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Cyamopsis tetragonoloba (L). Taub.: A Phyto- Pharmacological Review



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ABSTRACT

Cyamopsis tetragonoloba (L). Taub. belongs to genus *Cyamopsis* family fabaceae. It is a drought hardy, deep-rooted annual legume grown in India as a vegetable, fodder or green manure crop. It has possess anti-diabetic, hypocholesteremic, anti-ulcer, cytoprotective, anticholinergic, anticoagulant, hemolytic, antimicrobial, antiasthmatic, antiinflammatory, reversible antifertility, anthelmintic and wound healing activity etc. It is considered as a valuable source for food products. In pharmaceutical formulations, it has been used in colonic drug delivery and also as controlled-release carrier, as a binder, disintegrant in oral, in topical products as a suspending, thickening and stabilizing agent. This review gives a bird's eye view mainly on the pharmacognostical characteristics, traditional uses, phytochemistry and pharmacological actions of plant.



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INTRODUCTION

The genus *Cyamopsis* distributed in tropical Africa and Asia as main center, with its largest diversity cultivars in India ^[1, 2]. It is widely cultivated in countries like India, Pakistan, United State of America, Italy, Morocco, Germany and Spain and is thus considered as a new crop for western agricultural practices. Early taxonomy divided the genus into three species: *C. tetragonoloba*; *C. senegalensis*; *C. serrata* excluding *C. dentate* ^[2, 3], the intermediate type between *C. senegalensis* and *C. serrata*. *C. senegalensis* is regarded as the ancestral form of guar, and has similar gum concentration, composition and viscosity characteristics ^[4]. *C. senegalensis* and *C. serrata* are quite different from *C. tetragonoloba* (L.) Taub. Both of the former species are shorter in height (about 30 cm) with smaller leaves and pods, compared with *C. tetragonoloba* (L.) Taub. Seeds of *C. senegalensis* and *C. serrata* are smaller, short and cylinder shaped when mature than *C. tetragonoloba* round shaped. Pod shattering was observed in *C. senegalensis* and *C. serrata* when mature, but not in *C. tetragonoloba*. These morphological differences can be utilized to differentiate the genetic relationships among guar cultivars. Even if varieties are morphological distinct from each other, differences at the molecular level are not clear ^[5].

***Cyamopsis tetragonoloba* (L.) Taub.**



***Cyamopsis tetragonoloba* (L.) Taub.**

Synonym: *Cyamopsis psoralioides* DC. ^[5,6]

Vernacular Name: Sanskrit - Bakuchi, dridhabija, goraksha phalini, gorani; Hindi - Gowar, guar; Gujrati - Guwar; Marathi - Bavachi, gowar; Tamil - Kothaveray; Telgu.- Gorchikudu; Kanad - Gorikayi; Panjabi - Kulti, guar, kuwara; English - Cluster bean

Geographical distribution: Guar is mainly grown in India, Pakistan, United States, and recently in China. It is native to the Indian subcontinent and crop is mainly grown in the dry habitats of Rajasthan, Haryana, Gujarat and Punjab [2-5]. In addition to its major cultivation in India, guar is regarded as a cash crop in the southwest part of the United State, especially in Texas and Okladoma grown to limited extent in other parts of the world like Australia, Brazil and South Africa [5-7]. Guar does not exist in a wild state and is believed to have originated from an African species imported to India as horse fodder by Arabian traders [7]. It was turned into a gum-producing crop during the Second World War in the United States.

Following are some varieties/cultivars of *Cyamopsis tetragonoloba* (L.)Taub.

There are several varieties distinguished by height of plant size and shape of the pods. Two famous varieties are giant and dwarf. The former is commonly grown in Gujarat, while latter is popular in Punjab and Utter Pradesh. The different forms used for different purposes like as vegetable and as fodder. In Bombay three forms Pardeshi, Sotiaguvar and Deshi are famous [2, 8]. Many cultivars of guar are available. In one study six guar cultivars were divided into two subgroups: subgroup I consisting of Kinman and subgroup II consisting of Esser, Lewis, Monument, Matador and Santa Cruz, indicating that Kinman is genetically less similar to the other five guar cultivars. Modern commercial lines are originated from brooks and mills. Kinman and Esser are sister lines developed from a cross between Brooks and Mills, and Lewis and Santa Cruz are from a cross between T64001 and PI 33870-B [6].

