the sugar groups and the slow oxidation of the resulting compounds, thus releasing the free anthraquinones which act on the intestines to produce peristalsis (Fairbairn, 1964).

Plant tissue culture

Over the centuries, plants have made a major contribution to the health of mankind, particularly through their use as spices, flavours, fragrances, vegetable oils, soaps, natural gums, resins, drugs, insecticides and other significant industrial, medicinal and agricultural raw materials. Scraag (1986) noted that despite substantial advances in microbial and chemical production methods, plants still remain the source of active ingredients of some 25% of prescribed medicines. The continued demand of these compounds has encouraged scientists to search for reliable alternative sources. One of the significant contributions to the manipulative powers of modern biologists has been the development of tissue culture techniques. Plant cells in culture have been expected to produce secondary metabolites which are characteristic of the whole plant (Rai, 1976). Several patents dealing with the production from cultures of metabolites such as allergens, dios-genin, L-dopa, ginsenosides, glycyrrhixin, etc have been registered (Staba, 1982; Bajaj, 1988).

In this paper the establishment of tissue cultures of Cassia species and the careful phytochemical investigation of the controlled production of the hydroxyanthracene derivatives is discussed. An attempt to devise a sensitive, rapid and efficient analytical technique of these very closely related hydroxyanthracene derivatives by the use of HPLC will also be presented.

Materials and methods

Cultures

Cultures were established from seeds of *Cassia artemisioides* on Murashige and Skoog's modified tobacco medium. Cultures were incubated in the dark at 25°-27°C and maintained for more than 30 passages, each of 38 days. Static cultures were chosen for subsequent analysis rather than suspension cultures because they proved to give better results in the production of secondary metabolites. Anthraquinone content variation during a single passage of the culture was done with a view to subsequent investigation of the biotransformation of the compounds produced.

Phytochemical investigations

The phytochemical investigations followed the scheme shown in Figure 2.

Sensitivity screening for sennosides showed negative results. Nonetheless purification was carried out by column chromatography and preparative TLC. Five compounds - chrysophanol, emodin, physcion, aloe-emodin and rhein -were isolated and identified spectroscopically (UV, IR and MS) and by comparison of the melting points with those reported for chrysophanol, emodin, physcion, aloe-emodin and rhein.

Radio-tracer studies

Feeding technique

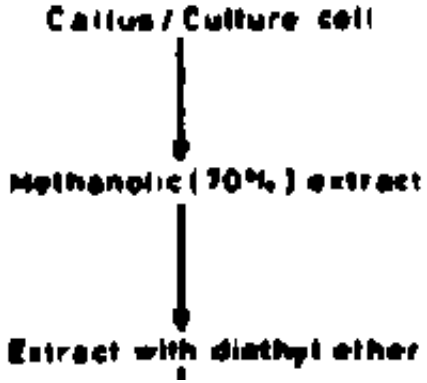
The precursors used were (1-^{14}C)-acetate and (2-^{14}C)-malonate. 0.1 μCi in 5 ml of each of the tracers was separately added onto the callus once the culture showed visible signs of growth. Cells were harvested at regular intervals,

extracted and the compounds were separated by high performance liquid chromatography (HPLC). Plants were fed with ^{14}C-malonate and radio-active incorporation monitored at regular intervals by HPLC. The malonate was fed at the leaf-base where an axillary bud was evident. The HPLC instrument consisted of Rheodyne rotary valve which was equipped with a 100 μl loop, in order to collect sufficient eluate from the column for scintillation studies.

Anthraquinones were consistently eluted in the sequence, aloe-emodin, rhein, emodin, chrysophanol and physcion. Using the reverse phase system, this elution sequence is broadly in accordance with their polarities: aloe-emodin polar, and physcion, least polar is eluted last.

Results

The results of the study to investigate the influence of ^{14}C-acetate and ^{14}C-malonate, intermediates in the biosynthesis of polyketides, on the production of hydroxyanthracene derivatives are shown in Figure 3A and 3B and also in Figure 4A and 4B. The incorporation rates of the two radio-tracers and the radio-activity values are given in Table 1.



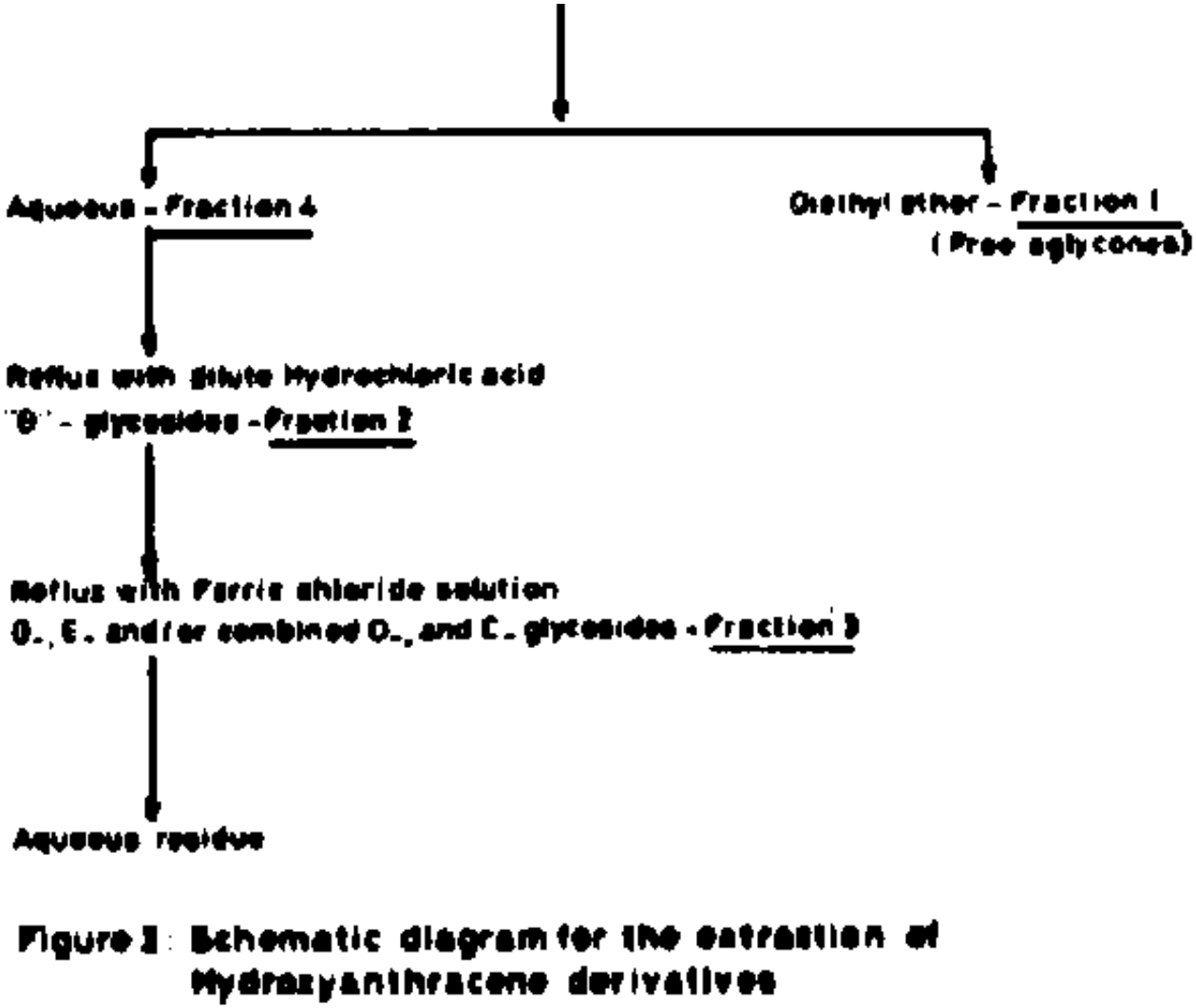


Figure 1: Schematic diagram for the extraction of Hydroxyanthracene derivatives

Figure 2 : Schematic diagram for the entraction of Hydroxyanthracene derivatives

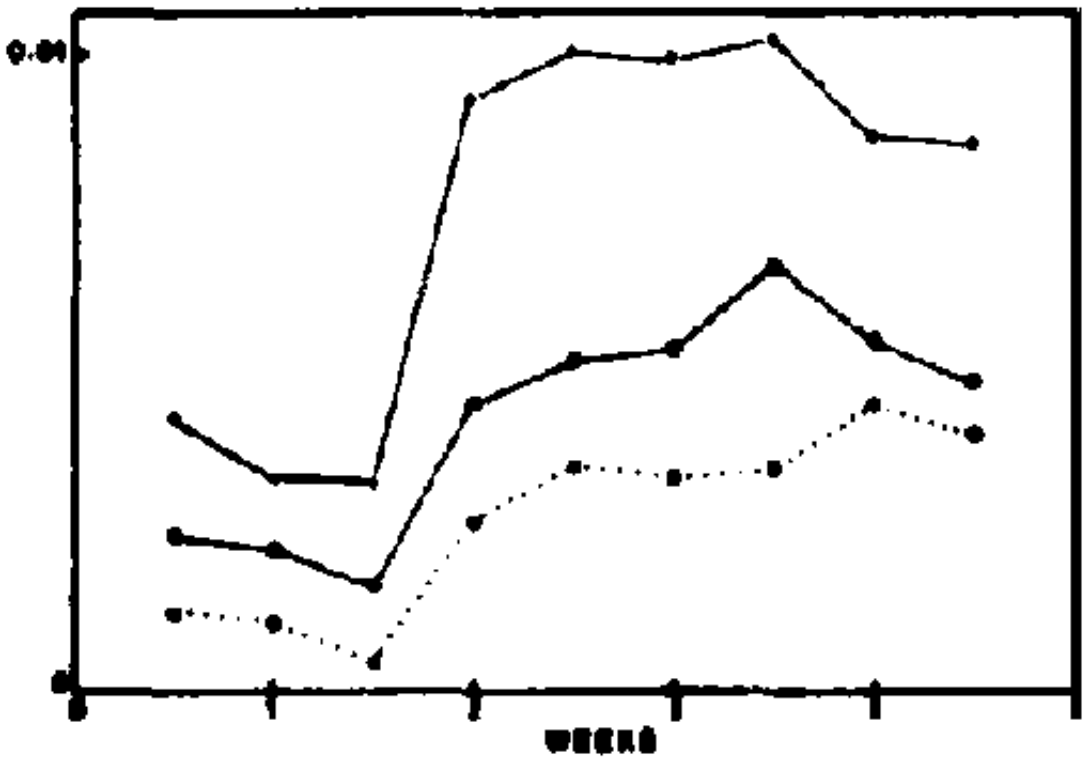


Figure 3A : Influence of acetate and malenate in rhein production in static cultures of Cassia senna

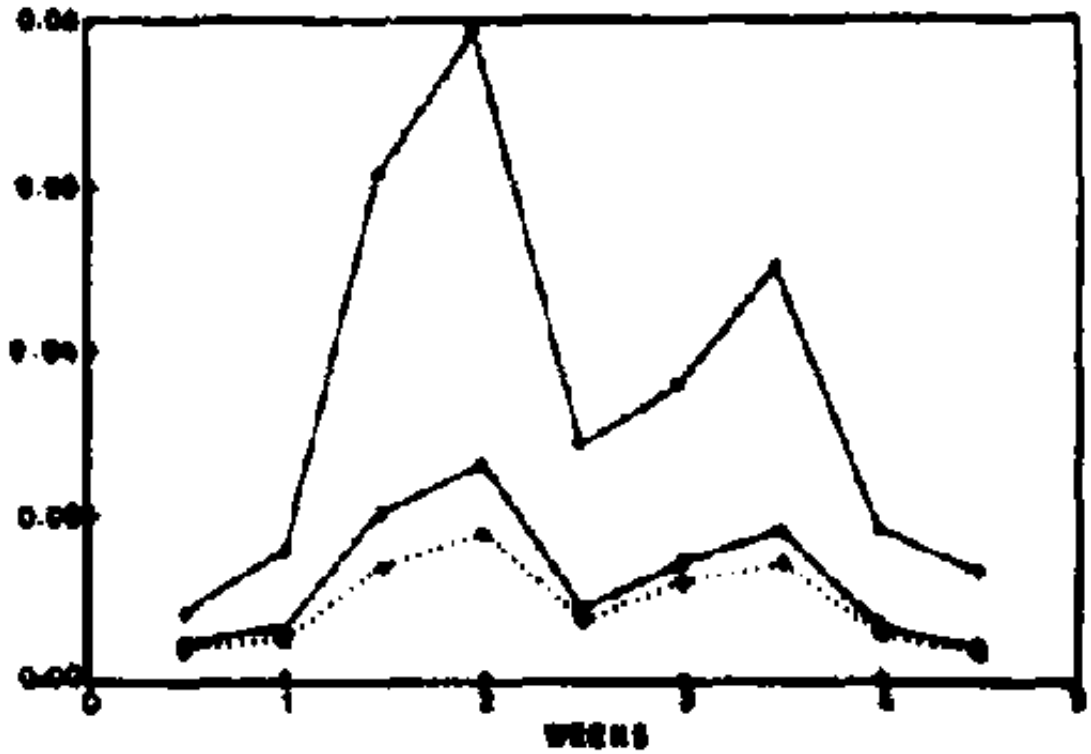


Figure 3B : Influence and radioactivity incorporation of acetate and malonate in emodin in static cultures of Cassia senna

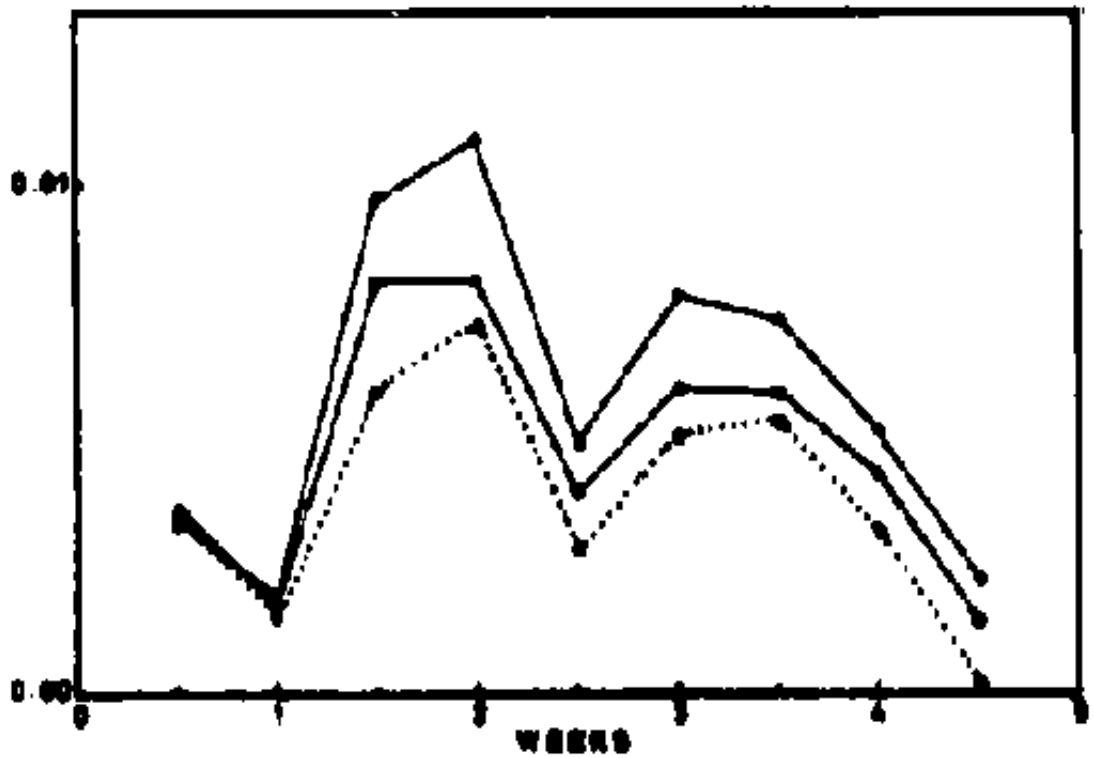


Figure 4A : Influence and radioactivity incorporation of acetate and malonate in chrysophanol in static cultures of Cassia senna

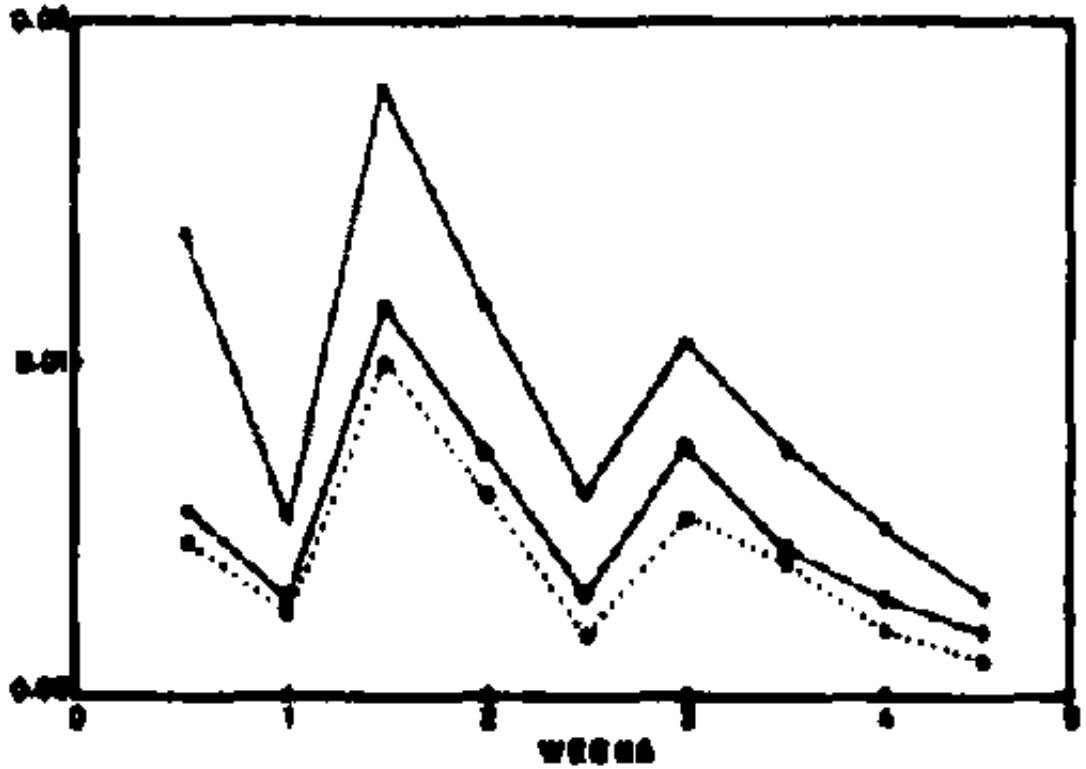


Figure 4B : Influence and radioactivity incorporation of acetate and malonate in aloe-emodin in static cultures of Cassia senna

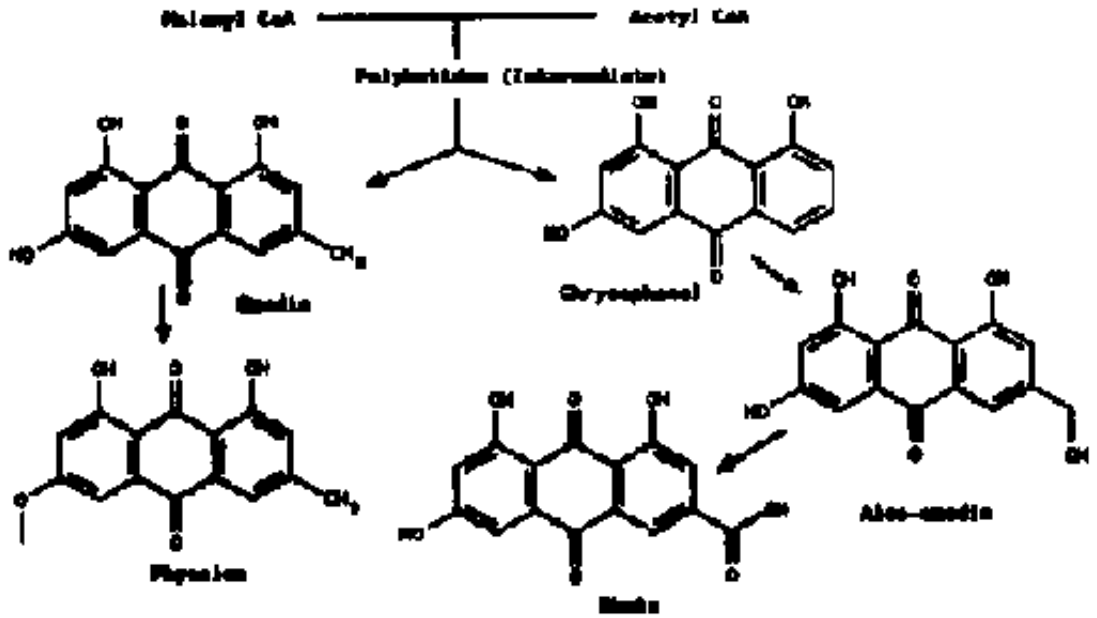


Fig 5 : Suggested transformation of anthroquinones derivatives

Comments:

(a) Anthracene derivatives were able to absorb the radio- tracers.

(b) Malonate was incorporated into hydroxyanthracene compounds at a higher rate than for acetate. The incorporation varied, chrysophanol being highest and with rhein much lower.

The suggested transformation of anthraquinone derivatives is given in Figure 5.

Discussion and Conclusion

From the results above the interconversions shown in Scheme 1 were found to occur.

Scheme 1

Le mdicament indigne Africaine: Sa standardisation et son valuation dans le cadre de la politique des soins de sant primaires

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Sommaire

Le mdicament indigne africain obit des rgles de prparation dont le respect permet d'obtenir des produits d'une standardisation acceptable, qualitativement et quantitativement.

L'tude des doses thrapeutiques proposes par le tradithrapeute, montre que ces doses sont galement acceptables.

L’efficacit thrapeutique tudie par des essais cliniques compars et l’importance de la consommation du remde indigne africain, constituent les lments de son valuation. Les rgles de cette valuation devrait tenir compte du concept du mdicament indigne africain.

Introduction

Il ne fait plus aujourd’hui aucun doute que les soins de sant primaires (SSP) offrent l’une des approches les plus viables pour atteindre l’accessibilit la sant pour tous.

En effet, cette approche suppose la prise en compte de toutes les ressources appropries disponibles y compris les pratiques et les remdes des systmes indignes de soins.

La composante pharmaceutique de cette politique des soins de sant primaires, de mande la mise la porte des populations, gographiquement et conomiquement, des mdicaments appropris.

Malgr l’engouement populaire, l’acceptabilit du mdicament indigne africain se heurte aujourd’hui encore une certaine mfiance; d’o la ncessit de son valuation et de sa standardisation afin d’en favoriser son homologation et son inscription sur les listes des mdicaments essentiels.

Si tout le monde est unanime sur la ncessit d’une valuation, il ne semble pas qu’il en soit de mme pour le recours aux conditions de mise sur le march appliques actuelle ment aux nouveaux mdicaments.

Notre propos n'est point de faire accepter n'importe quel mdicament pour les soins de sant primaires, ni encore moins d'opposer le remde indigne africain au mdicament europen; mais de prsenter une exprience ayant pour objectif de dissiper la mfiance cause par certains prjugs dfavorables et d'aider rsoudre le problme de sant publique qu'est l'approvisionnement rgulier des formations sanitaires en mdicaments.

Si une certaine analogie est apparente dans le concept de mdicament des deux systmes de soins, indigne africain et exotique europen, il n'en est pas moins vrai que la philosophie qui les soutend est diffrente: l'un relve de l'esprit analytique, du raisonnement et de l'exprimentation; et l'autre, de l'esprit systmique, de l'intuition et de l'empirisme.

Au prime abord on pourrait penser que les mdicaments du systme exotique europen traitent les causes de la maladie et que ceux du systme indigne africain soignent les symptomes.

Nous nous empressons d'ajouter qu'il ne serait pas juste de dire que les mdicaments indignes africains ne sont utiliss que pour des traitements symptomatiques.

Comme nous l'avons dj dit et crit, chacun des deux systmes de soins dispose de "mdicaments tiologiques" et de "mdicaments symptomatiques" dont l'laboration rpond certaines rgles. Il nous sembl indispensable et urgent de faire le point sur ces rgles afin de dfinir leurs limites de fiabilit et de permettre une meilleure standardisation du remde indigne africain.

Pour ce faire, nous avons essay de suivre le processus de son laboration et de son administration.

Elaboration du mdicament indigne Africain

La mfiance dont nous avons parl plus haut, pour ne pas dire la crainte, persiste encore vis--vis du remde indigne africain malgr l'engouement des populations.

On ne peut nier qu'elle soit justifie; mais malheureusement, on accuse trop souvent et abusivement la qualit ou les doses thrapeutiques du mdicament indigne.

"Les faux gurisseurs" sont hlas trop nombreux et il n'est point question de vouloir garantir leurs prparations et leur comptence.

Loin de nous l'ide de nier les insuffisances de l'art pharmaceutique traditionnel africain; mais il nous parait injuste de ne pas reconnatre qu'il existe des rgles de prparation et d'administration bien adaptes au systme. Il suffit pour s'en convaincre, de savoir que dans certains pays on dj procd la codification des rgles de la mdecine indigne en gnral et du remde indigne en particulier.

Matires premires

Nous nous limiterons volontairement aux plants mdicinales qui constituent actuellement la majeure partie de ces matires premires et dont les techniques de rcolte nous paraissent les plus respectes pour ne pas dire les mieux standardises.

Le respect scrupuleux des rgles de rcolte trouve son explication dans les craintes

que le phytothrapeute prouve dans leur transgression. Le geste qui semble le plus anodin n'est pas nglig; et nous ne sommes pas de l'avis de ceux qui ne voient toujours dans leur excution que superstition. Et mme si une possible superstition il y avait, il serait souhaitable de ne pas la combattre avant d'en connatre l'origine ou d'en faire son valuation complte; il y va de la prservation de bonnes conditions de remassage et de *l'obtention d'chantillons moyens de matires premires faciles tester et homologuer,* ce point de vue, la prsentation sous forme de bottes retenu notre attention; et nous avons essay d'en connatre le poids approximatif par espces vgtales.

Cette homologation, d'aprs notre modeste exprience, est beaucoup plus aise au niveau des phytothrapeutes qu'au niveau des herboristes soucieux surtout de la vente de leurs produits malgr l'homognit apparente des bottes.

L'identification de la plante n'est pas seulement morphologique; c'est un vritable diagnose que pratique le phytothrapeute partir galement des caractres Il connat en outre la priode et le lieu de rcolte, la partie de la plante qui lui permettent d'assurer des succs constants. Malheureusement beaucoup d'enquteurs ne s'en proccupent pas sur le terrain et ne posent pas suffisamment de questions. *Il est rare que le phytothrapeute conserve les matires premires au del d'une anne;* ce qui n'est point le cas chez les herboristes.

A notre avis, avec l'identification faite par le phytothrapeute, la connaissance de la partie utilise de la plante, des techniques, priode et lieu favourable la rcolte, *il est possible d'tablir les bases d'une homologation acceptable partir d'chantillons moyens.*

Il est certain, qu'il foudra ensuite que les institutions charges de l'tude des plantes mdicinales amliorent progressivement cette connaissance en la compltant par d'autres caractristiques que ne peuvent apprcier les tradipraticiens de sant. C'est la mthode d'approche qui nous conduit dterminer la bonne priode de rcolte, les grands groupes chimiques, les tenues en eau, cendres totales, huiles essentielles, etc.. Si l'thique mdicale traditionnelle oblige le phytothrapeute au respect rigoureux de rgles dfinies de rcolte, elle conseille au contraire une adaptation de la prparation et du traitement au patient. Cette pratique rend plus difficile une standardisation dans le cadre d'une fabrication industrielle du mdicament.

Composition du mdicament

La standardisation qualitative et quantitative de la composition du mdicament indigne africain s'avre une ncessit ds lors que sa fabrication industrielle ou mme semi-industrielle est envisage; car les rgles des prparations individuelles que peuvent prconiser les tradithrapeutes deviennet difficilement applicables. Il est cependant indispensable de ne pas trop s'en carter sans analyse critique pralable comme nous l'avons dj prconis pour les techniques de rcolte.

Sur le plan qualitatif, il n'est point aberrant de constater que *certains mdicaments indignes africains contiennent plus de dix constituants.* Le seul terme "excipient" de certains mdicaments qui sont inscrits dans un rpertoire srieux comme le "vidal" peut en contenir autant. C'est pourquoi, il est indispensable comme nous l'avons suggr, de ne rien considrer priori comme inutile. On pourrait cependant, la lumire des entretiens avec le tradithrapeute et de certains essais chimiques, pharmacologiques et/ou cliniques, liminer certaines drogues qui ne modifient pas notablement ni l'acceptabilit, ni la stabilit, ni l'innocuit et l'efficacit du mdicament.

Telle est notre mthode d'approche.

Concervant les quantits, il suffit de se les faire indiquer par le tradithrapeute, de *procder aux mesures pondrales ou volumtriques* appropries de chaque constituant; celles-ci pouvant ultrieurement tre *reproduites facilement partir des moyennes tablies aprs plusieurs mesures.*

Pour faciliter les modes de prparation, nous avons commenc par adopt le matriel de cousine qu'utilise le tradithrapeute; puis, au fur et mesure qu'on tablissait les valeurs limites de certains caractres, on remplaait ce matriel de cuisine par un appareil de pharmacotechnie approprie; ainsi on finit par tablir une certaine quivalence entre les deux outils de travail et favoriser les changes et le dialogue entre les systmes de soins.

Formes mdicamenteuses et modes d'obtention

S'il nous t relativement facile d'tablir des quivalences entre la tnuit des poudres obtenues partir des tamis locaux de cuisine et ceux de notre broyeur Forplex, il n'en pas t de mme pour les autres formes galniques. On peut cependant affirmer que l'observation rigoureuse des modes opratoires permet de garantir, dans une certaine mesure, la reproductibilit des caractristiques des prparations et par voie de consquence, celle des doses.

C'est ainsi que pour une dcoction par exemple le tradithrapeute tiendra compte la fois:

Sur le plan qualitatif de:

(i) la couleur du dcoct;
(ii) la viscosit, le cas chant;
(iii) le got (astringence);

Sur le plan quantitatif:

(i) du nombre de bottes de plantes;
(ii) des volumes d'eau au dbut et la fin de l'opration, souvent identiques respectivement par l'immertion et la non-immretion des bottes de plantes et non par le temps d'bullition.

Le contrle de cette reproductibilit peut se faire sur l'extrait sec obtenu partir du dcoct en dfinissant qualitativement et quantitativement certaines proprits et caractristiques.

Concernant une des critiques les plus frquentes, celle des conditions hyginiques de prparation, l aussi nous pensons qu'il n'est pas juste de dire que le tradithrapeute n'en aucun souci. Les techniques de filtration ou de dcantation et l'usage des rcipients neufs n'ayant pas encore servi auxquels il recours, de mme que la prise en compte des formes pharmaceutiques (surtout le dcoct; donc aprs bullition) et de la voie d'administration (surtout orale ou externe) expliquent en partie la situation.

Nous livrons pour rflexion un des principes fondamentaux de la mdecine indigne africaine:

l'organisme humain besoin d'un quilibre symbiotique et ne pourrait subsister dur une strilit absolue.

Administration du mdicament indigne Africain: la posologie

L'existence des doses dans la mdication traditionnelle africaine t souvent conteste, notre avis, on parfois imput tort cette mdication des accidents causs par l'imprudence des victimes elles-mmes. Notre propos est beaucoup plus d'affirmer l'existence de doses thrapeutiques acceptables que de nier l'insuffisance de la prcision des units de mesures.

Faire mieux connatre les rgles qui rgissent la dtermination des doses afin d'en permettre son amlioration est l'un de nos objectifs.

Comme nous l'avons dit, le respect rigoureux des modes de prparation permet d'obtenir des mdicaments comparables dans des limites qu'apprcie valablement le tradithrapeute et qu'une institution sommairement quipe peut dterminer d'une manire plus prcise. Pour ce faire, sans nous proccuper du principe actif, nous cherchons suivre qualitativement et quantitativement certains constituants (au moins deux) et certaines caractristiques (physico-chimies et/ou organoleptiques) qui nous permettent d'attester que les prparations sont comparables. L'existence des formes pharmaceutiques non unitaires ncessite la connaissance des rgles de mesures des prises avec les moyens utiliss cet effet.

Il ne suffit pas par exemple d'utiliser la mme cuillre et le mme produit pour croire que les quantits de poudre mesures sont gales. En effet, pour avoir la mme quantit il faut obligatoirement respecter la rgle de la mesure rase.

Par ailleurs, l'utilisation de la cuillre demande qu'on prcise s'il s'agit de la cuillre caf, & dessert ou soupe.

De mme, en pratique traditionnelle, il faut savoir que la pince s'effectue verticalement et est limite la premire phalange; qu'il faut bien prciser le nombre de doigts, dfaut duquel on retient la pince deux doigts.

L'tude pondrale des bottes de plantes fraches nous donn une variation du simple au triple (1,3 3,1). Celle des pinces une variation de 1 2,5 (voir annexes).

Par voie orale, les quantits de dcoct absorbes par les malades sont fonction de la capacit de leur estomac dont les limites de variation (1 litre 1,5 litre pour l'adulte) permettent aux tradithrapeutes de prconiser comme il le font, la boisson de certaines tisanes.

En prenant encore l'exemple du rpertoire Vidal, on constate que la dose usuelle journalire chez l'adulte peut varier souvent de 1 3 comprims; autrement dit, du simple au triple.

La comparaison entre ces diffrents chiffres nous permet de dire notre avis que les variations de doses thrapeutiques prconises par le tradithrapeute sont acceptables.

Nous pensons que la dtermination de la dose administrer dpend aussi de la comptence du praticien; et cela est valable pour les deux systmes de mdecine.

C'est au mdecin d'adapter cette dose usuelle journalire aux diffrents cas. Seule son exprience lui permettra d'viter les erreurs d'apprciations et les accidents. L'attitude du tradithrapeute comme celle du mdecin sera dicte par l'tat gnral du malade, de son sexe, de son ge, de sa corpulence (pour le tradithrapeute surtout) ou de son poids (pour le mdicin) et de la gravit de son mal.

Evaluation du mdicament indigne Africain

Elments d'valuation **L'efficacit thrapeutique et l'importance de l'usage du mdicament indigne africain constituent sans nulle doute des lments de son valuation.**

- **En effet, il n'est point besoin de rappeler ici les bons rsultats de certaines prparations traditionnelles qui sont la base de la dcouverte de produits purs cristalliss et de la synthse de substances analogues.**

- **La popularit recueillie pendant des dcennies "*(pharmacovigilance estimative)*" et la grande consommation d'un mdicament indigne permettent de situer son importance dans la couverture des besoins pharmaceutiques et juger de l'opportunit de son inscription sur la liste des mdicaments essentiels.**

La mthode d'valuation notre avis, devrait tre la comparaison (par essais cliniques) avec un mdicament dj existant sur le march et jouissant d'une trs bonne acceptabilit aussi bien sur le plan de cot que sur le plan d'efficacit et de disponibilit.

Conditions pralables de l'valuation du mdicament indigne africain

La mue sur le march d'un mdicament obit aujourd'hui des conditions de rigueur qui, si elles sont ncessaires et indispensables pour les nouvelles molcules, ne nous paraissent pas justifies pour le mdicament indigne ayant subi et vaincu l'preuve du temps aprs administration l'espce humaine. Ceci signifie en effet que la pharmacovigilance, autrement dit la surveillance des effets des mdicaments dans

leurs conditions usuelles d'emploi ne lui pas t dfavorable.

Loin de nous l'ide de nier toute possible toxicit tratogne de ces remdes; mais nous pensons galement qu'il n'est pas juste de minimiser le fait qu'ils ont vaincu l'preuve du temps aprs administration l'homme et non un animal de laboratoire. C'est pourquoi, nous prconisons une adaptation des conditions administratives et lgislatives, de mue sur le march afin quelles soient appropries et favorisent l'innovation au lieu de la freiner.

C'est ainsi que nous pensons que cette adaptation doit se faire en autorisant les es sais cliniques compars plus rapidement qu'ils ne le sont actuellement; tout au moins lgalement et officiellement.

Le problme pos est plus thique que scientifique; c'est pourquoi la solution doit tre conforme l'thique de notre environment socio-culturel.

Conclusion

Au terme de cette communication, nous pensons avoir expos avec assez de clart notre mthode d'approche, nos rsultats et nos conclusions en ce qui concerne la standardisation et l'valuation du mdicament indigne africain.

Nous nous sommes comprendre les attitudes et concepts qui sont la base des insuffisances des pratiques afin de trouver les moyens de les rendre reproductibles.

Nous tenons ajouter que cette approche ne s'oppose nullement la prise en compte ultrieure d'tudes plus approfondies sur par exemple, s'il existe, le principe actif, sa

toxicit et son mcanisme d'action.

Sans nier leur importance, notre priorit n'est point de rechercher un principe actif; de dterminer une DL 50, ou un mcanisme d'action; mais plutt de s'assurer de la reproductibilit et de la stabilit des prparations avec des normes de spcifications; car il s'agit l de mdicaments pour lesquelles l'preuve de la pharmacovigilance n'a pas t dfavorable.

Pour ce faire, nous pensons que la constitution d'chantillons moyens sur une priode donne de rcolte et le respect rigoureux de certaines rgles suffisent.

