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A REVIEW ON PHYTOCHEMISTRY AND PHARMACOLOGY OF *BEGONIA MALABARICA* LAM

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ABSTRACT

In ancient India, many plants and herbs are used as medicine. Medicinal herbs have curative properties due to the presence of various complex phytochemicals of different composition, which are mostly as secondary plant metabolites in one or more parts of these herbs. The present review is an attempt to highlight of *Begonia malabarica* Lam - Indian ethno-medicinal herb of *Begoniaceae* family which has different pharmacological activities such as antioxidant, anti-bacterial, anti-fungal, to increase stamina, hypoglycemic effect, anti-diabetic, blood cancer therapy, respiratory tract infection, diarrhea and skin disease, etc due to presence of alkaloids, flavanoids, phenolic compounds, saponins, quinines, catechins, carbohydrates, proteins, steroids, resins, tannins and thiols and many other secondary metabolites. The major ingredient of these plant was natural dye (anthocyanine).

KEYWORDS

Begonia malabarica Lam, Herbal drugs, Anthocyanine, Pharmacological activities and Ethno-medicinal herb.

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INTRODUCTION

Begoniaceae is a remarkable family of flowering plants in that all but one species belong to the huge pantropical genus, *Begonia*. *Begonia* is a highly monophologically diverse, tropical genus of the perennial flowering plant in the family Begoniaceae. There are two recognized genera in the Begoniaceae, the monotypic genus *Hillebrandia*, a genus with single species in the Hawaiian Islands (differentiated from *Begonia* by a suite of morphological characters) and the genus *Begonia*[1,2] third genus *Symbegonia* which recently included in *Begonia*. This genus has great

horticultural interest and has long been used as ornamentals throughout the world. *Begonia* was the common name as well as the generic name for all members of the genus. A reliable infrageneric classification and subdivision of large genera such as *Begonia*[1] was crucial in order to inform taxonomic monographs, biogeographic and evolutionary studies.

A nomenclature of *Begonia*s genus was very complex and confusing because of their showy flowers of white, pink, scarlet or yellow color and often attractively marked leaves of many natural species, innumerable horticultural hybrids and cultivars are cultated. *Begonia* is the fifth-largest angiosperm genera[3] of flowering plants. *Begonia* are native to moist subtropical and tropical climates, contains 1,795 different plant species (divided into 66 sections) in which some species are commonly grown indoors as ornamental houseplants in cooler climates. These species are terrestrial (sometimes epiphytic) herbs or undershrubs, and distributed throughout in subtropical and tropical moist climates with great diversity in America and Asia (> 600 species each divided in 29 sections), whilst being relatively less species in Africa (160 species) and very few or nearly absent in Australia[1,4]. The plants of *begonia* genus are easily characterized such as terrestrial or epiphytic, perennial or more rarely annual, monoecious or very rarely dioecious herbs, sometimes shrubs, stems herbaceous, often succulent, or woody, frequently rhizomatous, or plants tuberous and either acaulescent or short-stemmed, rarely lianoid or climbing with adventitious roots. The wild terrestrial species are terrestrial, perennial or annual with upright stems or less often rhizomatous or rarely with rhizomes from which upright stems arise or acaulescent; tubers absent or rarely present *(B. balansae, B. cowelliil);* stem herbaceous or woody (at least at base), tubercles in leaf axil absent, stipules persistent or early caducous, entire or dentate, junction petiole and leaf blade without a tuft of hairs.

The *begonia* plants are monoecious, with unisexual male and female flowers occurring separately on the same plant; the male contains numerous stamens, and the female has a large inferior ovary and two to four branched or twisted stigmas inserted directly below the ovary. *Male flower* with four free perianth segments; androecium actinomorphic, filaments equal or unequal, free or rarely fused below, anthers oblong, longer than the filaments, dehiscent with laterally positioned longitudinal slits (more than 0.5 of the anther length), apex not hooded, connective extended or rarely not *(B. decandra). Female flower* with five free perianth segments; ovary or fruit with three wings, wings unequal or less often equal or subequal in fruit, not hook- or spine-like, locules 3, placentation axillary, placental branches two per locule, ovules present between placental branches; styles three, free or fused less than halfway, forked once or rarely more than once *(B. repens),* persistent or rarely caducous in fruit *(B. pensilis),* stigma not kidney-shaped, in a band and spiralled. In most species, the fruit is a winged capsule containing numerous minute seeds, although baccate fruits are also known[1].