Description

Guar is an annual herb, which grows up to 60 cm high. Guar is a predominantly self-pollinated crop of the Fabaceae [8].

Flower- Flowers are axillary, 6-30 flowered racemes. The structure of flowers is arranged in fives. The sepals use fused and hairy on the outside. The lower calyx teeth are longer than the upper ones. The corolla is butterfly shaped (flag, 2 wings, keel formed from 2 fused petals), small and reddish. There are 10 stamens [2].

Fruit- Developing from a carpel is an upright, 3.8-5 cm long, sparsely haired legume with 5-6 seeds, these have a very well developed, slimy endosperm [2, 8].

Leaves- Alternate, trifoliolate and leaflets are broad elliptical acuminate, dentate, pubescent on both surfaces. They measure 3.8- 7.5 cm long and 1.2-5 cm wide. The petiole is 2.5-3.8 cm long while stipules are 6-10 mm long ^[3,4].

Root - The root and root tuber have symbiotic bacteria, which bonds nitrogen from the air^[7].

Reported Major Phyto-constituents

Green pods: In low concentrations: β -carotene, vitamin E; in medium concentrations: iron, protein; in high concentrations: ascorbic acid, vitamins i.e. thiamine, riboflavin, niacin, carotene vitamin C, and folic acid⁸.

Seeds: rich in proteins; gallic acid; carbohydrate; calcium; methionine; enzymes i.e. α -D-galactosidase, $\text{exo-}\beta$ -D-mannanase; antitryptic agent; fatty acids i.e. plasmatic, stearic, arachidic, oleic, linoleic and linolenic acid; polyphenolics i.e. gallic, chlorogenic, caffeic and ellagic acids, gallotannins, kaempferol-3-glucoside, kaempferol-7-glucoside-3-glycoside, kaempferol-3-rutinoside. Seed also contain galactomannan^[9].

Leaves: Saponins; polyphenols; Dried leaves: flavanoid tetra glycoside; tannin- condensed tannins gallic acid, gentisic, quercetin etc; calcium extremely high; leaves also contain galactomannan ^[5].

Traditional Uses

Fruit - Removes biliousness i.e., used to treat night blindness ^[2].

Seeds - used in curing sprains, swellings and arthritis¹, as anti-oxidant, antibilious, laxatives and in polluting boiling, dry seeds trypsin inhibitor. Boiled seeds are used as poultice in plague, enlarged liver, head-swellings and swellings due to broken bones ^[2].

Leaves - Used to cure night blindness and in asthma. Leaves are used boiled or stir-fried; green pods used boiled, stir-fried, or dried for storage; dry seeds processed for gum as thickener ^[1].

Pods - Oral administration of an ethanol extract of powdered pods antiulcer, antisecretory, cytoprotective effects on various experimentally induced gastric lesions in rats ^[2].

Guar gum- Fiber from the seed of plant, used as a laxative, treating diarrhea, irritable bowel syndrome (IBS), obesity, and diabetes, and for preventing “hardening of the arteries”

(atherosclerosis). Night blindness, dyspeptic complaints, anorexia, constipation and agalactia has also been treated with guar gum [5,9].

As per Ayurveda, the plant is used to reduce fire and can be used as cooling, digestive, tonic, galactagogue, useful in constipation, dyspepsia, anorexia, agalactia, hyetalopia and vitiated condition of kapha and pitta. The Plant is also mentioned as Appetizer and Flatugenic [6,10].

Pharmacological Activities

1). Anti-diabetic effect: An aqueous extract of pods of the plant at a dose of 250mg/kg of body weight significantly reduces blood glucose level in normal and alloxan induced diabetic rats¹¹. The effect of guar feeding was observed on serum total lipids, free and esterified cholesterol, triglycerides and phospholipids. Normal and alloxan induced diabetic guinea pigs¹². *Cyamopsis tetragonoloba* showed marginal anti-hyperglycemic effect on blood glucose level in normal fasted rats^[13].

2). Hypocholesteremic: The effect of guar gum obtained from endosperm of the seeds on indexes of protein absorption and utilization was also investigated along with its anti-diabetic and hypocholesteremic potential. In spite of fact that diabetes elevated blood lipids in all animals, guar gum diet significantly decreases serum concentration of cholesterol and triglycerides, furthermore, a concomitant increase in HDL-cholesterol with a substantial elevation of HDL/LDL cholesterol ratio was found. The gum promoted a general improvement in condition of diabetic rats, in body weight gain and indexes of protein absorption and utilization^[13,14].