***Le "remde indigne amlior",* comme nous l'avons appel, peut, la faveur d'une adaptation des conditions de mise sur le march conforme l'thique de notre environnement socio-culturel, tre accept et produit au moins semi-industriellement afin de rpondre dans l'immdiat au problme de la sant publique qu'est l'approvisionnement en mdicaments des formations sanitaires.**

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APPENDICES

1. Evaluation des Bottes de Plantes Fraches (en g)

No. d'ordre	Guiera senegalensis	Diospyros mespiliformis	Saba senegalensis	Opilia celtidifolia	Bridelia ferruginea (saguan)	Parkia biglobosa (nere)
1	110,2	185,5	182	51,5	232,2	181,5
2	140,4	191,8	177,5	130,2	226,1	220,9
3	116,1	224,4	166,4	164	257,2	169,8
4	122,8	149,4	190,9	142,7	194,9	252
5	161,9	184,3	155,1	105,8	206,4	184,2
6	130,7	230,3	138,8	115,8	184	179,2
7	167,6	191,8	177,5	130,4	190,6	136,5
8	113,5	212,5	113,2	140,2	215,7	153,2
9	147,9	212,3	192	136,5	187,6	104,7
10	122	207,9	189,8	94,6	194,1	193,3
11	1333,1	1990,2	1683,2	1211,7	2088,8	1775,3
Average	133,31	199,02	168,32	121,17	208,88	177,53

2. Calcul des Variations des Mesures de Pinces de la Poudre D'asthmagardenia

Dsignation des sries de mesures	Mesure extra infrieure (Mi)	Mesure extrme suprieure (Ms)	Report Ms Mi
1	0,2073	0,5278	2,5

2	0,1976	0,3212	1,6
3	0,1966	0,3282	1,6
4	0,2310	0,3443	1,5
5	0,2542	0,3600	1,4

Bottes de Plantes Fraches

Dsignation des plantes	Mesure extrme Infrieure (mi)	Mesure extrme suprieure (ms)	Rapport Ms
Guiera senegalensis	110,2	167,6	1,5
Diospyros mespiliformis	149,4	230	31,5
Saba senegalensis	113,2	192	1,6
Opilia celtidifolia	51,5	164	3,1
Bridelia ferruginea	184	257	21,3
Parkia biglobosa	104,7	252	2,4

D’asthmagardenia

No. d’odre	Tare Tare + Poudre		Poudre(g)
1	5,9558	6,2604	0,3046
2	6,2375	6,5157	0,2782
3	6,4909	6,6982	0,2073
4	5,8706	6,3035	0,4329
5	6,3572	6,7570	0,3998
6	5,7518	6,2796	0,5278
7	6,3614	6,7975	0,4361
8	6,1505	6,5910	0,4405
9	6,1310	6,4805	0,3495
10	6,0659	6,4950	0,4291

My = 0,3805 gm

D’asthmagardenia

No. d’odre	Tare Tare + Poudre		Poudre(g)
1	6,2980	6,5042	0,2062
2	6,1622	6,4777	0,3155
3	6,7003	6,9084	0,2081
4	6,2670	6,4646	0,1976
5	6,6130	6,9342	0,3212
6	6,1116	6,3390	0,2274

7	6,6522	6,9386	0,2864
8	6,2492	6,5276	0,2784
9	6,2055	6,4426	0,2371
10	5,6594	5,9298	0,2704

My 0,2548 g

6. Evaluation de la Pince de la Poudre

D’asthmagardenia

No. d’odre	Tare Tare + Poudre		Poudre (g)
1	6,2980	6,5032	0,2052
2	6,1620	6,3862	0,2242
3	6,7005	7,0287	0,3282
4	6,2672	6,5349	0,2677
5	6,6130	6,8559	0,2429
6	6,1113	6,3628	0,2515
7	6,6522	6,8795	0,2273
8	6,2489	6,4455	0,1966
9	6,2058	6,4220	0,2162
10	5,6593	5,8643	0,2050

My = 0,2364 g

7. Evaluation de la Pince de la Poudre D'asthmagardenia

No. d’odre	Tare Tare + Poudre		Poudre (g)
1	6,5,9559	6,2130	0,2571
2	6,2381	6,5824	0,3443
3	6,4914	6,7793	0,2879
4	5,8704	6,1430	0,2726
5	6,3573	6,6548	0,2975
6	5,7522	6,0433	0,2911
7	6,3616	6,6746	0,3130
8	6,1508	6,3818	0,2310
9	6,1312	6,4310	0,2998
10	6,0663	6,3322	0,2659

My = 2860 g

8. Evaluation de la Pince de la Poudre

D’asthmagardenia

No. d’odre	Tare Tare + Poudre		Poudre (g)
1	8,8108	9,1197	0,3089
2	6,1620	6,4421	0,2081

2	0,1020	0,4421	0,2061
3	6,7005	6,9547	0,2542
4	6,2673	6,5570	0,2897
5	6,6130	6,9702	0,3572
6	6,1112	6,4504	0,3392
7	6,6524	6,0124	0,3600
8	6,2493	6,5490	0,2997
9	6,2057	6,5402	0,3345
10	5,6595	5,9712	0,3117

My = 3135 g

Chemical Evaluation of Tanzanian medicinal plants for the active constituents as a basis for the medicinal usefulness of the plants

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ABSTRACT

Drugs derived from medicinal plants still form the basis for rural medical care in most developing countries, apparently either because of lack of modern medical facilities in these areas, or as a supplement to the latter. In practice, most of these drugs offer effective treatment. This is not surprising because about 40% of all pharmaceutical presently in use are derived from natural sources (plants, fungi and other microorganisms, animals, etc.), either used directly as such, or with some modifications. Unfortunately, the we of crude plant extracts without any scientific evaluation, could lead to serious complications. Ineffective drugs could be used just as a matter of belief or tradition; under/over-doses could be taken; highly toxic drugs with short term, long term, or cumulative effects could be prescribed etc. The last two effects, however, are much more difficult to recognise than the others, and hence potentially more serious. In addition to these, the preparation, handling and storage of the drugs could lead to decomposition or transformation of the hitherto active constituents to ineffective and/or harmful products. Thus there is a need to evaluate and establish a scientific rationale for the use of the traditional medicinal plants, through chemical, pharmacological, toxicological and microbiological studies. In this paper, chemical investigations of medicinal plants for the active constituents and the correlation between biological activity of the crude extracts and/or the pure chemical constituents with the medicinal uses of the plants will be discussed.

Introduction

Quite a number of plants are used in different parts of the world for the treatment of various ailments. The medicinal values of most of these plants were recognised since ancient times. In fact, it can correctly be argued that the development of modern pharmaceutical is based on this ancient knowledge of medicinal plants

and traditional medicines. Thus presently, about 40% of pharmaceuticals are derived from natural sources (plants, microorganisms, fungi and animals (Farnsworth, 1984). These drugs are used as such, or as derivatives. Moreover, several natural products obtained from medicinal plants, which cannot hitherto be used as such, have offered leads to the development of various pharmaceuticals, as analogues or derivatives.

In developing countries, traditional medicines from plants continue to form the basis of rural medical care. This is so because, obviously, these medicines are easily available and cheap. However, the use of such medicines in their crude forms without establishing scientifically their efficacy and safety could, in a short while or long run, be detrimental to the very health of mankind. Therefore, there is an urgent need to carry out scientific evaluations of these medicines worldwide. After all, apart from the efficacy and safety of traditional medicines, the scientific evaluation may lead to the isolation of a pure active ingredient which otherwise occurs, in minute quantities in the crude drug. And since medicinal plants depend on their geographical location, such isolated active principle can then be synthesized cheaply, so that eventually the drug is available to a larger population. Alternatively, knowledge of the structures of naturally occurring, medicinally useful compounds may give leads to the synthesis of analogues, which could be cheaper, and sometimes even more active than the naturally occurring compounds.

In 1976 we initiated a long term project on the scientific evaluation of Tanzanian medicinal plants, aimed at establishing the active constituents. So far we have studied plants which are used for the treatment of bacterial and fungal diseases (Sawhney *et al.,* 1978a and 1978b; Khan *et al.,* 1980), and those which are used

for malaria. Occasionally we also evaluated the isolated compounds for antitumour or other activities. In this paper results of our on-going research on plants used in Tanzania for the treatment of malaria and malaria-related fevers will be discussed. Prof. Khan will present our results on the chemical investigations of plants used for bacterial and fungal diseases (Khan and Nkunya, 1990).

The malaria problem

Malaria is one of the most prevalent tropical and subtropical diseases (WHO, 1982/83). Recently it has been estimated that about 260 million people are infested annually (WHO, 1988). In tropical Africa alone about one million children under 14 years die from the disease annually (Underson, 1986). It is now over forty years since campaigns to eradicate the disease were initiated but, unfortunately, until now there is no success in eradicating this disease in the poor, developing countries. Efforts to develop an antimalarial vaccine have been futile because of the complicated stages of malaria infestation (Mgani, 1990).

Efforts to eradicate the mosquito vector, the Anopheles mosquito, have been futile because of financial and management problems of the eradication programmes. Furthermore, the mosquitoes are now known to be developing resistance against the cheap insecticides, such as DDT, fenitrothin, proppoxur, malathion, clorfoxin, and synthetic pyrethrins, which are generally used in these programmes (WHO, 1984). The use of large quantities of these insecticides also poses an environmental problem, since some of them, such as DDT, are non-biodegradable. The economic difficulties being faced by the affected countries, coupled with the emergence of other killer diseases, such as AIDS, will, most likely, hamper financial commitments in the fight against malaria, particularly the massive

mosquito eradication programmes, since these involve huge financial requirements.

Due to the above constraints, at the moment, malaria chemotherapy should be given due attention. But again sad news have emerged in this direction. That is, the most dangerous human malaria parasite, *Plasmodium falciparum,* is developing resistance against the commonly used cheap drugs such as quinine and chloroquine (Breman and Campbell, 1984). The use of the new drugs, mefloquine, fansidar, amodiaquine, primaquine, etc, in malaria chemotherapy, poses other problems. These drugs are quite expensive and some have serious side effects. They particularly affect human liver, kidneys and the nervous system (Mtulia, 1976). Hence, at present, chloroquine and quinine continue to be prescribed to malaria patients. Larger doses of chloroquine are now being recommended for drug resistant strains of *P. falciparum.* However, long-term effects of such large doses of chloroquine we still unknown, but could be significant.

Due to the shortcomings discussed above, efforts are now being directed in obtaining drugs which have structural features that are different from those of chloroquine and related drags, and those of sulfa drugs, either synthetically or from plants.

Antimalarials from plants

After the isolation of quinine from *Cinchona* trees (Sterling, 1977), and artemisinine from *Artemisia annua* L. (Compositae) (Xu-Ren *et al*., 1985), it has become apparent that plants are a potential source of antimalarial drugs. Artemisinine (also known as ginghaosu) is one of the most potent antimalarial

drugs known at present, which is toxicologically the safest (Xu-Ren *et al.,* 1985). Since this compound has a structural feature which is different from that of any other known antimalarial, parasite resistance to this compound is unlikely to take place in the near future.

The drug is still obtained from the plant where it occurs in small quantities, since its synthesis is still very cumbersome (Gavagan, 1988). This makes the drug to be very expensive. It is, therefore, worthwhile to put more efforts in searching for other potent and abundant antimalarials from medicinal plants, or other sources, while efficient and cheap synthetic methods for artemisinine and its derivatives are being developed. That is why at present enormous efforts are being exerted in searching for antimalarials from medicinal plants, and several leads have so far been obtained. Thus, the vascular plant famines Amaryllidaceae, Meliaceae, Rubiaceae and Simaroubaceae, have been found to include plant species which are active against malaria parasites (Spencer *et al.,* 1947), and several active compounds have been isolated from some of these plants. Several quassinoids, which were isolated from some plants of the family Simaroubaceae, showed potent antimalarial activity *in vitro* (e.g., see WHO, 1984; Thaithong *et al.*, 1983). The compounds also - owed a strong mammalian cytotoxicity. However, preliminary studies on the structure- activity relationship of quassinoids have shown that the structural requirements for antimalarial activity and cytotoxicity are different (e.g. see Bray *et al.,* 1987). Therefore, one can expect that structural modifications of these compounds to suppress cytotoxicity, if feasible, can be performed to give modified compounds which might be safe antimalarials However, up to now such modifications have not been performed (Phillipson, 1990).

Recently, Prof. Hostettmann from Switzerland has found that the crude extract from *Psorospermum febrifugum* (Guttiferae) possesses an antimalarial activity at a level similar to that of artemisinine (Hostettmann, 1990). He has isolated the active constituents from the plant, and further evaluation of this compound for its potency as an antimalarial drug is in progress.

Antimalarials from Tanzanian medicinal plants

In our on-going research on Tanzania antimalarial plants, we have screened crude extracts from leaves, stem and root bark of sixty medicinal plants. The results are shown in Table 1 (Weenen *et al.,* 1990). Some of the most active plants were the tubers of *Cyperus rotundus* L. (Cyperaceae), and the root bark of *Hoslundia opposita* Vahl. (Labiatae). Chemical studies of the *C. rotundus* extracts led to the isolation of a number of compounds, some of which were active against the multidrug resistant K1 strain of *P. falciparum* malarial parasite *in vitro.* These included α-cyperone (1) and (+)-β-selinene (2) (Weenen *et al.,* 1990b). However, the activity of 2 appeared to be due to decomposition products. Thus, whereas the undercomposed compound was inactive, the decomposed material was active.

We have isolated three new compounds from the root bark of *H. opposita* which we have named hoslunone (3), hoslundione (4) and hoslundin A (5) (Marandu, 1990). All these compounds were active against *P. falciparum* malaria parasites *in vitro.* The crude *H. opposita* extract also gave several other active compounds, which were in minute quantities, and hence their structures could not be determined. We are now re-investigating the plant in order to obtain larger quantities of the compounds so that their structures can be identified.

Other active plants in our investigation were *Margaritaria discoidea* (Baill.) Webster (Euphorbiaceae), from which securinine (6) was obtained and found to be the active principle, and *Zanthoxylum gilletii* (De Wild) Waterm. (Rutaceae), which contains two active compounds, pellitorine (N- isobutyldec-2, 4-dienamide) (7), and fagaramide (8) (Weenen *et al.,* 1990b). Another compound (9) was obtained from the latter plant as well, but this metabolite, despite its novel chemical structure, was inactive (Kinabo, 1990).

All the compounds 1, 3-7 shown above, contain an α,β-unsaturated carbonyl moiety. It is believed that their antimalarial activity is due to the ability of the nucleic acids of *P. falciparum* malaria parasites to react with the α,β-unsaturated carbonyl moiety, in a Michael addition fashion (Weenen *et al.,* 1990).

We also isolated several compounds from the crude root bark extract of *Artemisia afra* Wild (Composite) (same genus as *Artemisia annua,* the source of artemisinine) but none of the isolated compounds had any marked activity (Kinabo, 1989).

***Azidarachta indica* A. Juss. (Mwarobaini in Swahili)**

***Azidarachta indica* is widely used in East and West Africa for the treatment of malaria and malaria related fevers. We therefore included this plant in our investigations. Results on the antimalarial activity of this plant are given in Table 1 (Weenen *et al.,* 1990a). As it can be noted, the plant showed only a mild activity. Apparently, the active component from this plant, which has recently been isolated in India, occurs in very minute quantities (Philipson, 1990). This might be the reason for the mild activity of the crude extract.**

Antimalarials from plants of the genus *Uvaria*

Uvaria **species have proved to be rich in a variety of compounds, some of which exhibit a wide range of biological properties, such as antibacterial, antifungal, and anticancer activities, and pharmacological properties (Leboef *et al.,* 1982). The chemistry and biological activities of these compounds have attracted interests in investigating these plants phytochemically. That is why in the course of our investigations on antimalarial plants, we decided to screen the *Uvaria* species, which grow in Tanzania, for their antimalarial activity, and ultimately isolate the active principles and/or any other chemically interesting compounds. After all, most of these *Uvaria* species (commonly known is Mshofu or Msofu) are used for the treatment of malaria (Kokwaro, 1976).**

We have screened nine *Uvaria* species which were collected from different parts of Tanzania. Their activities are summarised in Table 1 (Nkunya, *et al.,* 1990). It can be noted from Table 1 that all nine plants are active against the multidrug resistant K1 strain of *P. falciparum* malarial parasite, leaf extracts being the least active. Table 1 also shows that most of the activity is concentrated in the less polar or medium polar compounds, which are soluble in petroleum ether or chloroform.

Several compounds have been isolated from the most active extracts, and these have been assayed for their activity against the multidrug resistant K1 strain of *P. falciparum* malaria parasites (Nkunya, *et al*., 1990a). C-Benzylated dihydrochalcones (the uvaretins) (Mgani, 1990, Nkunya, 1985), and sesquiterpeneindoles (Nkunya *et al.,* 1987a, Nkunya and Weenen, 1989, Nkunya *et al.,* 1990b) have been found to be the active components of these plants. The

activity of the dihydrochalcones was found to depend on the presence of free hydroxyl groups, and on the molecular size of the compounds (Nkunya *et al*, 1990a). That is, small molecules showed a higher activity than large ones. The activity of the sesquiterpeneindoles appears to be due to the sesquiterpene side chain and not the indole moiety. The presence of an α,β-unsaturated alcohol moiety on the sesquiterpene side chain is also essential for the activity (Nkunya *et al.,* 1990a).

Despite their novel structures, both the benzopyranyl sesquiterpenes, lucidene (13) and tanzanene (14) isolated from *U. lucida ssp. Lucida* (Weenen *et al.,* 1990c) and *U. tanzaniae*, respectively (Weenen *et al.,* 1991) and the schefflerins 15 and 16 from *U. scheffleri* (Nkunya *et al.,* 1990b) are virtually inactive.

The three cyclohexene epoxides, (+) -pandoxide (17), (+)-β-senepoxide (18) and (-)-pipoxide (19), isolated from *U. pandensis* (compound 18 was also isolated from *U. faulknerae*), are weakly active. However, these compounds have been found to possess marked antibacterial, antifungal and antitumour activities (Nkunya *et al.,* 1986).

We would like to emphasize that the compounds isolated in our investigations were the major ones. We are presently investigating whether more active minor components are present and whether these compounds can be isolated.

Conclusion

Our studies have indicated that most of the plants which are used for the treatment of malaria show at least some activity against the multidrug resistant

K1 strain of *P. falciparum* malaria parasites. This, thus verifies the scientific basis for the traditional uses of these plants. However, these studies are only preliminary. More investigations for the *in vivo* activity and toxicity of the active plant extracts and pure compounds, are required for any definitive conclusions.

The results from our studies, and those reported by others, indicate that most of the active components are weakly, or medium polar compounds, which are soluble in petroleum ether or chloroform. However, in traditional medicines, water is the solvent which is used to prepare the extracts and concoctions. This is obviously so because the traditional healer has only water as the solvent for the preparation of his medicines. Thus in most cases the active ingredients in traditional medicines may be in minute concentrations, due to their low solubility in water. Therefore, larger quantities of these medicines are invariably needed for any curative effects. This appears to be the general practice with traditional medical practitioners.

The lack of suitable solvents means that many useful plants may not show any curative properties in traditional medicines, despite some of them containing highly potent compound(s), albeit in minute quantities. Therefore this calls for a massive scientific evaluation of plants so that should there be any potent, but minor component(s) in these plants, they should be characterised, so that efforts to synthesize them, or their analogues, can be initiated, with the objective of getting the compounds in larger quantities.

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Financial support for this research, for which we are grateful, was obtained from the University of Dar es Salaam, the Norwegian Agency for International

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Table 1: Antimalarial activity of extracts of Tanzanian plants

Family	Species	Part used[a]	Activity[b c]		
			PE	CH_2Cl_2	MeOH
Amarylidaceae	*Crinum stuhlmannii*	W.P.	N.D.	N.D.	**
	C. portifolium	W.P.	N.D.	N.D	-
	C. papilosum	W.P.	N.D.	N.D.	***
	Scadoxus multiflorus	W.P.	N.D.	N.D.	**
Anacardiaceae	*Ozoroa insignis*	R.B.	***	***	-
	Sclerocarya cafra	S.B.	-	-	-
	Sorindeia madagascariensis	R.B.	*	*	-
Annonaceae	*Enantia kumeriae*	R.B.	**	**	***
	Uvaria dependens Eng&Diels	R.B.	***	*	-
		S.B.	*	***	-
	U. faulknerea Verdc	leaves	*	*	-

	U. faulkneriea Verdc.	R.B.			-
		S.B.	**	**	*
		leaves	-	*	-
	U. kirkii Hook. f.	R.B.	***	**	-
		S.B.	***	***	-
		leaves	-	*	-
	U. leptocladon Oliv.	R.B.	***	***	**
		S.B.	***	***	*
		leaves	-	*	*
	U. lucida ssp. *lucida* Benth.	R.B.	***	****	**
		S.B.	***	****	****
		leaves	**	***	*
	Uvaria sp. (Pande)	R.B.	****	***	*
		S.B.	****	***	*
		leaves	*	**	**
	U. pandensis Verdc.	R.B.	*	**	*
		S.B.	**	***	-
		leaves	*	*	*
	U. scheffleri Diels.	R.B.	**	****	****
		S.B.	**	**	*
	U. tanzaniae Verdc.	leaves	**	***	**

	D. tanzaniae Verdc.	R.B.	. .	. . .	. .
		S.B.	***	***	**
Apocynaceae	*Rauvolfia mombasiana*	R.B.	*	***	***
		S.B.	N.D.	N.D.	-
Araliaceae	*Cussonia arborea*	R.B.	***	***	-
Bignoniaceae	*Kigelia africana*	S.B.	-	***	-
		leaves	-	-	*
Caesalpinaceae	*Caesalpinia bonduc*	W.P.	N.D.	N.D.	-
	Cassia abbreviata	R.B.	**	*	*
	C. occidentalis	W.P.	-	-	-
	Tamarindus indica	fruits	N.D.	N.D.	-
Celastraceae	*Catha edulis*	aerial	N.D.	N.D.	-
Compositae	*Artemisia afra*	R.B.	**	***	*
		aerial	***	***	*
	Conyza pyrrhopappa	leaves	*	***	**
	Crassocephalum bojeri	aerial	*	***	**
	Tridax procumbens	W.P.	*	*	-
	Vernonia amygdalina	leaves	N.D.	N.D.	-
	V. colorata	R.B.	*	**	*
		S.B.	-	**	-
		leaves	-	**	-
Cyperaceae	*Cyperus rotundus*	tubers	***	****	***

		aerial	N.D.	*	N.D.
Ebenaceae	*Diospyros natalensis*	R.B.	**	*	N.D.
	D. zombensis	R.B.	*	*	N.D.
	D. greenwayii	R.B.	-	**	N.D.
		S.B.	-	**	N.D.
		leaves	-	**	N.D.
Euphorbiaceae	*Bridelia cathartica*	R.B.	*	**	-
	Clutia robusta	R.B.	-	-	-
	Margaritaria discoidea	R.B.	***	***	*
Guttiferae	*Vismia orientale*	S.B.	N.D.	N.D.	-
		leaves	N.D.	N.D.	-
Labiatae	*Hoslundia opposita*	R.B.	****	***	*
		S.B.	**	-	-
Lauraceae	*Ocotea usambarensis*	R.B.	***	***	*
Leguminosae	*Acacia clavigera*	S.B.	*	*	-
	Albizia anthelmintica	S.B.	-	-	-
	Piliostigma thonningii	S.B.	*	*	***
		leaves	*	*	***
Meliaceae	*Azadirachta indica*	S.B.	N.D.	N.D.	-
		leaves	*	**	-
	Entandrophragma bussei	S.B.	***	***	*

Myrtaceae	*Psidium guajava*	leaves	***	*	**
Olacaceae	*Ximenia caffra*	leaves	-	*	*
Plantaginaceae	*Plantago major*	W.P.	*	***	-
Rhizophoraceae	*Anisophylia obtusifolia*	R.B.	****	-	-
		S.B.	-	*	-
Rosaceae	*Parinari exelsa sabin*	S.B.	***	***	-
Rubiaceae	*Crossopterix febrifuga*	S.B.	*	*	*
	Gardenia jovis-tonantis	S.B.	N.D.	N.D.	-
		leaves	N.D.	N.D.	-
		fruit	-	**	-
	Vangueria infausta	R.B.	-	***	***
		S.B.	N.D.	N.D.	*
Rutaceae	*Clausena anisata*	R.B.	-	*	-
		leaves	*	**	*
	Todalia asiatica	R.B.	**	-	***
		S.B.	***	*	***
	Zanthoxylum gilletii	R.B.	***	***	**
		R.B.	**	**	***
	Z. xylubeum	S.B.	*	*	*
Tiliaceae	*Grewia egglingii*	S.B.	**	N.D.	N.D.
	G. forbesii	leaves	-	*	*

Verbenaceae	*Lantana camara*	R.B.	****	***	*
Zygophyaceae	*Balanites aegyptica*	S.B.	-	***	**

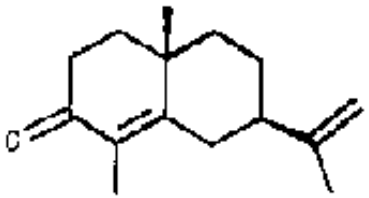
Key

a) W.P. = whole plant; R.B. = root bark; S.B. = stem bark.
b) Antimalarial activities are given in IC_{50} values and these have been categorized as follows:

******: IC_{50} = 5 to 9 μg/ml**
*****: IC_{50} = 10 to 49 μg/ml**
****: IC_{50} = 50 to 99 μg/ml**
***: IC_{50} = 100 to 499 μg/ml**
-: IC_{50} > 499 μg/ml

N.D.: Not determined.

c) P.E. = petroleum ether (boiling range 40-60°C); CH_2Cl_2 = dichloromethane; MeOH = methanol.



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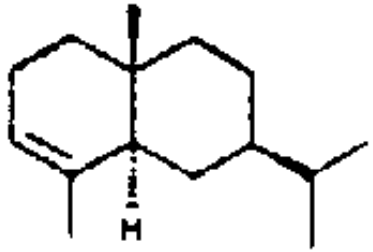

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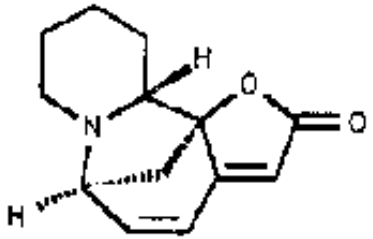

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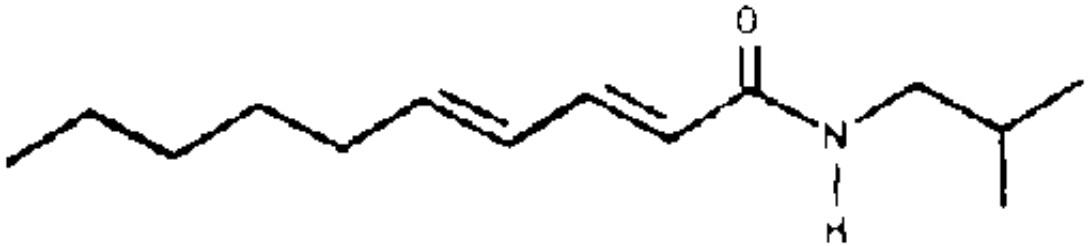

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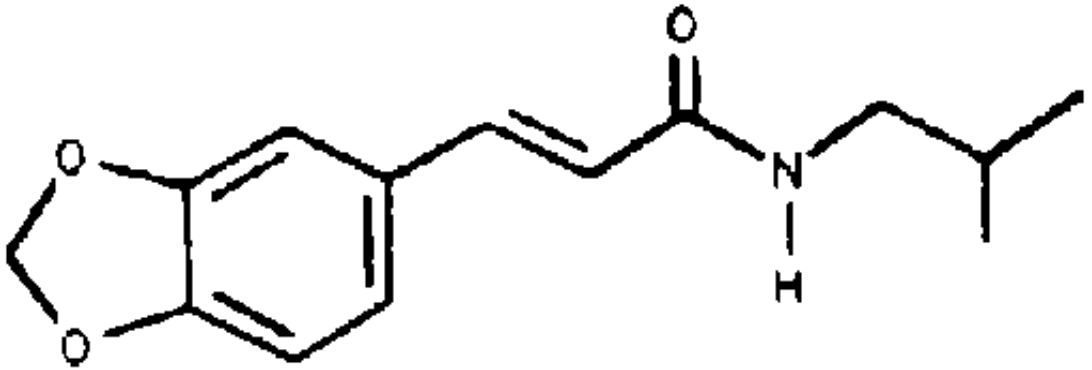

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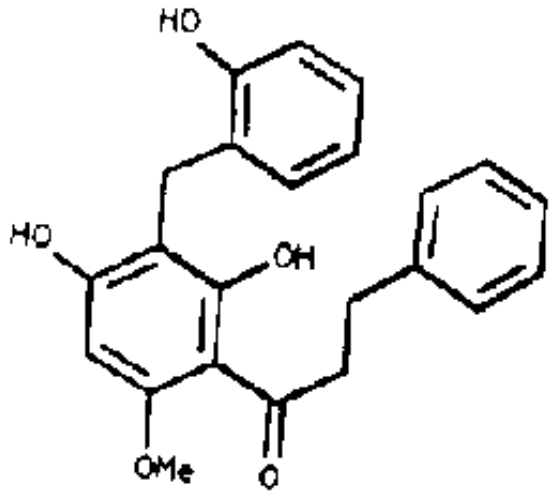

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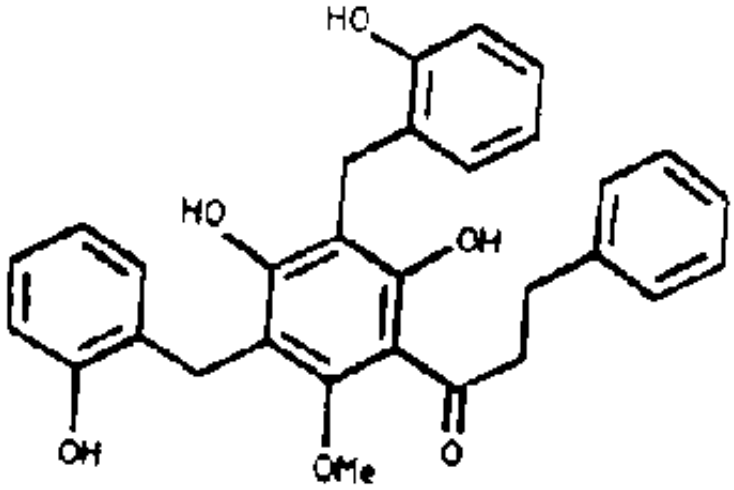

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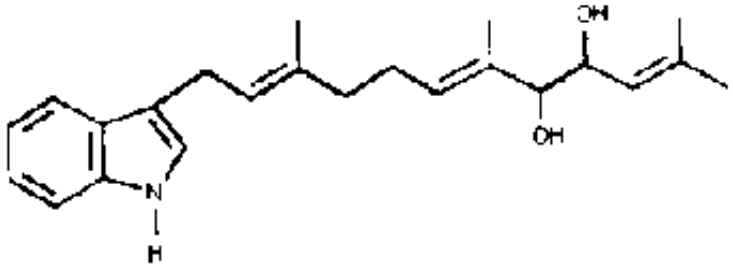

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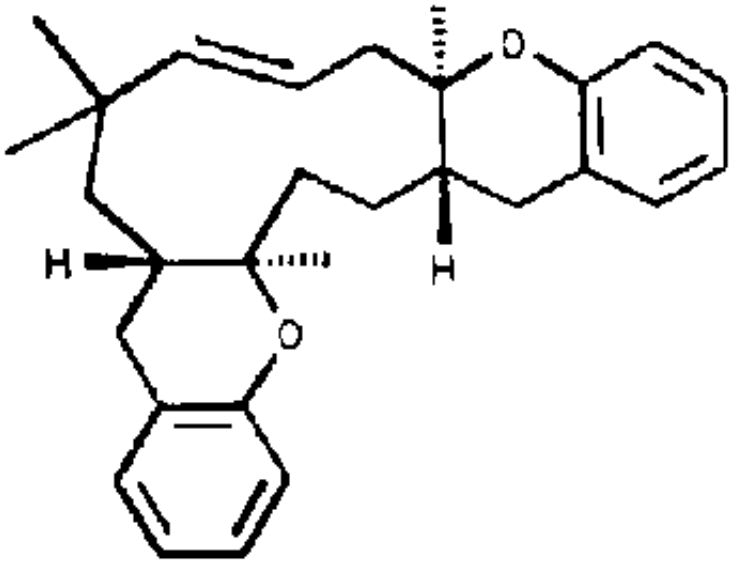

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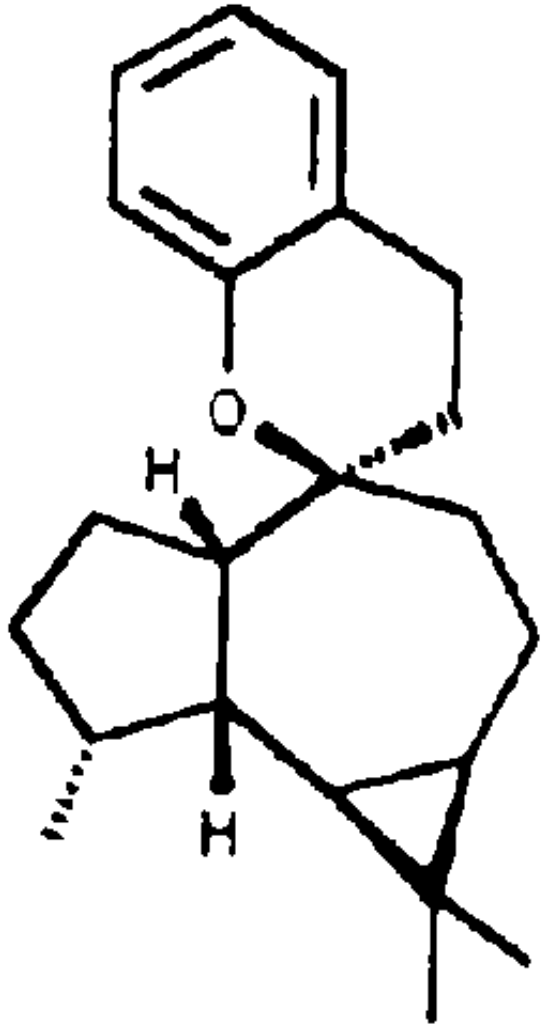

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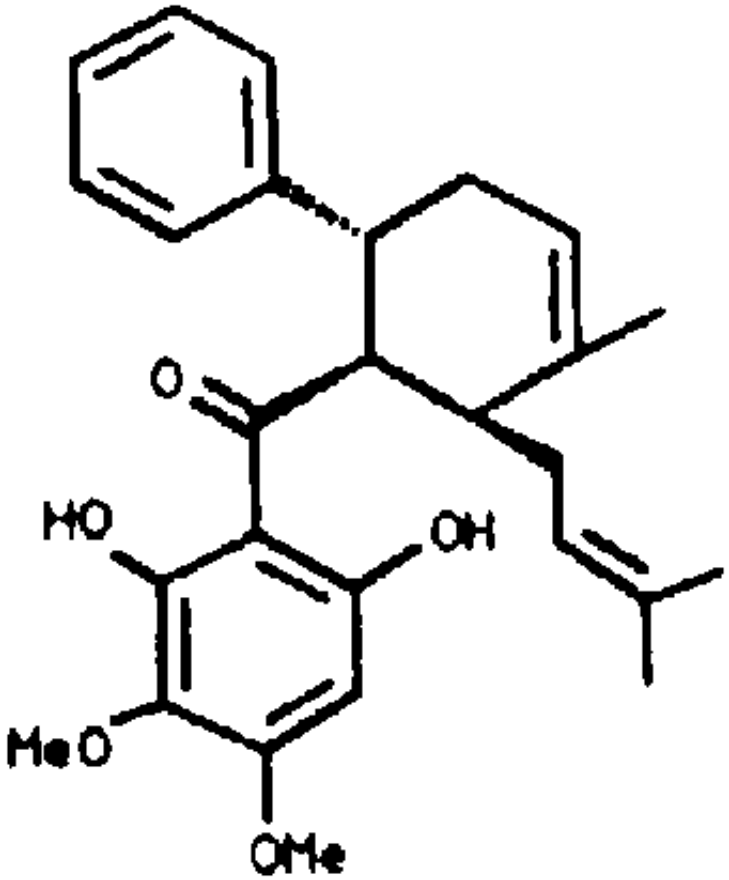

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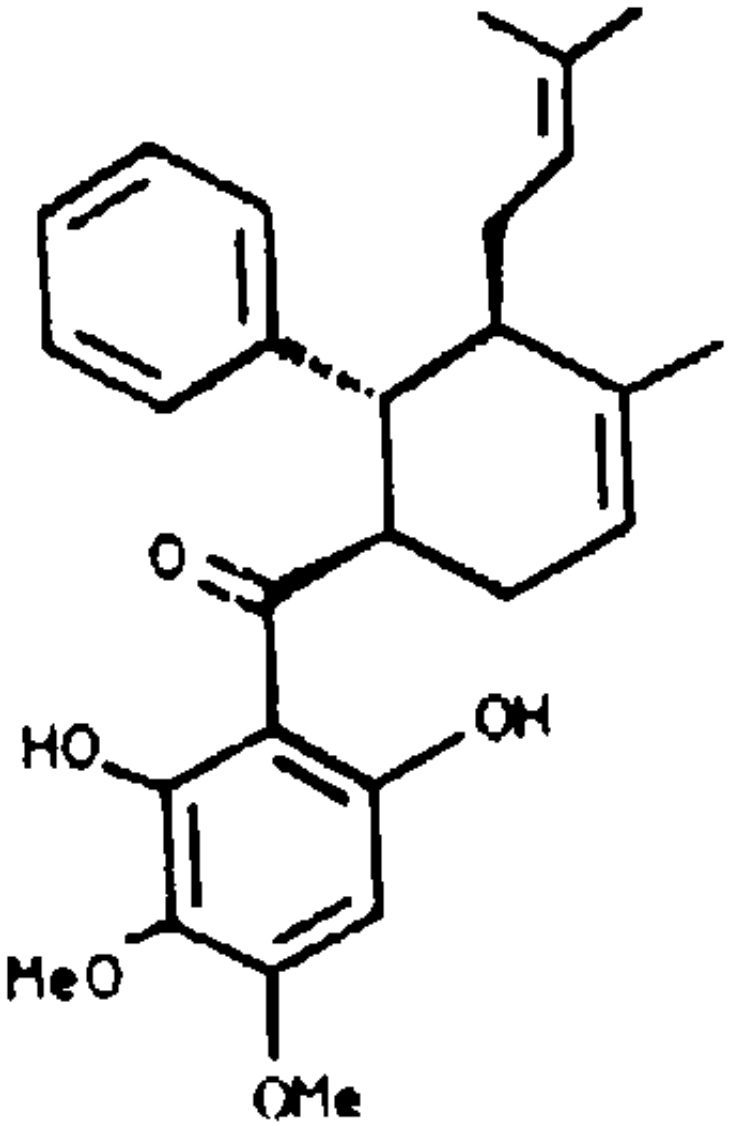

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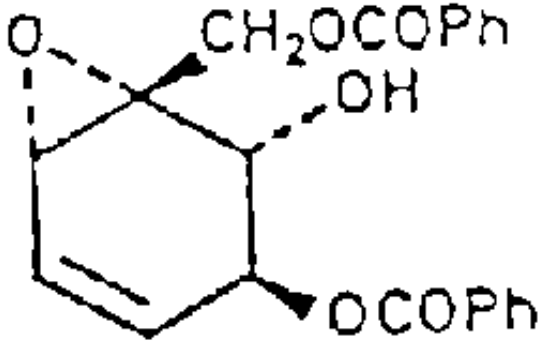

Figure

Ethnobotany and the medicinal plants of the Korup rainforest project area, Cameroon

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ABSTRACT

The Korup Rainforest of Southwestern Cameroon poses the twin challenges of high botanical and high ethnic diversity. Using innovative techniques, we have identified plants used in traditional medicine, that are a basis for both regional primary health care and raw material for pharmaceutical products.