*Begonia*s genus are usually easily recognized by their more or less asymmetrical leaves and dry three-winged fruit (in most species). The leaves, which are alternate, more than two, transverse or less often straight, asymmetric or rarely symmetric, not peltate, simple or rarely palmately lobed, venation palmate or less often palmate pinnate or pinnate often large and variously marked or variegated, are usually asymmetric (unequal-sided)[2].

The genetic and morphological diversity phants and herbs of the *Begonia* genus has been exploited through cultivation to produce more than 10,000 cultivars. All these are horticulturally divided into 5 classes:

- The tuberous *begonia*s (*B.* x *tuberhybrida*), a complex group derived from crosses between species such as *B. boliviensis* or *B. pearcei*,
- Elatior *begonia*s (*B.* x *hiemalis*), a cross between tuberous *begonia*s and *B. socotrana*,
- Lorraine *begonia*s (*B.* x *cheimanta*), a cross between tuberous hybrids and *B. dregei*,
- Semperflorens *begonia*s (*B. semperflorens*-cultorum), with *B. cucullata* and *B. schmidtiana* as important ancestors, and

- *Begonia*s grown for their ornamental foliage (*B. rex*-cultorum), Asiatic in origin[5].

Leaves of *Begonia* were used as a flavoring for mixtures of fish and meat[6]. In Indonesia, some *Begonia* species like *B. baliensis, B. lempuyangensis* and *B. multibracteata,* with a robust habit and big stems are eaten in salads or cooked with fish. In Paraguay, the leaves of the *B. cucullata* are eaten fried or in soup or salads while the sap is used to treat sore throats[7]. In Japan, India, Indonesia and Myanmar (Burma), *begonia*s have been cooked up as potherbs. Most of Tribes uses *B. lempuyangensis* as a palliative medicine for coughs; *B. lombokensis* and *B. longifolia* are also eaten and/or used medicinally[8]. *Begonia*s are also used as salads in China and Brazil. In northern Mexico and China, they are a favorite wild snack for children. In Java, the Philippines and Brazil these herbs are used as flavoring ingredients. The reports from several countries suggested that, *Begonia* species have been used for medicine, vitamin C and in some instances as a source of food[9]. In most part of Nepal, a few species of *Begonia* are use in different forms of food and in medicine[10]. In the West Indies *Begonia* leaves are used as a tea for colds. Roots and tubers of *Begonia* species have been used as emetics and purgatives. The leaves of *Begonia* genus were used for the treatment of respiratory tract infections, diarrhoea, blood cancer, and skin diseases and anti HIV activity[11].

In India, *Begonia* genus containing nearly 57 species distributed into 7 sections; mostly of them are collected from Himalayan region, Southern India, Shri Lanka, Eastern and Western Ghats[12].

SCIENTIFIC CLASSIFICATION

Kingdom: Plantae
Sub-Kingdom: Tracheobionta (Vascular plants)
Super division: Spermatophyta (Seed plants)
Division: Magnoliophyta / Angiospermae (flowering plants)
Class: Magnoliopsida / Dicotyledones
Sub-Class: Dilleniidae
Super-order: Begoniales / Cucurbitales
Order: Begoniales / Cucurbitales
Family: Begoniaceae
Genus: Begonia
Species: B. Malabarica
Binomial name: Begonia malabarica
Synonyms: Begonia hydrophila, Begonia fallax, Begonia rubrosetulosa
Common name: Malabar Begonia; Tamil - Rathasoori, Narayana-Sanjeevi

Morphological characters

The herb, *Begonia malabarica* Lam., is found in the hilly regions of Southern India and Sri Lanka[13]. The tribal name of the herb is "Narayana-Sanjeevi". The name itself indicates that this herb having miraculous powers. In India, this plant is commonly found in Nilgiris, Anamalais and Pulney hills upto an attitude of 6000 feet in the moist area[14]. They named this herb after Lord Vishnu because they believe that the consumption of the plant juice gives high disease resistance power and protect the body like the Lord protect the living being in the Universe. The medicinal herb *Begonia malabarica* is used by *Malasar* and Malai *Malasar* tribal community of Pollachi to cure arthritis and common joint pains[15]. M*alasar* tribe of Andrapradesh uses *Begonia malabarica Lam.* to treat diabetes[15].