3). Anti-ulcer effect: The intensity of gastric lesions induced by hypothermic restraint stress and Indomethacin was reduced significantly by Guar extract at a dose of 500mg/kg^[15].

4). Cytoprotective effect: It produced a marked cytoprotective effect against all the necrotizing agents used in the study. The extract not only increased the gastric wall mucus significantly but also restored the ethanol-induced depletion of non-protein sulfhydryl content in the glandular stomachs of rats^[15].

5). Anticholinergic effect: The extract inhibits acetylcholine induced contraction of isolated guinea pig ileum, suggesting anticholinergic activity^[15,16].

6). Anticoagulant activity: Low molecular weighted sulfated derivatives of galactomannan from seeds of *Cyamopsis tetragonoloba* was tested for their anticoagulant effect. In the study, galactomannan was depolymerized using immobilized enzymatic preparation celloviridin. A set of fragments having molecular weight ranging from 12.6 to 245.6K da were obtained. Sulfated derivatives of components of all fractions were synthesized in which the content of HSO₃ (-) group was 48.05% + 2.31. All preparations exhibited anticoagulant activity, which was tested by in-vitro and in-vivo models. The antithrombin activity was high up to 65-87 U/mg & did not depend on the molecular weight of sulfated derivative ^[17].

7). Hemolytic activity: Hemolytic activity of a saponin-rich extract prepared from guar meal was tested against chicken blood collected from mature roosters. Hemolytic assay was conducted in a 96-well microplate and preliminary scanning of hemolysis in culture plate at wavelength 405,455, 520 and 650nm showed that the 100% Methanol fraction was found hemolytic until diluted to less than 0.25mg fraction/ml. This hemolytic activity may think to be due to effect on cell membrane permeability by forming pores in membrane, altering the sodium-potassium and calcium-magnesium ATPase activities or insertion of the hydrophobic saponin nucleus into the lipid bilayer ^[17].

8). Antimicrobial activity: 20%, 60%, 100% methanolic extract of *C. tetragonoloba* was tested against *S. aureus*, *Lactobacillus* spp., *S. typhimurium* and *E. coli*. 20 and 60% methanolic extract showed a mild antibacterial effect with lactobacillus Spp. MIC was 3.13 & 0.78 fraction/ml for 100% methanolic extract against *S. aureus*, lactobacillus spp. respectively. A similar MIC was observed for 100% methanolic fraction exposed to *E.coli* and *S. typhimurium* at 1.56 and 0.78 mg fraction/ml ^[17].

9). Antiasthmatic activity: Alcoholic and aqueous extract of the leaves of this plant were found to inhibit histamine-induced contraction of isolated guinea pig ileum preparation in-vitro at a dose of 100µg/ml and also found to reduce bronchospasm produced by 1% histamine. Both the extracts were also found to reduce exaggerated leukocytosis and eosinophil count induced by the subcutaneous injection of milk. This effect showed adaptogenic effect of the extract, thus concluded that antiasthmatic activity of *C. tetragonoloba* may be attributed to its antihistaminic, anti-allergic and adaptogenic effect ^[18].

10). Anti-inflammatory activity: The anti-inflammatory activity of alcoholic and aqueous extract of the seeds (50 and 100mg/kg) of the plant was assessed in acute, subacute and

neurogenic inflammation against carrageenan induced paw edema, formaldehyde-induced paw edema, xylene-induced ear edema respectively. Ethanolic extract showed significant inhibitory effect on inflammation caused by various phlogistic agents in a dose-dependent manner. The anti-inflammatory activity may be correlated with its rich flavonoid and saponin content, which showed anti-inflammatory activity in various previous reports ^[18,19].

11). Reversible antifertility effect: Reversible antifertility effect of *Cyamopsis psoralioides* in male Swiss albino mice. Present study was undertaken to evaluate the reversible antifertility effect of *Cyamopsis psoralioides* (Guar gum) pod on male Swiss albino mice. The mice were orally administered the ethanol crude extract (200mg/Kg body weight and 400mg/Kg body weight) for 40 days. Effect of the treatment on reproductive organs and fertility was investigated and the testosterone level was determined by RIA. The results revealed that the low dose of 200mg/Kg body weight treatment caused 50% reduction in the fertility of male mice, whereas in high dose 400mg/Kg body weight caused 100% reduction in the fertility of male mice ^[20].