Introduction

Project Background

The Korup Project in Southwestern Cameroon is a joint Cameroon World Wide Fund For Nature (WWF) venture that is aimed at combining rural development with nature conservation on one of Africa's most genetically diverse forests (WWF, 1987).

Two sites constitute the project area (Figure 1). The first is the 126,000 hectare, Korup National Park, where uses are limited to the protection and observation of the forest ecosystem, and the second is a 300,000 hectare area surrounding the park, where an integrated rural development activity takes place. In the second area a spatial approach has been adopted where the land is zoned for different classes of land use.

The project that has been operating since 1987 is very complex and uses a multi-disciplinary approach to attain its goal. The operations are grouped into Natural Resources Management projects and Support Activities that are concerned basically with infrastructural development. Natural Resources Management includes sustainable agricultural systems for the various ecological zones, appropriate agroforestry systems to meet the socio-economic and environmental needs of the area, and the investigation of the potential for sustainable harvesting of the diverse products of the forest, such as, medicinal plants, natural herbicides and pesticides, dyes, gums, resins, leaf proteins, nuts and fruits.

Ethnobotanical Background

In the past, tropical forests were commercially exploited for products, principally timber and little attention was given to the secondary products, though they provided the local people with food, medicines and materials for crafts and construction purposes (Thomas *et al.,* 1989).

The ethnobotanical study that we have undertaken is part of the inventory needed for sound forest management and rural development. The two background components to the study of ethnobotany, especially medicinal plants, are a knowledge of the vegetation, and an understanding of the culture.

Botanical Background

The plant species of the Korup Project area are fairly well known through the botanical inventory carried out by Duncan Thomas with the Missouri Botanical Garden and the Cameroon National Herbarium. The forest is thought to be richer in plants and animal species, perhaps than any other African forest.

This area is dominated by a closed canopy lowland forest with high alpha-diversity, and relatively low beta- diversity. Letouzey (1985) has divided the forest into two associations. The first is made of the Atlantic-Biafran forest, occurring on sandy clays at low attitude of up to 300 m. This is a species rich association, with many gregarious species of the Caesalpinioideae, like *Guilbertiodendron.* Also, *Oubanguia alata, Dichostemma glaucescens* and *Cola spp.* are abundant, especially *C. semecarpophylla.* The second is the Atlantic-Northwestern association, found on clay soils at higher altitudes 300- 700 m. It has fewer *Caesalpinoideae,* while *Terminalia* and *Entandrophragma* species and *Anonidium manii* are common. This is the most species - rich association in

Cameroon and is also rich in endemics like *Medusandra mpomiana.* Forest on steep hill sides and ravines are distinctive. Unlike the two associations described above, they are relatively species - poor, but rich in gregarious Cluciaceae such as *Garcinia conrauna* and *G. nobilis.* The species *Grossera macrantha* as well as the rare endemic *Nopoleonea equertonii* are restricted to these hillside forests.

Ethnocultural Background

Much of the background information on the culture of the area has been drawn from the study of the Northern villages of Korup by Di Nola (1988), a forestry and agricultural visit by Ramshaw (1988) food survey of Mundemba town and Ndian Estate by Malleson (1987), forestry survey in the Korup project by Synnott (1989), a survey on the people of Korup by Devitt (1988), and from being familiar with most prevalent illness of the area and some treatments.

The Korup Project area is ethnically diverse since the boundary between the Bantu people of the Cameroon-Congo group and Semi-Bantu people of the Nigeria - Cameroon Cross River area runs through it (Figure 2). The main ethnic groups of the Cross River area are the Ekoi, the Ejagham, the Ibibio and the Korup, while those of the Cameroon-Congo Bantu Sector are the Uroko and Mbo tribes, to the east of the project area.

Methods

Data collection was preceded by extensive preliminary studies, so as to be familiar with all parts of the project area and design the field work around a viable timetable.

We defined a sampling site as a village. A minimum of two villages were sampled for each ethnic group in the area of study. The four major ethnic groups are the Ejagham, the Upper Balong, the Korup and the Okoko.

Two formal data sets were required for this study, together with a large quantity of information obtained in informal discussions. The data sets were collected in May, June and December 1988, and February to May 1989.

Show-and-tell methods

This was a method used for comparative ethnobotany study to obtain comparative information on plant names and uses.

A standard herbarium that could be examined by villagers as the centre piece of the study was collected from a wide range of habitats in the area. The herbarium contained 260 plant specimens, chosen to test a number of hypotheses concerning plant use in Korup. It enabled us to show all the important structures of plants, such as leaves, flowers and fruits.

By using a fixed set of species instead of a stochastic sub-set of the total flora, direct comparisons were made between data sets. Furthermore, by using an empirical approach where the same specimens were shown in each village, we obtained replicate data sets and built up an overall picture of the names and uses of each species and could easily spot in consistent results.

Walk-in-the woods method

Before the comparative study was carried out, information on plant names and

uses was collected by walking around the village and nearby area with our traditional experts and guides. This exercise was known as the "walk in the woods".

This is a standard ethnobotany method used to obtain information through the study of living plants. This approach helped establish the credentials of our informants, identify any useful plants of the area not included in the comparative study, and improved the quality of the comparative data, by obtaining some names in advance that assisted identification of the herbarium specimens.

Traditional treatment and primary health care

Role and Tiers

In developing countries, a large number of people, especially children, die daily of preventable or curable diseases because of lack of simple health care. In most cases this is due to limited resources, poor communication, vast distances, poverty, lack of education etc. (Sofowora, 1982).

As a result of this, traditional medicine has become more accessible to most of the people in rural parts of Africa, where some 80 per cent of the population rely on indigenous forms of medicine. In Korup, where traditional skills exist and where natural resources and phytochemicals are extensively used, it is possible to achieve rural development objectives in the area of primary health care. For example, filaria is widespread in the project area, including both river blindness and loa-loa. The *Simulium,* whose secondary host is the black fly, is common in all fast -flowing, unshaded streams. Ayong village is situated on the bank of a large

stream and with abundant simulian host in the village. According to the villagers, blindness was not a serious problem and that worms in the eye were destroyed using eye drops from *Scleria boivinii.*

Two tiers of indigenous medicine have been identified in the Korup area. One is traditional medicine proper, that uses specialised skills in diagnosing, preventing or eliminating physical, social and mental diseases. The other, known as "folk" medicine, need not involve a specific medical system, but relates rather to use by traditional remedies by villagers, who do not derive their income from this source.

Although the two tiers are not very distinct and overlap to a considerable extent, folk medicine is regarded as part of the first tier of health care system. For serious illnesses, the patient may seek treatment in the second tier: a traditional practitioner, or a hospital.

Preparation of Herbal Remedies

We cannot adequately assess the importance of drug preparation and other aspects of treatment in Korup because our investigation was botanically oriented.

Although the preparation of individual medicines has not been studied in detail, many customs govern the preparation and administration of each remedy, and these vary from one village to another. Some preparation customs however, appear to be important, such as the condition and time of collection of the material, dose and method or form of administration.

The common forms of preparation are aqueous infusions or decoctions and pastes. The whole plants or plant parts are generally steeped in cold or hot water, or

occasionally in cold palm wine or palm gin, locally known as "Afofo". Decoctions are usually prepared with boiling water. In the case of ointments and orally administered medicines, the plants are often ground to a paste with palm oil, and other ingredients like *Aframomum melegueta* seeds are added.

Infusions and decoctions are frequently drunk or used as enemas, while pastes are eaten, or used as poultices or as ointments. They may even be rubbed on, or put into shallow cuts in the skin, often seven in number. In some cases, medicines are first chewed, and then spat into wounds or incisions. The treatment of fevers is often accompanied by steam baths.

Treatment using plants

The term medicinal plants, when interpreted broadly, includes all plants whose usefulness is derived from specific phytochemicals produced as secondary derivatives of major metabolic pathways (Thomas and Mbenkum, 1987).

Classifications of medicinal plants are frequently based on the type of chemical action involved. We have not used this approach because the study involved neither chemical analysis nor an extensive literature search. Another approach involves the listing of plants under the illnesses or symptoms treated. We have tried to follow this plant as far as possible, despite confusion over what disease or problem the plant was actually treating. We have listed those plants used in traditional medicine, which are quite distinct from ceremonial and magical plants that we have left out.

Conclusion

Traditional medicine is very widely practised in the Korup area, where all villages have at least one traditional practitioner with considerable knowledge, while some remedies are known by most villagers. These treatments are most useful for primary health care and represent the equivalent of non- prescription drugs in orthodox medicine.

Research and extension work are the keys to integrating folk medicine into modern primary health care. The major objective should be to match safe, effective remedies to common illnesses, using local medicinal plants. The problem is that very little is known about fold medicine and traditional medicine proper, and it is impossible to say how effective they are without a lot more research.

In order to accomplish this integration, inventories of medicinal plants and the flora of the various regions must be carried out. This should be followed by consultations between medical doctors, pharmacologists and ethnobotanists, aimed at listing the diseases the villagers can identify and treat, along with the plants to be considered for treating them. Meanwhile, additional phytochemical and pharmacological research should be carried out on important medicinal plants to determine their chemical composition, biological activity, toxic effects and optimal doses. These studies could identify plants which could be used to manufacture medicines for the treatment of numerous common ailments of both humans and animals. These medicines could be used to reduce dependance on imports, and their manufacture would provide a domestic pharmaceutical industry, leading to the development of much local expertise in this field.

Preliminary studies by WWF and Cameroon scientists, have shown that many of the Korup forest plants contain useful chemicals that include fungicides,

pesticides, dyes, and even natural contraceptives and aphrodisiac compounds. So far, over 90 substances have been isolated - 38 new to science, with potential commercial use in industry and medicine. Furthermore, one or two species we have identified, contain phytochemicals with anti-viral properties and could be researched as a possible treatment or control of *AIDS*. It is likely that more will be discovered since much of the flora has not yet been researched.

TREATMENT USING PLANTS OF KORUP

Group	Indications -	Plants	Part Used	Administration
1. FILARIASIS	ONCHOCERCIASIS (River blindness)	*Scleria boivinii* (Cyperaceae)	Young shoots	Sap as eye drop
		Cleome rutidoesperma	Aerial parts	Sap as eye drop
		Anchomanes difformis (Araceae)	Root tubers	Juice as eye drop
		Mangifera indica	Leaves	Infusion as enema
2. MYCOSIS	FUNGAL INFECTIONS	*Cassia alata* (Caesalpiniaceae)	Leaves	Mashed leave rubbed on skin
			Bark	Decoction for washing
		Carica papaya	Aerial	Latex, rubbed on skin
		Ficus exasperate	Leaves	Rub skin with

		(Moracere)	leaves	
3. BACTERIAL AND VIRAL INFECTIONS	EAR INFECTION	*Cylicomorphus solmsii*	Trunk	Water from holloro trunk as ear drop
		Cleome rutidosperma (Capparidaceae)	Leaves	Mashed leaves squeezed to nuke ear drop
	EYE INFECTION	*Antrocaryon klaineanum drop* (Anacardiaceae)	Fruits	Juice as eye
		Emilia coccinea (Asteracere)	Inflorescence	Juice as eye drop
		Enantia Chlorantha	Bark	Eye drop for conjonctivitis
		Rhektophyllum mirabile	Stem	Sap used as eye drop
		R. Camerunense (Araceae)		
	TUBERCULOSIS	*Morinda lucida* (Rubiaceae)	Bark	Infusion drunk
		Treculia obovoidea (Moraceae)	Bark and Leaves	Infusion drunk
	MEASLES	*Aframomum sp.* "tondo"	Fruits	Infusion used as enema

		(Zingiberaceae)		
			Seeds	Ground seeds rubbed on skin.
	CHICKEN POX	*Citrus lemon* (Rutaceae)	Fruits	Fruits Juice rubbed all over body
			Leaves and Roots	Infusion used to wash skin
	TETANUS	*Anthonotha macrophylla*	Leaves	Mashed leaves with *Aframomum melegueta* rubbed into cuts in jam to release muscle
4. PARASITES	INTESTINAL WORMS	*Acanthus montanus* (Acanthaceae)	Leaf	Infusion as enema
		Aframomum hanburyi (Zingiberaceae)	Stem	Chewed
		Afrostyra lepedophyllus (Styracaceae)	Bark	Ground and eaten
		Canthium manii (Rubiaceae)	Bark	Ground and eaten
		Dennettia tripetala	Leaves	Chewed

		(Annonaceae)		
		Neoboutia glabescens (Euphorbiaceae)	Root bark	Ground and chewed with "fu-fu", eaten between 3 and 7 times
		Schumanniophyton magnificum (Rubiaceae)	Bark	Infusion as enema
		Telfaire occidentalis (Cucurbitaceae)	Leaves	Chewed
	MALARIA	*Boehmeria platyphylla* (Urticaceae)	Leaves	Cold-water Infusion drunk
		Enantia chlorantha (Annonaceae)	Bark	Alcohol infusion drunk
		Eupatorium odorathum (Asteraceae)	Leaves	Decoction drunk
		Harungana madagascariensis (Hypericaceae)	Leaves	Infusion as enema
		Morinda lucida (Rubiaceae)	Root	Cold-water infusion drunk
	LICE	*Tephrosis vogelii*	Leaves	Rubbed

		(Papillionoideae)		
		Spilanthes diginosus (Asteraceae)	Plant	Rubbed
		Cleome rutidosperma (Capparidaceae)	Leaves	Rubbed
5.VENERAL DISEASES	SYPHYLIS	*Sjatrarbiza maccantha* (Menispermaceae)	Leaf	Infusion taken
	GONORRHOEA	*Anthocleista schweinfurthii* (Loganiaceae)	Bark	Ground with red oil and eaten
		Myrianthus arborus (Moraceae)	Bark	Decoction drunk
		Nephrolepis undulate (Pteridophyte)	Leaves	Mashed in palm wine and drunk
	CYSITIS	*Bambuss vulgaris* (Poaceae)	Leaves	Infusion drunk often
	VAGINAL INFECTION	*Angylocalys tabbotii* (Papillionoideae)	Seeds	Decoction of ground seeds
		Eribroma oblong (*Sterculiaceae*)	Pods	Heated, ground to paste and applied
		Mucana	Seeds	Decoction used

		cochinichinesis (Papillionoidae)		
	BED WETTING	*Barteria fistulosa* (Passifloraceae)	Bark	Decoction as anemia
	GROIN	*Baillonella toxisperma*	Bark	Decoction as anema
	ABSCESS	*Clerodendron globuliflorum* (Verbenaceae)	Leaves	Poultice from heated leaves
		Harungana madagascariensis (Hypericaceae)	Latex	Rubbed and abcess
	HERNIA	*Afrostyrax lepidophyllus* (Styracaceae)	Bark	Aqueous infusion as anema or drink
		Alstonia boonei (Apocynaceae)	Bark	Extract
		Amaranthus spinous (Amaranthaceae)	Leaves	Purge
		Ancistrocarpus densispinus (Tiliaceae)	Roots	Aqueous infusion as enema
		Celtis tessmanii (Ulmaceae)	Bark	Aqueous infusion as enema
		Fagara macrophylla	Bark	Aqueous infusion

		Fagara macrophylla (Rutaceae)	Bark	Aqueous infusion as enema
		Pycnanthus angolensis (Myristicaceae)	Aril	Used to treat hernia
		Schumanociophytum magnificum (Rubiaceae)	Bark	Infusion as drink
6 REPRODUCTION	MALE IMPOTENCE	*Angylocalyso tabbottii* (Papillionoideae)	Seeds	Ground to improve erection
		Carpolobia lutes (Polygalaceae)	Bark	Ground or decoction
	FEMALE INFERTILITY	*Anonidium mannii* (Annonaceae)	Bark	Infusion as enema
		Jatrorhiza macrantha	Leaves	Infusion as vaginal douche
		Scyphocephalim mannii (Myristicaceae)	Bark	Mashed with *aframonum melegueta* fruits as enema
		Musanga cecropioides (Moraceae)	Bark	Mashed with *afromonum* as enema
	PREGNANCY	*Ancistrocarpus*	Leaves	Juice drunks to

	COMPLICATION	*densispinosus* (Tiliaceae)		ease delivery
		Cola acuminata (Sterculiaceae)	Seed	Ground decoction as enema to cause abortion
		Cola lateritia (Sterculiaceae)	Leaves	Infusion drunk to avoid miscarriage
		Cola pachycarpa (Sterculiaceae)	Juice	Infusion + limestone anema to avoid miscarriage
		Musanga cecropioides (Moraceae)	Juice	Used to avoid miscarriage
		Palisota tracteosa "barteri" (Commelinaceae)	Leaves	Infusion as enema to stop bleeding
		Piper umballatum (Piperaceae)	Leaves	Infusion as enema to stop bleeding
		Stachytarpheta indica (Verbenaceae)	Leaves	Use to stop miscarriage
	CHILD BIRTH	*Alchornea floribunda* (Euphorbiaceae)	Roots	Decoction to ease Childbirth
		Lola acuminata	Bark	Decoction as

		(Sterculiaceae)		enema kelp delivery for young mothers
		Laportea evalifolia (Urticaceae)	leaves	Aqueous infusion to advance labour
		Megraphynium macrostachyum	Fruits	Decoction as enema for delayed childbirth
		Piper guineensi Piper umbellatum (Pipperaceae)	Seeds	Decoction as enema to deliver placenta
		Raphidophora africana (Araceae)	Leaves	Infusion as enema stops bleeding after birth.
		Tephrosis vogelii (Papillionioideae)	Roots	Infusion as enema; accelerates labour
	TREATMENT OF NEWBORN	*Irvingia gabonensia* (Irvinginaceae)	Bark	Infusion rubbed on albino babies to stop bleeding
		Massularia acuminata (Rubiaceae)	Fruits	Decoction as enema to deduce umbillical hernia
	LACTATION	*Alstonia boonei* (Apocynaceae)	Bark	Decoction drunk to increase lactation

		Angylocalyx tabbotii (Papillionioi Deae)	Roots	Infusion drunk to increase lactation
		Pycnanthus angolensis (Myristicaceae)	Bark	Ground bark eaten in food to stimulate lactation
7. WOUNDS AND ACCIDENTS	WOUNDS	*Angylocalyx tabbotii* (Papillionioideae)	Bark	Ground bark as dressing
		Bridelia micrantha (Euphorbiaceae)	Bark	Powder as dressing stops bleeding
		Aspillia africana (Asteraceae)	Leaves	Juice stops wounds from bleeding
		Tabernaemontana brachyantha Tabernaemontana crassa (Apocynaceae)	Latex	Used to coagulate blood
	SORES	*Alchornea cordifolia* (Euphorbiaceae)	Bark	Powdered and put in sores and infected cuts
		Dorstenia barteri	Roots and fruits	Mashed and used as dressing
		Paulinia pinnata (Sapindaceae)	Leaves	Ground and applied to sores
		Rauvolfia vomitaria	Root sap	Applied to infected

		(Apocynaceae)		wounds
	SNAKE BITE	*Diodia scandens* (Rubiaceae)	Leaves	Mashed with *Ageratum conyzoides* leaves and eaten
		Pycnanthus angolensis (Myristicaceae)	Bark	Chewed to get strength to get back home for treatment
8.GASTRO ENTEROLOGICAL	HEPATITIS JAUNDICE	*Cassia alata* (Caesalpiniaceae)	Leaves	Hot-water infusion as enema
		Harungena madagascariensis (Hypericaceae)	Bark	Infusion as enema
		Pentaclethra macrophylla (Caesalpiniaceae)	Bark	Infusion as enema for liver problems
	SPLEEN	*Massulania acuminata* (Rubiaceae)	Fruit	Decoction from mashed fruits
		Portulaca oleracea (Portulacaceae)	Plants	Infusion from mashed fruits
	STOMACH ABSCESS	*Fegara macrophylla* (Rutaceae)	Bark	Infusion as enema
	PILES	*Thonningia*	Stem	Used to treat piles

		sanguinea (Balanophoraceae)		
9. PAIN	TOOTHACHE	*Alchornea cordifolia* (Euphorbiaceae)	Leaves	Chewed and juice retained in month
		Anchomanes difformis (Araceae)	Tuber	Paste rubbed around teeth to cure infected gums
		Spilanthes uliginosus (Asteraceae)	Flowers & Leaves	Chewed to reduce pain
	CHEST	*Acanthus montanus* (Acanthaceae)	Leaves	Mashed in red oil and eaten for breathing trouble
		Dennettia tripetata (Annonaceae)	Leaves	Chewed for chest pain
		Mimosa pudica (Mimosaceae)	Plant	Infusion drunk for chest pain
		Petersianthus africanus (Combretaceae)	Bark	Boiled, cooled and drunk for chest pain
	WAIST AND SIDE	*Albizia zygia* *Albizia feeruginea* (Mimosaceae)	Bark	Powdered, boiled and as enema for side pain
		Glossocalyx brevipes (Monimiaceae)	Leaves	Infusion as enema for waist pain

10. ABDOMINAL PROBLEMS	DIARRHOEA	*Alchornea floribunda* (Euphorbiaceae)	Leaves	Infusion drunk
		Anthocleista vogeli (Loganiaceae)	Bark	Decoction drunk
		Bochmeria plathyphylla (Urticaceae)	Leaves	Mashed and eaten
		Lasianthers africana (Icacinaceae)	Leaves	Infusion drunk
		Trichilia rendelotii (Meliaceae)	Root	Decoction as enema
	PURGATIVE	*Alstonia congensis* (Apocynaceae)	Leaves	Used to purge
		Struchium sparagosphora (Asteraceae)	Leaves	Infusion as enema
		Uapaca staudii (Euphorbiaceae)	Bark	Eaten with *Ricinodendron* fruits
	EMETIC	*Baphia sp.* (Papillionioideae)	Leaves	Infusion drunk
		Scoparia dulcio (Scrophulariaceae)	Plant	Infusion drunk

Seaweeds in medicine and pharmacy: A global perspective

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ABSTRACT

The term seaweed carries the connotation that the plants under discussion are useless and worthless. In this paper the author reviews the state of the art with respect to the utilisation of seaplants in various parts of the world, and shows that there are more uses of the plants most people realise. Indeed, he concludes that the term seaweed is inappropriate for the marine plants in question. He gives an outline of the utilisation of seaweeds in medicine, in pharmacy, and in various other applications, on a worldwide basis. He advocates that in Africa, seaweeds are a grossly under-exploited resource, and calls for scientists in the region, and in the Third World countries in general, to pursue a regional collaborative approach in the development of the seaweed resources. Finally, he appeals to donor agencies for financial assistance towards the realisation of goals pertaining to the development of the unique marine plant resources.

Introduction

Let me begin my presentation by taking your minds back to the beginning of things; and allow me to start with a quotation from the First Book of Moses in the

Bible:

> **...And God - id, "Let the waters under the heavens be gathered together into one place and let the dry land appear". And it was so. God called the dry land Earth, and the waters that were gathered together, He called Seas. And God saw that it was good" (Genesis 1:9-10, Revised Standard Version).**

Allow me to quote further from the same author, in order to drive home the subject of my presentation

> **...And-God said, "Let the waters bring forth swarms of living creatures...' So God created the great sea monsters, and every living creature that moves... And God saw that it was good. And God blessed them saying, 'Be fruitful and multiply, and fill the waters in the seas...' (Genesis 1:20- 22).**

And the seaplants multiplied. In the region of the Atlantic Ocean known as the Sargasso Sea the floating community of *Sargassum* alone has been estimated to be 5 to 10 million tonnes, fresh weight (Chapman and Chapman, 1980).

The plants that will constitute the subject of this presentation, the *seaweeds* fall within the framework of the great sea monsters referred to in the book of Genesis. Some may actually attain a height of 30 to 40 metres. This exceeds the height of most of the tall trees found on land. The plants in the sea fall under two broad ecological divisions. The first embraces the tiny microscopic algae, the *phytoplankton,* which grow in a freely floating condition within the seawater mass. The second division comprises the macroscopic algae which, typically, grow

attached to the seabed and other solid objects in the ocean. The latter are referred to as *benthic algae. Seaweeds* fall within the domain of the benthic algae.

Because we are, essentially, terrestrial mammals, and since many of us were born and raised in far inland localities, we never come to a full understanding of the usefulness and economic potential of the marine plants that are embraced under the term *seaweed.* The situation is aggravated by the fact that the term "weed", as stated above, carries the connotation of useless and worthless plants. But actually, the marine plants in question have innumerable uses to mankind.

Many seaweeds are edible. When used as food they not only supply the body with a wide range of vitamins and essential mineral elements (including iodine), but some are also rich in protein and digestible carbohydrates (Chapman and Chapman, 1980). The protein content of the blue-green alga *Spirulina platensis* is, for example, up to 60 -70% protein, on a dry weight basis. This is the highest protein level reported for any plant species (Leonard and Compere, 1967).

The use of seaweeds as food for man goes far back into antiquity. In a book published in China by Sze Teu about 600 B.C., it is stated that some seaweeds are a delicacy, fit for the most honourable guest, even for the King himself (Johnston, 1966). The most widespread uses of seaweeds for food are found among the inhabitants of Japan, Korea, China, Indonesia and Hawaii. The most commonly eaten marine plants arc species of *Porphyra, Laminaria, Monostroma,* and *Undaria.* Currently these arc produced largely through farming, and the annual crop production is incredibly high. For *Laminaria,* the 1983 production figure for China alone was 1.4 million tones, wet weight (or 230,000 tones dry). For *Porphyra,* the 1981 production figure in Japan alone was 340,000 tones, wet weight (Tseng and

Fei, 1987). These seaweeds now constitute a multi- million dollar industry.

The potential utilisation of seaweeds for food in Africa, Latin America and India is an issue which certainly deserves greater attention than has hitherto been the case. Indeed, it is remarkable how singularly little attention has been paid to the algae as food by the inhabitants of these regions.

Many seaweeds could also be developed for use as livestock feed supplements. This is by virtue of their rich content of vitamins and inorganic mineral nutrients, including many trace metals. Some seaweeds are also rich in protein. Indeed, the production of livestock meal supplements from seaweeds constitutes a well developed industry in Western Europe, and especially in Norway and Scotland. Over 20,000 tonnes of the seaweed *Ascophyllum nodosum* are produced as livestock feed supplements in Norway alone per annum (Jensen, 1978; Chapman and Chapman, 1980).

Considering that many countries in Africa support large population of cattle, goats, sheep, camels, and poultry, and considering the well-documented advantages of using seaweeds as livestock feed supplements (Levring *et al.,* 1969; Chapman and Chapman, 1980), one can see the need for us to pay increasingly greater attention to our seaweed heritage. Seaweeds could also be used as an agricultural fertilizer. When used as manure, they supply the crop plants not only with a wide variety of inorganic mineral nutrients (including the essential trace metals), but also with valuable organic substances which serve as crop pesticides (Fenical, 1983), or as growth hormones (Augier, 1977; Mooney and Van Staden, 1984). Additionally, many seaweeds contain colloidal substances in their cell walls, which could help to bind the soil particles together, improving the crumb-like structure of the soil,

and facilitating aeration (Chapman and Chapman, 1980). The use of seaweeds as manure actually goes back to the days of the ancient Chinese, the Vikings, and the Greeks. In France, it is documented that as long ago as 1681, a royal decree was issued, regulating the conditions under which seaweeds could be collected from the shore for application as manure (Aitken and Senn, 1965).

In the more recent times, seaweeds have been developed for the production of liquid agricultural fertilizers, which can be concentrated, and thus be transported more easily for application in the more inland regions. The liquid fertilisers can also be applied foliarly by spraying, with the use of air crafts, etc.

The liquid seaweed fertilizers are marketed under various commercial names, such as *Maxicrop, Alginure,* etc. (Chapman and Chapman, 1980; Abets and Young, 1983). It is now well documented that plants which are sprayed with the liquid seaweed extracts, not only produce significantly higher crop yields, but are also rendered free of attack by most of the common crop pests. They also become more drought resistant. The use of seaweed for the production of liquid fertilisers is thus now very popular, and is a multi- million dollar industry. Again, the use of seaweed as manure is something which Africa has, on the whole, neglected and to which we must now draw greater attention (Mshigeni, 1983).

Have I drifted away from the theme of the conference too far, and for too long? Yea, but with a purpose. If by using seaweed as food man gets adequate levels of protein, this means that we have freed him from *kwashiorkor.* If by eating seaweed man gets the essential vitamins, this means that we have freed him from *beriberi, scurvy* or other hypovitaminoses. If by eating seaweed man gets adequate levels of iodine, this means that we have freed him from goitre. Actually,

in localities where seaweeds are regularly eaten as food, goitre is completely unknown. All this could be labelled *preventive medicine.* But even in curative medicine, there is a big hope in seaweeds.

The fact that there is such a wide range of medicinal products from the vascular plants on land, that two-thirds of our planet is covered with seawater, and that the ocean waters support a wider variety of plant, types than what we are used to seeing on land, one would expect many of the plants in the sea to possess chemical substances which could be used in curative medicine. This is, indeed, the case, as will now be elaborated.

Direct uses of seaweed as medicine

A survey of the literature indicates that the earliest records on the direct utilisation of seaweeds as medicine go back to the days of Emperor Shen Nung who, in 2700 B.C., documented medicinal uses of seaweeds in a Chinese herbal (Moi, 1987). The Chinese *Materia Medica,* published in the 8th Century A.D., (Chapman and Chapman, 1980), also lists many algae used in medicine (e.g., in the treatment of goitre, for wound-healing and for reducing hypertension, etc.).

In Mediterranean Europe, the Greek physician, Stephanopoli, discovered in 1775 that the red seaweed *Alsidium helminthochorton,* found on the rocky shores of Corsica, was an efficient vermifuge (Chapman and Chapman, 1960). The Hawaiians have also, from days immemorial, used the seaweed *Hypnea nidifica* for curing stomach ailments (Reed, 1906). In Indonesia, *Hypnea musciformis* was also used as a vermifuge from the very ancient times (Zaneveld, 1959).

In New Zealand, the Maori people traditionally harvested the seaweed *Durvillea* for use as medicine for the treatment of scabies, and also as a vermifuge (Schwimmer and Schwimmer, 1955). In Tonga, the inland pregnant women traditionally used to go to reside on the coast, in order to gather some particular seaweeds, which were believed to be beneficial to them in their pregnancy conditions (Lucas, 1936).

In latin America, South American Indians, from the ancient times, used to collect *Sargassum bacciferum* for use as a cure for goitre and kidney disorders (Schwimmer and Schwimmer, 1955). In many of the Caribbean Islands, and especially in Cuba, *S. vulgare* was also widely used as a vermifuge (Chapman and Chapman, 1980).

More recent studies by various scientists in different parts of the world, have revealed that there are more species of seaweeds which are used in traditional medicine than is generally conceived. In the Philippines, *Ulva pertusa* is used for wound healing. Other Philippine seaweeds used as medicine include *Gracilaria lichenoides* and *Ulva lactuca* (Nuqui, 1987). In Malaysia, *Acetabularia major* is commonly used for the treatment of gall stones, and *Chondria armata* is used as a vermifuge (Moi, 1987). In China and Hong Kong, species of *Sargassum* are commonly used for the cure of goitre, coughs, fever, and various tumours; *Digenia simplex* is used as a vermifuge; *Lithothamnium pacificum* is used as an expectorant, as a cough remedy, for reducing fever, and for the inhibition of tumours; and *Caloglossa leprieuri* is used as an antiheminthic agent (Tseng, 1983, Win Shin-Sun, 1987).

In the Mediterranean, in Western Europe, and in North America, *Hypnea*

musciformis is used as a vermifuge; _Palmaria palmata_ is also used as a vermifuge; _Dictyopteris polypodioides_ is used for the cure of lung diseases; and _Laminaria digitata_ was, in 1682, introduced by Dr. C.F. Sloan, for use as a cervical dilator, to facilitate baby delivery (Chapman and Chapman, 1980; Hale and Pion, 1972).

Other documented medicinal uses of seaweeds include their utilisation as an aphrodisiac (e.g., _Porphyra_ sp. in the Philippines, under the name "gamet"); as a cure for menstrual troubles (e.g., _Laminaria japonica_ in China) and also as a cure for syphilis, (e.g. _Laminaria saccharina_ in China (Chapman and Chapman, 1980; Nuqui, 1987).

Curative medicinal substances in seaweeds

For many traditional practices, modern scientific and technological advances have, _post facto,_ revealed that the ancients were, in fact, right. Most of the seaweeds (e.g., _Sargassum_ spp.) which were traditionally used as a cure for goitre, have now been found to contain appreciable high levels of iodine, the curative substance (Chapman and Chapman, 1980). _Digenia simplex,_ which was traditionally used as an anthelminthic agent, has been shown to contain kainic acid and allokainic acid (Levring _et al.,_ 1969). For _Chondria armata,_ also used as a vermifuge, the curative substance has been found to be domoic acid. To-day one can buy medicinal drugs manufactured from fronds of _Digenia,_ marketed under the trade name _helminal,_ or _digesan,_ for use against _Ascaris lumbricoides._

Recently there has been a rapidly growing awareness on the need for research to be undertaken on the uses of seaweeds for modern medicine. Many species of marine algae have now been screened, and also tested against the common

disease-causing bacteria, fungi and protozoans. In these studies the test organisms included gram-positive bacteria such as *Staphylococcus aureus* and *S. pneumoniae,* gram-negative bacteria such as *Escherichia coli* and *Pseudomonas aeruginosae* and fungi such as *Trichophyton mentagrophytes,* and the yeast *Candida albicans,* as well as the *protozoan, Trichomonas foetus.*

These studies have revealed that many species of seaweeds are biologically active against many of the common disease pathogens. Amongst the Green Algae (or the Chlorophyta), the biologically active members include species of the genera *Codium, Halimeda, Ulva, Cladophoropsis Caulerpa* and *Enteromorpha.* Amongst the Phaeophyta (Brown Algae) the taxa with antimicrobial activity include species of *Dictyopteris, Zonaria, Ecklonia, Durvillea, Dictyota, Sargassum* and *Turbinaria.* Amongst the Rhodophyta (Red algae) microbial activity has been detected amongst the species of *Chondria, Digenia, Laurencia, Caloglossa, Grateloupia, Hypnea* and *Murayella* (Chapman and Chapman, 1980; Tseng, 1983; Baker, 1987; Sivapalan, 1987).

Many scholars are now going beyond the screening stage. They are actively involved in extracting and characterising the active substances responsible for suppressing the growth of, or totally destroying the disease-causing bacteria, fungi or the protozoans referred above. Members of this audience who wish to go deeper into this issue, are referred to the excellent works of (Fenical, 1980, 1983; Fenical and McConnell, 1983; Glombitza, 1977, 1979; Glombitza *et al.,* 1982).

According to Fenical (1983), many seaweeds show the presence of a wide range of biologically active compounds, which are often quite unrelated to those of their terrestrial counterparts. Many blue-green algae, indeed, contain substances which

show potent anti-leukemic activity. Extracts from *Lyngbya majuscula* have recently given rise to a novel powerful antibiotic, malyngolide (Fenical, 1983).

In their recent studies on species of *Sargassum* that were traditionally used in Chinese herbal medicine for the treatment of cancer, Yamamoto (1974), and Yamamoto *et al.* (1977, 1982) revealed that the extract from *S. fulvellum* was active against leukemia and sarcoma tumour cells implanted on mice. Extracts of *S. thunbergii* were also tested (Yamamoto *et al.,* 1981). In both cases the extracts from the seaweed gave an inhibition ratio of up to 93.7%, which showed a very high promise as an anti-tumour agent. The author referred to above found the anti tumour component to be a polysaccharide, which was suggested to be either a sulphated peptidoglycuronoglycan, or a sulphated glycuronoglycan (Yamamoto *et al.,* 1981, 1982).

Several other species of *Sargassum* have also been found to contain extracts which are very active against bacteria, including *Staphylococcus aureus, Escherichia coli* and *Salmonella* spp. The active anti-bacterial constituent of *Sargassum kjellmanianum,* has been found to be a cyclopentenone (Fenical, 1983), whose structure has been determined.

Other applications of seaweeds in medicine and pharmacy

Let us now consider the indirect uses of seaweeds in medicine and pharmacy. In addition to their vitamins, inorganic minerals, proteins, and the medicinal compounds discussed above, seaweeds also contain colloidal polysaccharides which are of great significance in industry and commerce. The best known of these is *agar,* a sulphated galactan which is extensively used in microbiological and

public health laboratories, as a culture medium for bacteria and fungi.

The name *agar* is of Malaysian origin. It was the traditional name for the red seaweed *Eucheuma,* which the people of Malaysia harvested, dried, and boiled to produce a gel that was used for food. The significance of agar in medicine and pharmacy was not, however, realised in the western world until 1881, when Robert Koch introduced its use for the culture and isolation of pathogenic micro-organisms. Since then agar has become a necessity for every hospital and bacterial research laboratory. Agar is preferred to any other solid culture medium because it is relatively inert, and is not decomposed by most bacteria.

Today most of the agar supplies of the world are extracted from species of the red seaweeds *Gracilaria, Gelidiella, Gelidium* and *Pterocladia,* which are well represented on our African shorelines. Indeed, Madagascar exports the agarophyte, *Gelidum madagascariense,* to Japan.