Leaves are oblique, 3-8 inches long and 2-3 inches broad near at the base, heart-shaped, pointed, acute to nearly acuminate, slightly serrated, hispid on both surface, upper surface green and reddish beneath, leaves sparsely arranged with, 2-3inches petioles, stipules scarious and adnate. Stem erect, 5-10 inches, reddish, glabrous, succulent with distinct nodes and internodes. Flowers are rose and light pink colored, not very many on a peduncle, nearly round with two perianth leaves, arranged in axillary cyme and pendulous. Males flowers have 2 sepals about 1.5 cm, hairless, round, no petals, stamens-40. Female flowers have perianth nearly as in male flowers, styles 3, each dividing into two curved and twisted branches. Capsule is 1.8 x 1.8 cm, including the wings[16].

Phytochemistry

The *B. malabarica* are reported important secondary metabolites and nutrients such as alkaloids, flavanoids, phenolic compounds, saponins, quinines, catechins, carbohydrates, proteins, steroids, resins, tannins and thiols[17,18]. The main important secondary metabolites are extracted from leaves of *Begonia Malabarica* are luteolin,

quercetin, β–sitosterol, friedelin, epi-friedelinol, β-sitosterol-3-β-ortho glucopyranoside[11,17,19,20]. It also contains secondary metabolites like total phenols, ortho-dihydroxy phenols, tannins, flavonoids, and alkaloids are present in the leaves of *Begonia Malabarica*[19]. Methanolic extract of stem of *B. malabarica* contain Flavanoids, Carbohydrates, Proteins, Steroids, Resins, Tannins and Thiols[21]. Leaves and fruits contain flavonoids, alkaloids, phenols, saponins and tannins[21].

The content of leaf extract of *B. malabarica* in methanol were detected by GC-MS, seven different phytochemicals such as anthocyanine (polyphenolic named flavonoid), phenol 2,4-bis(1,1-dimethylethyl); hexadecanoic acid methyl ester; 9,12-octadecadienoic acid (Z,Z) methyl ester; 9,12,15-octadecatrienoic acid methyl ester, (Z,Z,Z)- or (alpha-linolenic acid)-PUFA; 1,2-benzenedicarboxylic acid diisooctyl ester or phthaleic acid; Spiro [furan-2 (5H), 2'(1'H)-naphtho [2,1-b] furan] -5-one, 3'a,4',5',5'a,6',7',8',9',9'a,9'b-decahydro-3,3'a,6',6',9'a-pentamethyl; and androst-1-en-3-one, 4,4-dimethyl-, (5.alpha.)[22].

Pharmacological importance

Flavones, one class of the secondary metabolite are responsible for the antimicrobial study and many groups have isolated and identified; different flavones possessing antifungal, antiviral and antibacterial activity. Some nitrogen containing flavones have been reported to have considerable antimicrobial activity. The compounds, bearing different substituents - amino alkyl, cyano- or alkenyl alkyl group on piperazine are found to be the potent antibacterial and antifungal agents[23]. The flavonoids possess capabilities to form complexes with extracellular soluble protein and bacterial cells[24].

The oral administration of decotion of *Begonia malabarica* stem was taken to increase the stamina and methanolic extract of *B. malabarica* containing steroids, terpenoids, carbohydrates, anthocyanins, tannins, carboxylic acids and saponins (detected by suitable test) had shown a significant hypoglycemic effect in normal rats at third and fourth hour after treatment[25]. The methanolic extract does not show any test of alkaloids. The mechanism of action of these activities was not studied but the activity due to some physiological changes was reported[26]. After 25 days treatment of methanolic extract of *B. malabarica* (100 and 200 mg/kg) on streptozotocin induced diabetic rats, it has been found that extract had reduced both the fasting as well as postprandial plasma glucose levels. During this treatment, it has been also found that serum insulin levels and liver glycogen level get increased but it does not shows any alpha-glucosidase inhibition effect and not changing serum triglycerides and total cholesterol content.