12). Anthelmintic activity: Ethanol and aqueous extracts from leaf, stem and fruits of *Cyamopsis tetragonoloba* (L.) Taub. investigated for their anthelmintic activity by using four concentrations (12.5, 25, 50, 100mg/ml) of each extract against *Pheretima posthuma* as test worms. The ethanol and aqueous extract of fruit and leaves exhibited significant anthelmintic activity but extracts from stem part were not effective against test worms. The results support fruits and leaves of *Cyamopsis tetragonoloba* (L.) Taub. as an anthelmintic agent ^[21].

13). Wound healing activity: The hydrogels prepared from ethanol extracts of leaves and fruits of *Cyamopsis tetragonoloba* (L.) Taub. investigated for their healing effect on excision and incision wound surface on Swiss albino mice. In excision model healing was 99% in gel containing 5% w/w fruit ethanol extract and 90% in gel containing 5% w/w leaf ethanol extract ($p < 0.001$) on 12th day compared to 80% and 60% of healing with standard metro gel (1% w/w) and control, respectively. In incision wound model there was significantly increase in tensile strength ($p < 0.001$). The result revealed that gel formulation has got potential wound healing activity ^[22].

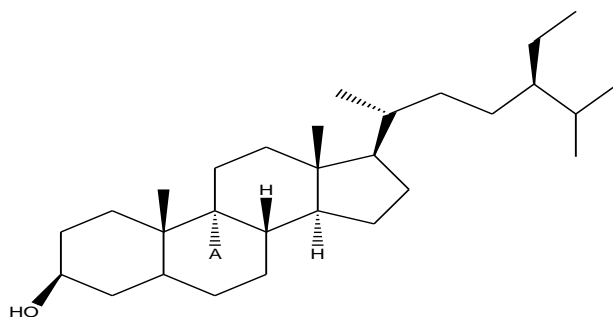
12). Other studies: Antioxidant and anti-cataract activities in guar gum were also studied ^[23, 24].

Applications in pharmaceutical formulation

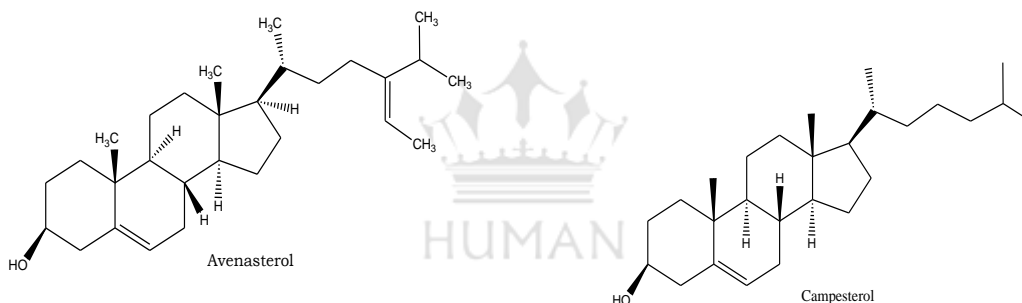
Guar gum commonly used in cosmetics. It has also been used as an appetite suppressant, although its use for this purpose, in tablet form, is now banned in UK^[25].

Structure of some phytoconstituents of *cyamopsis tetragonoloba* (L.) Taub.