Another colloidal polysaccharide from seaweeds, which has a wide range of applications in industry and commerce, is *carrageenan.* This is also a sulphated galactan, extracted from red seaweeds such as *Chondrus, Gigartina, Hypnea, Sarconema,* and Eucheuma Since 1950, Tanzania has been involved in the export of several species of *Eucheuma* to Western Europe, where they are processed for carrageenan production. There are now serious efforts in the country, aimed at augmenting the export tonnage of *Eucheuma* through farming. The colloid from the seaweed, like agar referred to above, readily forms gels in hot water, and is thus referred to as a hydrocolloid.

***Carrageenan* and *agar* find innumerable applications in food products, cosmetics,**

and pharmaceutical industries, as gelling, thickening, emulsifying and stabilising agents. Many chocolate milks and infant food preparations, many medicinal syrups, many ointments ... contain varied proportions of agar or carrageenan. For a more thorough study of these applications, the reader is referred to the excellent works of Levring *et al.,* (1969) and Chapman and Chapman (1980).

The Brown Seaweeds produce a different kind of hydrocolloid, *algin,* which is a polymer of guluronic and mannuronic acids. The tropical seaweeds containing exploitable quantities of algin include species of *Sargassum, Turbinaria, Hormophysa* and *Cystoseira.* In the temperate waters, the most important sources are species of *Macrocystis, Laminaria, Ecklonia* and *Nereocystis.* Algin is also extensively used as a gelling thickening, emulsifying and stabilizing agent in many branches of modern industry. These include the textile industries, the pharmaceutical industries, the breweries, and film industries, etc. Many medicinal substances are also delivered to the patients in the form of capsules which are coated with algin. Here again, the reader is referred to the detailed account on algin in the publications by Levring *et al*., (1969) and Chapman and Chapman (1980). The reader will, indeed, find that medical practitioners indirectly prescribe the use of seaweed colloids more frequently than they normally imagine. Perhaps many of our dentists are also not aware of the fact that dental industries also make very extensive uses of algin, in various dental preparations. Modern physicians additionally make frequent uses of algin as an adsorbent in wound dressing; as a haemostatic in brain and thoracic surgery (Schwimmer and Schurmmer 1955) and in many other medical practices.

Conclusions and recommendations

From what, has been outlined above, it is self evident that the plants discussed in this paper are not weeds in the real sense of the word. The name seaweed is certainly a misnomer for the seaplants it represents.

In this paper the thrust of the discussions has been on the utilisation of seaweeds in medicine and pharmacy. But it has also been shown that the plants could similarly be developed for use as food, fodder, manure, and as source of industrial colloids. To a small extent, there are a few localities in Africa where seaweeds are being exploited on a commercial scale (Mshigeni, 1983; 1987). But, by and large, Africa is a *terra incognita* with respect to the stage of exploration and mopping of her marine plant resources.

To make any significant step forward towards the development of our seaweed resources for medicine and pharmacy, our Third World institutions of higher learning, and our research and development centres, must attract more scientists into research on the biology, biomass ecology, biochemistry and microbiology of the marine plants in question, than is the case at present. Indeed, we need to pursue a multidisciplinary approach, involving botanists, chemists, medical doctors, sociologists, etc. Currently our progress is curtailed by the lack of an adequate number of well trained scientists, who are working full time on the subject. In view of the fact that most of the Third World countries share this problem, and considering that this could be most effectively solved through regional collaboration, and through the sharing of the human and other available resources, it is recommended that the Third World countries represented in this conference, consider the possibility of establishing a small international Task Force, to dig deeper into the issue of developing our vast, but neglected, marine plant resources. It is recommended also that the donor agencies represented at

the conference also consider, favourably, requests for scholarship support, library support, and for the acquisition, of pieces of research equipment, which are so vital in the characterisation of some of the chemical substances contained by the seaplants.

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Biotechnology and medicinal plants

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ABSTRACT

Tie paper reviews issues on biotechnology, and medicinal plants. Third World

countries do not have mechanisms for safeguarding sovereignty over their genetic resources, or foe the conservation of tropical products and the traditional knowledge of indigenous people. Advances in biotechnology have heightened interest among biotechnological and pharmaceutical companies in herbal plants and microbiological organisms of the South, as a source of raw materials for new pharmaceutical products. Third world countries must also benefit from their knowledge and biological treasures. Long term conservation measures of their plant resources must thus be put in place. In the process, the indigenous people who enrich the scientists with a wealth of information on traditional medicinal uses of the plants, must be treated with respect, and be given the recognition they deserve.

Introduction

With advances in biotechnology there is renewed and increased interest in the vascular and other plants of the South as a source of raw materials for developing new pharmaceutical products. At least 7000 medical drug compounds in modern Western pharmacopeia are derived from plants. In 1985 the retail value of plant-derived drugs in the industrialized world was estimated to be at least $43 million. In recent decades, pharmaceutical companies have focused on the synthetic production of medicinal products, but the chemists have found it difficult to improve on what nature has provided. In fact, of all the useful plant-derived drugs, only 10 are synthesized in the laboratory. The rest are still extracted from plants.

With advances in plant molecular biology, new cell culture techniques, new bio-assays, and the availability of new and precise analytical methods for screening

the plants, discovery of natural products is expanding. A 1988 consultancy report by a United Kingdom firm, Mc Alpine and Warrier, indicated that the market potential for sophisticated herbal drugs in the Western World could range from $4.9 billion to $47 billion by the year 2000, if the AIDS epidemic continued unchecked.

The world's tropical moist forests cover 6% of the earth's surface, and contain at least 50% of all the vascular plant species. It should be noted that, 65 - 75% of higher plant species are indigenous to the rain forests. Little is known about the vast majority of these species, and, because of deforestation, they are becoming extinct at a rate unparalleled in human history. Yet, the rain-forests plants have been considered to be a *complex* chemical storehouse for modern medicine (Principe, 1989).

The world picture

Less than 1% of tropical forest species have been examined for their possible use to human kind. But at least 1400 plant species of tropical forests are believed to be of potential in curing cancer. It is noted with concern that with tropical forests being destroyed at the rate of up to 100 acres per minute, and the global rate of species extinction now estimated at 400 times faster than in the recent geological past, scientists warn that 20 - 25% of the world's vascular plant species will be lost by the year 2000 (RAFI, 1989).

It is difficult to put a price tag on medicinal plant species, but it helps to consider the enormous social and economic value of a few of our tropical medicinal plant *"superstars".*

The first example, Madagascar's rosy periwinkle plant *(Catharanthus roseus)* is a source of at least 60 alkaloids, of which the two important alkaloids, vincristine and vinblastine, have revolutionized the treatment of childhood leukemia and hodgkin's disease. One requires 15 tonnes of the plant leaves to make one ounce of vincristine, which sells for US 9100,000 a pound. Commercial sales of drugs derived from rosy periwinkle total approximately $160 million per year.

The second example is *Rauvolfia.* Material obtained from the plant, the so-called, "shake root" plant, from monsoon forests in India, contains an alkaloid, reserpine, which forms the base of tranquilizer products, and other drugs used in the treatment of hypertension and schizophrenia. In the early 1980s the retail sales of reserpine-based products in the U.S.A. alone, exceeded $280 million a year. Biotechnological companies and Pharmaceutical Corporations are combing the tropical forests of the Third World countries, in pursuit of exotic medicinal plants as they are interested in natural products screening (RAFI, 1989).

It is reported that, the Japanese and European companies are even more active than the United States counterparts. Few of them are doing their own collections in tropical forests, and some are contracting with third party collectors. For example, Merck Sharpe and Dohme from United States, a leader in natural products discovery, routinely makes contracts for the collection of tropical plants. The company is now in Brazil, searching for a medicinal plant superstar, *tiki uba,* which has uses as an anti- coagulant. Some of the companies have turned to China, where herbal remedies have been used for centuries. It is reported, for example, that a United State drug company, Up John, is studying ten compounds from the ancient Chinese herbal medicines, with the aim of developing new drugs to fight cancer, cardiovascular diseases, and disorders of the central nervous

system. G.D. Searle and Company, is evaluating extracts from Chinese plants used for gastro-intestinal disorders.

It is further reported that the Biotics Company from the United Kingdom started working with the European Commission in 1986 as a commercial broker to supply exotic plants from developing nations, for pharmaceutical screening. Major pharmaceutical companies, such as ICI, Beechams, Rhone Paulen, Glaxo, Hoechst, Novo and Sandoz, expressed interest in obtaining extracts from indigenous plant species from the Third World. According to information available, Biotics Limited, for example, provided Glaxo Pharmaceuticals (UK) with plants from Ghana.

Medicinal substances extracted from vascular and other plants from the South today will become the patented products of biotechnology of tomorrow. The potential for developing new drugs, which may hold promise for curing diseases such as cancer and other life threatening ailments, is great. Despite the potential benefits, there is a historic disregard for Third World cultures from which these plants are extracted.

The discovery of medicinal substances from vascular plants does not just happen by accident. The people who have traditionally lived in tropical forests are the key people to assist the modern scientists in the understanding, utilization and conservation of tropical plant diversity.

Professor Norman Farnsworth of the University of Chicago, U.S.A., estimates that three quarters of all plant-derived drugs were discovered because of their prior use in indigenous medicine. Mark Plotkin of the World Wildlife Fund, observes that *"...because you have a Ph.D. and the other guy can't read, it does not mean you*

know more about botany than he does". **He gives the example that forest dwelling Indians employ at least 1,300 plant species for medicine and related purposes.**

Worldwide, Third World communities use at least 3000 plant species to control fertility. According to Plotkin, every time one medicineman dies, it is as if a library was burned down. He goes on saying that it is worse than that, because if a library is burned, most of the information can be found in other libraries. However, when a medicineman dies his knowledge is lost, and is lost forever!

The most efficient way to identify plants, and their medicinal properties, is to ask the people who use them (Plotkin 1988). Most healers, in our experience, have no written records of the plants they use.

It should be further added that the demand for the South's exotic germ plasm is not limited to plants only, nor is collecting restricted to tropical forests and land surfaces. There is also interest in bacteria, algae, fungi and protozoa, and a wide range of marine organisms. These also have potential as sources of valuable pharmaceutical raw materials. For example, Mycosearch, a small biotechnology company in the USA collects fungi samples from around the world, and screens them for valuable natural compounds. The company maintains a collection of over 20,000 fungi, and over 50% of them originate from the tropics. Pharmaceutical companies such as Hoffman La Roche, Dupont, Ciba Geigy, Schering Plough, and others, pay hundreds of dollars per sample for potentially valuable fungi.

Companies such as Smith Kline and French, and the National Cancer Institute (USA), are involved in collecting from tropical waters, corals, sponges, anenomes and other organisms. Sea Pharm, a marine pharmaceutical company from the USA,

has a $3.6 million contract with NCI, to collect in tropical seas and elsewhere. Scientists believed that organisms were not capable of growing more than 30 metres below ground but the recent discovery of subsurface microbial collections, located 600 metres below the earth's surface, has uncovered a potentially vast and new frontier for discovering living organisms that may be a future source of pharmaceuticals.

The conservation and utilization of medicinal plants is socially and economically important for our developing nations. WHO estimates that 80% of the World's population depend on traditional herbal medicine. Indeed, herbal medicines offer tremendous economic potential, not only as an export crop, but - the resources for developing *locally controlled industry,* which can substitute the costly pharmaceutical imports. Such developments are taking place in Thailand, Turkey, the Philippines, and in China, where herbal medicines constitute a big business.

Conclusions

In conclusion, Third World countries should not be the loser in the frantic search by biotechnology and pharmaceutical transnationals in the tropical forests. Our vascular plants in the forests are the raw materials for new drugs and for genetic seed improvement. Plants which can withstand hostile environments, which resist attack by the common pests, or which give more and better fruits are the material of a US 116 billion world seed market.

In 1985, industrialized countries paid at least US $43 billion for plant-derived drugs. Indeed, developing countries get nothing for the plants collected by the gene hunters, on behalf of powerful companies. At least they should pay royalties

for the products developed from them (Shand, 1989). Furthermore, industrialized countries have now recognized that the useful properties of the South's plants are the result of centuries of a careful selection by many generations of peasants, but they are resisting the logical conclusion that developing countries should be compensated for their traditional knowledge and biological storehouse.

The search for new medicinal plants is a race against time. Tropical forests of the Third World hold an incalculable value, as an untapped emporium of germplasm for the development of new drugs. The most powerful scenario is that pharmaceutical and biotechnological interests will become powerful allies in an effort to stop or curtail the destruction of the world's tropical forests. Third World countries and indigenous people should also benefit from their knowledge and biological treasures. Long term conservation measures must be put in place. In the process of collecting the plants, the indigenous people must be treated with respect, and be given the recognition they deserve. Procedures should be developed to compensate the healers and others for the utilization of their knowledge and their biological resources. Here is where we require the cooperation of the Third World countries, for a common plan of action.

Lastly, despite the many constraints which exist in developing countries, such as lack of skilled or trained manpower, lack of technical know-how and financial resources, and shortage of equipment, frequent exchanges of ideas and experience among scientists and technologists should be encouraged and financed, so as to lead to self-reliance, in the various aspects of research and development in the proper utilization and judicious exploitation of herbs, as a natural resource. It is noted that, in developing countries, there are no substitutes for herbal drugs in terms of both cost and availability of raw materials. Hence the technology

involved elsewhere, in the revival and use of herbal-based medicines, should be made available to the developing countries for the better use of their natural resources. In this respect, the role of some of the United Nations Organizations such as UNDP, UNESCO, UNIDO, FAO and WHO is vital, in providing necessary assistance in various aspects of research and development, and in improving the efficiency and capability of the local scientists.

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Phytochemical investigations of four medicinal plants of Malawi: What next?

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ABSTRACT

Results of the phytochemical investigations of four plants of Malawi used in traditional medicine are given. The biological activity of the isolated compounds indicate that information from traditional healers is vital, as it gives useful leads in the selection of medicinal plants to be studied. The question on how the results obtained in phytochemical investigations, such as this, are usefully utilised and developed for the benefit of the people, has not yet been fully addressed at. In this paper suggestions on this issue are given.

Introduction

Research on plants of Malawi used in traditional medicine has gathered momentum. The selection of plants with acclaimed biological properties is made possible from information obtained from traditional healers. The traditional healers in Malawi have formed a professional association called the Herbalists Association of Malawi, chaired by Chief C.W. Mbatata. This Association collaborates with the Government, medical personnel, and scientific researchers, in their endeavour to promote good health to the people of the country, under a politically stable environment prevailing in Malawi.

The information obtained from traditional healers gives useful leads to plants that may have biological activity, and, in most cases, the plants so investigated do show remarkable biological properties.

The plants

In Eastern, Southern and Central Africa, the tuberous roots of *Mondia whytei*

Skeels (Asclepiadaceae, Milkweed family) are ground to a powder, and taken orally in porridge, beer, soup or tea, as an aphrodisiac, and also to treat anorexia, schistosomiasis, constipation, and gonorrhoea (Gelfand *et al.* 1985). A phenolic glycoside was isolated from the methanol extract of the tubers, using combined chromatographic techniques. The structure of *1* was determined by spectroscopic methods (proton and carbon-^{13} NMR, ultraviolet and infrared spectroscopy) and by synthesis of the aglycone.

The powdered tuber was extracted successively with dichloromethane, methanol and water at room temperature. The methanol extract was separated by droplet counter current chromatography (DCCC) (chloroform:methanol:isopropanol:water 5:6:1:4, descending mode), followed by column chromatography on Sephadex LH-20 (Methanol (MeOH)). Final purification was achieved by medium pressure liquid chromatography (MPLC), RP-8 (MeOH-H_2O, step-wise gradient).

Acid hydrolysis of the glycoside with 5% ethanolic sulphuric acid afforded the aglycone, xylose and glucose (thin layer chromatography (TLC)). The mass spectral (MS) data indicated that xylose was the terminal sugar. The interglycosidic linkage was deduced from carbon-13 nuclear magnetic resonance (^{13}-NMR) data.

Synthesis of the aglycone from 2,4-dihydroxybenzoic acid was achieved in three steps. Methylation, to give 2-hydroxy-4-methoxymethyl benzoate, followed by reduction to yield 2-hydroxy-4-methoxybenzyl alcohol, and then partial oxidation of the primary alcohol with pyridinium chlorochromate (PCC) to give 2-hydroxy-4-methoxybenzaldehyde, the NMR data of which were identical to those of the

aglycone, which was obtained after hydrolysis of the glycoside.

The pharmacological interest in the genus *Hypoxis* (Hypoxidaceae) arises from its use in traditional medicine by people in Eastern, Central and Southern Africa. Infusions of the tuber are used as a remedy for prostate hypertrophy and uterine cancer (Gelfand *et al.,* 1985).

Compounds so far isolated from various *Hypoxis* plants are zeatin and zeatin glycoside (Van Staden, 1981), hypoxoside from *H. obtusa* (Marini-Bettolo *et al.,* 1982), acuminoside from *H. acuminata,* nyasicoside (Marini-Bettolo *et al.,* 1985), nyasicoside from *H. nyasica* (Galefi *et al.,* 1987) and 1-(3",4"-dihydroxyphenyl)-5', 4'-dihydroxyphenyl)pent-l-en-4-yne from *H. rooperi.* These compounds show strong anticancer activity (Drewes *et al.,* 1989).

Phytochemical investigations of *Hypoxis obtusa* have led to the isolation of a new phenolic glycoside named *obtusaside,* together with known compounds such as, accuminoside, hypoxososide and nyasoside, from the methanol extract of the whole plant, using chromatographic separation techniques. The structure of the glycoside was established by spectroscopic methods and chemical transformations.

The whole plant was cut into small pieces and extracted with methanol. The methanol extract was washed with dichloromethane and n- butanol, following which, the n-butanol extract was fractioned chromatographically.

Enzymatic hydrolysis of the glycoside with β-D-glucosidase, gave 2,5-dihydroxybenzyl alcohol from the ethyl acetate extract, identified as its triacetate,

whereas acid hydrolysis with 5% ethanolic sulphuric acid gave 3- hydroxy-2, 6-dimethoxyethyl benzoate and glucose, as the sole monosaccharide in the aqueous solution (TLC). The presence of glucose was confirmed by the formation of pentaacetyl glucitol, and by comparison with an authentic sample (gas chromatography (GC)).

The glycoside was converted to the hexaacetyl derivative, while permethylation only gave the tetramethyl ether, due to steric hindrance of one phenolic hydroxyl group by the sugar moiety. The glycoside, an off-white armophous powder, gave a dark blue colour with iron (III) chloride, a positive test phenolic hydroxyl groups.

The spectroscopic data was consistent with the structure of the glycoside.

From the methanol extract of the tubers of *Hypoxis nyasica,* three glycosides: hypoxoside (previously isolated from *H. obtusa*), nyasoside and nyasicoside were isolated, together with two new monoglucosides named mononyasine A and mononyasine B.

These glycosides have the same aglycones, nyasoside (1-(4'-hydroxyphenyl)-3-(4"-hydroxyphenyl))-1,4-pentadiene. The structures were assigned by comparison of their spectroscopic data (and of the corresponding methyl and tretrahydromethyl derivatives) with those of nyasoside (and tetrahydronyasoside) (Messana *et al.,* 1987).

In our continued studies on plants used in traditional medicine, we undertook the phytochemical investigations of *Sesamum angolense* Wel. (Pedaliaceae). This plant is used in traditional medicine to treat leprosy and related skin diseases. It

is also used as a substitute of soap to wash women's hair. It is also endowed in particular with haemostatic properties and is used in Malawi to prevent bleeding after tooth extraction. Sesangolin and fatty acids have been previously isolated from the steam distillation of the leaves (Msonthi, 1984). The methanol extract of the root bark has resulted in the isolation of two new naphthoxirene derivatives (Potterat *et al.,* 1987), and a new iridoid glucoside methyl antirrinoside-4-carboxylate, sesamoside, together with known compounds; phlomiol, pulchelloside-1, β-hydroxyipolamiide and a phenylpropanoid glycoside called verbasicoside (Potterat *et al.,* 1988).

The methanolic extract from the root bark of *S. angolense* was submitted to DCCC (chloroform-methanol-isopropanol-water (5:6:1:4) as solvent system in the ascending mode). Further purification by medium pressure liquid chromatography on RP-8 afforded these compounds, which were characterised by spectroscopic methods and by comparison with authentic samples (TLC and HPLC). Tests are underway to determine if these compounds could be responsible for the haemostatic properties of the plant.

Having got these results, there is a need for the government to take action on how best we can utilize these findings, through participation of local pharmaceutical industries and other relevant institutions in developing these compounds for their ultimate use, if any, by the general public.

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The chemistry and pharmacology of the essential oil from the leaves of Hyptis suaveolens (L) Point

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Introduction

The use of indigenous plants for medical purposes is one of the greatest heritage our community must be proud of and preserve. Through trial and error, our ancestors collected the knowledge of plants which they used for various reasons. They developed medicines to cure ailments, arrow poisons to paralyse animals and birds, made colours, for decorating ornaments and clothes, cosmetics, perfumes and made preservatives. The proper knowledge of the plants which are useful and authentic is left with old men and women who are just ending their life span, and a few are left. Unlike in other continents, the African herbal knowledge is non-documented, which is resulting into a gradual extinction of traditional methods of healing using herbs and natural salts. We are hereby calling scientists of all professions to come to the rescue of our culture which is useful to none, except ourselves. We won't go in detail mentioning specific drugs in the pharmaceutical shelves which are of plant origin, but it is estimated to be about

60%. We believe that the duty of experts involved in traditional medicine research is to provide scientific basis of the practices of our herbalists aimed at upgrading, improving or authenticating their practices, pointing out without fear, the bogus medicinemen and fake traditional healers and assure medical practitioners that, the drugs made from indigenous plants are as good as modern ones. Thus by doing this the scientific community shall be making a very useful contribution to therapeutic innovation in primary health care in Africa.

We shall now present our research results on one of the medicinal plants commonly found in Tanzania which is called *Hyptis suaveolens.*

The plant is a herb of about 60 - 90cm tall. It is widely distributed all over Tanzania (Watt and Brandwijk 1969) and it is known by different vernacular names; e.g. Mvumbasi (Swahili), Mkamba (Chagga) and Mwatabazimu (Haya) etc. The plant is used by traditional healers to treat epilepsy, febrile, convulsions and abdominal pains (direct communication with healers). It is also reported to cure parasitic cutaneous diseases and fungal infections.

Chemical analysis of the plant led to the isolation of L-sabinene, d-limonene, fenchone, α-terpinene and felandrene (Mukherje *et al.* 1964), as well as several triterpenic acids, such as ursolic acid (Misra *et al.* 1983), diterpenoids, such as suaveolic acid and suaveolol (Misra *et al.* 1981).

We have extracted the volatile oil from the leaves of *Hyptis suaveolens* and investigated its chemical nature and then determined the antiepileptic activity of the extract in experimental animals.

Methods

Extraction of the volatile oil

The oil was extracted from fresh leaves by steam distillation using a Cleavenger apparatus. Then the extract was dried using dried sodium sulphate. The oil had a specific gravity of 0.6554 and specific rotation of +0.50°, in chloroform. Twelve normal alkanes C_9 to C_{20} were used as internal standards. Results are reported in Table 3.

Screening for anticonvulsant activity

The anticonvulsant activity of the oil was investigated in white albino mice of the genus *Thaillers,* weighing 20 - 30 g. The experiment consisted of three parts:

(i) Establishing the working dose of metrazol (Table 1).

(ii) Establishing the optimum working dose of the essential oil (Table 2).

(iii) Screening for the anticonvulsant activity of the essential oil as compared to phenobarbitone (Table 4).

Table 1: Establishing a Safe Working Dose for Metrazol

Mouse	Weight(g)	Time to convulse (Sec)	Time to Death (Sec)
Gr. I[a]			
1	24	-	-

2	26	-	-
3	27	-	-
4	28	-	-
5	25	-	-
6	27	-	-
Gr. II[b]			
1	29	445	-
2	25	120	-
3	27	161	-
4	28	132	-
5	25	170	-
6	26	170	-
Gr.III[c]			
1	27	108	180 min lethal dose
2	27	92	106
3	26	60	200
4	28	75	150
5	29	105	-
6	28	100	160

[a]Dose give = 50 mg/kg; [b]Dose given = 60 mg/kg; [c]Dose given = 70 mg/kg

Table 2: Establishment of the Safe Working Dose of the Essential Oil of Hyptis Suaveolens

Mouse	Dose of the Hyptis oil Ml/Kg.	Time to death (sec) and % mortality in brackets
Gr. I	1.0	700 (60)
Gr. II	0.9	3600 (10)
Gr. III	0.8	4800 (1)
Gr. IV	0.6	-
Gr. V	0.5	-
Gr. VI	0.4	-
Gr. VII	0.3	-
Gr. VIII	0.2	-
Gr. IX	0.1	-
Gr. X	0 (only archis oil)	-

***Average weight of the mice was 28 g.**

Table 3. Identified Peaks With Retention Time, Kovat's Retention Indices, Area Percentage, and Identification

S. No.	Peak No (Min)	Retention (Time) Indices	Kovat's retention	Percentage Identification composition
1	14	14.259	916	0.026Eumene

1.	14	14.259	916	0.026Eumene
2.	15	14.655	924	0.00915-methyl-3 heptanone
3.	17	15.531	939	1.6978Benzaldehyde
4.	18	16.238	952	0.0539 Camphene
5.	21	16.994	964	2.12952-Octanone
6.	22	17.226	968	0.0801Sabinene
7.	23	17.575	973	0.7877β-Pinene
8.	24	18.01	980	1.5211Octan-3-ol
9.	25	18.299	984	1.1144Myrcene
10.	26	19.485	1006	0.0711Phellandrene
11.	27	19.769	1006	1.0194Benzyl alcohol
12.	28	20.058	1011	1.00793-Carene
13.	29	20.298	1015	0.3210α-Terpinene
14.	30	20.474	1017	2.6766P-cumene
15.	35	24.02	1070	0.1067Methyl benzoate
16.	36	24.12	1071	0.1829Fenchone
17.	37	24.55	1077	9.9796Linolool oxide
18.	38	25.1	1084	0.6196Linalool
19.	41	26.69	1106	9.6622Fenchyl alcohol
20.	43	27.67	1120	0.0288Cresol
21.	44	28.31	1130	0.483Camphor
22.	45	28.71	1135	0.0333Borneol acetate

22.	45	28.71	1135	0.0223Benzyl acetate
23.	46	29.16	1142	0.0347Menthone
24.	47	30.01	1154	0.5535Borneol
25.	49	30.81	1164	0.626Menthol
26.	50	31.12	1168	0.7354Terpinene-4-ol
27.	51	31.82	1178	1.5883α-Terpeneol
28.	56	34.35	1121	0.0491Citronellol
29.	57	34.93	1220	0.0187Cinnamaldehyde
30.	58	35.56	1229	0.0018Piperitone
31.	59	35.95	1235	0.0065Geraniol
32.	60	36.23	1239	0.0054Linalyl acetate
33.	61	36.85	1247	0.0179Citral (trans)
34.	63	37.92	1262	0.0615Anethole
35.	65	38.55	1271	0.0020Bornyl acetate
36.	66	38.98	1276	0.0137Cinnamyl alcohol
37.	74	42.89	1332	0.0477Terpinyl acetate
38.	75	43.53	1341	0.2090Eugenol
39.	76	45.04	1363	0.0113Nerol acetate
40.	78	46.53	1398	0.0126Isoeugenol (cis)
41.	79	47.23	1398	0.1187α-Guaiene
42.	80	47.61	1398	0.0126β-Guaiene
43	82	48.57	1413	0.0394 Longifelone

44.	83	48.95	1418	0.0245Isoeugenol (trans)
45.	84	49.59	1428	8.0610β-caryophyllene
46.	86	50.52	1443	0.0242β-Bulsesene
47.	87	50.86	1448	0.1643Aromadeodrene
48.	88	51.71	1461	0.5037Humulene
49.	89	52.23	1468	0.1324Alloaromadendrene
50.	90	52.86	1477	0.0244Guaia-3,7 diene
51.	92	53.8	1491	0.1424β-Bulnesene
52.	94	54.85	1507	0.0244α-Chigadmarene
53.	95	55.38	1515	0.1155Nerolidol (cis)
54.	99	57.61	1551	0.0820Nerolidol (trans)
55.	100	58.3	1562	0.0391Apitonene-1
56.	101	58.67	1568	0.0512Apitonene-2
57.	103	59.56	1582	0.4500Caryophyllene oxide
58.	114	65.59	1680	0.4990Farnesol (trans)
59.	116	67	1702	0.0308Farnesol (cis)

Table 4: Anticonvulsant Activity of Hyptis Oil as Compared to Phenobarbitone

Volatile oil 0.5 ml/kg body weight = VO
Arachis oil added to 1.0 ml = AO

Metrazol 70 mg/kg body weight = Metrazol

Phenobarbitone 50m g/kg body weight = (Pb)

-Ve Control AO + Metrazole			Test V.O. +MetrazoIe			+Ve control Pb +Metrazole		
Mouse weight	**Time to Conv.) (Min)**	**Time to Death (Min)**	**Mouse weight (g)**	**Time to conv. (Min)**	**Time to Death (Min)**	**Mouse weight (g)**	**Time to Conv. (Min)**	**Time to Death (Min)**
A.								
27	120	150	28	-	-	30	-	-
28	100	106	24	-	-	22	-	-
25	121	138	25	-	-	27	-	-
28	108	160	28	-	-	28	-	-
26	93	110	30	-	-	25	-	-
27	75	102	28	-	-	27	-	-
B.								
25	100	145	25	-	-	25	-	-
25	75	132	29	-	-	28	-	-
28	82	102	22	-	-	27	-	-
29	61	121	27	-	-	26	-	-
25	99	150	26	-	-	29	-	-
26	102	200	25	-	-	25	-	-
C.								

25	110	160	25	-	-	25	-	-
28	69	109	26	-	-	30	-	-
30	95	132	27	-	-	25	-	-
22	102	149	22	-	-	27	-	-
26	100	140	27	-	-	28	-	-
27	82	120	28	-	-	25	-	-

Metrazol (60 mg/kg body weight) is the maximum toxic dose which induced convulsions in mice with minimum mortality rate, whereas 70 mg/kg body weight is the minimum lethal dose causing 99% mortality of the mice. The volatile oil 0.5 ml/kg body weight injected intraperitoneally was safe to mice, but higher doses such as, 1 ml/kg body weight of the volatile oil caused 60% mortality; 0.9 ml/kg body weight caused 10% morality and 0.8 ml/kg body weight caused 1% mortality.

0.5 ml/kg body weight of the *Hyptis* oil gave 100% protection against metrazol (70 mg/kg) induced convulsions, which was equivalent to the protection offered by phenobarbitone (50 mg/kg).

Discussion

There has not been any report on the anticonvulsant activity of the volatile oil from the leaves of *Hyptis suaveolens.* The results of the present study show that the volatile oil offered protection against metrazol and induced epileptic convulsions. The results confirm the usage of the leaves by traditional healers in the management of epilepsy. The toxicity of the oil cannot be overlooked as it has

high mortality in mice injected intraperitoneally in higher doses (above 0.5 ml/kg). However, since the oil has been used for a long time without any reported toxicity we would advise the traditional healers to continue administering the medicine on a first aid basis using natural methods.

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Some CNS effects of Datura stramonium L (Solanaceae) in mice

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ABSTRACT

The leaves of Datura stramonium L. (Solanaceae), or mnanaa in Swahili, are used us an additive in local brews to increase the intoxicating effect of the beer. In Tanzania, there are three Datura species which are used medicinally. One of these is D. stramonium. Because of its extensive use by the traditional beer producers, the plant attracted attention for studies on the active ingredients in its leaves. The plant was found to contain a mixture of the alkaloids hyoscyamine, and hyoscine,. Of more interest, was the finding that with the recemization of hyoscyamine, some atropine is formed. When an extract from the leaves was tested in laboratory mice versus phenobarbitone (a known depressant) its effect was found to be closer to that of amphetamine, i.e. behaving as a (CNS) stimulant. The interpretation of this result must be carefully done. However, since the dosage of the leaves put in local brew is unknown, and no one has studied it, there is a strong need for this work to be done. It is tempting to denounce the practice off-hand, yet the potential it possess must be critically and scientifically examined. Is it possible, perhaps, to counteract the CNS alcohol mediated (particularly respiratory centre) depression, with the extract in correct formulations? There are more questions remaining than answers. However this does not remove the potential application of the observed results.

Central nervous system

Introduction

The genus *Datura* (Solanaceae) comprises of ten species which are globally distributed in the tropics and the warm temperature regions. In Tanzania three species are found, namely, *D. stramonium* L., *D. metal* L., and *D. innoxia* L., which is least represented. All the three species have medicinal properties, and are employed in both traditional and modern medicinal applications. *D. stramonium* L. is the most widely used species. In Tanzanian traditional medicine, *D. stramonium* L. is used to alleviate or cure a number of diseases and conditions.

Leaves of the plant are used as an additive in local brews, where they are claimed to increase the intoxicating effect. The flowers are smoked as an asthma remedy. A combination of leaves and roots is used for the treatment of coughs, and snake bites (Chhabra *et al.,* 1989).

***D. stramonium* L. contains from 0.2 to 0.45% alkaloids, the chief of which are hyoscyamine and hyoscine. But some atropine is also formed from the hyoscyamine by racemization. *D. stramonium* seeds contain about 0.2% of mydriatic alkaloids and about 15-30% of fixed oils. The roots contain, in addition to hyoscine and hyoscyamine, digitoyl esters of 3, 6 - dihydroxyatropane and 3, 6, 7 - trihydroxytropane, respectively and alkylamines (Trease and Evans, 1978).**

Atropine has a stimulant action on the central nervous system, and depresses the nerve endings to the secretory glands and plain muscles. Hyoscine lacks the central stimulant action of atropine, but its sedative properties enable it to be used in the control of motion sickness. Atropine and hyoscine are used, to a large extent, in ophthalmic practice, to dilate the pupil of the eye (Trease and Evans,

1978).

Materials and methods

Powdered leaves of *Datura stramonium* were soaked in diethyl ether. After 5 min. a 10% ammonia solution was added to make a basic solution (pH 8), which was left to stand for one hour at room temperature. The diethyl ether extract was filtered through cotton wool. To the filtrate, some water was added, and left to stand until a clear separation of the two phases was observed. To the dimethyl ether extract, 1% hydrochloric acid was added followed by gently shaking and subsequent filtration through cotton wool. The filtrate was again treated with 10% ammonia solution, to make a basic medium, and then the alkaloids were extracted with chloroform. The solvent was evaporated at reduced pressure to give viscous liquid extract, which was soluble. This was used in the subsequent experiments.

The following study was, therefore, undertaken with a view to establish the activity of *D. stramonium* on the Central Nervous System due to its extensive use by traditional beer producers, and as a therapeutic agent in both traditional and modern medicine.

In the subsequent experiments, the drugs used consisted of the following:

(a) amphetamine (dextro): 2.5 mg/kg body weight, dissolved in double distilled water, and injected intraperitoneally;

(b) phenobarbitone: 5 mg/kg body weight, dissolved in double distilled water, injected intraperitoneally; and

(c) an extract of *D. stramonium:* 5 mg/kg body weight, injected intraperitoneally.

The animals used were white albino mice which weighed 25-30 grams (reared in the laboratory, and housed at a concentration of 10 per cage, and with free access to water and food).

The mouse open field consisted of a 46 cm diameter white base, which was divided into 6.5 cm squares by pale blue lines. The wall (30 cm high) which surrounded the base, was made of aluminum sheeting. The apparatus was illuminated by a 60 watt white bulb, positioned 60 cm above the floor of the apparatus. All observations were carried out between 0900 and 1200 hours.

The parameters measured were: (a) ambulation: the number of squares crossed; (b) rearing: the number of times the animal lifted its forepaws and raised itself from the floor (standing on its hind legs); (c) grooming: the number of times the animal stopped and cleaned or preened itself and (d) defaecation: the number of faecal boli deposited during the 3 min observation period.

The data that were obtained were tabulated and analysed statistically and the results that were obtained are summarized in Table 1.

Results

Table 1. Effects of *D. stramonium* extract on white albino mice as compared to d-amphetamine and phenobarbitone

Activity	Amphetamine	Phenobarbitone	Extract

Activity	Amphetamine	Phenobarbitone	Extract
Ambulation	117 + 13.6	*72.3 + 14.4	150.3 + 16.53
Rearing	10.13 + 2.9	3.13 + 1.7	**18.9 + 3.6
Grooming	2.87 + 1.1	4.13 + 1.7	2.5 + 0.6
Defaecation	0.25 + 0.16	0.13 + 0.13	1.25 + 0.5

*** P = 0.003 Extract compared to phenobarbitone**
**** P = 0.002 Extract compared to phenobarbitone.**

It was observed that mice treated with the extract of *D. stramonium* had an ambulation that was almost similar to that of amphetamine. The extract also significantly increased the rearing activities. The mice given phenobarbitone had decreased ambulation scores.

Discussion

The open field test is a method whereby the emotionality of a rodent is assessed (Candland and Nagy, 1965; Tachibana, 1982 and Halliday, 1966). This test has been widely used to assess the emotional state of animals for the following reasons:

(a) the ease with which animals may be placed into a novel, stressful environment
(b) the ease with which its basic behaviour can be observed and measured
(c) the simplicity of the technique

Some investigators suggest that animals explore or are active because they are

fearful. This implies that with continuous exploration, the fear decreases (i.e. familiarization occurs). The opposing viewpoint is that fearful animals explore little until fear decreases. Less fearful animals explore more than animals that are more fearful (Candland and Nagy, 1968). In this case, the central nervous system stimulant amphetamine, was used as a basis for assessing the effects of the extracts of *Datura stramonium* on the open field behaviour of the white albino.

Since the main alkaloids of the extract are hyoscyamine and hyoscine, the expected results were that, the ambulation would have been decreased significantly, compared to that of amphetamine or similar to that of phenobarbitone, due to their sedative properties. Instead, the extract acted like a stimulant, the open field ambulatory behaviour being similar to that of d-amphetamine. More central nervous system effect tests of the *Datura stramonium* extracts are being done.