The methanolic extract of whole herb, *B. malabarica* contain appreciable amounts of total phenolic contents, total flavonoid and exhibited potential in vitro antioxidant activity in DPPH radical scavenging, Hydroxyl radical scavenging, superoxide anion scavenging, ABTS radical cation scavenging activity and reducing power assay[27]. All these study shows that methanolic extract of the herb shows higher activity than ascorbic acid. The reducing power value of the extract was slightly higher than that of ascorbic acid. The methanolic extract shows highest ABTS+ scavenging capacity than the other. The quantitative amount of the phenolic and flavonoid contains was responsible for the antioxidant and free scavenging activity. Anthocyanin was one of the important phytochemical present in *Begonia* cultivars which was one of the important antioxidant. The results of antioxidant study of *Begonia* cultivars suggested that anthocyanin was responsible the antioxidant activity i.e. potential source of natural antioxidant[28].

Phytochemical and antimicrobial analysis[21,29] of different extracts of leaves and steams *Begonia malabarica* was showed the presence of bioactive secondary metabolites such as flavanoids, carbohydrates, proteins, steroids, resins, tannins and thiols. Aqueous extract of leaves was comparatively more active against the fungal than the bacterial strains; maximum activity was observed against *Vibrio cholerae*, the maximum among the fungal strains was observed against *Aspergillus Niger*[29].

The aqueous and organic extracts of leaves of *Begonia malabarica* showing broad spectrum Anti-bacterial activity (gram-negative bacteria except *Vibrio parahaemolyticus*) and antimicrobial activity[17] which claims the usefulness of the herb

against diarrhoea and skin diseases caused by pathogenic bacteria. The chloroform and methanol extracts shows activity against all tested bacteria strains; chloroform extract was more active against *C. violaceum* and *V. parahaemolyticus* and methanol extract was more active against *K. pneumoniae* while hexane extract did not shows any activity. All extracts does not shows any activity against strains of fungi. The antimicrobial activity of extracts of *Begonia malabarica* in different solvent extracts like acetone, ethyl acetate and methanol shows that methanol extracts has highest activity against *Staphylococcus aureus* and minimal activity against *Escherichia coli* and *Klebsiella pneumonia* while acetone extract was least active. The ethyl acetate extracts do not shows any activity against *Candidan albicans*, *Escherichia coli* and *Streptococcucs faecalis*[18].

The leaves are used in blood cancer therapy and respiratory tract infection[19]. It is also used in the treatment of diarrhea and skin disease. The leaves of *B. malabarica* are used for the treatment of respiratory tract infections, diarrhoea, blood cancer and skin diseases[11].

Electrochemical Impedance Spectroscopic studies[30] of dye extracted from the leaf of *Begonia malabarica* Lam. which was used as sensitizer of solar cells by discussing characteristic parameters electron transport, charge transfer, time constant, etc. The evaluation of these parameters suggested that cell has an efficiency of 1.74 % and fill factor of 45%.