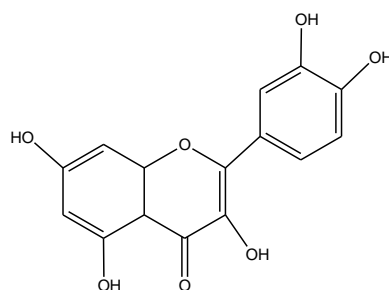
Sterols



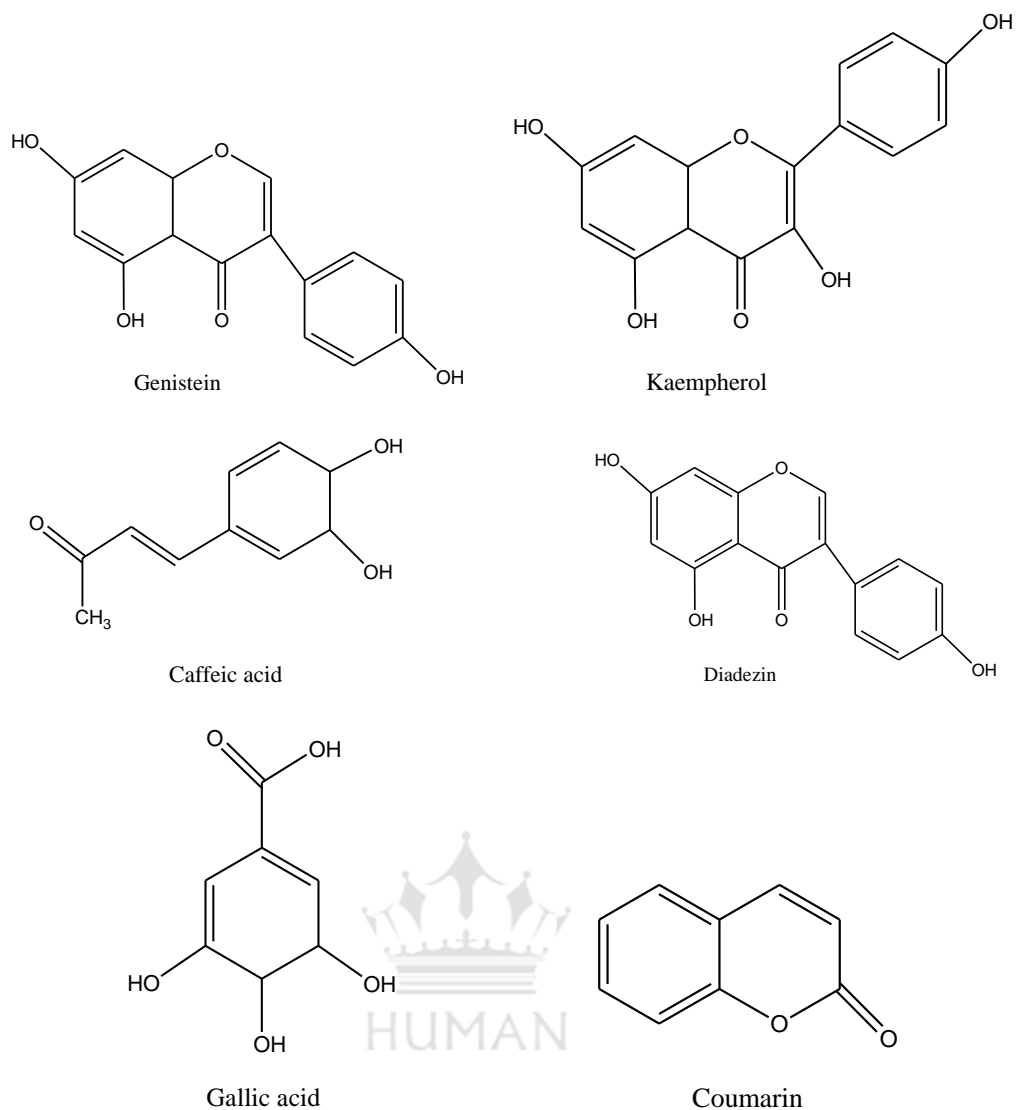
β -Sitosterol



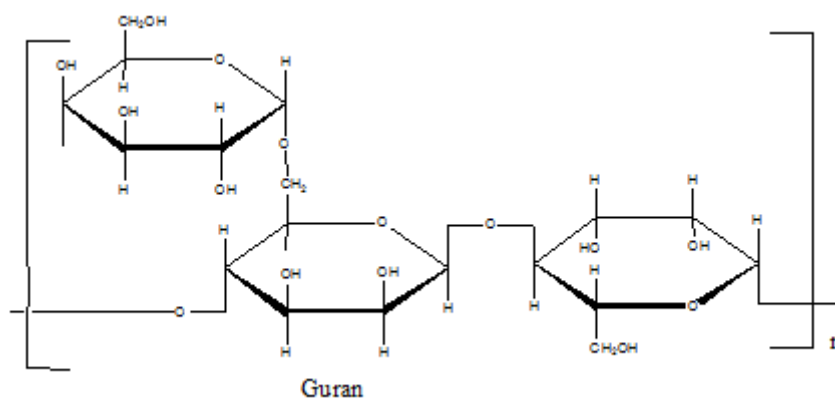
Tannins and Phenols



Quercetin



Galactomannan



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