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Discovery and development of drugs from natural sources

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Introduction

Half a century ago, there were relatively few useful drugs available. However, today there are nearly 1400 drugs in use which are derived from both natural and synthetic resources. Most countries, especially those in the tropics, are endowed

with a wealth of natural (often herbal) products as well as inorganic materials which have been explored, and to a lesser extent exploited through the years. During the 19th Century, systematic evaluation of herbal remedies involved the establishment of active substances within these drugs, identification of the properties responsible for their actions, and subsequent synthesis of drugs which were more effective. During this period only as little as 5% or less, of all new molecules isolated were found to be of use as therapeutic agents. Seeking to establish the relationship between structure and activity, eminent scientists of the 19th and 20th centuries including Pasteur, Koch, Lister, Ehrlich, Domagk, Dale, Fleming and others made outstanding contributions to the advancement of knowledge in chemical and biological sciences, which have had remarkable influence on public health.

It is a popularly held opinion that most of these herbal products should be put into use in developing countries to reduce the much needed foreign currency now incurred on imported pharmaceutical products. If this opinion finds general acceptance, one does not see why anyone should go into trouble and expense to discover and develop new drugs. The major reasons for the development of new drugs today include the desire to satisfy intellectual curiosity; the need to improve on the efficacy of existing substances; an effort to control new diseases, e.g. AIDS; and the need to fight drug resistance (mostly antibiotics).

The search for products from natural sources has to go a long way towards meeting such objective goals.

The importance of products from natural sources

Naturally occurring substances form a significant base of raw materials for the chemical and pharmaceutical industry as well as for the cosmetic and food industry. They are a starting point for a series of pharmaceutical products with specific therapeutic efforts, various volatile oils and other products used in cosmetics and skin care products. Aromatic plants are often processed into various extracts used in the alcoholic and soft drink industry and in production of consumer goods such as tea (simple or compound products), spices, syrups, tablets and dry extracts. In countries with developed chemical and pharmaceutical industries, the production of products of natural origin is gaining more and more importance year after year.

Discovery and development

Cardiac glycosides from some *Digitalis* species are almost certainly the only major discovery of the 18th Century, followed later by morphine from *Papaver somniferum,* quinine from *Cinchona* species, atropine from *Belladonnae* species, papaverine from the family Papaveraceae and cocaine from the Coca plant, *Erythroxylon coca,* which were isolated from crude drugs (Serturner, 1805 and 1817, Pelletier, *et al,* 1833, Merck, 1848, Wohler, 1860 and Bowman, 1979). By the end of the 19th Century there were only about 20 useful drugs listed in the first few editions of the British Pharmacopoeia (Bowman, 1979). Indeed most of the molecules isolated were found to be of little or no use as therapeutic agents, and this aroused interest in scientists to look for the relationship between structure and activity. The work of eminent scientists such as Pasteur, Koch, Lister, Ehrlich, Domagk, Dale, Fleming and others during the 19th and 20th centuries resulted in advances which had an impact on public health (Weatherall, 1986).

It is quite obvious that the most important drugs in use today have been developed from natural sources. While we continue with the search and introduction of more drugs from plant sources today, the systematic appraisal of herbal remedies was epitomised by the 19th Century pharmacologist, Rudolph Bucheim, who wrote: "The mission of pharmacology is to establish the active substances within these drugs, to find the properties responsible for their action and to prepare synthetically drugs which are more effective (Bucheim, 1876)." Today we are just as far away from achieving this goal as we were in the last century.

The design of modern drugs has, today, reached a state of sophistication where some of the physical parameters can be predicted by use of computer graphics. However, this has not so far permitted prediction of biological activity of a drug from its chemical structure. So most drugs, whether derived from natural sources, or prepared synthetically, are developed the same way.

Figure 1 shows some of the important scientific operations involved in drug discovery and development. The important stage here is that of identification of "lead compounds", i.e. those with biological activities which are interesting. Essentially, random screening of large numbers of herbs and chemicals is time consuming, expensive and rather wasteful although often there are no short cuts to arrive at a "lead compound".

Constraints of new product development

(i) Approximately 10,000 candidate compounds have to be screened to afford one new chemical entity marketable as a therapeutic agent. This

takes about ten years for the work to be completed.

(ii) Financial investment for such a task is of the order of 100 - 200 million US dollars for research and development only.

(iii) The commercial risk involved here is that a new product enters a competitive market and has the task of having to establish an adequate earnings level.

(iv) Development of a new product stands the risk of being affected at any time by regulatory intervention or by parent life erosion.

These constraints do apply to the development and introduction of traditional medicinal products although, I would say, the financial risk is not of the same order of magnitude.

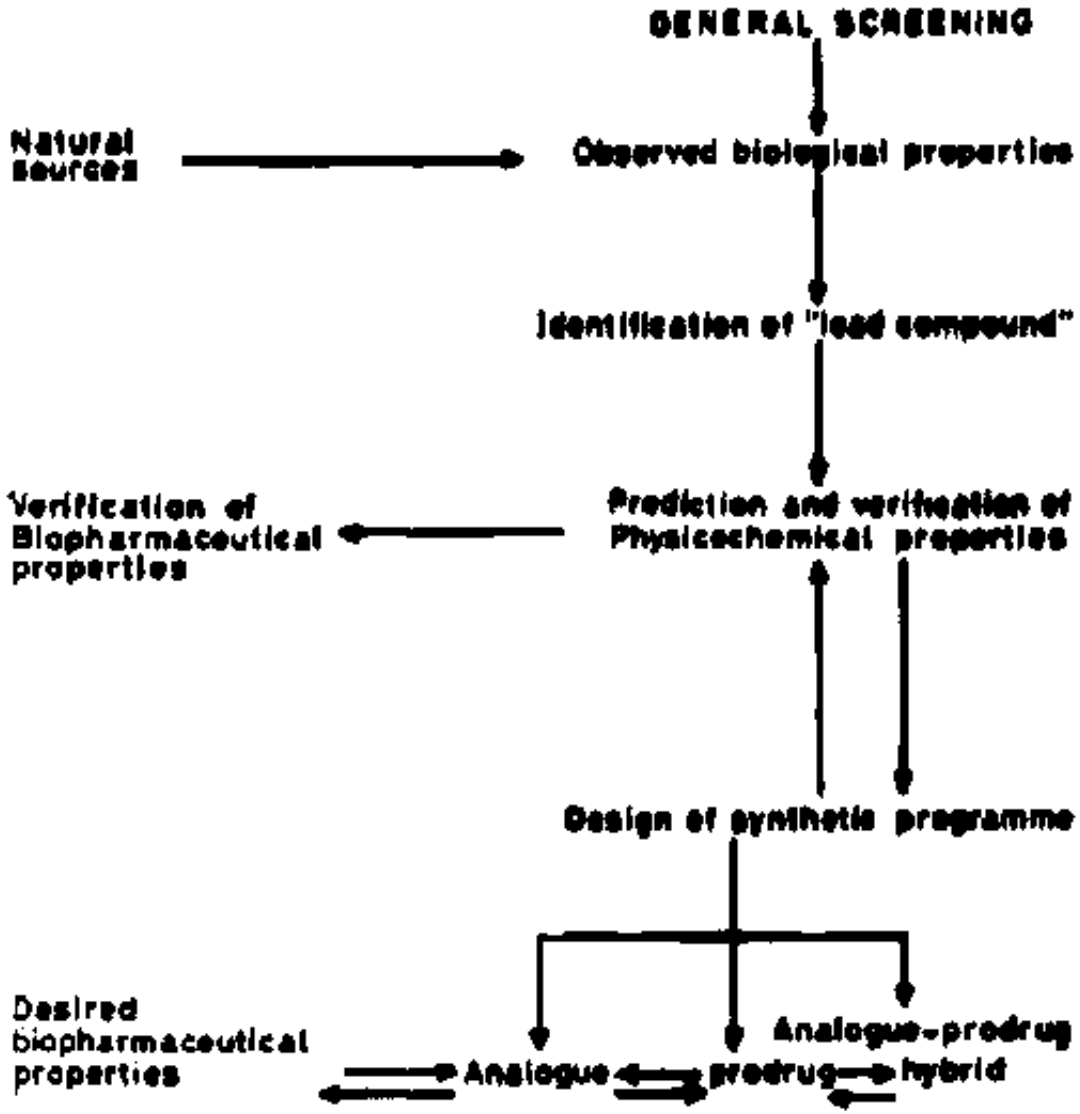

Figure 1: Programme of drug discovery and development

Patent protection of pharmaceutical products

The maximum duration possible for a patent is laid down by the laws of each country, and lies between 10 years (e.g. Peru and Venezuela) and 20 years (e.g.

Belgium and France). The differences between countries are also increased in that the duration of the patent sometimes begins with the filing date (Germany and Switzerland); sometimes with the laying open to public inspection (Japan and Yugoslavia); sometimes with the granting date (USA and Canada), and also in that many places the duration of protection begins later than the duration of the patent. Extension of duration may be obtained on request in certain circumstances, e.g., in the U.K. and Australia.

Yearly fees have to be paid to maintain the patents in force (except in USA and Canada) and the amounts vary from about 20 to 1000 US dollars.

Pharmaceutical products have special patent regulations in many countries. The motives, therefore, are frequently felt to be justified by national expediency and/or social conditions. These can go so far that pharmaceutical products and even processes for the production thereof are denied patent protection, e.g. in Italy. Another means for the erosion of patent protection in this sector is the too great use made of compulsory licenses, for which often an application without any supporting ground is simply insufficient. Great Britain and countries having similar laws and practice, such as Canada, India, etc. are to be noted for this. The granting of a license is at the "discretion" of the competent authority. Opposition to the granting of such licenses, however, at most only delays the granting of a license and is generally never able to prevent it.

In most countries no patent can be obtained for the protection of the pharmaceutical use of a substance because the application of medicaments to the human body is not a technical procedure, i.e., it is not a "new invention which can be put to commercial use" (in the sense of Art. 1 of the patent law), but it is a

procedure of medical art. Such patents are granted in principle in some countries such as the USA and France.

The protection of natural products or products of nature can be quite difficult. Only when you have definite controlled processes for arriving at the end products, as is apparent in genetic engineering, can such products withstand scrutiny with respect to novelty, technical progress, and also unobviousness. Where the products are achieved as a result of established extraction procedures the protection of the substances *per se,* or of the process, may be difficult. Our chances of protection of our traditional medicinal products with existing legislation, seem rather remote.

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A Survey of medicinal plants in Tabora region, Tanzania

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ABSTRACT

A Survey of medicinal plants was conducted in Tabora Region between December, 1970 and July, 1989. 27 traditional healers from 30 villages in 25 village wards (i.e. about 15% of the Region) were interviewed. Also plants in the field and at the Lushoto herbarium were indentified. A total of 127 plant species belonging to 45 families and 05 genera were identified as medicinal plants used for the treatment of some 66 different human diseases in the region. The family Leguminosae was found to be leading by having 33 different medicinal plant species from 20 genera followed by Euphorbiaceae which had 9 species from 7 genera. Antidotes for snake bites were leading with 32 plant species, followed by stomach-ache and coughs, which had 21 and 14 medicinal plant species, respectively.

Introduction

Traditional medicine in Tanzania, like in other developing countries where medical facilities cannot satisfy national demands, plays a big role in combating both human and animal diseases. It is estimated that about 80% of the people who live in rural areas rely on traditional healers for their treatment using medicinal herbs. However, these medicinal plants have not been well studied, tested or documented. Most of the information is still in the hands of traditional healers (FAO 1986). Due to the current threat brought by diseases like malaria, cancer, hypertension, AIDS and others, it is now high time we carried an international combined effort from both scientists and traditional healers to do some more research on medicinal plants which might give us some positive results. Some of the information which is now available about medicinal plants in Tanzania includes the work of Watt and Breyer -Brandwijk (1962), in a book on *Medicinal and Poisonous Plants of Southern and Eastern Africa; Medicinal Plants of East Africa* by Kokwaro (1976); and that of Raimo Harjula (1988) who made some ethnomedicinal studies in Meru, Arusha. The Traditional Medicine Research Unit at the Muhimbili Medical Centre in Dar es Salaam is responsible for this work and is currently undertaking some research on traditional medicine. The Tanzania Forestry Research Institute at Lushoto has been conducting some botanical surveys in Dodoma, Singida and East Usambara. Part of this information has been published by FAO (1986). (Some will won be published by Ruffo *et al.* This paper reports about a survey of medicinal plants which was done in Tabora Region, Tanzania.

Tabora Region has a total area of 7,615km^2, and receives an average annual rainfall of 700-800 mm (ICRAF 1988). The main tribe in the region is the Nyamwesi, who live mainly as peasant farmers. According to the 1988 Census, the

population in the region was estimated at 1,036,293 people, with an average annual growth of 2.4%. The vegetation of Tabora region is mainly *Miyombo* or *Brachystegia* woodland dominated by *Brachystegia spiciformis, Julbernardia globiflora* and *pterocarpus angolensis* (Polhill, 1968).

Methodology

A survey of medicinal plants in the Tabora Region of Western Tanzania floristic Region T4, was conducted by the now Tanzania Forestry Research Institute under the Ministry of Lands, Natural Resources and Tourism between December, 1970 and July, 1989 by interviewing 27 traditional healers from 30 villages in 25 village wards, covering about 15% of the Region. Figure 1 shows a map of Tabora region where medicinal plants were surveyed and Appendix 1 gives a list of villages and traditional healers who were interviewed during the survey. These medicinal plants were identified in the field, except for taxonomically difficult plants which had to be collected and pressed for further identification at Lushoto Herbarium. The data for each medicinal plant, including the name of a plant, disease treated, plant part used, method of preparation and dosage, was recorded (Appendix 2). These data were then summarised.

Results

A total of 127 plant species belonging to 45 families and 95 genera, were identified as medicinal plants used for the treatment of 66 different human diseases in the Tabora region. The family Leguminosae was found to be leading by having 33 different medicinal plant species from 20 genera, followed by the Euphorbiaceae, which had 9 species from 7 genera. For the body problems, snake

bites were leading with 32 medicinal species, followed by stomach-ache and coughs, which had 21 and 14 medicinal plants, respectively (Table 1 & 2).

Conclusions and recommendations

From the above results obtained from Tabora Region, it can be concluded that Tanzania has a big potential on medicinal plants, especially after comparing with the total of 127 medicinal plants for 66 human diseases from 15% of Tabora region (i.e., 25 village wards out of 166 wards of the 1988 census) and when this is compared with 44.4 million ha. of Tanzania natural forests, containing some 10,000 species of higher plants which also carry a very high degree of species diversity and endemism in the world (Lovett 1988, Lundgren, 1975 and Polhill, 1968).

It was also noted that some of these medicinal plants such as *Annona senegalensis, Flacourtia indica* and *Friesodielsia abovata* had multipurpose uses, including edible fruits and fuelwood.

It is therefore recommended that:

(a) Further studies be carried out in other areas of Tabora as well as in other regions of Tanzania to establish a sound basis for further research on medicinal plants.

(b) These medicinal plants be collected, screened and tested for their active principles on the diseases for which they are used.

(c) Medicinal plants which prove to be really curative be developed and

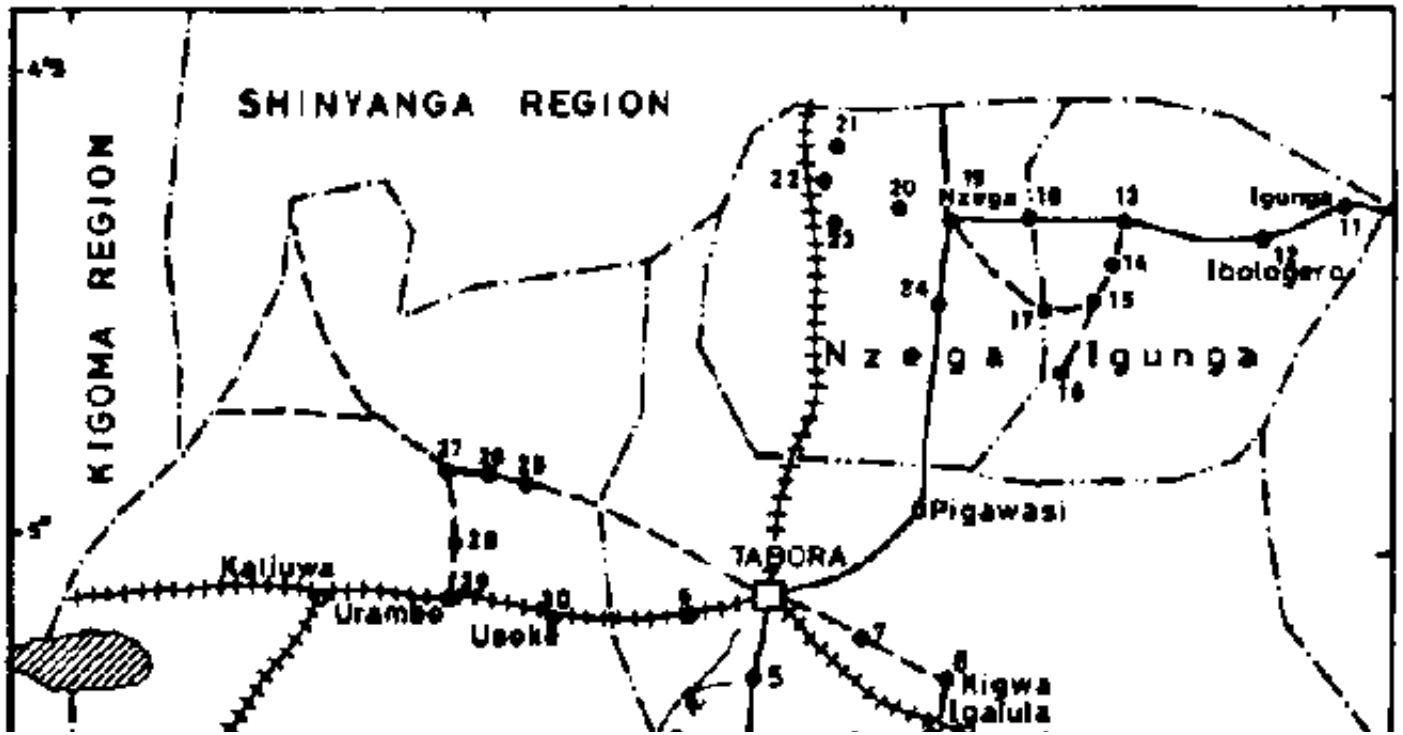
incorporated with modern medicinal practice.

(d) Silvicultural studies be carried out on medicinal plants in order to facilitate their establishment in villages and botanical gardens.

(e) Traditional healers be encouraged to incorporate their knowledge of medicinal plants with modern medicinal practice.

(f) Medicinal plants of Tanzania be documented in a journal, such as, Journal of Tanzania Traditional Medicine, etc.

(g) An international cooperation for exchange of knowledge and seed samples of medicinal plants be established.



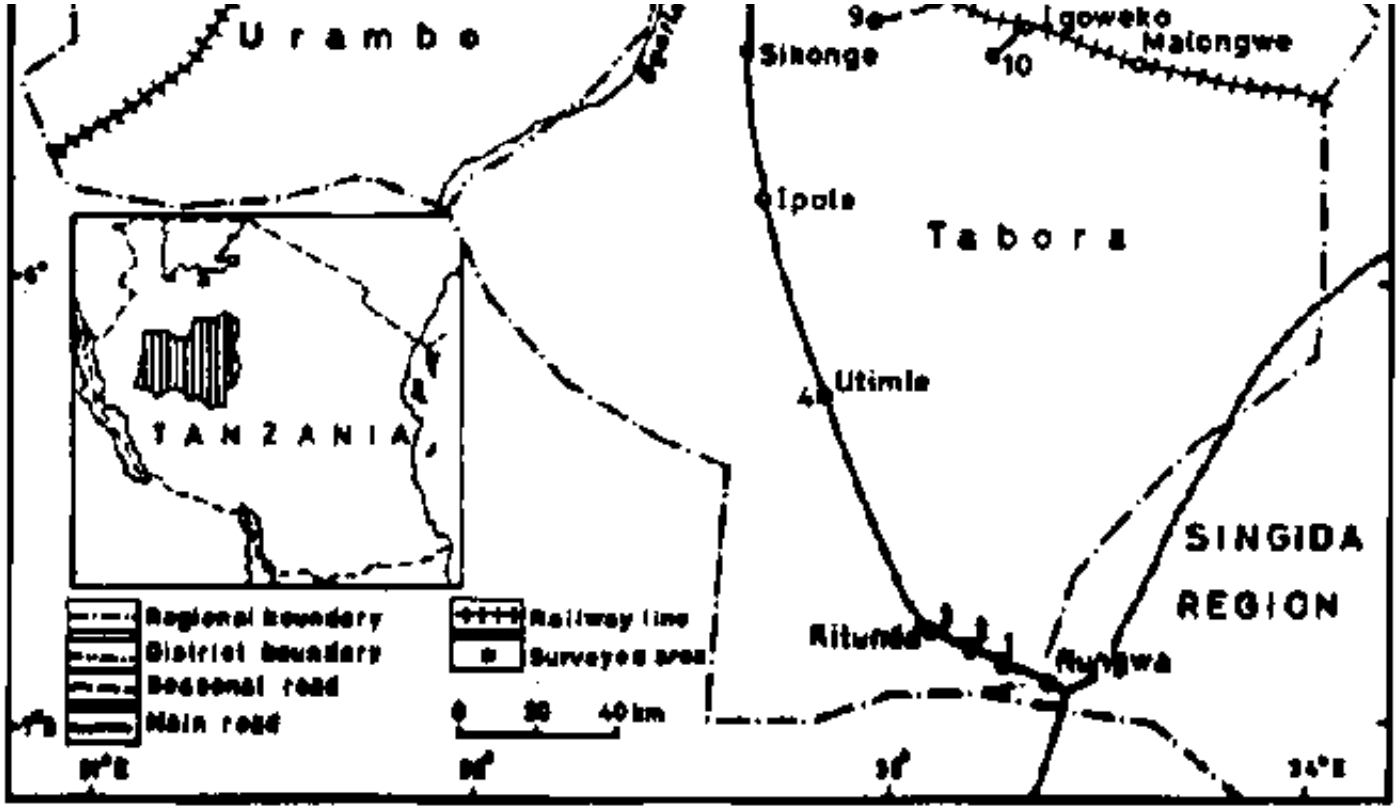


Fig. 1. Map of Tabora Region showing areas where medicinal plants were surveyed

Acknowledgement

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Table 1: Alphabetical list of medicinal plants from Tabora region with their vernacular (Nyamwezi) names, part(s) used and diseases treated

Botanical name	Vernacular name	Part used	Diseases treated
Anacardiaceae			
Lannea schimperi	*Mugumbu*	Bark & root	Mental disorders and snake bites
Ozoroa reticulata	*Mukalakala*	Bark	Body swellings, coughs, diarrhoea, gonorrhoea, malaria, epilepsy, prolapse of rectum and stomachache
Annonaceae			
Annona senegalensis	*Mutopetope Mufila Mukonola*	Roots	Snake bites and Stomachache
Friesodielsia obovata.	*Musalasi*	Roots	Anaemia, infertility snake bites
Apocynaceae			
Condylocarpon diplorhynchus Holarrhena pubescens	*Musonga Musongati Musongalukuga*	Bark & leaves Roots	Galactogogue, wounds and sores Gonorrhoea, bilharzia and stomachache
Strophanthus eminii	*Musungululu Muvelevele*	Bark & roots	Asthma, syphilis, Constipation, measles small pox, scabies, epilepsy, spleen and heart diseases

Araceae			
Pistia stratiotes	*Ileve, Maleve*	Roots	Fire burns
Asclepiadaceae			
Calotropis procera	*Mpumbula*	Roots	Boils, hydrocele, stomach and tooth ache
Gymnema sylvestre	*Luhaga*	Roots	Aphrodisiac
Aristolachiaceae			
Aristolachia -	*Kilikamo*	Roots	Convulsions, petersiana poisoning, stomachache, snake bites
Bignoniaceae			
Kigelia africana	*Mudungwa, Mulegeya, Mwicha, Msanhwa*	Bark, roots	Convulsions
Boraginaceae			
Trichodesma zeylanicum	*Igungulu*	Roots	Coughs, poisoning and stomachache
Burseraceae			
Commiphora africana	*Musagasi, Mupondamu, Mutonto*	Bark	Snake bites and traucoma
Capparidaceae			
Boscia salicifolia	*Muguluka*	Bark,	Headache, rheumatism, scabies and

		Roots	toothache
Gynandropsis gynandra	*Mugagani*	Leaves	Colds, coughs, earache and eye-diseases
Celastraceae			
Maytenus-galensis	*Mwezya*	Roots	Snake bites, infertility and stomachache
Combretaceae			
Combretum cillinum	*Mulandala*	Roots leaves	Snake bites
C. fragrans	*Muluzyaminzi*	Roots, leaves	Malaria, wounds and traucoma
C. longispicatum	*Vugoveko*	Roots	Malaria and snakebites
C. molle	*Mulama*	Leaves	Earache and wounds
C. obovatum	*Vugoveko*	Roots	Gonorrhoea
C. zeyheri	*Musana*	Roots, leaves	Coughs, diarrhoea, rectal prolapse, Snake bites and stomachache
Terminalia mollis T. sericea	*Mudisi, Mukelenge Mupululu, Muzima*	Bark, roots Leaves	Bilharzia Coughs, measles, rectal prolapse, and stomachache
Compositae			
Bidens pilosa	*Ndasa*	Leaves	Wounds and relapsing fevers in children
Vernonia glabra	*Kilulankunja, Mukalinkali*	Roots	Malaria, gonorrhoea, syphilis and measles
Cyperaceae			

Cyperaceae			
Cyperus articulatus	*Vulago, Vuseli*	Roots	Intestinal worms
Ebenaceae			
Diosypros fischeri	*Mufuvata*	Roots, leaves	Snake bites
Euphorbiaceae			
Antidesma venosum	*Musekela*	Roots, leaves	Snake bites and poisoning
Bridelia duvigneaudi	*Muvuzivuzi*	Roots	Intestinal worms
Euphorbia candelabrum	*Mulangali*	Twigs	Constipation
E. grantii	*Mudulansongo*	Roots	Constipation, epilepsy and snake bites
E. hirta	*Vakikulu*	Leaves	Menstrual disorders, ringworm and snake bites
Jatropha curcas	*Inyanga*	Seed	Intestinal worms
Hymenocardia acida	*Mupala*	Leaves	Coughs, rectal prolapse and stomachache
Oldfieldia dactylophylla	*Muliwanfwengi*	Roots	Aphrodisiac, gonorrhoea and hernia
Phyllanthus engleri	*Mugogondi, Mung'ong'o Ntandala*	Roots leaves	Coughs and bilharzia
P. reticulatus	*Muvinzandimi*	Roots,	Snake bites

		leaves	
Flacourtiaceae			
Flacourtia indica	*Mupugusura, Musingila Musungu*	Roots	Coughs, snake bites, Infertility and stomachache
Graminae			
Pennisetum purpureum	*Ibingobingo, Isumbu, Vupemba*	Stem Stem	Measles Infertility
Labiatae			
Ocimum suave	*Ilumbasya, Ilumba*	Twigs	Colds, fever, Dementia
Leguminosae			
Abrus precatorius	*Muchichi, Mshiti*	Roots	Aphrodisiac, scabies, smallpox, anaemia, eye and spleen diseases
A. schimperi	*Vugagati*	Roots	Hypertension and postpartum stomach pains
Acacia drepanolobium	*Vuvula*	Roots	Abscess and bilharzia
A. hockii	*Munyenyela*	Roots	Abscess
A. mellifera	*Mugongwa, Ilugala*	Roots	Impotence
A. nilotica	*Mugulunga, Mudubilo*	Roots	Anaemia, asthma
A. senegal	*Katita, Mgwata*	Roots	Abscess
Albizia harveyi	*Mupogolo*	Leaves	Chest pains, wounds and stomachache
A. petersiana	*Musisigulu*	Roots	Hernia, and lung . . .

Brachystegia spiciformis	*Mutundu*	Bark	Coughs and snake bite
Burkea africana	*Muganda, Mukalati*	Bark	Headache
Cajanus cajan	*Mubalazi, Mutengwa.*	Roots	Aphrodisiac
Cassia abbreviata	*Mumulimuli,*	Roots	Hernia, intestinal worms, gonorrhoea, syphilis
	Mulundalunda,		Snake bites, stomachache, bilharzia, sores, malaria,
	Muzoka		postpartum stomach pains and poisoning
C. obtusifolia	*Muzegezega*	Roots	Hernia, yellow fever, dementia and convulsions
C. singueana	*Mudimwambuli, Musambisambi*	Roots Leaves	Convulsions, coughs, intestinal worms, malaria, epilepsy and yellow fever
Dalbergia melanoxylon	*Mugombe*	Roots, Leaves	Convulsions, menstrual disorders, snake bites, traucoma and toothache
D. nitida	*Kafinulambasa*	Roots	Toothache
Dichrostachys cinerea	*Mutunduli*	Leaves	Boils, coughs, wounds, galactogogue, snake bites, menstrual disorders and stomachache
Entanda abyssinica	*Mufutwambula*	Roots	Gonorrhoea, anaemia and hypertension
Isoberlinia angolensis	*Muva*	Bark	Coughs, wounds and snake bites
Lonchocarpus	*Muvule*	Roots,	Snake bites

capassa		leaves	
L. bussei	*Muvule*	Roots	Allergy
Oormocarpum trachycarpum	*Mukondwapuli Muvulwambuli*	Leaves	Snake bites and pneumonia
Pericopsis angolensis	*Muvunga*	Leaves	Coughs, fire burns, sores and snake bites
Piliostigma thonningii	*Mutindambogo*	Bark	Snake bites
Pterocarpus angolensis	*Muninga*	Bark	Diarrhoea and wounds
P. tinctorius	*Mukulungu*	Bark	Eye problems
Swartzia madagascariensis	*Kasanda*	Roots	Malaria and yellow fever
Tamarindus indica	*Musisi*	Leaves	Malaria, wounds, mental disorders and stomachache
Xeroderris stuhlmannii	*Munyenye*, *Mjungu*	Bark	Mastitis and backache
Liliaceae			
Aloe sp.	*Itembwe, Lugaka*	Leaves	Aphrodisiac, heart pains, impotence, spleen and kidney diseases
Asparagus falcatus	*Kasolanhanga, Sawi*	Roots	Aphrodisiac, hernia and gonorrhoea
Loganiaceae			

Strychnos innovia	*Mukulwa, Mumundu*	Roots	Aphrodisiac
S. potatorum	*Mugwegwe, Mupandepande*	Roots, Leaves	Coughs, malaria and gonorrhoea
S. spinosa	*Mwage*	Roots	Intestinal worms, gonorrhoea and syphilis
Meliaceae			
Ekabergia benguelensis	*Mutuzya*	Roots	Mental disorders
Turraea sp.	*Mulingiwe*	Roots	Convulsions
Menispermaceae			
Cissampelos pareira	*Mukuluwanti*	Roots	Snake bites, poisoning and stomachache
Moraceae			
Ficus natalensis	*Mulumba*	Bark, twigs	Whooping cough
F. sycomorus	*Mukuyu*	Bark, twigs	Diarrhoea
Musaceae			
Musa sapientum	*Idoke*	Flowers	Asthma
Myrtaceae			
Psidium guajava	*Mupera*	Leaves	Diarrhoea, malaria and wounds
Ochnaceae			
Ochna	*Kayulwampako*	Roots	Poisoning and snake bites

Ochna schweinfurthii	*Kavalwampako Kawantundwe Kupande*	Roots	Poisoning and snake bites
Olacaceae			
Ximenia americana	*Munembwa, Mutandwa*	Roots	Anaemia, hernia, intestinal worms mental disorders
X. caffra	*Munembwa, Mutandwa*	Roots	Anaemia, hernia, intestinal worms and mental disorders
Oleaceae			
Schrebera trichoclada	*Muputika*	Bark, leaves	Coughs, snake bites, traucoma, stomachache and eye diseases
Orchidacene			
Anselia africana	*Inyazya*	Stems	Rheumatism, snake bites and body swelling
Pedaliaceae			
Sesamum angolense	*Mulenda-gwawima Ilendi-lya-wima*	Roots leaves	Measles and poisoning
Polygalaceae			
Longipenduculata securidaca	*Muteyu*	Roots	Constipation, hernia, infertility, toothache and stomachache
Rhamnaceae			
Ziziphus mucronata	*Kagovole, Lugugunu*	Roots	Snake bites and stomachache
Rubiaceae			

Rubiaceae			
Catunaregan spinosa ssp. taylorii.	*Mochangoko, Mupongolo*	Roots	Cunvulsions, hernia, hypertension and intestinal worms
Fadogia cienkowskii	*Kambolambola*	Roots	Infertility
Crossopterix febrifuga	*Musaswambeke*	Bark	Diarrhoea and convulsions
Gardenia ternifolia ssp. jovi stonantis	*Kilindila Mugunda*	Roots	Coughs, snake bites
Hymenodutylon parvifolium	*Muginya, Mujungululji Mpepesavakia Muvinzwansanzu*	Roots	Intestinal worms, snake bites and menstrual disorders
Multidentia evassa varapula	*Mukukumba, Muyogayo*	Roots	Earache
Rothmania engleriana	*Mkondokondo Mutwinya*	Roots	Snake bites and stomachache
Rutaceae			
Citrus aurantifolia	*Mudimu*	Leaves	Asthma
Verpis glomerata	*Mulungusigiti*	Roots	Body swelling, constipation and infertility
Zathoxylum chalybeum	*Mudali, Mulungulungu*	Roots	Malaria and body swellings
Sapindaceae			

Sapindaceae			
Zanha africana	*Mukalya*	Roots	Colds, convulsions stomachache
Sapotaceae			
Chysophyllum bangweolense	*Museveye*	Roots	Diarrhoea
Manilkara mochisia	*Mukonze*	Bark	Mastitis
Solanaceae			
Physalis peruviana	*Sinkini*	Roots	Intestinal worms
Solanum gilo	*Mutole*	Roots	Hernia
S. incarnum	*Mudulanu, Mutulantu*	Roots	Constipation, hernia, wounds, tonsillitis and intestinal worms
Sterculiaceae			
Sterculia africana	*Muhozya, Muhoja*	Bark	Snake bites and mental disorders
Waltheria indica	*Ikumbo-lyaza, ikandagizi*	Roots	Coughs, poisoning and snake bites
Filiaceae			
Grewia bicolor	*Mukoma*	Roots	Anaemia and fertility
Umbelliferae			
Steganotaenia araliaceae	*Munyongampembe Mbyotolo*	Roots Leaves	Snake bites
Verbenaceae			

Verbenaceae			
Clerodendrum capitatum	*Kapolo*	Roots	Constipation in children
C. myricoides	*Mnindi, Mpugambu*	Leaves	Dementia
Premna senensis	*Mununhwanhala*	Roots	Aphrodisiac
Vitex mombassae	*Mutalali, Masumgwi*	Roots	Diabetes
Vitaceae			
Cissus carnifolia	*Mutandamwaka*	Roots	Hernia and bilharzia
C. quadrangularis	*Vula-wo-nsuwi*	Roots	Rectal prolapse
Cissus sp.	*Lonzwe*	Roots	Hernia and hypertension

Table 2: A list of diseases and their respective medicinal plants from Tabora region.