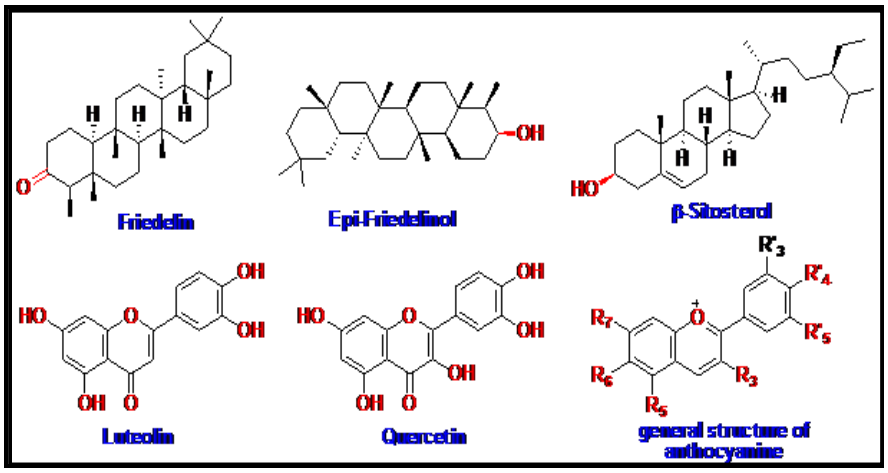
General Uses

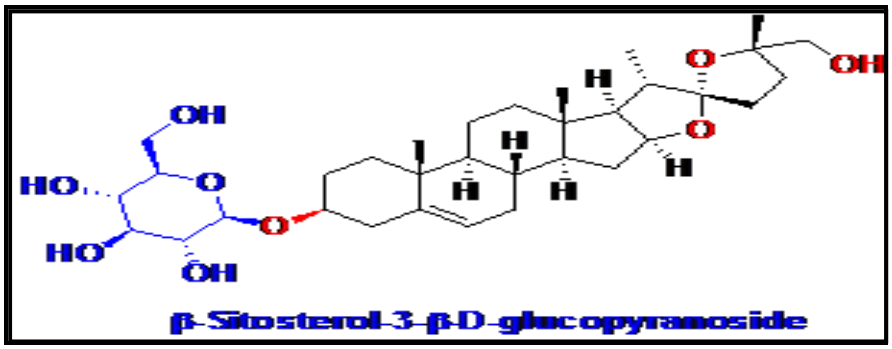
1. Dried aerial parts of *B. malabarica* is made paste with coconut oil is taken twice a day to rheumatic pain[31], it takes seven days to dissolve kidney stone. *B. malabarica* herb juice along with honey is taken regularly for blood purification.
2. It is given in for fever to reduce the body temperature and it is taken as a general health tonic. The leaf juice mixed with ginger is taken for treating anemia. It was used along with different medicinal plants because of its protective role in organ toxicities induced by different chemicals and environment[16].
3. *Kanikkar* tribals of Agasthiarmalai Biosphere Reserve, Tamil Nadu, used the fresh leaf juice of *B. malabarica* with salt to treat giddiness[32]. It is also taken as an astringent.
4. The fresh leaf juice is taken orally in empty stomach to relieve a stomach pain by the *Kanikkar* tribals of Agasthiarmalaimalai Biosphere Reserve, Tamil Nadu[33].
5. Leaf juice used for head ache and to cure wounds[34].
6. The paste of fresh leaves *Begonia malabarica* is applied externally once in a day for one week to treat foot sores by Kanikkar tribals of Tamil Nadu[35].
7. *Begonia malabarica* was rich natural source of vitamin C and aqueous extract of leafs are used anti-bacterial source[36].

Table No.1: Flowers by Botanical Names of Begoniaceae family (flowers of India)

S.No	Botanical Name	Synonyms	Common name
1	Begonia albococcinea Hook	Begonia grahamiana	Red and White Begonia
2	Begonia cathcartii	Begonia nemophila, Platycentrum cathcartii	Red-Hair Begonia
3	Begonia coccinea	--	Angel Wing Begonia
4	Begonia concanensis	--	Konkan Begonia
5	Begonia crenata	--	Common Begonia
6	Begonia dioica	Begonia tenella, Begonia amoena	Three-Petal Begonia
7	Begonia floccifera	--	Woolly Begonia
8	Begonia grandis	--	Hardy Begonia