Disease	**Medicinal Plant**
Abscess	*Acacia drepanolobium, A. hockii, A. sieberiana*
Acute coughs Aphrodisiac	*Pericopsis angolensis, Schrebera trichoclada Aloe sp., Asparagus falcatus, Abrus precatorius, Cajanus cajan, Gymnema sylvestre, Indigofera rhinchocarpa, Oldifieldia dactylophylla, Premna senensis, Strychnos innocua*
Allergy	*Lonchocarpus bussei, Vepris glomerata*
Anaemia	*Abrus precatorius, Acacia nilotica, Entada abyssinica, Friesodielsia obovata,*

	Grewia bicolor, Ximenia americana, X. caffra
Ankylostomiasis	*Bridelia duvigneaudii, Cassia singueana, Physalis peruviana, Ximenia americana, X. caffra*
Asthma	*Acacia nilotica. Citrus aurantifolia, Musa sapientum, Strophanthus eminii*
Backache	*Xeroderris stuhlmanii*
Body swellings	*Anselia africana, Ozoroa reticulata, Vepris glomerata, Zanthoxylum chalybeum*
Boils	*Calotropis procera, Dichrostachys cinerea*
Chest pain	*Albizia harveyi*
Colds	*Gardenia ternifolia ssp. jovis-tonantis, Gynandropsis gynandra, Ocimum suave, Zanha africana*
Constipation	*Clerodendrum capitatum, Jatropha curcas, Euphorbia candelabrum, E. grantii, Securidaca longependunculata, Solanum incanum, Strophanthus eminii, Vepris glomerata*
Convulsions	*Aristolochia petersiana, Caturanegam spinosa, Cassia obtusifolia, C. singueana, Crossopterix febrifuga, Dalbergia melanoxylon, Gardenia ternifolia ssp. jovis-tonantis, Kigelia africana.*
Coughs	*Brachystegia spiciformis, Cassia singueana, Combretum zeyheri, Flacourtia indica, Gynandropsis gynandra, Hymenocardia acida, Dichrostachys cinerea, Julbernardia globiflora, Ozoroa reticulata, Phyllanthus englerii, Schrebera trichoclada, Strychnos potatorum, Terminalia sericea, Waltheria indica.*
Dementia	*Cassia obtusifolia, Clerodendrum myricoides, Ocimum suave.*
Diabetes	*Vintex mombassae*

Diarrhoea	*Combretum zeyheri, Chrysophyllum bangweolense, Crossopterix febrifuga, Ficus sycomorus, Ozoroa reticulata, Psidium guajava.*
Earache	*Cannabis saliva, Combretum molle, Gynandropsis gynandra, Multidentia crassa.*
Epilepsy	*Cassia singueana, Euphorbia granii, Ozoroa reticulata, Strophanthus eminii.*
Eye disease	*Abrus precatorius, Gynandropsis gynandra, Pterocarpus angolensis, P. tinctorius, Schrebera trichoclada.*
Fire burns	*Pistia stratiotes, Pericopsia angolensis*
Fever	*Ocimum suave.*
Gonorrhoea	*Asparagus falcatus, Cassia abbreviata, Combretum obovatum, Holarrhena febrifuga, Entada abyssinica, Oldifieldia dactylophylla, Ozoroa reticulata, Strychnos potatorum, Vernonia glabra.*
Headache	*Boscia salicifolia, Burkea africana*
Head sores	*Cassia abbreviata*
Heart pain	*Aloe sp, Strophanthus eminii*
Hernia	*Albizia petersiana, Cassia abbreviata, C. obtusifolia, Asparagus falcatus, Caturanegam spinosa ssp. taylorii, Cissua cornifolia, C. sp., Oldifieldia dactylophylla, Securidaca longepedunculata, Solanum incanum, S. gilo, Ximenia americana, X. caffra.*

Hydrocele	*Albizia petersiana, Cassia abbreviata, Lotropis procera.*
Hypertension	*Alrus schimperi ssp. africanus, Caturanegam spinosa up. taylorii, Cissus*

	sp., Entada abyssinica
Impotence	*Acacia mellifera, A. Senegal, Aloe sp., Indigofera rhinchocarpa.*
Infertility	*Grewia bicolor, Securidaca longependunculata, Sorghum vulgare.*
Intestinal worms	*Aloe sp., Acacia nilotica, Caturanegam spinosa ssp. taylorii, Cassia abbreviata, Cyprus articulatus, Ficus natalensis, Jatropha curcas, Solanum incanum.*
"Kalimi" (Tonsillitis)	*Acacia nilotica, Ficus natalensia, Trichodesma zeylanicum, Solanum incanum.*
Kidney disease	*Aloe sp.*
Lactation problem	*Dichrostachys cinerea, Diplorhynchus condylocarpon*
Leprosy	*Terminalia stuhlmannii*
Lung disease	*Albizia petersiana*
Madness	*Ekebergia benguellensis, Isoberlinia angolensis, Lannea schemperi, Sterculia africana, Tamarindus indica, Ximenia americana, X. caffra.*
Malaria	*Cassia abbreviata, C. singueana, Combretum fragrans, C. longispicatum, Dalbergia melanoxylon, Ozoroa reticulata, Psidium guajava, Strychnos potatorum, Swartzia madagascariensis, Vernonia glabra, Zanthoxylum chalybeum.*
Mastitis	*Manilkara mochisia, Xiroderris stuhlmannii*
Measles	*Pennisetum purpureum, Sesamum angolensis, Strophanthus eminii, Terminalia sericea, Vemonia glabra.*
Menstrual	*Dalbergia melanoxylon, Dichrostachys cinerea, Euphorbia hirta, Fadogia*

Neonatal problems	*Ekebergia benguellensis, Blighia sapida, Euphorbia hirta, Fadogia cienkowskii, Hymenocardia acida.*
Pneumonia	*Ormocarpum trachycarpum*
Periodic fevers	*Bidens pilosa*
Poisoning	*Aristolochia petersiana, Antidesma venosum, Cassia abbreviata, Cissampelos pereira, Ochna schweinfurthii, Sesamum angolense, Trichodesma zeylanicum, Waltheria indica.*
Post-partum stomach pains	*Abrua schimperi, Cassia abbreviata.*
Prolapse of rectum	*Cissus quardrangularis, Combretum zeyheri, Ozoroa reticulata, Terminalia sericea.*
Restlessness	*Ekebergia benguellensis, Isoberlinia angolensia*
Rheumatism	*Anselia africana, Boscia salicifolia, Vepris glomerata, Zanthoxylum chalybeum.*
Ringworm	*Euphorbia hirta*
Scabies	*Abrus precatorius, Boscia salicifolia, Strophanthus eminii, Terminalia sericea.*
Schistosomiasis	*Acacia drepanolobum, Cassia abbreviata, Cissus connifolia, Holarrhena pubescens, Phyllanthus engleri, Terminalia mollis.*
Small pox	*Abrus precatorius, Strophanthis eminii.*
Snake bites	*Annona senegalensis, Anselia africana, Aristolochia petersiana, Antidesma venosum, Brachystegia spiciformis, Cassia abbreviata, Cissampelos pereira, Cissus cornifolia, Combretum collinum, C. longispicatum, C. zeyheri, Commiphora africana, Diospyros fischeri, Euphorbia grantii, E. hirta, Friesodielsia obovata. Gardenia ternifolia ssp. jovis-tonantis,*

	Hymenodictyon parvifolium, Julbernardia globiflora, Lannea schimperi, Lonchocarpus capassa, Ochna schweinfurthii, Pericopsis angolensis, Piliostigna thonningii, Maytenus senegalensis, Ormocarpum trachycarpum, Rothmannia engleriana, Steganotaenia araliaceae, Securidaca longepedunculata, Schrebera trichoclada, Strophanthus eminii, Sterculia africana, Strychnos popatorum, Waltheria indica.
Sores	*Diplorhynchus condylocarpa, Pericopsis angolensis*
Spleen disease	*Abrus precatorius, Aloe sp., Strophanthus eminii.*
Sterility	*Fadogia ceinkowskii, Flacourtia indica, Friesodielsia obovata, Maytenus senegalensis, Sorghum vulgare, Vepris glomerata.*
Stomachache	*Annona senegalensis, Aristolochia petersiana, Calotropis procera, Albizia harveyi, Combretum zeyheri, Cissampelos pereira, Crossopterix febrifuga, Dichrostachys cinerea, Flacourtia indica, Hymenodictylon parvifolium, Maytenus senegalensis, Ozoroa reticulata, Rothomannia engleriana, Securidaca Longepedunculata, Schrebera trichoclada, Strychnos potatorum, Tamarindus indica, Terminalia serica, Trichodesma zeylanicum, Zanka africana, Ziziphus mucronata.*
Syphilis	*Asparagus falcatus, Cassia abbreviata, Strophanthus eminii, Strychnos spinosa, Vernonia glabra.*
Tonsillitis	*Sesamum angolense, Schrebera trichoclada, Solanum incanum.*
Toothache	*Boscia salicifolia, Calotropia procera, Dalbergia melanoxylon, D. nitidula, Securidaca longepedunculata.*
Trachoma	*Commiphora africana, Combretum fragrans, Dalbergia melanoxylon, Schrebera trichoclada.*
Whooping	*Ficus natalensis*

cough	
Wounds	*Albizia harveyi, Bidens pilosa, Combretum fragrans, C. molle, Diplorrhynchus condylocarpon, Dichrostachys cinerea, Julbernardia globiflora, Pericopsis angolensis, Pterocarpus angolensis, Psidium guajava, Solanum incanum, Tamarindus indica.*
Yellow fever	*Cassia obtusifolia, C. singusana, Swartzia madagascariensis.*

Intrt pharmacognosique des plantes de la flore mdicinale Rwandaise: valeur chimiotherapeutique de quelques plantes Rwandaise

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Introduction

Dans le cadre de la valorisation de la thrapeutique traditionnelle rwandaise et de la recherche de l'activit biologique dans la flore mdicinale, une investigation approfondie a t mene sur des plantes rwandaises.

Cette tude qui s'ajoute aux nombreuses autres, aussi bien dans notre pays qu'a l'extrieur visant & rechercher de nouveaux ou de meilleurs mdicaments dans le monde vgtal, nous a permis de justifier l'utilisation en thrapeutique de certaines plantes par les gurisseurs traditionnels rwandais. Le prsent chapitre rsume la

mthodologie suivie et dcrit les principaux rsultats obtnus.

L'tude porte sur quelques plantes utilises largement en mdecine traditionnelle rwandaise.

Il s'agit de *Burus rigidus* SM. (Umukeri) de la famille des Rosaces, *Lantana trifolia* L. (Muhengeri) de la famille des Verbnaces et de *Vernonia amygdalina* DEL (Umubilizi), appartenant la famille des Astraces.

Le document vise donc rassembler d'une manire condense les rsultats attints jusqu' date, lors d'une tude systmatique visant a dmontrer la valeur pharmacologique et/ou chimiothrapeutique de ces plantes. Pour dmontrer l'impact en thrapeutique de ces plantes, nous sommes partis d'une hypothse globale selon laquelle en plus de sa valeur psycho-socio-culturelle reconnue par tous les peuples, la mdecine traditionnelle utilise aussi des plantes activit biologique certaine et pouvant tre mise en vidence sur les modles scientifiques des recherches biomdicales.

Pour l'une des plantes dont les rsultats laissent entr'ouvoir dj ce stade, une possibilit d'utilisation en clinique, l'investigation t pousse jusqu' l'exploration des paramtres toxicologiques. Les donnes sont encourageantes. La majorit des rsultats sont consigns dans des publications qui seront indiques tout au long de cette prsentation et dans lesquelles le lecteur dsireux des informations plus approfondies peut lire les dtails souhaits.

Tout en poursuivant la recherche de l'activit thrapeutique dans les plantes tudies, l'isolement et l'identification des molcules chimiques mme inactives vis--vis du

secteur explor, permet d'une part de complter les connaissances phytochimiques de ces plantes qui, en gnral, sont tudies pour la premire fois et d'autres parts, d'obtenir des informations toxicologiques souvent inaccessibles lors de l'utilisation des extraits bruts. Le premier lment est important surtout lors de la rdaction des monographies des pharmacopes portant sur ces plantes, le second est trs utile non seulement dans la production des mdicaments utilisables, mais aussi permet aux chercheurs de donner des conseils judicieux aux tradipraticiens qui incorporent ces espces dans leur mdication.

La description commencera dans la suite par la mthodologie gnrale utilise. Suivra l'tude dtaille de chaque espce et qui sera centre sur les molcules chimiques identifies et leur activit biologique. Comme une conclusion partielle aura t donne lors de l'tude de chaque espce, une brve discussion suffira pour rsumer l'intrt des plantes tudies pour le dveloppement du secteur mdicopharmaceutique nationale. Enfini, une rfrence bibliographique montrera aussi bien les principaux documents consults lors de ces recherches que ceux dans lesquels ont t publis la plupart des rsultats.

Mthodologie gnrale

Le choix des plantes a t effectu dans l'ensemble de la flore mdicinale rwandaise, grce surtout aux informations fournies par les tradipracticiens (1,2,3,4) au sujet de l'action thnopharmacologique de ces espces.

Pour chacune d'elles la recherche a t charpente sur une mthodologie pouvant tre rsume en sept points principaux:

(a) description botanique et tude de la distribution gographique des plantes retenues;

(b) inventaire de l'utilisation des plantes en thrapeutique traditionnelle au Rwanda et, parfois aussi, au niveau de l'Afrique Centrale;

(c) screening biologique orient portant sur l'extrait total de la plante;

(d) screening phytochimique et tude bibliographique dtaille des plantes retenues;

(e) fractionnement chromatographique des extraits tout en poursuivant l'activit identifie prcdemment;

(f) isolement, purification et identification des produits responsables de l'activit;

(g) tude dtaille comportant une valuation de l'effect thrapeutique et de la toxicit ventuelle des produits actifs, en comparaison avec des produits dj connus en thrapeutique.

La dtermination botanique a t faite au CURPHAMETRA o les spcimens des plantes peuvent tre trouves. La distribution gographique a t faite en consultant les spcimens dposes au CURPHAMETRA et l'Herbarium du Jardin Botanique National de Belgique (5).

Les mthodes phytochimiques d'extraction d'isolement et d'identification spectroscopique des produits sont dcrites dans beaucoup d'ouvrages. Certains cas

particuliers aux prsentes recherches sont galement dtaills dans les rfrences cites. Nous n'estimons pas indispensable d'y revenir. Sera prsent para contre le rsum de certaines techniques utilises dans la recherche des activits biologiques, vu l'aspect particulier de certaines d'entre elles. La mise en vidence de l'activit chimiothrapeutique antibactrienne et antifongique a t mene en recourant aux mthodes dites de dilution et de diffusion(6)

Nous avons chaque fois test les microorganismes reprsentatifs de grands groupes reconnus comme principaux agents pathognes. Pour les produits actifs purifis nous avons recherch la concentration minimale inhibitrice (CMI) suivant la mthode classique. Chaque fois que cela a t possible l'activit d'un produit tait compare celle d'un tmoin connu utilis en thrapeutique.

L'activit antivirale des extraits des plantes et des produits purs a t tudie suivant une technique beaucoup plus complexe impliquant la culture et l'entretien des tissues cellulaires, le dvelopement des virus sur ces cellules et l'valuation de l'activit antivirale en observant l'absence ou la persistance de l'effet cytopathogne des virus selon que le produit test possde ou n'a pas d'effet antiviral. Nous avons utilis surtout la technique de dilution des virus dans les plaques de microtitrage mise au point par l'quipe de Hronovsky(7) et adapte par Vanden Berghe et ses collaborateurs(7).

Le choix des virus a t opr de manire voir des reprsentants des diverses classes. Ainsi l'Adenovirus a t retenu comme reprsentt des virus ADN sans enveloppes; le Poliovirus et le Coxcachievirus reprsentaient les virus ARN sans enveloppe, le Herpes les virus ADN avec enveloppe, tandis que le virus de la Rougeole et le Semliki Forest reprsentaient les ARN portant une enveloppe.

L'activit cardiovasculaire a t mise en vidence sur les modles exprimentaux suivants: les plaquettes sanguines de lapin, les oreillettes droite et gauche de cobaye, l'artre centrale de l'oreille du lapin, les microsomes de la vsicule sminale de mouton(5,8).

Quelques unes de ces techniques ont t effectues a l'Universit d'Anvers (UIA), en Belgique. Quant aux tudes toxicologiques portant surtout sur la 3-mthoxyquerctine isol de *Veroninia amygdalina* nous les avons dvelopes Butare, au CURPHAMETRA sur les modles experimentaux dcrits ci-aprs.

1. Toxicit de la 3-MQ en usage interne (9)

Prparation et administration du produit.

La 3-MQ utilise a t isole des fleurs de *Vernonia angydalina* (Umubilizi) suivant la procdure dcrite ailleurs(5).

Une suspension acqueuse a t prpare notamment en broyant pralablement la poudre dans un mortier. La suspension dose une concentration de 15 mg/20 ml d'eau distille tait administre aux souris a raison de 30 mg/Kg de poids corporel de l'animal; ce qui revient, a titre d'exemple, fournir 0.8 ml de suspension pour une souris de 20 g. La suspension tait administre a l'aide d'une seringue en plastic munie d'un embout inoxydable et conu de faon ne pas provoquer des traumatismes chez l'animal.

Manipulation des souris et observations

Dix souris blanches (souche OF1) des deux sexes, d'ge ± identique, de poids

moyen gal 22,4 g au dpart ont t rparties en deux groupes de 5 units chacun.

L'tat gnral et la temprature de chaque animal ont t observs et nots durant la journe prcdent l'administration du produit.

Le lendemain, l'un des deux groupes a reu la suspension de 3-MQ proportionnellement au poids des animaux, tandis que l'autre groupe recevait des quantits quivalentes d'eau distille.

L'observation des animaux tait faite chaque jour (la mme heure en ce qui regarde le poids et la temprature) et portait notamment sur:

- **l'tat gnral de chaque animal;**
- **l'agitation ou la somnolence ventuelle;**
- **la temprature;**
- **l'tat et la forme du pelage;**
- **le poids corporel de chaque animal.**

Les animaux taient maintenus par groupe de 2 dans des cages rectangulaires en matire plastique.

Le produit a t administr pendant 10 jours sans interruption, tandis que l'observation des paramtres prcdents a t mene durant 44 jours en premier temps.

Les animaux recevaient de la nourriture et de l'eau ad libitum certaines dates, c'est--dire le 1er, 9,II,14, 22, 29, 36 et 44 jour, nous avons relev le poids individuel de chaque souris des deux lots et avons calcul les poids moyens correspondant ces dates. Ces poids moyens, en comparaison au poids initial nous

ont permis d'valuer l'influence du traitement sur l'volution pondrale et, partant, sur la croissance des animaux d'exprience.

Pour rechercher l'influence ventuelle du produit sur la reproduction, nous avons procd de la manire suivante : un lot de dix souris femelles de la mme souche que prcdemment a reu la suspension acqueuse du produit pendant 10 jours. Un autre lot galement femelle a reu de l'eau distille de la mme manire qu'au cours de l'exprience prcdente. Au 11 jour, les souris des deux lots ont t accouples et maintenues par paire dans des groupes de cages diffrentes pour chaque lot o elles recevaient de la nourriture habituelle et buvaient ad libitum.

A la naissance, nous avons compt le nombre de petits pour chaque lot et nous avons tabli une comparaison.

Manifestation toxique d'une pommade de *V. amygdalina* en UE(10)

Le travail a port sur 10 lapins adultes d'un poids variant entre 2,8 et 4 kg. Ils ont t rpartis en deux lots de 5 units chacun. Aprs la prise de poids et l'observation minutieuse de l'tat gnral des animaux, chaque lapin a t pil sur une surface de 4x4 cm au niveau du dos. Ils taient maintenus dans des cages individuelles et nourris ad libitum. Le premier lot tait trait par une pommade 5% de la fraction hydromthanolique fournie par les fruits de la plante. L'expient tait constitu de vaseline. Le deuxime lot (tmoin) tait trait avec de la vaseline seule. Le traitement consistait en une application une fois par jour et de manire identique d'une petite couche de pommade, ou d'expient seul selon le cas, et en frottant lgrement de faon oindre uniformment la surface pile.

L'exprience a t mene durant un mois(du 4 dcembre 1987 au 4 janvier 1988). L'application de la mdication a t arrte au 180 jour. Le contrle consistait en une observation quotidienne, de manire comparative dans les deux lots et oriente principalement vers les paramtres suivants: l'tat gnral des animaux, le poids, le repousse des poils et surtout l'apparition ventuelle des manifestations d'irritation sur la surface traite.

Etude dtaille de chaque plante et rsultats

Rubus rigidus SM.

L'espce est bien rpandue au Rwanda et dans les pays voisins (5,11). Les tradipraticiens rwandais l'utilisent surtout contre les maladies caractre bactrien et fongique, mais sans qu'il existe une dlimitation nette vis--vis des autres secteurs de pathologie, comme les verminoses, les morsures de serpents(4,5)...

L'tude prliminaire avait montr une activit antimicrobienne, surtout antifongique dans l'extrait total de plante(12). Les tudes phytochimiques ont permis d'isoler et d'identifier dans la fraction active des tiges l'acide pyogallique, connu communment sous le nom de pyrogallol(voir fig. p14').

L'activit antibactrienne et antifongique de ce produit qui est d'ailleurs connue dans les littratures(13) a t confirme par nos travaux, avec une concentration minimale inhibitrice(CMI) proche de 250 microgrammes. Les microorganismes les plus sensibles ce produit sont le *Staphylococcus aureus,* le *Pseudomonas aeruginosa* le *Microsporum canis,* le *Trichophyton mentagrophytes* et le *Candida albicans (5,14).*

Aucune autre action, qu'elle soit antivirale ou pharmacologique (cardio-

vasculaire) n'a t mise en vidence dans cette plante par les prsents travaux. Par contre les recherches bibliographiques ont montr que le psyrogallol est dou aussi d'une activit hpatoprotectrice importante qui se manifeste aux doses de mme ordre de grandeur que celle qui ont montr l'effet antimicrobien. Ce triphnol partage cette action avec les autres phnols de structure apparente, les catchnines et les tannins(13).

En conclusion, nous avons tabli que l'activit chimiothrapeutique du *Rubus rigidus* exploite par les tradipracticens rwandais serait due principalement la prsence du pyrogallol. Dur point de vue mdico-pharmaceutique, le pyrogallol a dj connu plusieurs utilisation, surtout en usage externe; les littratures consultes font mention, entre autres, des pommades antimicrobiennes avec des doses de 2 10% (15).

Cependant, une certaine toxicit reconnue ce produit par voie interne nous invite suggrer aux gurisseurs qui utilisent le *Rubus rigidus* de privilgier les prparations usage externe.

Lantana trifolia L.

C'est une Verbnace largement rpandue au Rwanda. Elle est cannue en Kinyarwanda sous le nom d'Umuhengeri. Elle avait aussi montr au stade prliminaire une activit antimicrobienne surtout dans les feuilles. Les gurisseurs rwandais l'emploient contre les syndromes de tout genre (2,5).

Il va tre montr dans la suite que c'est l'activit antimicrobienne qui fourni les rsultats les plus intressants. Comme pour l'espce prcdente, les autres activits

biologiques recherches au niveau prliminaire n'ont pas fourni des donnes pouvant justifier la poursuite de l'investigation dans d'autres secteurs.

L'tude chimiothrapeutique antimicrobienne sur la fraction active a permis d'isoler et d'identifier une srie de produits dont certains possdent une activit intressante. Ces produits isols de *Lantana trifolia* sont: deux hydrocarbures aliphatiques saturs, chaines linaires(c33H68 et C35H72), le saccharose, deux triterpnes pentacycliques du groupe de l'ursane (alpha-amrine,urs-12-ne-3- one), un nouveau flavonoide polymethoxyque (5-hydroxy-6,7,3",4',5'-pentamthoxyflavone) auquel nous avons donn le nom d'Umuhengerine en partant du nom de la plante en kinyarwanda(16), et enfin la diospyrine qui est une binaphtho-quinone apparent la juglone (voir fig.p14'). L'Umuhengerine est isol pour la toute premire fois du rgne vgtal alors que la diospyrine avait t jusqu' prsent, identifie uniquement dans les diffrents genres de Diospyros (Ebeneces) (17)

Parmi ces produits isols, seuls les deux derniers ont manifest une activit antimicrobienne digne d'intrt. L'Umuhegerine possde un spectre antibactrien et antifongique relativement troit des concentrations de 300 microgrammes.

La diosyprine quant & elle, possde un spectre trs large portant sur les G', les G-et quelques champignons avec une prdilection contre les mycobacteries (ex. agent de la lpre et de la tuberculose) dont le reprsentant s'est montr sensible une CMI proche de 2, 5 microgrammes. Le tableau suivant rsum ces rsultats.

Il y a lieu de signaler pour l'activit de cette plante que mme si la comparaison des CMI n'est pas le seul paramtre tenir en considration, la diosyprine manifeste son

action & une concentration pareille (parfois mme meilleure) celle de la plupart des produits antimicrobiens utiliss en thrapeutique, c'est le cas de son action sur le *M. fortritum* (CMI =2,5 mg) en comparaison la Neomycine tmoin qui ne dploie son action qu'avec une CMI = 32 microgrammes/ml. L'Umuhengeri possde un spectre antimicrobien plus faible soit, mais vue sa structure chimique, il pourrait en plus agir au niveau de la balance lipophile, facteur reconnu actuellement comme dterminant pour l'activit des molcules chimiques contre les bactries G-et G(18). De plus, son identification contribue nettement l'amlioration de la connaissance chimique de cette espce.

Tableau 1: Dtermination de la CMI de la Diospyrine

Nom du micro-organisme	Concentration en microprogrammes (par ml pour les champignons)					
	100	**50**	**20**	**10**	**5**	**2,5**
Staphylococcus aureus	*	*	*	*	-	
Staphylococcus pygenes	*	*	*	*	*	-
Bacillus subtilis	*	*	*	*	*	-
Bacillus cereus	*	*	*	*	*	-
Mycobacterium fortuitum	*	*	*	*	*	*
Neisseria gonorrhoeae	*	*	*	*	*	
Klebsiella pneumoniae	*	*	*	-	*	
Escherichia coli	*	*	*	-	*	
Shigella dysenteriae	*	*	*	-	*	

Sherratia marcescens	*	*	*	-	*	
Pseudomonas aeruginosa	-					
Proteus vulgaria	-					
Salmonella typhimurium	*	*	-			
Aspergillus niger	-					
A. flavus	-					
A. fumigatus	-					
Microsporum canis	*	*	*	*	*	*
Trichophyton mentagrophytes	-					
Candida albicans	*	*	*	*	*	*

*** = activit; - = absence d'activit.**

D'aprs les littratures sur *Lantana camara,* une autre Verbnace qui ressemble beaucoup la prcdente, cette autre espece renferme des produits toxiques surtout au niveau du foie et de la peau vis--vis de laquelle ils manifestent une certaine photosensibilisation (5); un exemple de ces structures est le lantadne A.

Nous n'avons pas isol ce genre de produits dans la fraction active de *L. trifolia.* Cependant nous ne sommes pas mesure de conclure leur absence dans toute la plante; il est trs probable que les mmes produits toxiques puissent tre mis en vidence par des mthodes purement chimiques qui ne prendraient pas comme fil conducteur l'activit biologique. Ici aussi la recherche bibliographique sur le genre lantana nous invite une certaine prudence dans l'utilisation de la plante tudie.

Vernonia amygdalina Del.

C'est une Astrace appartenant, comme sa dnomination l'indique, a la sous-famille des Vernonies, trs largement rpandues dans l'Afrique tropicale et intertropicale. Elle est appele Umubilizi au Rwanda et dans certains pays voisins comme l'Uganda et le Burundi(19).

Son utilisation en mdecine traditionnelle dans nos rgions, a la mesure de sa grande distribution gographique (5), va des hpatites aux affections cardiaques et en passant par une large gamme de syndromes tels que les verminoses, le paludisme, les coliques et troubles abdominaux, les morsures de serpents, les czmatides.

En commentant nos propres publications(20), les auteurs de la Revue: "Communauts Africaines" viennet de confirmer l'utilisation de *V. amygdalina* au Cameroun dans l'alimentation humaine et que nous avions dcrite auparavant au niveau de l'Afrique orientale et mridionale (5).

En complment l'activit biologique notamment antitumorale et cytotoxique identifie auparavant dans cette plante ( ), l prsente tude a permis d'identifier d'autres structures qui n'avaient jamais t signales et de mettre en vidence d'autres activits thrapeutiques intressantes, comme l'action chimiothrapeutique antivirale et l'effet pharmacologique au niveau de l'agrgation plaquettaire et des affections cardiaques.

Le travail porte sur l'extrait des fleurs sches de la plante qui a t prpar et fractionn suivant le schma dj publi dans d'autres articles (21,22,23). Compte tenu de son

importance actuelle en chimiothrapie, c'est l'activit antivirale qui a servi d'orientation dans la sparation et la purification des molcules actives. Il a t possible d'isoler et d'identifier dans la plante un certain nombre de structures chimiques:

- **11 acides gras aliphatiques saturs, chaine linaire allant de C 22 C 32;**
- **5 esters d'acides gras drivs du glycrol;**
- **un sesquiterpne lactonique appel vernolide (voir fig. p14')**
- **une serie de composes flavoniques de la famille des flavonols;**

  il sa'agit de la querctine (3,5,7,3',4'- pentahydoxyflavone) (Q) de la 3-mthoxyquerctine (3-MQ), de la 3,3'-dimthoxyquerctine(3,3-DMQ), de la rutine;: querctine-3-0-1 bta-D-glucose-6-1 alph-L-rhamnose) et du kaempherol (3,5,7,4'-ttrahydroxyflavone (K).

  La 3-MQ(Fig.p14') qui semble tre le chef de file des flavones, a t isole avec un rendement proche de 1% par rapport la poudre des fleurs sches la temprature ambiante.

L'tude approfondie de l'activit thrapeutique des produits isols a montr que ce sont les flavonoides et le vernolide qui constituent les principes actifs, tandis que les acides gras et les esters ont t dcrits comme les produits alphatiques associs ces principes actifs(23). Quatre groupes d'activits biologiques ont t tudies jusqu' un stade considr comme intressant.

Il s'agit de l'activit cardiovasculaire, l'activit antiparasitaire, l'activit antivirale ainsi que la vrification de certains paramtres toxicologiques des produits

susceptibles d'tre exploits au niveau clinique.

Activit cardiovasculaire

1. Effet contre l'agrgation plaquettaire. Tous les dtails techniques du protocole concernant la mise en vidence de cette action ont t dvelopps ailleurs, surtout dans la "Revue Mdicale Rwandaise" en 1986 (8).

La technique utilise a permis de dmontrer que les flavonoides querctine, 3-methylquerctine et la rutine un degr moindre, inhibent l'agrgation plaquettaire et l'action de la lipoxygnase et la cyclooxygnase une concentration de 100 microgrammes (110 M) par millilitre. Signalons ds prsent que cette concentration est d'ordre de 1000 fois plus leve que celle qui manifeste un effet antivirale intressant.

Le vernolide lui aussi manifeste une inhibition compltement rversible de l'agrgation plaquettaire induite par l'acide arachidonique, mais cette action est assez faible.

2. Autres activits cardiovasculaires

A des doses de 10 microgrammes par millilitre la 3- mthoxyquerctine manifeste un effet chronotrope positif sur l'oreillete droite et une action antiarythmique sur l'oreillete gauche du coeur isol de cobaye (5,24).

Activit antiparasitaire

Elle a t mise en vidence indirectement et c'est surtout le vernolide qui en est

responsable. En effet, pendant que nos recherches taient en cours, un autre groupe travaillant indpendamment a isol le mme produit partir de *Vernonia colorata* et a montr qu'il possde une action antiparasitaire surtout contre l'Entamoeba histolitica un niveau proche de celui des antiparasitaires utiliss en clinique comme le mtronidazole (Flagyl) (25).

En mettant en vidence le mme produit dans *V. amygadalina* nous dmontrions du mme coup le bien fond de l'utilisation de cette plante contre les parasites intestinaux.

Activit antivirale

La 3MQ et la 3,3'-dMQ sont responsables d'une action antivirale trs intressante et qui s'est manifeste des concentrations aussi faibles que 10 nanogrammes.

Ces produits exercent un effet slectif en empchant la formation de l'ARN et des protines virales sans interfrer avec le mtabolisme de la cellule hte. Ils sont actifs notamment et surtout contre le virus de la poliomylite, le coxcachie-virus, le vesicular stomatitis virus (VSV), le Rhinovirus et contre certains virus d'origine africaine comme le Bangin et le Bunyamwera. L'intrt de cette plante en chimiothrapie antivirale est ainsi vident d'autant plus qu'il s'agit d'un secteur dans lequel mme la mdecine europenne, dveloppe est encore dpourvue des mdicaments.

Fort heureusement la famille des produits isols de cette plante permet mme d'envisager des recherches ultrieures avec un espoir de succs mme sur d'autres groupes de virus comme des rtrovirus. Des preuves existent dont certaines sont mme trs rcentes: en 1979, Mr. Apple et ses collaborateurs avaient dj dmontr

l'inhibition de la transcriptase rverse des oncornavirus par certains flavonols d'origine vgtale.

En mai de cette anne-ci encore l'quipe japonaise d'ONO Katsuhiko, en collaboration avec des chercheurs franais sont revenus sur l'action de certains flavones apparents la querctine en tant qu'inhibiteurs, de la transcriptage reverse(27), enzsyme mis en cause dans le syndrome de l'imminodficience humaine.

Mme si les recherches ultrieures venaient a conclure l'absence d'une action intressante dans ce secteur, l'intrt de *Vernonia amygdalina,* aussi bien au niveau des extraits semi-purifis que des produits purs est vident compte tenu aussi de la faible toxicit de la plante; il y a lieu d'envisager srieusement l'utilisation prochaine de cette espce en thrapeutique.

Avant ce stade nous avons commenc par l'exploration de certains paramtres toxicologiques du principe actif majoritaire.

Etude toxicologique prliminaire de la 3-MQ en usage interne

Les rsultats de cette investigation ont t eux aussi publis l'anne passe dans la "Revue Mdicale Rwandaise"(9).

Il a t ainsi possible de conclure a une absence de toxicit aigue et subague pour la 3-mthoxyquerctine qui est en concordance avec les donnes rapportes antrieurement dans les littratures pour les flavonoides en gnral, et pour la 3-MQ en particulier. De plus, aucun effet ngatif n'a t constat sur le systme reproducteur des animaux d'exprience; tous les dtails pourraient tre trouvs dans la rfrence

correspondante(9).

Manifestations toxiques en usage externe

Dans le mme but que prcdemment nous avons essay d'tablir l'importance des manifestations toxiques susceptibles de se produire lors d'une utilisation ventuelle de la plante sous forme de pommade contre les maladies dermatologiques tels que le zone et les eczmatices. Le rsultat de cette tude montre que l'application d'une pommade 5% d'un extrait semi-purifi de *V. amygadaline* ne provoque aucune irritation dcelable chez les lapins de laboratoire traites comparativement a ceux qui reoivent l'expient seul(29).

Conclusion Gnrale et Discussion

En rapportant les rsultats de ces recherches nous avons soulign une fois de plus que la valeur des plantes mdicinales africaines en gnral et rwandaises, en particulier, n'est plus dmontrer dans le traitement des maladies de toute sorte.

L'usage en thrapeutique traditionnelle des plantes sur lesquelles s'est concentre la prsente communication semble largement justifi par l'activit biologique des produits qui y ont t mis en vidence. Nous avons rencontr trois groupes de produits chimiques du point de vue de l'action thrapeutique des plantes explores.

Il y tout d'abord des produits possdant une activit dj connue auparavant, mais dont nous ignorions la prsence dans la plante tudie, ex. le pyrogallol.

Viennent ensuite des produits qui taient trs bien connus en chimie comme inactifs ou presque mais chez lesquels la technique de recherche utilise nous a permis de

mettre en vidence une activit trs utile et parfois mme inconnue ailleurs dans le secteur mdico-pharmaceutiques; un exemple de ce groupe est la 3-mthotyquerctine isole de *V. amygdalina.* On a enfin des produits toxiques ou inactifs, par rapport a l'activit recherche mais dont la mise en vidence contribue fortement augmenter les connaissances toxicologiques ou phytochimiques des plantes tudies.

Comme on devait s'y attendre, les plantes explores ne semblent pas manifester un mme intrt pour le dveloppement du secteur socio-sanitaire ultrieur. L'activit du *R. rigidus* est au bas de l'chelle; son grand intrt rside presque uniquement dans la justification du bien fond de l'utilisation en thrapeutique traditionnelle. Le *Latana trifolia* par contre renferme des produits d'activit similaire celles des antibiotiques les plus actifs; mais comme la plante est galement fort toxique, les produits prsents pourraient tre purifis et servir de dpart & la mise au point de nouveau mdicament en chimiothrapie antimicrobienne. La *Vernonia amygdalina* par contre est trs peu toxique, bien rpandue dans nos rgions o elles poussent presque spontanment.

Son activit diversifie, trs remarquable surtout en chimiothrapie antivirale et comme antelmintique nous suggre a mettre trs rapidement en place une recherche dveloppement visant son exploitation trs prochaine mme sans devoir isoler les molcules actives. L'on pourrait utiliser son extrait semi- purifi.

A note on the utilization and commercialisation of traditional medicine

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ABSTRACT

Third World countries have no mechanisms to safeguard sovereignty over their genetic resources or for conservation of tropical products and traditional knowledge of the indigenous people. Advances in biotechnology have prompted rapid interest among biotech and pharmaceutical companies to exploit herbs and microbes in the south, as a source of raw materials for new pharmaceutical products.

This paper gives a general review on the utilization and general economic values of medicinal plants world wide.

Introduction

Tanzania has one of the richest vascular flora in Tropical Africa, with over 10,000 species. But most of the species, particularly those with medicinal values, are constantly being threatened as a result of industrialisation, villagisation and other developments.

In the past there have been many instances whereby plants used in the traditional pharmacopoeia of developing countries, such as Tanzania, have been exported and are now available as modern, industrially processed pharmaceutical preparations. In addition, there are many others which, because of their long standing use in traditional pharmacopoeia, are receiving closer attention.

There are also many other plants which have recently been shown to exhibit promising clinical effects, and which could be processed industrially into modern medicines for use in both developing and the more developed countries. Few of such plants are those which can be used as laxatives and purgatives, for example, *Cassia absus, C. alata, C. obtusifolia, Tamarindus indica* and *Phytolacca dodecandra.*

Indeed, many species of vascular plants have for long supplied us with excellent drugs such as morphine from *papaver somniferum* (used as a pain killer), digitoxin and digoxin from *Digitalis lanatan* and *D. purpurea* (for treating congestive heart failures), quinine from *Cinchona spp.* (for malaria), ergotamine (for migraine headache), from *Claviceps purpurea* and vincristine from *Vinca rosea* (for treating leukaemia in children). In addition, the natural plant drugs have served as useful prototypes for even better medicines. With the help of synthetic chemists, morphine has become hydromorphine; lysergic acid has been converted to methylysergide; cocaine has yielded procaine; physostigmine has been converted

into neostigmine and salicin has been changed into acetylsalicylic acid.

The world statistics

There is no comprehensive world list on medicinal plants and the pharmaceutical products derived from them. However, the national trade statistics of many developed and some developing countries show the contribution to world trade, made by economically important vascular plant-based drugs, and the trend of their contribution. Over 400 botanical products arc marketed internationally. These find applications in a wide range of industries, such as food, cosmetics and pharmaceutical industries.

With regard to the plants used for pharmaceuticals, the imports of the vascular plants into the U.S.A. in 1980 were nearly 34,000 tons worth $78 million. The imports into the European Economic Community were 80,738 tons worth $180 million. The exports from the USA and the EEC in 1980 were, in contrasts, 4000 and 7,300 tons respectively. (Principe, 1989).

The total worldwide imports of medicinal plants increased from $355 million in 1976 to $551 million in 1980. In the Federal Republic of Germany, the imports of medicinal plants in 1979 amounted to 28326 tons, and were worth $56.8 million while imports of medicinal plants to the United States declined from $52 million in 1976 to $44.6 million in 1980. With respect to the domestic market for the plants, the monetary value in the USA in 1981 was $3.912 billion. In Japan, the imports grew from 21,000 tons in 1979 to 22,640 tons in 1980. But the value of those imports declined from $50 million to $48 million (Principe 1989).

The prescription drugs, in contrast, on a world-wide scale, comprised a value in excess of $87 billion in 1984 (in manufacturers prices). That was an increase of about 1.75% over the 1983 figures. The 1985 sales were projected to increase to over $90 billion (in manufacturers prices). In Japan, 13 per cent of the pharmaceuticals found in the 10th edition of the Japan Pharmacopoeia are derived from plants. The demand for these drugs has been increasing over the last decade, but their production only accounts for 1.5% of the total production. In 1984, the sales of traditional medicines in Japan by prescription totalled $227 million (Principe 1989).

In the Federal Republic of Germany, new plant drug preparations, and new plant constituents are continually being introduced into the market by a relatively large number of manufacturers. An interview with women, carried out in the country, showed that 76% of the respondents drank herbal tea for their beneficial effects and about 52% turned to herbal remedies for their initial treatment of minor ailments (Tyler, 1986).