9	Begonia hatacoa	Begonia rubrovenia, Platycentrum rubrovenium	Red-Vein Begonia
10	Begonia integrifolia	--	Entire-Leaf Begonia
11	Begonia maculata	Begonia argyrostigma, Begonia corallina, Begonia dichroa	Polka Dot Begonia
12	Begonia malabarica	Begonia hydrophila, Begonia fallax, Begonia rubrosetulosa	Malabar Begonia
13	Begonia megaptera	--	Large Winged Begonia
14	Begonia 'Nonstop Red'	--	Begonia Nonstop Red
15	Begonia phrixophylla	--	Shimpli
16	Begonia picta	Begonia echinata	Painted Leaf Begonia
17	Begonia 'Red Cascade'	Begonia malabarica	Hanging Basket Red Begonia
18	Begonia roxburghii	--	East Himalayan Begonia
19	Begonia sempeflorens	--	Begonia Fair Lady
20	Begonia subpeltata	Reichenheimia subpeltata	Shield-Leaf Begonia
21	Begonia tessaricarpa	--	Rebe
22	Begonia trichocarpa	--	Hairy-Fruit Begonia
23 24	Begonia tuberosa 'Ruffled Yellow'	--	Ruffled Yellow Begonia
25	Begonia x semperflorens-cultorum	--	Wax Begonia





CONCLUSION

Now days, people were focusing on the herbal medicines which are made from single herb or mixture of herbs. The concept of use of single herbs and poly herb formulations as potential therapeutic agents was being experimentally and clinically documented because of multi faced therapeutic properties of herbs. Narayana-Sanjeevi (*Begonia malabarica* Lim) was herb possessing variety of phytochemicals has been proved as medicinal herb (weed). Very few researches were done on this herb. Some research studies suggest that, it contains alkaloids, flavanoids, phenolic compounds, saponins, quinines, catechins, carbohydrates, proteins, steroids, resins, tannins and thiols and many other secondary metabolites therefore it used as natural dye, antioxidant, anti-bacterial, anti-fungal, to increase stamina, hypoglycemic effect, anti-diabetic, blood cancer therapy, respiratory tract infection, diarrhea and skin disease, etc. The *Begonia malabarica* Lim. was the component of promising herbal drug because of its safety and effectiveness.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

BIBLIOGRAPHY

1. Doorenbos J, Sosef M, de Wilde J. *The sections of Begonia (Studies in Begoniaceae VI), Backhuys Publishers, Leiden, The Netherlands,* 1998, 266.
2. Forrest L L and Hollingsworth P M. A recircumscription of *Begonia* based on nuclear ribosomal sequences, *Plant systematic and evolution*, 241(3-4), 2003, 193-211.

3. Frodin D G. History and concepts of big plant genera, *Taxon*, 53(3), 2004, 753-776. Hughes M and Hollingsworth P M. Population genetic divergence corresponds with species level biodiversity patterns in the large genus Begonia, *Molecular ecology*, 17(11), 2008, 2643-2651.
4. Goodall-Copestake W, Perez-Espona S, Harris D J and Hollingsworth P M. The early evolution of the mega-diverse genus *Begonia* (Begoniaceae) inferred from organelle DNA phylogenies. *Biological journal of the linnean society*, 101(2), 2010, 243-250.
5. Haegeman J. Tuberous Begonias. Origin and development, *J. Cramer,* 1979. ISBN 376821219X. Vaduz, Liechtenstein, Hvoslef-Eide A K and Munster C. *Begonia*. History and breeding, In: *Flower Breeding and Genetics, chapter 9*, Anderson, NO., (ed.), 2007, 241-275. Springer, ISBN 9781402044274, Dordrecht, The Netherlands.
6. Burkill I H. A Dictionary of the Economic Products of the Malay Peninsula. *I (A-Cod), Governments of the Straits Settlements and Federated Malay States by the Crown Agents for the Colonies, London,* 21935, 1870-1965.
7. Jordan D. Waxing about edible Begonias, 2008. http://www.eattheweeds.com/ www.EatThe-Weeds.Com/EatTheWeeds.com/Entries/1958/5/25_Begonias.
8. Girmansyah D. A taxonomic study of Bali and Lombok *Begonia (Begoniaceae*), *Reinwardtia*, 12(5), 2009, 419-434.
9. Jain S and N Dam. Some ethnobotanical notes from north-eastern India, *J. Econ. Bot*., 33(1), 1979, 52–56. Lauferriere J. On the edibility of Begonias (J), *The Begonian,* 57(2), 1990, 175. Gaur R D. *Flora of the District Garhwal North West Himalaya (with ethnobotanical notes), Trans Media Publication, India,* 1999, 811. Basurto-Pe F, Delia Castro-Lara, Miguel Angel Martínez-Alfaro. Edible Begonias from the north of Puebla, Mexico, *J. Econ. Bot.,* 57(1), 2003, 48-53. Lans C A. Ethnomedicines used in Trinidad and Tobago for urinary problems and diabetes mellitus, *Journal of Ethnobiology and Ethnomedicine,* 2, 2006, 45. Murugkarm A D. Interventions using wild edibles to improve the nutritional status of Khasi tribal women, *Human Ecology,* Special Issue No.14, 2006, 83–88. Sajem A L and Gosai K. Traditional use of medicinal plants by the Jaintia tribes in north Cachar Hills district of Assam, northeast India, *Journal of Ethnobiology and Ethnomedicine,* 2, 2006, 33.
10. Rajbhandary S. Traditional uses of *Begonia* Species (Begoniacae) in Nepal, *J. Nat. Hist. Mus.* 27(2013), 2013, 25-34.
11. Kiritkar K R and Basu B D. Indian Medicinal Plants, Indological and Oriental Publishers, Delhi, 2nd Edition, 1975, 215. Wu, Pei-Lin P L, Lin, Fu-Wen F W, Wu, Tian-Shung T S, Kuoh, Chang-Sheng C S, Lee, Kuo-Hsiung K H, Lee, Shiow-Ju S J. Cytotoxic and anti-HIV principles from the rhizomes of *Begonia nantoensis*, *Chemical and pharmaceutical bulletin,* 52(3), 2004, 345-9.
12. Uddin A. Distribution and Status of Indian *Begonia* species, *J. Econ. Taxon. Bot,* 31(3), 2007, 591-597. Uddin A, Gogoi R, Mao A A and Phukan S. Rediscovery of *Begonia adscendens,* C. B. Clarke from Esii Hill, Manipur, India. *Rheedea,* 18(1), 2008, 53-55.
13. Clarke C B. Begoniaceae. In: Hooker JD. (Ed.), Flora of British India, *L. Reeve and Co, London,* 2, 1879, 635-656.
14. Gamble J S. Flora of the Presidency of Madras, *Desmodium Gyrans* D C, F.B.I. ii.174. W. and A. 227, Wt. Ic.t.294. Adlard and son Ltd. W C Jayyed Press, Ballimaran, Delhi, 1, 1935, 348.
15. Pandi kumar, Ayyanar M, Ignacimuthu S. Medicinal plants used by Malasam tribes of Coimbatore district, Tamil nadu. *Indian J Tradit know,* 6(4), 2007, 579-582.