Drug development

The cost of drug development in the U.S.A. is between $50 to 100 million dollars per new product. Because of the high costs involved the activity is restricted to a few of the largest pharmaceutical manufacturers. In the Federal Republic of Germany, the case is different: the smaller companies have the resources needed in innovations pertaining to the plant drug field. This stimulates competition and encourages new product development.

The process of proving whether or not a plant drug is effective and absolutely safe

is very costly, a doctrine of reasonable safety should be substituted after clinical trials by general practitioners have given the necessary evidence, and after the experiments have been repeated and the scientific truth verified by the manufacturers and other researchers. In doing so a number of plant remedies will be added to the market, particularly those commonly used for self-medication and those widely prescribed by physicians for minor ailments. But regulatory measures, as now practiced, are still necessary in order to protect public health. Nevertheless these should not be so strict as to discourage and prevent innovative research.

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Experience on the use of Tanzanian medicinal plants for the last decade (1979-1989)

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ABSTRACT

This paper highlights on the various methods of herbal therapeutics. It indicates where a herb is administered as an infusion, a decoction, a maceration, a juice, a lotion, a powder etc. It is to be noted that the gathered plants, whether growing wild or cultivated, should be, as far as possible, free of contaminated dangerous chemicals (e.g. DDT). In this paper the author presents the common herbs with their botanical, local, and Swahili names. Be also touches on a few common tropical diseases. A brief classification of herbs and reference to dangerous drug groups, are also given. A note on herbal preparation of insecticides and insect repellents is also provided.

Introduction

Prior to the introduction of the "germ theory" in Europe in the 19th century,

homeopathists and traditional healers were brand names in health care deliveries. After this, the beginning of what is called "Western Medicine" took shape and monopoly. That was also the beginning of the belief that because the plants are surrounding us, and they cost nothing, or very little, people could not believe on their efficacy. Traditional healers - cum - herbalists bad never advocated their practices as absolute. Nature is absolute, and even man's intelligence on the use of natural resources does not warrant absolution. A traditional doctor embraces it in his belief that in case of failure to cure a patient, he must refer the patient to a "Western Medicine" doctor, but this is not the case in the *vice versa* aspect. This appears to be a tendency to declare *"oneself"* absolute. It is from this angle of perception that a global and intergovernmental clarification should be revisited.

The little information in this paper is not conclusive but is an attempt to show how herbal medicine can develop towards the so- called "Western Medicine". It is not indicative of a change in therapeutic principles, but a modernization of the therapeutic systems of herbal medicine. At this juncture, and for the purpose of this conference, the paper will give some highlights on the use of various plants for treating the common tropical diseases.

Disease diagnosis

I feel it is worth mentioning that my experience in traditional medicine does not reflect the explicit experience of a traditional healer. In most cases, a patient is required to have his blood sample, urine or stool examined at a routine level, in our clinical laboratory. Cases of AFB positive, cultural and sensitivity, and gram smear, are referred to hospitals with a modern laboratory for comments. This concept of healing, I feel, is to be left to the herbs' self pharmacodynamics and

only to be catalysed by man's intelligence. It is like in modern medicine: a Doctor "does not" cure, it is the drug that cures, under a Doctor's prescription. So being cured, and being healed are resultant action of man's therapeutics, intelligence on herbs, or drugs.

Furthermore, this paper shall not deal with the manigfaltigen disease causations or disease etiologies, sometimes classified as personalistic etiologies and naturalistic etiologies. However, since the latter is believed to be caused by natural forces, like heat, wind, and cold, or natural conditions, like the imbalance of basic body nutrients and elements, it is vivid that the paper shall deal with it. In that, after diagnosis, the answer to the question "what", and sometime "how" is answered.

The question of "who" caused the disease (personalistic etiology) is, therefore, uncalled for. Nonetheless, it would appear too unpluralistic not to unveil the fact that I have met many times cases of personalistic etiologies in the community. These etiologies ranged from godly punishments, vague evil forces, witchcraft, evil spirits, to even hereditary malpractices of ancestors' disciplines. I, therefore, admit that in this line, I have not gathered any experience nor administered any pattern of health care utility, save a few placebos when the family of the patient unveils the causation, as having been due to hereditary malpractices of ancestor disciplines.

Storage requirements and expiry dates

The importance of correct adherence to proper storage facilities - cum - requirements does not need to be overemphasized. While it is explicitly clear for

modern drugs to have their manufacturers's dates and thereafter their expected expiry dates, the case is complicated in herbal medicines. One was tempted to take the time of correct harvesting of the herbal medicine as the date of "manufacture", in comparison with modern medicines. That means the "manufacturer's" date in herbal medicine starts off at the time when the plant parts away with its herbal portion. But when it comes to herbal properties embodied in fruits, it is when the fruit is ripe, and, therefore, ready for use. In some fruits like bananas and pawpaws, it does not take too long before over-ripening and decay.

For some nuts, it is better to take the time it has dried properly as the date to start with. Similarly, the bulbs of onions are taken to be ripe and ready for use when they are dry. But here again, it does not take too long before regermination.

The packing of drugs for better and proper storage to enhance the required (longer) expiry dates, is not a manner of only modern pharmaceutical drugs manufacturers. Traditional practitioners have known this for quite a long time. Herbal medicines have been stored in various sizes of gourds, earthenware pots, and when necessary, even in porcelain. Although there was a concept of "secretising" the herbal values, the main reason was also to keep it "air tight", and free from direct sunlight. The earthenware pots were ideal for burning some herbs to ashes without the danger of cracking the pot as a result of heat. Even in the ultimate storage, it is easier and more convenient to pour the powder ashes from a little opening. This is important, especially when several herbs are required to be mixed at very small ratios.

It is also known that keeping herbal drugs in such containers makes them free of

moisture and unnecessary heat. A further element is of cultural expression. These containers are not expensive, and are easy to make. They are also useful for depicting culture and traditional capability. Such containers include baskets made of coconut plant leaves, bags made of animal hides and sea shells, to mention but a few. The more "dangerous" the drug is, a much more durable the container that is used. In this way herbal drugs could be kept in forms of liquid, powder, or solid.

The expiry dates of herbal medicines very much depend on the types of herbs, the duration of preparation before use, and the quality of storage against water, heat, or direct sunlight (where it is not required). Herbal medicines decompose easily when in "contact" with these conditions.

It is presumed that the expiry dates of herbal drugs in powder form is shorter than the same drug stored in the form of a bark, or as seed. Still longer is when the same drug is kept "intact", with the piece of plant itself. Herbal drugs from green plant leaves, do not stay long unless the prescription calls for the use of dried leaves. It is recommended that when a mixture of herbs is required, some in form of roots, barks, and leaves or flowers, leaves and flowers should be harvested last, preferably on the same day of preparation and use.

Examples of medicinal plants and the diseases they cure

***1. Pears: Pyrus communis* (local name: *mapeasi*)**

These are used to treat diuretic and urinary complaints. The medicine is prepared from an infusion and decoction of barks, leaves, or flowers, either of one or of all leaves, dried in the shade. The quantities are as follows: 100 g to 1000 ml of

water. The decoction is allowed to set for 15-30 minutes, and dosage administered is 200-250 ml t.d.s. for adults, and 50-100 ml t.d.s. for children over 5 years. This is for a period of 2 - 3 days.

2. Apples Pyrus malus

These are used to supply the body with vitamins, sugars, enzymes and minerals. They are also used for the treatment of rheumatism, gout, liver and kidney diseases. They are also used as a laxative, as a stimulant and for the constriction of distended blood vessels. The parts of the plants which are used are leaves, flowers, buds and barks which are dried in the shade.

When eaten (1.0 to 1.5 kg a day) the fruits are good for the digestive system, the liver, and the kidneys. When prepared as a medicine, the infusion and decoction is prepared from leaves, flowers, buds and bark (150 g to 1000 ml of water). The decoction is allowed to set for 30 minutes and the dosage is 200 - 250ml bid or tds for adults, and 50 - 100 ml bid or tds for children. The infusion of flowers alone is good for sore throats and coughs, and is administered for two days.

3. Cabbages*: *Brassica oleracea

The plants are used to make a decoction for the treatment of cirrhosis of the liver, dysentery, upset bowels, and also as a vermifuge. They are also used as a decongestant, for treating tonsillitis and the loss of voice. In their use as a vermifuge the juice of the plant is squeezed through fine cloth. The dosage is 15 ml tds for children and 30 ml tds for adults. When used as a decongestant, squeezed syrup of the plant extract is heated up with an equal amount of sugar

and honey, and then left to cool. The dosage used is 15 ml tds for children and 30 ml tds for adults. When preparing a decoction for use as a purifying agent 2-3 large leaves are placed in 1000 ml of water and the decoction is allowed to set for 30 min. to 1 hr. The dosage is 200 ml tds for adults and 50 - 100 ml tds for children.

4. Carrots: Daucus sativus

The plants are used to supply the body with Vitamins A, B, C, D & E. It is used to treat anaemia, general weakness, scurvy, etc. It also has antidiuretic properties, and is also a vermifuge. It *i*s administered as a decoction, as a juice and as a syrup as described above. The dosage for adults and for children is as indicated above. For treating ulcers, burns and eczema a pulp is prepared of four carrots in 1000 ml of water. A further dilution may be necessary for burns. Then a hand-bath, or a foot- bath, etc. is administered. The frequency recommended is three baths per day.

5. Eucalyptus: Eucaliptus globulus

The plant is used as an antiseptic; for the treatment of asthma, bronchitis, tonsillitis, colds, urinary troubles and hemorrhages. It is used as an infusion and as a decoction of leaves. 100 g is broken, dried leaves are added to 1000 ml of water. The decoction is allowed to settle for 1/2 hrs. The dosage applied is 200 ml tds and 50 - 100 ml tds for adults and children, respectively. When used as a powder, 15-20 g are added in a cup of tea or in honey, on bread, or on tablespoon, once daily, for asthma and bronchitis. For external use, 100 g are added to 1000 ml of water and applied as foot-hand-hip-baths, as dressing lotion, and enema.

6. Lemon: Citrus medica, Citrus limon

The plant is used as a sedative, as a tonic, as a vermifuge, as antispasmodic, as a diuretic substance, and for the supply of vitamins A, B, B_2, and C. In its use, 100 g of dried leaves are added to 1000 ml of water, and the decoction is allowed to set for 30 min.

The dosage for adults and children are stated above. For external use, and as a gargle, the juice of one lemon is added to 1000 ml of water. For use in treating acid stomach, the juice is mixed with honey, or with water, at one lemon to 2000ml. When used as a vermifuge one lemon juice is mixed with castor oil instead of water, at a proportion of 1 lemon juice to 15 ml of castor oil. Please note that lemon is not highly recommended for patients or people with gout, rheumatism, and kidney problems because of the acidity of its juice.

7. Maize: Zea mays

The plant is useful as a sedative and also as a diuretic. It is also useful in easing pains of renal colic, bladder stones, cyctitis, gout, and rheumatism. In its use an infusion of maize tassels (about 1000 ml of water) is prepared. The dosage recommended is four cupfuls a day (adult). For external use one half of such a quantity is added to 1000 ml of water. This is added to the painful area (same for foot and hand baths).

8. Onions: Allium cepa

These are used for treatment of diuretic, antiscorbutic (rich in Vitamin C), and

antidiabetic (has glucoquinone that lowers blood sugar level). It is also useful as a vermifuge and as an antiseptic. Furthermore, it has aphrodisiac qualities, and is therefore good for impotent people. In its use an infusion of two large onions (sliced) in 1000 ml of water is administered. This should be all in one day. It is also useful as an antipoison. In this use it is prepared as above, but it is taken for 3-4 days, consecutively. When used as a vermifuge, 4 to 5 onions are treated with 1000 ml of water and sweetened with honey (as it boils). The dosage recommended is 200 - 300 ml tds for adults. For the treatment of diuretic cases 4 large crushed onions are mixed with 1000 ml of white wine, and then 100 gm of honey are added. The mixture is allowed to set for 14 days. The dosage recommended is 15 ml tds for adults. Onions can also be prepared for tinctures, poultices, juices, foot baths, and hand baths, and also for ointments.

9. Artemisia afra (Fivi)

This is used as an antimalarial. For its preparation, green or dried leaves are boiled for 20 minutes. Alternatively a powder of dried leaves is placed in a hot water decoction for 15 minutes and filtered with clean cloth. The dosage recommended is 100 ml tds for adults, and 15 to 20 to 40 ml tds for children over 5 years. If in powder form, 1 tablespoonful is added to 100 ml of a hot water decoction. At home a child may need a body-bath of 1/2 cup of powder, to 1 bucket water b.d. For patients used to drinking a lot of water these may be given sugarcane juice, or water sweetened with sugar. An hour after the administration of the treatment, the patient's temperature may rise, and, therefore, there may arise a need for a tepid sponge.

10. Aristolochia densivenis (Unkulwe)

The plant is used for the preparation of antisnake bite antidotes. It is thus a source of a snake venom antidote. For the administration of the First Aid, the snake's teeth are taken off the bitten area of the body. The patient is then tied tightly 15 cm upward from the bitten spot. For the preparation of the plant extract a 1/4 of teaspoonful of the powder of the plant, or the corresponding piece of bark, root chew, and swallow saliva, is mixed with one tablespoon of water. The chewed stuff is then taken to the bitten spot. The area is then bandaged, and the patient is taken to the hospital. The patient may need much water and even vomit a tittle.

For a poisoned stomach (food poisoning), 3/4 cu cm of a piece of bark or root is chewed quickly and swallowed with much water (2-3 glasses). In this treatment the patient may vomit the poison immediately. He may also purge. The patient should use fatty soups, and soft foods for 3-4 days. He should also visit the hospital.

11. Warburgia ugandensis (Mlifu), Ocotea usambarensis (Kulo), and Myrica salicifolia (Mshegheshe)

These plants are used for treatment of rheumatic and spasmodic patients. For *Warburgia* and *Ocotea* the part used is the bark. For *Myrica* it is the root. In the preparations, the barks and roots should be mixed in equal quantities, 1:1. The mixture is pounded to a powder. The dosage recommended is 5 ml to 100 ml of hot soup tds, and the treatment is continued until the patient feels better.

During and after the therapy the patient should use protein-and carbohydrate-rich foods. He should also not be subjected to fatigue. If the drug is to be used by a

number of patients, and also for longer days, the mixed powder should be made to suffice for 4 weeks. The other remaining drug should be kept intact with the bark or root and should be powdered only as, and when required.

12. Deinbollia borbonica (Mbwakambwaka), Ximenia caffra* (*Mtundwi*), and *Balanitbes aegyptiaca (Mkonga)

These plants are useful for the treatment of hernia. For all of them it is the root which is used. In their preparation, the roots are taken fresh or dry. 7.5 cm pieces are cut into and 4 -5 smaller pieces, boiled with beef bones for 1 hr, and allowed to cool, but not to get cold. On the dosage, 100 ml of the mixture at tds are administered for 4-5 days.

Each of the plants above can be prepared separately. In each case the patient should not be subjected to fatigue; he should not drink much water; he should not be subjected even to light duties which will require him to bend for longer periods; and he should visit the hospital.

13. Acacia schweinfurthii (Kerefu-mzitu), Cassia didymobotrya (Muinu)

Roots of the plants are useful for the treatment of asthmatic patients. In the preparation of the plants for medicinal use, the roots are pounded separately. 200 g extracts of each plant are mixed with 20 g of pounded salt. On the dosage, 1 teaspoonful of powder is chewed and swallowed. This is administered for 2-3 days, or even longer. For children 1/4 teaspoonful is used, also for 2-3 days.

It is also recommended that the patients should avoid alcohol and smoking. They should stay in well ventilated rooms, and should avoid cold water, both for body

wash or for drinking. Additionally the patients should not be subjected to fatigue; and their food should also contain no pepper. Their tea could be sweetened with honey, if possible, instead of sweetening with industrial sugar.

14. Abrus precatorius (Lufyambo)

The plant is used for treating impotence (for males). For its preparation, roots of the plant are dried in the shade, ground to a powder, and mixed with a powder of pound salt. The mixture is chewed and swallowed. The treatment is administered for 3 to 4 days.

It is also recommended that the patient could use dried ground nuts and drink a lot of water. The patient could also use much onion salad, and/or an onion decoction. The patient should also eat protein - rich foods. Wherever possible he should also "discourage" the feelings of impotence.

15. Plants used as insecticides and repellents

In an experiment done at Lushoto early in 1986, during the outbreak of plague in the district, the following herbs were found to be effective against fleas. These could thus find application as insecticides:

(a) *Derris elliptica:* The active part of the plant is the root tuber. A powder is extracted and used to prepare an effective liquid.

(b) *Tephrosia vogellii:* The active parts of the plant are the green stems, the leaves, and the seeds. These parts of the plant are used to prepare an effective liquid extract.

(c) *Neorautanenia mitis:* The active part of the plant is the tuber. The tuber is processed into a powder, and this is subsequently used to make an effective liquid extract.

(d) *Nicotiana tabacum:* The active parts of the plants are the leaves and the young shoots. These are also used to make an effective liquid extract.

Some plants are also effective as insect repellents. These include:

(a) *Ocimum suave* (Msubasha): The effective parts are the leaves.

(b) *Lippia javanica* (Mvuti): The effective parts are the leaves.

(c) *Cinnamomum camphora* (Camphor Leaves): The effective parts are also leaves.

The preparation of the insecticides from the tobacco leaves is as follows:

1/2 - 1 kg of cured tobacco leaf or waste are placed in 2 gallons of water. This is boiled and allowed to simmer for a while. The accrued liquid, after straining, may, if not too strong, be used straight for spraying or it may be slowly diluted with water, until it is of the desired strength.

In order to make it more effective 30 ml of soft soap are added to each gallon of emulsion.

The preparation of tobacco smoke can be effected as follows: tobacco, or pieces of paper steeped in tobacco liquid extract, are burnt without a flame. Each of these

plant parts may be used as fumigants, by the method of burning without a flame, in houses infected by fleas just as in tobacco smoke.

Classification of Herbal Drugs into Dangerous Drug Groups

The classification of drugs is not one man's job. This section is just an indication of an attempt to draw peoples' attention that there are dangerous herbs "in the market", which attain similar levels of danger as dangers inherent in modern medicine.

Discussion

As has been mentioned before, this paper has attempted to document traditional experiences. It does not, in any way, depict substantial research findings on herbal medicines. It is also worth noting that most of the herbs included are those practised on the Usambara Mountains, and to a certain extent also the Amani Mountains, in Muheza District, Tanga Region.

The herbs as contained in this paper are just a few of the many herbs used in these areas. On the issue of conserving, planting, and the furtherance of research, for example to the extent of planning four herbal pharmaceutical industries, centres like the East African Silvicultural Institute at Lushoto and the National Institute for Malaria Research at Amani, should be put to task, in collaboration with The Traditional Medicine Research Unit of the Muhimbili Medical Centre, Dar es Salaam. It is my sincere hope that the analysis of herbs made on this paper, could be a small, but significant pointer on the way of systematically itemizing herbal drugs and their various uses in the country, i.e. in the different ethnic tribes

of the United Republic of Tanzania. Such a strategy can only be achieved through countrywide teamwork. The further aim of itemizing the herbal drugs with their botanical names, is that when it comes to global collaboration and co- ordination, it should be easier for any country to explore the herbal therapeutics of one plant used in different ways, in different countries. When such a co-ordination shall have been "fully" accomplished, then we could think about establishing a "global" Herbal Pharmacopoeia. I wish such a dream to come true, as we enter the year 2000.

A comparison of the status of medicinal plants development in Africa with selected parts of the world

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ABSTRACT

Tropical countries of Africa, Asia, Latin America and developing countries of the South have more than 200,000 plant species out of 300,000 plant species available on earth. Because of inadequate health care, people in developing countries die daily of preventable and curable diseases associated with malnutrition.

As a result of the deplorable economic and health status of man in Africa, there is a need for re-evaluation and maximisation of potentials, such as, medicinal plants and other natural resources, for the alleviation of diseases and improvement of

nutrition and sanitation.

In this paper a call for the production of plant derived drugs in the countries of the South is advocated and a recommendation is made to establish an international organization for the South to coordinate activities related to:

- ***exchange of information on medicinal plants;***
- ***promoting and protecting the interest of the Southern countries in the world medicinal plants market;***
- ***and arranging for the production of drugs from medicinal plants for certain uncommon or non-Western tropical diseases, etc.***

Introduction

More than 200,000 out of the 300,000 plant species on the earth are in the tropical countries of Africa, Asia, Latin America and the developing countries of the South, whose experts are gathered together for this meeting. The developing countries also share a number of other things in common that are relevant for our consideration. The developing countries are characterised by extremely limited resources, poor communication, vast distances, individual and community poverty, etc. These factors act upon one another and leave the developing countries in a perpetual state of poverty. Because of inadequate health care measures, people in the developing countries die daily of preventable and curable diseases, often associated with malnutrition.

While per capita income for man in Africa, for example, is of the order of $100 (in

Mozambique) to $360 (in Kenya), the figure is from $19,380 (for U.S.A.) to $27,000 (for Switzerland).

The life expectancy at birth in Africa (as at 1988) is equally discouraging: 42 years for Guinea and Sierra Leone, compared with 75 years for U.S.A. and 78 years for Switzerland. This deplorable situation of the economic and health status of man in Africa, calls for a re-evaluation and maximisation of potentials like medicinal plants and other natural resources for the alleviation of disease, and improvement of nutrition and sanitation.

Since the 1968 meeting of the OAU/STRC on medicinal plants of Africa, held in Dakar, Senegal, and several African countries have started screening their medicinal plants for biocactive principles such as antimicrobial, antihelmintic, antihypertensive, antisickling, antiviral, antimalarial etc. The structures for the bioactive compounds (e.g., Khalid *et al.*,) from the plants have been characterised in many cases, but in some cases, compounds of interesting organic structures are still being isolated and characterised without any link to the biological activity reported in the plant (e.g. Fakunle *et al.,* 1989; Boum *et al.,* 1989).

The status of drug production from medicinal plants in Africa

Drug production from plants in Africa is definitely at a negligible stage Apart from Egypt, most of the other countries in Africa still depend on imported synthetic drugs, while only a few produce up to 20% of the drugs they need locally. In fact, in the case of Nigeria, as much as U.S. $3 m worth of laxatives were imported in 1977 alone, when several plants with laxative properties grow in that country and are prescribed regularly by traditional healers for their patients.

One of the problems hindering the production of drugs from plants in Africa, was the absence of a continent-wide pharmacopoeia, to control the quality of medicinal plants to be used in such drug product and in trade. For a long tune, Egypt has had its own Egyptian pharmacopoeia which contains a host of medicinal plants, their uses, dosage and pharmaceutical formulations. An African pharmacopoeia describing about 100 medicinal plants, their uses, dosage, pharmaceutical preparations, and specifying standards to be met by commercial samples, was produced in 1985 and 1986 by the OAU/STRC in two volumes. Volume 1 contains monographs of the plants, while volume 2 contains the methods of analysis and quality control to be applied. Other problems hindering drug production from plants in Africa are lack of appropriate machinery, expertise in such techniques, and, of course, finance.

In an effort to remove these problems, the African Biosciences Network (ABN) has put up a proposal to the UNDP for funds to cover a two-phase project to stimulate drug production from plants in Africa. Phase 1 is to gather information on the existing facilities for drug production in African countries; locate expertise already available, and set up a data bank which will be used in phase 2 by consultants, that will mobilise the resources to initiate three pilot drug production projects in three regions of Africa. The actual production of simple extracts, powders, tea bags and essential oils from plants in these three model centres will enable consultants to convince other African governments and entrepreneurs to invest in drug production from medicinal plants in Africa. That project proposal is still being considered by the U.N.D.P.

Part of the phase 1 exercise was completed for Africa by a group of experts under the aegis of the Economic Commission for Africa (E.C.A.) in Addis Ababa in 1989.

An E.C.A. document resulting from that exercise was published in March 1989 (document No. ECA/IND/CHM/003/8a) titled "Technical publication on the application of research findings in the development of pharmaceutical industries on the basis of indigenous raw materials". This document gives, among others, flow charts for processing medicinal plants to simple dosage forms; it gives the scales of production suited to African conditions and needs; description of processes; quality control; specification of major equipment required; as well as an analysis of manpower and investment requirements. The design of two simple extraction units were also provided by UNIDO in the document. A list of African medicinal plants that yield active principles and/or intermediates is provided, along with a list of medicinal plants recommended for commercialisation. A list of institutions conducting research and development in Africa on medicinal plants is also provided.

Unfortunately, like many useful publications needing only exploitation, few African countries will actually take the bold step to produce drugs from plants, as simplified in this document, unless there is some constant external prodding by consultants or experts. This is why the A.B.N. proposal to U.N.D.P. is still so vital for the realisation of large scale production of drugs from medicinal plants by African countries.

The little effort being made to produce drugs from plants and to set up cultivation trials by Rwanda, Kenya, Tanzania, Ghana and Madagascar are worthy of praise and should be encouraged.

Although some 55, 000 species of plants (including the 10,000 or so which are endemic to Madagascar) exist in Africa, these have not been developed or

cultivated to any appreciable extent for drug production.

Medicinal plants and drug production in Asia

My experience after travelling to India and China is that, we in Africa are still lagging far behind in the field of medicinal plants development. For years, India and China have produced drugs from plants, and it is difficult to differentiate a package of a plant-derived drug, from that of a synthetic drug coming from China, in terms of the quality of the finished product.

Large scale plantations of medicinal plants that exist in India and China have an organised collection system by the rural dwellers for plants growing wild on the mountains. These collection systems supplement the cultivation plantations, and help to keep the large scale manufacturing machines going, on rotational basis, for the production of the various plant drugs.

In April/May 1989, an Indian trade mission went to the European Economic Commission (E.E.C.) in Brussels, in connection with the impact of 1992 on the medicinal and aromatic plants and pharmaceuticals from India. India's efforts with the E.E.C. in Brussels is a good forward looking move, especially as that country's plant-derived drugs also meet standards required abroad. China already exports large quantities of medicinal plant products, either in the form of the crude plants, purified extracts, or active principles isolated from plants.

African countries can benefit from a cooperative effort with India and China, for the development of medicinal plants in Africa, by obtaining expertise on the preparation of liquid extracts, dry extracts, tea bags and other simple dosage

forms of presentation of medicinal plants in standardised form for the population. Cheap equipment for processing plants, appropriate technology and expertise, can be acquired through a South-South collaboration among developing countries which I hope will be evolved at this meeting. 1992 will come and E.E.C. will be stronger. It is necessary for the developing countries to plan now for modalities for a southern solidarity, in the exploitation and exportation of medicinal plant products.

Recommendations

There may be need to set up a small organisation among the developing countries of the South to specify standards and control measures. Plant products that are already commercial products in some Southern countries, but which plants do not grow in Africa, should be imported for prevalent African diseases, while Africa exports purified or finished products of its own plants to the other southern countries and the developed world.

Such an organisation can help to prevent a situation that was once proposed, that Africa should produce plenty of spices for export because Asia is making plenty of money from the same trade. If Africa were to produce the same spices, the situation will be disastrous for Asia and, eventually, for Africa also in the long run. However, a coordinated effort, through an international organisation for the South, can take care of the following points:

(a) Information exchange among the southern countries producing medicinal plants.

(b) Harmonisation of tariffs where similar products are made.

(c) Removal of geographical trade barriers.

(d) Promoting and protecting the interest of the southern countries in the world medicinal plants market.

(e) Promoting solidarity in bargaining.

(f) Encouraging partial purification of the plant extracts rather than selling raw materials only. This is because it has been shown by U.N.I.D.O that prices increase ten-fold just by selling a purified extract instead of the raw plant.

(g) Encouraging the development of machinery for processing medicinal plants at village level.

(h) Arranging for the production of drugs from medicinal plants for certain uncommon or non-western tropical diseases, e.g. orphan drugs. The development of drugs for tropical diseases may not be pursued vigorously by the multinationals.

(i) Ensuring that many countries of the south are not producing and selling the same drugs, as this will flood the market.

(j) Ensuring diversification.

(k) Arranging for periodic meetings of member countries to exchange

experiences, compare notes, review progress and plan strategies for the future.

Exprience du Burkina Faso en matire de pharmacope traditionnelle

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Gnralit

Donnes gographiques

Situ au coeur de l'Afrique Occidentale, le Burkina Faso est un pays compltement enclav sans accs direct la mer. Il est limit l'Est par la rpublique du Niger, a l'Ouest par la Cte d'Ivoire, Au Sud par le Ghana, le Togo, le Benin et au Nord-Ouest par le Mali.

Le territoire couvre une superficie de 274 000 km^2 avec une population estime 8,600,000 habitants en 1988.

Caractristiques dmographiques

La densit de la population est de 31 habitants/Km^2. La population Urbaine est faible: 12 % 88 % des burkinab vivent en zone rurale. La population est jeune:

42,2 % lout moins de 15 ans.

Le taux de natalit est de 49,9% et la mortalit infantile est leve . 134 % tandis que le taux de mortalit brute est de 24%.

Le taux d'accroissement annuel de la population est de 2,68 %.

Structures administratives

Le pays est divis en 30 provinces, 300 dpartments et 7285 villages. Cette structuration relev du Ministre de l'Administration Territoriale.

Aperue de la situation sanitaire La situation sanitaire est domine par:

- **Les problmes d'assainissement et de fourniture d'eau potable**
- **L'insuffisance quantitative et qualitative de la couverture sanitaire**
- **La persistance des maladies pidmo-endmiques d un bas niveau socio-conomique et qui restent les causes d'une mortalit encore leve surtout chez les enfants (134%).**

Pour palier ce flau, l'Etat Burkinab a entrepris de campagnes de vaccination dont:

- **L'opration "vaccination commando" en 1984**
- **L'opration "ports ouvertes sur les vaccinations" en 1988**
- **L'opration "vaccination au quotidien" en 1989.**

Ces opration permis de vacciner en peu de temps un nombre important d'enfants. Il a galement entrepris d'autres actions plus permanentes telles que l'institution

des postes fixes de vaccination et la cration des postes de sant primaires (PSP) dans les villages. Tout ceci permis d'amliorer la couverture sanitaire.

Politique sanitaire national

Objectifs

La politique sanitaire est base sur les soins de sant primaire avec pour objectif la "sant pour tous d'ici l'an 2000". Pour ce faire, un plan sanitaire pour la decennie 1980-1990 a t labor, et ce plan prvoit la matrise des principaux problmes de sant de la communaut. Pour y parvenir, des actions de promotion de soins curatifs et de radaptation dans des infrastructures fonctionnelles avec l'quipement et le personnel ncessaires sont mener.

Compte tenu des ralits savoir que ce plan chappe aux possibilits financires du pays, il y eu une rvision qui tient compte des priorits sanitaires sur le plan national. Les grandes lignes du plan s'articulent autour des points suivants:

- **L'excution et le dveloppement des programmes de contrle des maladies transmissibles endemo-pidemiques**
- **Le dveloppement des services de sant de base surtout la sant maternelle et infantile**
- **La formation et le perfectionnement du personnel paramdical dans le domaine de la sant publique et du contrle des endemo-pidemies.**

Dispositif

En vue de pouvoir rpondre aux objectif de la politique nationale sanitaire, un systme pyramidal de sant a t prconis et structur ainsi:

De la base au sommet on a:

- **ESSA: Ecole Suprieure des Sciences de la Sant**
- **MS-AS : Ministre de la Sant et de l'Action Sociale**
- **H.N. : Hpital National**
- **CHR : Centre Hospitalier Rgional**
- **C.M : Centre Mdical**
- **CSPS : Centre de Sant et Promotion Sociale**
- **PSP : Poste de Sant Primaire.**

Politique pharmaceutique nationale

L'insuffisance de la couverture du territoire national en mdicaments est un des handicap majeurs pour la mise en place effective des soins de sant primaires du Burkina Faso. Aussi la politique pharmaceutique nationale s'est fix les objectifs suivants:

Objectifs gnraux

- **Metrre le mdicament essentiel la disposition de la population un cot abordable et de faon permanente**

- **Amliorer la gestion des mdicaments dans toutes les structures sanitaires en vue d'une utilisation rationnelle des ressources affectes l'approvisionnement sanitaire.**

- **Instituer et developper la production nationale en y integrant les recettes de la mdecine et la pharmacope traditionneles.**

Objectifs spcifiques

- **Evaluer et essayer de satisfaire les besoins des formations sanitaires publiques en mdicaments essentiels et matriels tchniques.**

- **Slectionner les mdicaments jugs essentiels au Burkina Faso.**

- **Surveiller les effets des mdicaments mis sur le march avec l'aide des comptences nationales et internationales.**

- **Contribuer la lutte contre l'abus et le trafic illicite des drogues.**

- **Exploiter et mettre la disposition des usagers toute information ou documentation relative aux produits pharmaceutiques**

- **Promouvoir la pharmacope et mdecine traditionnelles.**

Les moyens

Dans le souci de pouvoir atteindre tous ces objectifs un certain nombre de dispositions ont t prises savoir:

- **Cration d'une direction des Services pharmaceutiques (DSPH) comportant un service de pharmacope et mdecine traditionnelle. Cette direction a pour mission de veiller l'application de la politique pharmaceutique nationale.**

- **Cration d'une socit nationale d'approvisionement pharmaceutique (SONAPHARM) en 1985 qui joue le rle de grossiste de l'Etat et qui doit permettre d'avoir le mdicament un prix abordable.**

- **Mise sur pied d'un laboratoire des mdicaments du Faso (MEDIFA) en 1989 qui produits des soluts (srum sal et glucose). Dans le mme ordre d'ide on a galement l'IRSN (Institut de Recherche sur les substances naturelles) cre depuis 1978. Il relve du Ministre des Enseignements Suprieur et contribue dans une certaine mesure la production locale et la promotion de la mdecine et pharmacope traditionnelle.**

Politique du Burkina Faso en Matire de Pharmacope Traditionnelle

Justifications

Malgr la cration de la Sonapharm en 1985 qui a permis de baisser les prix de certains mdicaments, le budget de l'Etat supporte difficilement la demande en mdicaments de premires ncessit dans les formations sanitaires. Aussi, la nouvelle politique d'approvisionnement en mdicament est contrainte de s'orienter uniquement verse les mdicaments d'urgence.

Le cot des autres mdicaments doit tre forcement support par les populations. Et malgr les efforts dploys par l'Etat le prix du mdicament reste toujours lev compte tenu de la situation embryonnaire de la production nationale. Aussi la majorit de la population Burkinab qui a un faibre revenue se tourne vers la tradimdecine.

Historique

Au Burkina Faso, la mdecine et la pharmacope traditionnelle ont connu 4 grande priodes historiques:

- **l'poque prcoloniale**
- **l'poque coloniale**
- **l'poque nocoloniale**
- **l'poque rvolutionnaire**

L'poque prcoloniale

A cette poque la mdecine traditionnelle tait totalement sous la responsabilit des tradipraticiens disperss dans tous les villages. Parmi eux il yavait aussi bien des gnralistes que des spcialistes (rebouteurs, gynco-obsttriciens, etc...). Leurs activits taient pratiquement secrtes entirement prives, empreints d'humanisme et s'exeraient titre gratuit.

L'poque coloniale

On assiste a une interruption brutale de l'volution de cette mdecine avec l'arrive du pouvoir colonial qui interdisait la pratique soit disant que la mdecine "civilise" de la mtropole tait bien suprieure. Mais cette tentative fut vaine car plutt que de disiparaitre, cette mdicine traditionnelle est entre dans la clandestinit.

L'poque no-coloniale

Dbute avec l'indpendence formelle de 1960 cette priode s'instaure une tentative de codification. On assiste l'laboration de textes timides et imprcis quand aux droits d'exercise des gurisseurs. Ceux-ci n'avaient pas encore acquis une

considration vritable de la part des pouvoirs locaux.

L'poque rvolutionnaire

Aprs l'avnement de la rvolution d'Aot 1983, la mdecine traditionnelle burkinab sort de sa lethargie. Le pouvoir est ouvertement favourable la participation des tradipraticens a la rsolution des problmes de sant des populations en vue de pouvoir atteindre l'objectif "sant pour tous d'ici l'an 2000". Mais la mdecin traditionnelle, pour participer efficacement ce dfi doit s'adapter la mouvance du temps et des connaissances. Ceci a justifi la dclaration du Ministre de la Sant et de l'Action Sociale l'ouverture du 1er sminaire National sur la mdecine et la pharmacope Traditionnelle le 16 Novembre 1987:

> **Le combat que nous avons engag pour redonner confiance a notre peuple dans le domaine de la sant publique ne doit pas se contenter de contempler le pass, mais travailler donner a cette richesse mdicale, une valeur scientifique confirme".**

Depuis 1984 une collaboration progressive entre les deux mdecines est grandement dvelopp. Le Gouvernement ne cesse de favoriser l'exploitation de la mdecine et de pharmacope traditionnelle.

Actions d'envergure

Les actions ont pu tre menes grce un certain nombre de facteurs.

Facteurs favourables

(a) Cration d'un service de pharmacope traditionnelle au sein du Ministre de la Sant et de l'Action Sociale et plus prcisment au sein de la DSPH (Direction des Services Pharmaceutiques).

(b) Dveloppement de l'IRSN (Institut de Recherche sur les Substances Naturelles) Le service de pharmacope traditionnelle cr en 1984 avait pour mission de:

(i) Promouvoir les relations avec les tradipracticiens en vue d'une bonne collaboration dans le systme national de sant

(ii) Collecter et exploiter tous les moyens disponibles en vue d'laborer une pharmacope locale.

(iii) Organiser et coordonner toutes les activits de la mdicine et pharmacope traditionnelle au niveau national

Actions menes

Les actions menes peuvent se mesurer travers:

- **La cration de cellules pharmacopes**
- **Les symposiums de Farako-b**
- **Le 1er sminaire national sur la mdecine et pharmacope traditionnelles**
- **la cration d'association de tradipraticines**
- **le renforcement de certains services de pharmacope**
- **les journes portes ouverte sur "plants mdicinales et pharmacope traditionnelle au Burkina Faso.**

Cration des cellules pharmacopes

Au niveau de toutes les provinces, il a t demand en 1985 la cration des cellules pharmacopes.