16. Murugesan Suresh, Kokkaiah Irulandi, Vadivel Siva and Palanichamy Mehalingam. A Short review on Ethnomedicinal uses, phytochemistry and pharmacology of *Begonia malabarica* Lam, *International Journal of Botany Studies*, 1(6), 2016, 16-17.
17. Ramesh N, Viswanathan M B, Saraswathy A, Balakrishna K, Brindha P and Lakshmanaperumalasamy P. Phytochemical and antimicrobial studies of *Begonia Malabarica*, *J Ethnopharmacol,* 79(1), 2002, 129-132.
18. Sethupandian Geetha, Kokkaiah Irulandi and Palanichamy Mehalingam. Evaluation of Phytochemical screening and Antimicrobial potential of *Begonia malabarica* Lam, *Asian Journal of Biochemical and Pharmaceutical Research,* 3(6), 2016, 165-169.
19. Selvaraaj T, Rajesh kumar S, Nisha M C, Tesso M. Effect of *Glomus mosseae* and plant growth promoting rhizo-microorganisms (PGPR's) on growth, nutrients and content of secondary metabolites in *Begonia malabarica* Lam, *Maejo Int J Sci Technol*, 2(3), 2008, 516-525.
20. Desai H K, Gawad D H, Govindachari T R, Joshi B S, Kamat, V N, Parthasarathy P C *et al.* Chemical investigation of some Indian plants VIII, *Indian Journal of Chemistry,* 13, 1975, 97-98.
21. Suresh S N, Nagarajan N. Antimicrobial activity and preliminary phytochemical analysis of *Begonia malabarica* Lam, *J Pure Appl Microbio*, 3(2), 2009, 801-803.
22. Aswathy J M, Preetha T S and Murugan K. Comparison of bioactive Anthocyanin components from *Begonia malabarica* Lam, and *Begonia rex-cultorum* 'Baby rainbow' L.H.Bailey by GC-MS analysis, *IJABPT*, 6(3), 2015, 217-222.
23. Singh M, Kaur M, Silakari O. Flavones: an important scaffold for medicinal chemistry, *Eur. J. Med. Chem.*, 12(84), 2014, 206-239. DOI: 10.1016/j.ejmech.2014.07.013.
24. Cushnie T P, Lamb A J. Detection of galangin-induced cytoplasmic membrane damage in *Staphylococcus aureus* by measuring potassium loss, *J. Ethnopharmacol.* 101(1–3), 2005, 243-248. DOI: 10.1016/j.jep.2005.04.014.
25. Pandikumar P, Prakash Babu N, Ignacimuthu S. Hypoglycemiand antihyperglycemic effect of *Begonia malabarica* Lam, In normal and streptozotocin induced diabetic rats, *J Ethnopharmacol,* 124(1), 2009, 111-115.
26. Ortiz-Andrade R R, Garcia-Jimenez S, Castillo-Espana P, Ramirez-A, Vila G, Villalobos-Molina R, Estrada-Soto S. α-Glucosidase inhibitory activity of the methanolic extract from *Tournefortia hartwegiana*: an anti-hyperglycemic agent, *Journal of Ethnopharmacology,* 109(1), 2007, 48-53.
27. Kalpanadevi V, Mohan V R. *In vitro* antioxidant studies of *Begonia malabarica* Lam, and *Begonia floccifera* Bedd, *Asian Pac J Trop Biomed*, 2(3), 2012, 1572-1577.
28. Aswathy J M, Dinesh Babu K V and Murugan K. Anthocyanin from *Begonia* Cultivars and its Antioxidant Potentialities, *Int J Pharm Bio Sci,* 7(1), 2016, 1-6.
29. Suresh S N, Nagarajan N. Preliminary phytochemical and antimicrobial activity analysis of *Begonia malabarica Lam*, *Journal of Basic and Applied Biology*, 3(1-2), 2009, 59-61.
30. Lakshmi K. Singh, Tado Karlo and Arvind Pandey. Electrochemical Impedance Spectroscopic Study on DSSC Sensitized with *Begonia malabarica* Lam, *Materials Science Forum,* 771, 2014, 133-141.
31. Bose M F J, Aron, Mehalingam P. An ethnobotanical study of medicinal plants used by the Paliyars aboriginal community in Virudhunagar districit, Tamil nadu, *Indian J Tradit know*, 13(3), 2014, 613-618.
32. Mohan V R, Rajesh A, Athiperumalsami T, Sutha S. Ethnomedicinal plants of the Tirunelveli district, Tamil Nadu, India, *Ethnobot Leaflets*, 12(1), 2008, 79-95.

33. Lalitharani S, Mohan V R, Regini G S. Ethnomedicinal plants used by Kanikkar in Karayar of Agastiarmalai Biosphere Reserves, Tamil Nadu, *J Econ Taxon Bot*, 34(2), 2010, 472-477.
34. Jayanthi P, Aravindhan V, Rajendran A. Phytotherapeutic Plants of Madukkarai Hills In The Southern Western Ghats Of Coimbatore District, Tamil Nadu, India, *J Ayu Her Med,* 2(5), 2012, 807-906.
35. Lalitharani S, Mohan V R, Regini G S. Ethnomedicinal plants used by Kanikkars of Chinna and Periyamylar regions of Agastiarmalai Biosphere Reserves, Tamil Nadu, *J Non timber for prod,* 16, 2009, 209-210.
36. Ariharan V N, Meena Devi V N, Rajakokhil M and Nagendra Prasad P. A new natural source for Vitamin–C, *IJPAES,* 2(3), 2012, 92-94.

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