Composition:

La cellule pharmacope se compose comme suit:

- **Un prsident qui est le plus souvent le pharmacien provincial**
- **Un vice-prsident**
- **Un secrtaire et son adjoint**
- **Un trsorier et son adjoint**
- **Deux commissaires aux comptes**
- **Des conseillers tchniques.**

Notons que tous ces membres ne sont pas uniquement de la sant. On peut y trouver des agents d'autres Ministres tel que l'Environnement et Tourisme, l'Agriculture et l'Elevage etc...

Mission:

La cellule avait pour mission:

- **De formuler clairement certaines recettes traditionnelles simples en vue de leur exploitation**
- **Superviser et coordonner toutes les activits de mdecine traditionnelle au niveau provincial.**

La cellule tait la reprsentation de la DSPH dans la province. Toutes ces actions devaient concourir l'objectif global qui est l'panouissement de la mdecine et la pharmacope traditionnelle.

Difficults rencontres

Les cellules ont plus ou moins bien fonctionn au dbut. Mais par la suite elles ont t confrontes un certain nombre de problmes dont:

- **Problme de matriel pour raliser les recettes**
- **Problme financier pour le dmarrage effectif des travaux (collecte des plantes, achat de matire premire etc...)**
- **Problme de rglementation. Certains tradipraticiens voulaient des cartes ou des autorisations d'exercer leur fonction**
- **Rticence de certains tradipracticends dans la livraison de leurs recettes.**

Pour rsourdre le problme de matriel, le Gouvernement Burkinab a essay de doter chaque province d'un matriel de base simple tel que tamis, casserole, filtre eau etc... pour leur permettre de raliser quelques recettes simples.

Mais pour ce qui est de la dlivrance des autorisations d'exercer, le refus des autorits sanitaires ft catgorique compte tenu des mauvaises expriences que certains pays tel que le Mali avaient vcu.

Impacts

La cration des cellules pharmacopes au niveau des provinces permis un dbut de collaboration entre mdecine moderne et traditionnelle et un contact avec les tradipracticiens.

Objectif de ce sminaire

Runir tous les spcialistes des services concerns afin d'laborer ensemble un plan d'action national pour la promotion et le dveloppement de la mdecine et pharmacope traditionnelles au Burkina Faso.

Impact

Ce sminaire permis:

- **Un enrichissement des connaissances en matires de mdecine et pharmacope traditionnelle par l'exprience des autres pays (Mali, Togo)**

- **Des propositions intressantes qui ressortent dans les recommandations sur trois niveaux.**

1er niveau: **exercice de la mdecine et pharmacope traditionnelle**

- **L'amlioration des conditions de travail des tradipracticiens (alphabtisation)**
- **L'laboration des texts et cration des associations des tradipracticens.**

2 niveau**: La promotion de la mdecine et pharmacope traditionnelles**

- **Utilisation de la mdia pour faire connatre et apprcier la mdecine *et* pharmacope traditionnelles du Burkina Faso.**
- **Introduction des notions de base de la mdecine et pharmacope traditionnelles dans les coles de sant.**

3 niveau: **La rglementation de l'exploitation et la production des plantes mdicinales**

- **Cration de centre de culture de plantes mdicinales dans chaque province**
- **Rglementation de l'exploitation et de l'exportation des plantes mdicinales au Burkina Faso.**

Une consquence importante de ce premier sminaire qu'on ne saurait oublier est la cration d'association des tradipracticiens.

Cration d'association des tradipraticiens

Esprit

La cration de ces associations tait faite pour concrtiser la recommandation du 1er sminaire national dans le cadre de l'exercice de la mdecine et pharmacope traditionnelle.

Objectif

- **Crer un cadre organisationnel o les tradipracticiens peuvent exercer leurs fonctions**
- **Faciliter les actions de formation et d'alphabtisation des tradipraticiens.**

Impact

La cration d'association des tradipractiens a permis d'lever leur niveau de collaboration confraternelle. En mme temps on a not un panouissement de ces tradipractiens car ils ont rellement senti que l'on s'intressait eux. Cela a d'ailleurs provoqu un intrt grandissant de la population. La mfiance n'tait plus de rigueur vis vis des tradipraticiens.

Difficults

Les plus importantes sont d'ordre rglementaire et financier.

Certains tradipracticiens vont se proccuper d'une rmunration comme au niveau de la mdecine moderne. Quelques uns voulaient qu'on cre un cadre particulier de travail. la majorit prfrait demeurer dans leur milieu.

Le problme de dlivrance de cartes va tre pos. Il subsiste quelques retinces jusqu' nos jours de certains tradipraticiens qui n'acceptent pas livrer leurs recettes.

Renforcement de certains services de pharmacope

Objectif

L'objectif tait de centraliser toutes les forces sur les directions provinciales de la sant beaucoup intresses et avances en matire de pharmacope traditionnelle.

En effet on s'est rendu compte que toutes les provinces n'taient pas intreses par les activits de pharmacope traditionnelle. Aussi il a t retenu le renforcement de 3

services provinciaux pour en faire des centres rgionaux de pharmacope: Banfora l'Ouest (province de la Como), Ouagadougou au Centre (province du Kadiogo) et Fada N'Gourma l'Est (province du Gourma).

Impact

- **Cette option suivie d'actions a pouss quelques provinces voisines des trois slectionnes s'intresser d'avantage la pharmacope traditionnelle**
- **Les 3 services retenus ont t mieux quiper et ont ainsi amlior leurs activits dans ce domaine.**

Difficults

Toujours d'ordre financier les moyens ont manqu pour les quipement prvus. Des demandes (notamment en matriel) sont restes insatisfaites.

Journes portes ouvertes "plantes mdicinales et-pharmacopes traditionnelles au Burkina Faso

Esprit

Ces journes ont t organises conjointement par le Ministre des Enseignements Secondaires, Suprieur et de la Recherche Scientifique et le Ministre de la Sant et de l'Action Sociale. Elles ont eu lieu Ouagadougou du 28 Novembre au 2 Dcembre 1989.

Objectifs

- **Faire connatre l'IRSN(Institut de Recherche sur les Substances Naturelles) par le public et surtout sa contribution dans le domaine de la pharmacope traditionnelle.**

- **Jeter les bases de l'laboration d'un programme national en vue d'un plan d'action concert pour la valorisation de la mdecine et pharmacope traditionnelle. Dboucher sur une coordination nationale des activits et l'laboration d'une lgislation sur la mdicine et pharmacope traditionnelles au Burkina Faso.**

Impact

Ces journes ont permis de dcouvrir les objectifs de l'IRSN et le stade de ses recherches. L'IRSN, en collaboration avec l'Universit libre de Bruxelles (ULB) a dj ralis des tests pharmacologiques d'un certains nombre de plantes dont:

- **Euphorbia hirta (Euphorbiaces)**
- **Holarrhena Floribunda (Apocynaces)**
- **Nauclea Latifolia (Rubiaces)**

Il est galement envisag une extraction semi industrielle de matire premire partir de plants mdicinales pour une formulation mdicamenteuse dont le Datura Stramonium (solanacae).

Ces journes ont galement permis aux tradipraticiens de s'exprimer et poser clairement leurs problmes. C'est ainsi qu'ils ont accept l'ide d'laboration des textes rglementaires et lgislatifs pour eux. Ils ont cependant rejet l'ide d'un encadrement et demander qu'on les laisse s'organiser comme ils le souhaitent. De

nombreux tradipraticiens ont nanmoins accueilli favourablement l'institution des rencontres de ce genre.

Difficults

Il y a eu des difficults organisationnelles. Notamment des structures d'hbergement ont fait dfaut ce qui fait limiter le nombre des tradipraticiens. Aussi la dlgation des tradipraticiens n'tait pas trs reprsentative sur le plan national.

Perspectives d'Avenir

Plan d'action court terme

Pour l'anne 1990 notre plan d'action vise:

- **Au renforcement du systme de rglementation de l'exercise de la mdecine traditionnelle**
- **a l'laboration d'une lgislation en matire de mdecine et pharmacope traditionnelle**
- **la mise en place d'une commission nationale de pharmacope traditionnelle dote d'un secrtariat permanent**
- **l'laboration d'un programme national cohrent et oprationnel en matire de pharmacope et mdecine traditionnelles.**

Orientation long terme

Il existe des projets de cration de 2 units de fabrication de mdicaments base de plants. Un project pour Kaya (province du Sanmatenga) sera financ par la PNUD. Un projet pour Banfora (province de la Como) financement rechercher. Le projet de semi industrialisation de l'extraction des principes actifs vgtaux suit son court au niveau de l'IRSN.

Conclusion

La promotion de la mdecine et de la pharmacope traditionnelle n'est pas une mince affaire au Burkina Faso. Elle n'est pas non plus la panace de la politique pharmaceutique nationale.

Les actions que nous venons de signaler ont t menes avec dtermination. Elles ont fait surgir diverses difficults attendues ou imprvues. Il est desormains reconnu que

- **Le tradipraticien ne peut tre organis que dans son contexte**
- **La collaboration entre mdecine traditionnelle et mdecine moderne est possible dans une certaine mesure de respect et de comprhension mutuelle des enracinements respectifs**
- **La valorisation des pratiques mdicales ancestrales ncessite un minimum de recherches scientifiques visant viter toute dpossession.**

Au Burkina Faso, la mdecine et pharmacope traditionnelles a cess d'tre peru comme une mdecine au rabais. Les succs que remporte toute manifestation s'en rfrant le prouve. Toute fois il existe encore des problmes a et l pour en faire une

composante du dveloppement socio-culturel national. Mais la prise de conscience grandissante en la matire, des autorits, des tradipraticiens et du personnel de sant, nous permet d'affirmer qu'il faudra compter de plus plus avec la mdecine et pharmacope traditionelle au Burkina Faso pour atteindre l'objectif "Sant pour tous d'ici l'an 2000".

The role and use of ethnomedical data in the research on traditional medicines and medicinal plants

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ABSTRACT

Any research work on traditional medicines from medicinal plants has invariably taken its lead from an ethnomedical data in one form or another. Ethnomedical data or information refers to the information on the use of a plant or plants for the treatment of certain disease conditions. It also provides some details on the botanical identity of the plant, the method of preparation, and its use in therapy. However, many researchers in this field have often made very little use of the ethnomedical information in their work;

Consequently the phytochemist is, for example, often faced with the problem of identifying and isolating the active principle(s) from a plant material which

contains many compounds. The identification of the compound which produces the therapeutic effects, may be impracticable. It has been found that judicious integration of ethnomedical data with ethnobotanical, phytochemical, pharmacological, and toxicological information on an extract can yield much more meaningful results. This paper presents brief accounts on how this approach has been used on:

(a) the Luo traditional salt, prepared from papyrus reed ash;
(b) the antimalarial preparation from Azadirachta indica; and
(c) a traditional antifertility agent with sustained action.

The use of ethnomedical data can facilitate a rational application of pharmaceutical principles in the phytochemistry, pharmacology, toxicology and therapeutics of medicines prepared from plants. The need for greater use of ethnomedical information in medicinal plants research is discussed in this paper.

Introduction

Ethnomedical data on a traditional medicine provides information on the identity of raw materials, the method of preparation, the administration and the therapeutic indication of the medicine. The data can be obtained from three main sources, namely, from traditional healers; from knowledgeable individuals who are not practising traditional healers; and from various literature sources.

The traditional healer is a very useful source of ethnomedical data. However, it is usually difficult to obtain complete information from this source, because the practising traditional healer considers such information as his source of income,

and he is therefore, unwilling to part with it freely. Knowledgeable individuals, who do not practice traditional healing, are much more willing to give information on plants used in traditional medicines. Evidently, using such people is one of the ways of securing reliable information. It should be further noted that, such knowledgeable persons are elders, who find themselves duty bound to treat a disease condition, or to solve a health problem in a community. The literature source of ethnomedical data is often derived from the two sources mentioned above. It can provide valuable leads to the investigation of traditional medicines. Some of the currently available publications that provide ethnomedical data, include those of Kokwaro (1976), Watt and Breyer-Brandwijk (1960), Oliver (1956) and Nadkarni (1960). These literature sources can provide very valuable sources for the investigation of traditional medicines and medicinal plants.

The purpose of this paper is to outline how the above three sources of ethnomedical data collection can be used in order to obtain results that can be readily applied in the health care system.

Correlation of ethnomedical data with pharmacological and toxicological data

The therapeutic indications given for a medication can provide a good lead to the design of pharmacological models that can be used to evaluate the medicine. Thus, in the development of the traditional medicine for malaria (KRM 913), the following studies were done: (a) botanical identification of the plant; (b) preparation of the medicine, according to the traditional formulation; (c) investigation of the preparation, using an in vitro model testing against *Plasmodium falciparum;* and (d) animal toxicity tests.

A similar strategy was used in the evaluation of a traditional antifertility preparation. The biological model used in stage (c) to establish an antifertility activity, was a mouse.

Correlation of ethnomedical data with phytochemical profiles

The phytochemical profile can provide useful information for correlation. The investigation of the papyrus reef ash, be along the points raised above, will be cited as an example.

With respect to the chemical composition of the extract, it was concluded that the elemental composition of the ash extract could explain the therapeutic efficacy of this extract in hypertension.

Traditional pharmaceutical formulation of Traditional medicines

The mode of pharmaceutical formulation is of critical importance. An understanding of this process can assist immensely in making an evaluation on the principles extracted and their relative stability during the preparation and storage. A preparation that is made by extracting with water only, is likely to contain water soluble compounds only. This aspect can be correlated with the phytochemical studies in order to establish the compounds that are readily extracted in the formulation process.

Discussion

The integration of ethnomedical data which includes formulation, pharmacology, toxicology and phytochemistry, leads to faster means of evaluating traditional

medicines. In such medicines or plant extracts, a very large number of chemical compounds can be detected and isolated. However, the identification of the therapeutically active principles can become impracticable because one may be dealing with an extract containing over 50 compounds and ions, some of which may be present in only trace amounts, and yet could be the desired principles. The integration of the type suggested above can provide a basis for targeting the active principles in the following manner: (a) preparation of the extract; (b) determination of its activity, using the pharmacological model; (c) doing further analyses on the fractions and follow-up on their activities; (d) determination of the correlation of this activity with the observed clinical effects.

With respect to the ethnomedical information from traditional healers, this can be very valuable, if the above strategies are pursued. In many cases first hand clinical information can be obtained for designing the correlative studies. However, in some other cases, tangible results can be achieved through the literature or verbal information from knowledgeable persons, without involving the traditional healer at all.

Conclusion

The use of ethnomedical data can greatly facilitate the research on traditional medicines and medicinal plants. It is desirable to use ethnomedical data from traditional healers for guiding to scientific research on what plants or what parts of plants one should test for active substances. However, the other sources of ethnomedical information mentioned above can also yield useful results.

One advantage of using ethnomedical data from traditional healers is that a close

working relationship with the traditional healers can enhance the diffusion of scientific methods of doing research to the traditional healers. This kind of interaction can be very useful especially if a formal training programme for the traditional healers cannot be carried out immediately. This approach has, so far, been applied in Kenya in the traditional medicines programme of the Kenya Medical Research Institute. Through this approach it has been possible to upgrade the traditional medicine practices in Kenya, and to promote public awareness on traditional medicine. An operational research is planned to evaluate this development.

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Traditional medicinal plants: Our cultural heritage

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ABSTRACT

The practice of traditional medicine, an indispensable cultural heritage, has been legalized and integrated into primary health care in Zambia. Rigorous training programmes for traditional birth attendants and Traditional healers are being conducted by the Ministry of Health with the support of WHO and UNICEF. A Traditional Medicine Research Unit exists in Zambia which collects and conducts analysis on medicinal plants. The maladies existing between traditional medicine and allopathic medicine are examined. Further, avenues for dialogue between the two therapeutic systems are proposed in order to achieve the global objective of health for all by the year 2000.

Introduction

All countries develop their culture and traditional practices. These indigenous traditional practices are created by needs and the available means to satisfy these needs, and to overcome the difficulties in satisfying them. In times of difficulty, such communities may resort to mystic and supernatural powers for help. This has been the trend from times immemorial, the world over.

Zambia, with a population of 7.6 million people, has an indigenous and traditional

culture which is essentially African, and remains so in most parts of the country's nine provinces with 72 tribes in a large country of 750,000 square kilometers.

In spite of passing through successive moulding and transformation, by the introduction of other Western cultures over the ages, Zambian culture, like most of East and Central African Cultures, is still composed of that from the era of myth and magic, through the era of religious dependence to the modern Western culture.

Traditional Medicine **in this paper will be defined as medicine of certain people, acquired, taught and practiced in the informal sector, or organized health care of a particular society.**

Despite its fundamental role in traditional health care, traditional medicine has been treated with contempt and even branded "Primitive and witchcraft to medical approach." This was more amplified by the colonialists in the African Continent.

One thing these colonialists failed to distinguish was the difference between traditional medicine and its practices, culture and witchcraft. We are all aware that health is an integral part of all communities and that the healthier the people in a given community, the greater is their contribution in the social and economic development of their community. It is therefore important that essential health care services be made universally accessible to every individual, at a cost that can be afforded. In this case the cheapest and most abundant medicinal services are derived from traditional medicinal plants.

Association of traditional healers

In Zambia only one association of traditional healers, has been in existence since 1979. Over 10,000 traditional healers have been registered by the Ministry of health, compared to less than 500 modern doctors.

Amendments of law

A vigorous programme has to be mapped out by relevant ministries to review and amend the old and outdated medical-allied and midwives and nurses acts, as well as the witchcraft acts of the laws of East and Central Africa, in order to enhance full accommodation of both allopathic and traditional medicine and its cultural heritage.

Training programmes

In Zambia to date over 2,000 traditional birth attendants (TBA's) have been trained by WHO and UNICEF, in conjunction with the Ministry of Health. This is aimed at improving health delivery services provided by the ministry's medical and paramedical staff to mothers and children at the (under five) clinics in rural areas. Healers are also being taught to use surgical gloves, oral rehydration salts (ORS), to be more hygienic, to guard against over-dosage, and toxicity on traditional practices, an to use appropriate techniques of storage. At a recent Seminar at N.R.D.C. in September 1989, Dr. Paul Fraund, a WHO representative, expressed willingness to use traditional healers in distributing ORS as it is the case in Brazil, Swaziland, etc. Training is thus vital for the healers.

Research on medicinal plants

A Traditional Medicine Unit has been established at Springbok House, Lusaka, to

monitor and promote the collection of herbs from the Traditional Healers through the association's Research Board and other institutions like the National Council for Scientific Research (NCSR), Institute for African Studies at the University of Zambia, Medical Stores Ltd, Mount Makulu Research Station etc. The NCSR came up with a curative drug for tuberculosis through these efforts.

It is in this light that it has become an imperative necessity for ethnobotanists, phytochemists, pharmacognosists, herbal healers, policy makers, financial institutions and other bodies to come together not only for the purpose of dialogue and exchange of information in the use and preservation of medicinal plants, but also in the practical implementation of theories and resolutions resulting from such gatherings.

I would like to recommend that Third World countries should seriously consider the creation of botanical farms for medicinal plants. In such farms herbs collected from other countries could be introduced, preserved and analysed scientifically. Furthermore, I would like emphasise the following points:

(i) There is a great need for integration of traditional healers in national hospitals in order to offer health care to the majority of Zambians.

(ii) Traditional healers, who are the majority among the health care personnel, live and practice within a community whose cultural beliefs, customs, taboos and norms they understand. Hence their services could be quite beneficial to the society.

(iii) The herbs used in traditional medicine are locally, abundantly, and

cheaply obtained; and do not require foreign exchange, expensive equipment, or highly trained manpower to develop.

(iv) On one hand healers are not capable of conducting major operations, or give intravenous drips, or to administer injections, blood transfusions, artificial respiration, etc. These are better manned by allopathic doctors. On the other hand when it comes to cases of psychosomatic disorders, anxiety, depression, stress disorders, behaviour problems, hysteria and other neuroses, etc, the traditional healer is the expert to consult.

(v) Over 80% of our African population depend on traditional medical practices for health care.

Summary

Modern medicines should get out of their ivory towers and take the initiative for dialogue, exchange of ideas and imparting their knowledge and skills to traditional healers.

Are healers too greedy, proud or defensive to admit inadequate knowledge of internal medicine where it counts? Are modern doctors too proud or conceited to educate the healers or share their knowledge? The result is the citizen of Central and East Africa who pays the price of the perpetual ill-health and short and unproductive life span. Doctors have to come to terms with the reality of traditional healers and its power on our society. Dialogue is the only answer at present.

At present and for the foreseeable future, if we do not continue this sort of

dialogue, we are and will be at each others throats, and the Third World and its economic development will be the victim. When we continue with this stupidity we are like two men fighting on a hut roof. A fall of either is fatal! Is the only option to take the other man with you if you are going to fall?

This allegory finds expression in statements that are facile and puerile in the extreme, such as the challenges to treatment modalities by numbers.

(i) The Government should review the witchcraft act and all outdated laws that suppress the development of traditional medicine.

(ii) Adequate finance for traditional medicine research should be assured under government's regular budget, and external finance should be supplementary to the government's main efforts.

(iii) How will the new generation of healers be trained, examined and certified?

(iv) There is a need for the promotion of dialogue to destroy suspicion, secrecy and hostilities existing between traditional healers and modern doctors.

(v) We should refrain from unsubstantiated claims of "know- alls."

(vi) Referral mechanism should be a priority without punitive repercussions on either traditional or modern medicine.

(vii) We need to strengthen training and research on traditional medicine,

and start with the most readily feasible herbal remedies.

(viii) We should boost our national economies by joining forces in preventive, community, and productive health care for our people.

To achieve these objectives, and those of health for all by the year 2000 and thereafter, open heart dialogue between the two disciplines of medicines is a must. For neither allopathic nor traditional medicine alone can adequately meet the health needs of our nations.

The use of traditional medicinal plants: The cultural context

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ABSTRACT

In nature, man lived within a forest environment; through time man has continued to tame and interfere with nature; and now, man lives in a built-in environment, devoid of plants, except very few plant he domesticates (mostly fruits), e.g. pawpaws, oranges, peppers, etc. However, both in the wilderness and now, man has continued to exploit the forest environment, not only as a source of food, game, honey and other resources, but also as a source of curative herbs. In doing this, he has selectively used these resources for his betterment. Where successful, this knowledge has been transmitted from one generation to another in a variety

of ways. This knowledge of the potential use of plants, ethnobotany, constitutes a major part of man's cultural knowledge, particularly in times of stress, e.g. hunger and disease.

The medical and pharmaceutical sectors, through history, have continued to exploit plants as sources of medicines, but have continually failed to realise, that what they are exploiting is knowledge, knowledge which is not only cultural, but also power. Given this fact, it is important that a certain level of cooperation, communication, and at times inclusions, of the cultural dimension are essential to the adoption and use of medicinal plants in modern medicinal and pharmaceutical practice.

Introduction

The anticipated increased use of traditional medicinal plants must necessarily involve the 'tapping' or transference of the knowledge of their use and potentiality from the traditional to the modern sector. It is this change in the context in which such medicines will be used, that this paper wished to address itself to: the change from a *Cultural* to a *Hospital* context, for these are the respective operational spheres of traditional and modern medicines. The concept of culture has been defined in a number of ways, but the simplest definition offered here is that Culture is a way of life that is characteristic of a people, which identifies and distinguishes them from other people. Culture as defined here is the inevitable product of the interaction and interrelationship between man and environment. It includes, among other things, the material culture, social organization, organization and use of space, environment and things therein, belief systems (others will call this religion), and the general world view. All these aspects will

be characteristic of a certain people and will differ from one people to another.

Viewed this way, what this conference is exploring may be seen as an examination of how man in the South wants to maximise the use of the products of his environment and share his knowledge on the curative properties of plants in the region. This is an attempt to share our cultural experiences and practices with the world.

Man and his environment

Present scientific knowledge, from archaeological evidence, places the origin of man to between 3.2 -3.5 million years ago. This evidence comes from the Rift Valley regions of Eastern Africa, from Omo in Ethiopia, through Lake Turkana in Kenya, and Olduvai and Laeotoli in Tanzania. Other corroborative evidence in the South, comes also from China, Southeast Asia and Southern Africa. In this long historical (archeological) span, the rise of modern civilizations in the Near East, the Mediterranean and other centres on the African, Asian and Latin American continents, is a comparatively recent phenomenon. This means that for a greater part of the history of humanity on this earth, man has lived in and with the wilderness. Put crudely, human beings have been part and parcel of the wilderness, and despite man's present level of technological developments, he is part of that wilderness or nature.

Man's operational spheres include: (a) the household, (b) the home range, and (c) the wilderness.

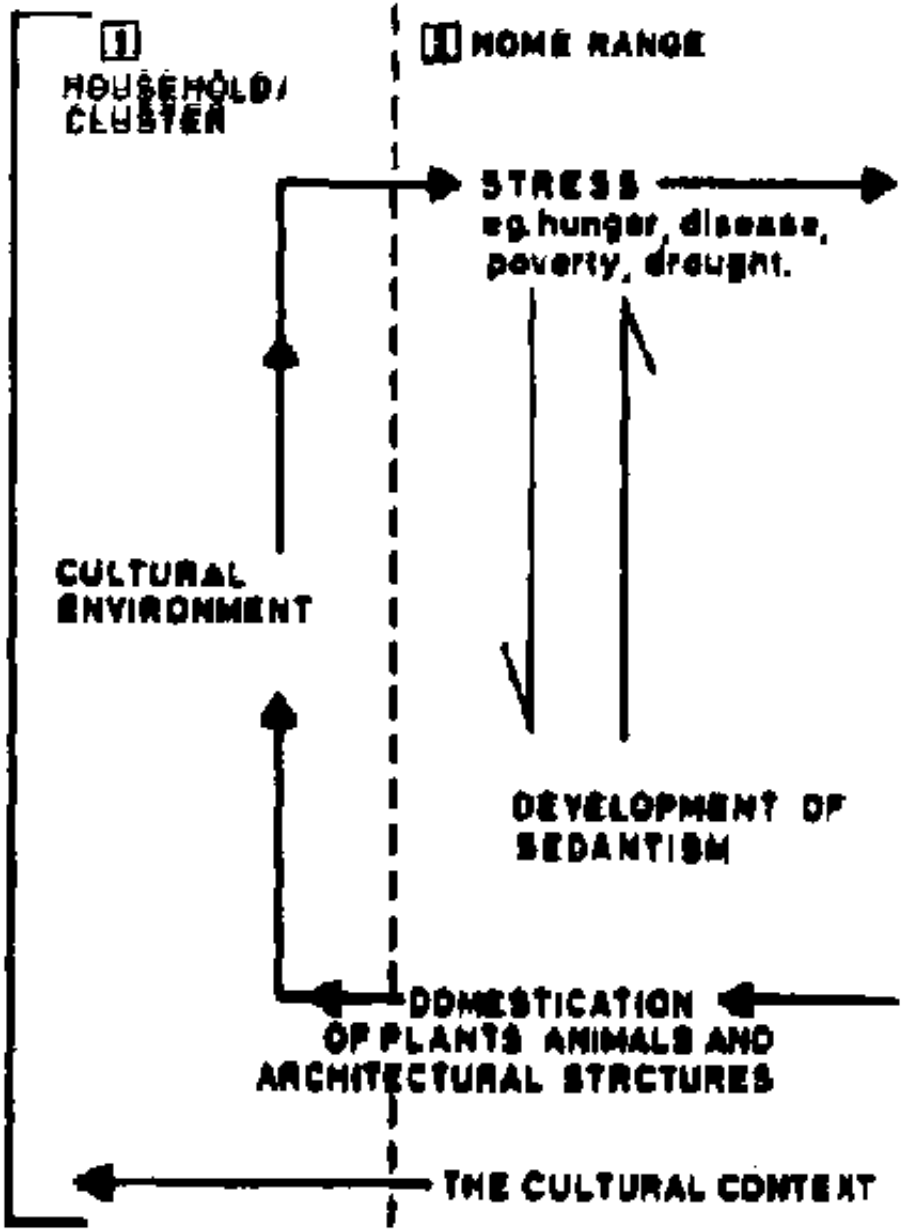

Figure 1: Diagrammatic sketch of man's operational spheres

With respect to the household cluster, one of the major technological advances that human beings have made, through time has been in architecture. From the

rockshelters, branch shelters and other open air occupation sites/areas, man has developed permanent and semipermanent architectural structures, houses. These structures have become man's basic operational base from where he retires to at night, in times of danger or stress, and wakes up in order to tame his environment in his attempts and endeavours to satisfy his basic needs of food, shelter and clothing.

The houses may be built of plants or materials of plant origin and within them there may be stores for medicinal herbs, roots, barks, twigs, powders, mixtures and of course, other items of material culture. But these plants are mostly 'dead' and in usable or near usable form.

The home range operational sphere may differ from a few meters to several kilometers, depending on the type of social organization of the people, their subsistence pattern, the environment, ecology and climate. Hunters and gatherers will normally have a larger home range than agriculturalists. Women and children in foraging communities, will have a smaller home range than men and adults. Shifting agriculturalists and pure pastoralists will have a larger home range than intensive agriculturalists and mixed farmers. And, by extrapolation, people of the North will have a smaller home range than those of the South. The home range in a way, is more of an extension of the household and it is the main source of man's requirements of not only food and game, but also medicinal plants.

With regard to the wilderness sphere, this is more of the area beyond where man treads carefully. It is the area where few people venture to go. It is the region of the hunter, the brave, and I will dare to suggest, the man.

Man exploits this territory for medicinal plants, but the range of exploitable plants here is more limited than in the preceding two ranges. And, probably this is the area where most of the medicines stored in the household originate from, because this area is not easily accessible compared to the home range.

The acquisition of traditional medicine knowledge

Modern doctors, pharmacists, nurses and other medical personnel, acquire their basic skills through an intensive and selective education, specialising in the related medical disciplines. These skills are perfected with experience through years of practice. In contrast, the relevant skills in traditional medical practice, are acquired primarily through observation and a long and tedious apprenticeship. Others acquire it through normal cultural media of oral literature, oral traditions, folklore, rites de passage, borrowing, exchange, purchase and at times even divination. Given these differences of knowledge and use of traditional medicine, medicinal plants are peculiar and at times culture specific, compared to the universal modern medicine and medical practice. Particularisms of traditional medicine may also be greatly affected by belief systems, religion, and to a greater extent, ecology. Man will exploit most those plants and medicines that are within the immediate environment. Also, the cures that will be discovered or invented, will be in most cases those that are relevant to the diseases that are common to that particular society and the contiguous areas. Thus, this knowledge may not be easily transferrable to or easily accepted in other societies. Put differently, the knowledge and use of traditional medicinal plants is largely grounded in the ethnobotany of a particular people and can be strongly and negatively ethnocentric.

The processing of plants used in Traditional medicine

Modern medicine, the medicine which is preferred and openly acknowledged by most of the participants of this conference, is normally processed in sophisticated modern laboratories after a careful scientific analysis of the constituents and chemical combinations of the raw materials. The processing and manufacturing process is therefore standardized, and more often involves mass production and worldwide use and marketing of the end product. This process is normally preceeded and accompanied by careful studies of the after effects of these medicines on animals and human beings, in order to minimise short-term and long-term adverse effects. Also, according to modern commercial practice, the resultant medicines are produced under registered trade marks and are patented. Thus, replication of the medicines is not easy, though it is common to read of medicines that are marketed under false trade marks or those with the same general properties, ingredients and after effects. Traditional medicine, in contrast, is not easy to replicate, and the dosages administered are not easy to quantify. Thus, its use necessarily involves not only trust in the healer, but also belief in the ability of the medicine to cure and the capability of the medicineman to administer the right dose or doses. Its effectiveness is assumed and only demonstrable by seeing or hearing of people who had associated symptoms of a disease cured. This fact, at times, limits the universal applicability and acceptability of such medicine in other areas and hence makes such medicines cultural specific.

The processing of traditional medicine is normally considered unhygienic and unscientific, not because this is necessarily so, but largely because people are biased against the various methods of grinding, pounding, chewing, boiling, etc., that are used. Often these methods are just as hygienic as any in the modern

industrial manufacturing process of medicine. The use of such 'crude' methods of processing may be dictated more by the scale of operation, the amount of raw materials, the market situation, and other physical or chemical characteristics of the plant itself.

Administration

Probably more than in any other areas, modern medicine diners from traditional medicine in its administration. All of us are familiar with the picture of the nurse, the doctor, and the hospital white uniform: a colour that is culturally associated with purity, hygiene, and probably modern science and technology. The administration of modern medicine is effected orally, by injections, or by topical applications etc. These methods are generally the same as the traditional methods, which also use incisions and excisions in addition to those mentioned above. But, instead of the colour of uniforms of the modern medicine, black is the typical colour of most traditional medicine practices. This is due to the processing and manufacturing process more than anything else, a process which is equally, clean, hygienic and definitely scientific.

Hospitals, modern medical practice and the doctor-patient relationship, are very objective and impersonal. The modern doctor and nurse, though belonging to the society, is generally detached from it in the execution of his or her duties. In most cases, one patient is taken to be just the same as any other patient. Individual or personal interest is only aroused when the patient or the manifestation of the diseases is peculiar, abnormal, and therefore of scientific interest. Even here, the patient becomes a case.

In comparison, the local healer and medicineman is part of the culture. He or she operates within a known cultural environment, with its own definite known cultural norms, values and beliefs. He is in most cases the next door person, an uncle, brother, grandmother, grandfather or any other relative. After all, the range of social relationships in any community is limited and prescribed. Therefore, the medicineman has a personal interest and stake in the patient. He is not a mere dot in a chain of people Stringing through the doctor's consultation office. There is a necessary cultural bond between the two. In fact, there are known instances of a healer taking the medicine on behalf of the patient, or even other people within the community doing the same for the patient. Normally when traditional medicine is removed from its cultural context and used in modern clinics, it loses this community touch and subjectivity and becomes impersonal and objective. This factor is very significant in considering how to use traditional medicine in modern contexts.

Research on traditional medicinal plants

To the author, the primary objective of research in traditional medicines, is to expand modern medical practice and medicines to cut down the bill for modern medicines and, as other people in this conference have said, to promote the return to nature. In short, to supplement and complement modern medicine. This brief review suggests that for this research to be meaningful, it is important to incorporate several cultural dimensions.

Cultural knowledge

It has been mentioned here that traditional medicine is, first and foremost,

culture-specific, and exploits and responds to the local environment and at times, beliefs. Traditional medicine researchers should therefore, start with or ground themselves in social and cultural research methods, and use these methods in their research. Results of such research may necessitate, first, the need to be accepted and trusted in the research area, to understand the local cultural norms and values, the nutritional methods and taboos, and other similar cultural premises.

The initial social and cultural research may prove to be cost cutting in the long run. It is for example a fact that diseases common in low-lying, forest costal areas, may not be present in high altitude areas, and vice versa. Thus, a researcher can benefit more by researching only in those areas where certain diseases are known to be typical. Thus, by using modern hospital clinic dispensary records, it should be possible to produce a map of the diseases that are characteristic of certain areas. The maps could then be used for identifying traditional medicines that are used to treat them and their effectiveness and thereafter, chart out a research programme for not only recording and testing these, but also for research in other possible medicines that may be in use in similar areas elsewhere.

Cooperation with local traditional medicinemen

If one acknowledges the fact that, culturally, people believe in the old, while looking forward to the modern, then it is only logical that we shall incorporate the use of traditional medicine in modern medical practice, and *vice versa.* Programmes should be worked out between modern and traditional clinics, whereby problematic cases may be treated collectively. This should not be very

difficult At least in Benin, this method is successfully being used at the local level)

Gender consciousness

Earlier it was mentioned that man operates in three spheres, the household, the home range and the wilderness. Generally, and culturally, the household is the sphere of the women and the children while that of the wilderness is the territory of the man. This means that cures for diseases which are associated with the household, for example, prenatal, natal, post natal children's diseases, are in many cases known to the women, especially the mature and elderly women in the society, while cures for such things as snake bites are known to men. Thus, when planning for and undertaking research in traditional medicine, it is important to take cognizance of this very critical factor. It is not easy for a male to get access to medicines associated with child birth and maternity care. This concept can also be extended to age groups or groupings.

Social status

Recently, the Government of Tanzania restructured its salary structure. In the new structure, medical doctors and pharmacists have been categorised as being in rare professions. This is, in a way, a recognition of their special role and position in the Tanzania Society. It is an acceptance and an ascription of special status. This status is based on the special knowledge they have, the rigorous programme they had to go through in acquiring this knowledge, and their special relation to the process of life and living. However, in assessing the place of the traditional healers in this and previous societies, we tend to forget the fact that in their case too, our societies gave them similar or even more consideration. Therefore when

undertaking our various researches in traditional medicine, we should be aware of the fact that by getting this pool of knowledge from our villagemen, a process which to them appears to be unidirectional, we are in fact stripping them of their special place in the society and hence their status. It is largely because of this fact that the author advocates for cooperation and collaboration in both research and use of traditional medicine by both parties.

Policy

Most countries of the South recognise the special role and the need for aggressive research in and use of traditional medicinal plants. Most of them have established special programmes of research in this sphere, usually at the University level. However, few of our governments have established clear-cut policies on traditional medicine, policies which define the role of the institutions and personalities involved in using traditional medicine. Such policies are needed to give due respect to the good traditional medicine practitioners. It is the author's hope that the holding of this conference is one step in the right direction towards the realization of definite policies on the use of traditional medicines, including traditional medicinal plants.

Conclusion

In this paper, the author has attempted to show that man's total social and natural environment constitutes his or her operational cultural context, and that the use of traditional medicinal plants, and other traditional medicines is not only logical, but is also natural. Realizing that research in traditional medicines is;

> **...the will of people prepared to innovate and bring new responses to new circumstance while bringing in a keen practical sense and social responsibility informed by ingenuity and creative inauguration (Winston, 1975:509).**

The author has argued for the need for modern and traditional medicine to cooperate and collaborate in all their endeavours and to establish a dialogue between them. In short, he emphasises the need for traditional medicine to incorporate in their practices, the modern dimensions while modern medicine should also include the cultural dimension, for the betterment of their practices, and for the benefit of the community.

In this regard this paper gives credit to the process so far, with the same attitude as Narakobi's in the 'Malenisian way': "Every nation needs an ideology or a philosophy. What I say wrongly to-day, let the learned of tomorrow, or even this very day, set right. But if I do not say something today, those of tomorrow will have nothing to go from, or even to correct" (Narokobi, 1980:40).

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