INTERNATIONAL JOURNAL OF UNANI AND INTEGRATIVE MEDICINE

E-ISSN: 2616-4558
P-ISSN: 2616-454X
IJUIM 2021; 5(2): 147-151
Impact Factor (RJIF): 6.3
Peer Reviewed Journal
Received: 01-04-2021
Accepted: 03-05-2021

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An appraisal of medicinal properties of Katira (*Cochlospermum religiosum* (Linn.) Alston.): A review

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Abstract
The use of medicinal plants for the prevention and treatment of various ailments has been in practice from the time immemorial. *Cochlospermum religiosum* (Linn.) Alston belonging to family *Cochlospermaceae* has been mentioned by the name of katira in ancient Unani literature. Different parts of the plant *viz*., Gum, Bark, Leaves, Flowers and Seeds are used as medicine among various ethnic and rural societies. Indian gum katira is the dried gummy exudate which is popularly known as *Gond e katira* in traditional Unani medicine. The parts of the plant are considered as demulcent, emollient, haemostatic, bulk laxative with good nutritional value in Unani medicine. This communication is an attempt to compile and document information on different aspects of *C. religiosum* mentioned in classical Unani as well as modern literature. The plant has been suggested to be taken up for further scientific investigations so as to validate the medicinal claims presented herein and to utilize its maximum therapeutic potential.

Keywords: Katira, *Cochlospermum religiosum* (Linn.), unani medicine

Introduction
Indian gum katira is the dried gummy exudate of the tree *Cochlospermum religiosum* (Linn.) of the family *Cochlospermaceae*. It occurs in India, Pakistan and to some extent in Africa. It is widely distributed throughout India in the states of Gujarat, Konkan, Deccan, dry forests of Madras Presidency, Rajputana and central India. Katira is a derivative from *Chochlospermum religiosum*, but Karaya gum which is also used as Katira in Indian medicine is a derivative of *Sterculia urens*. The height of plant *Sterculia urens* is about 15 meter, while of *Chochlospermum religiosum* is only 4-5 meters. Unani scholar Kabiruddin states that originally gum Katira is obtained from the plant known as *Qataad* which is *Astragalus gummifer* grown in the highlands of Asia minor while in India gum Katira is obtained from both i.e. *C. religiosum* and *S. urens*. Therefore, it can be inferred that presently used Katira is not the authantic drug but a substitute because original Katira is not available in India. Currently used gum may be a latest introduction in Unani materia-medica, because the real Tragacanth is not available in Asian market [1, 2].

Botanical description
It is a small deciduous tree, young parts more or less pubescent, trunk erect, straight, bark white, smooth, papery, the outer surface thin, peeling off, the inner coat fibrous and netted. Leaves 20-25 cm diameter, crowded at the end of the branches, shallowly palmately 5 lobed, flowers greenish yellow, small in terminal panicles, follicles 4 to 6 ovoid-oblong 2.5 cm diameter, coriaceous, red, covered with tinging hairs, seeds 3 to 6 oblong, black. The gum exudates naturally from the bark throughout the year, but most of the time it is generally produced by tapping or blazing by stripping off the bark. Tapping is done from April to June, before the rains and then from October to January, after the rains. The gum is better in quality if collected before the rain and yield also increased as weather becomes warmer. Gum occurs in irregular, transluscent often vermiform pieces which vary in colour from almost white to pinkish-brown, with water it swells and gives viscous mucilage. It has a distinct odour of acetic acid. It is largely used as a substitute for tragacanth. Various other parts *viz*. fruits, roots, bark and leaves of the plant are used for medicinal and commercial purposes [3, 4, 5].

Scientific Classification

Kingdom: Plantae
Phylum : Tracheophyta
Class : Magnoliopsida
Order : Violales
Family : Cochlospermaceae
Genus : Cochlospermum
Species : *C. religiosum* (Linn.) Alston

Synonym: *Cochlospermum gossypium* DC.
Vernaculars [4, 5]
Arabic: Shajartul-quds, Katira
Assam: Hatchanda
Bombay : Gular, Gulu, Gwira, Kadai, Kandai, Kando, Kandol, Kulu, Pandruka
Gujrati: Kada, Kagdol, Karai
Hindi: Bali, Gular, Gulu, Karrai, Kulu, Tabsi, Tanuku
English: Gum Karaya, Indian tragacanth, Sterculia gum
Malayalam: Tonti
Marathi: Gwira, Kandol, Kandula
Tamil: Kavalam, Puttali, Sendalai, Tanakku, Vellaipputtali, Sendanakku
Telugu: Ettaponaku, Kavili, Ponaku, Tanuku, Tapasi
Uriya: Kavili
Urdu: Katira, Qataad, Nawaras

Phytochemical constituents
A glycoside compound named as 5,7,3',4'- tetrahydroxy-3-methoxy-flavone-7-O-β-D-glucopyranosyl-(1- 4)-O-β-D-galactopyranoside was isolated from the seeds. [6] A bioactive flavonoid designated as Isorhamnetin-3-glucoside was isolated from the leaves. [7] Phytochemicals *viz*. phenols, tannins, flavonoids and alkaloids have been detected in the leaves and stem bark. [8] Gum consists of an acetylated, branched heteropolysaccharide with a high composition of D-galacturonic acid and D-glucuronic acid moieties. Hydrolysis of the gum affords D-galactose (13-26%), L-rhamnose (15-30%), D-galacturonic acid, aldobiuronic acid, 6-β-D-glucopyranosyl uronic acid, 3-β-D-galactopyranosyl-D-galactose, acetic acid and an acid trisaccharide. Uronic acid residues are present in (37-40%) amount in the gum. Starch is absent and it does not contain methoxyl groups. Due to presence of acetyl group (8%) gum is insoluble and only swells in water [3, 9, 10].

Mizaj (Temperament)
Cold $^{1^{\circ}}$ Dry $^{1^{\circ}}$ [2, 11,12, 13]
Moderately cold and hot [5]
Moderate and Moist [14]

***Afa'al* (Pharmacological actions in Unani Medicine)**
As per Unani medicine Gond-e-Katira manifest following actions:
- *Mulattif* (Demulcent) [2, 5, 12, 14, 15, 16]
- *Man-e-Surfa* (Anti-tussive) [2, 12, 13, 14, 15]
- *Habis-ud-dam* (Haemostatic) [5, 12,13, 14, 15]
- *Mulayyin-o-Mumallis* (Bulk Laxative and Emollient) [3, 12, 14 ,15, 16]
- *Mubarrid* (Cooling agent) [12, 13]
- *Musakkin-e-Hrarat* (Antipyretic) [12, 13]
- *Musakkin Hiddat-e-Akhlaat* [12, 13, 15]
- *Mugharri* (Mucilagenous) [2, 5, 14, 15, 16]
- *Musakkin* (Sedative/Relaxant) [2]
- *Dafe Is'haal* (Anti-diarrhoeal) [12, 13]
- *Muqawwi ama* (Intestinal tonic) [12]
- *Musleh Advia* (Drug Corrective) [12, 13]
- *Musammin-e-Badan* (Nutritive/Anabolic) [5, 12, 13]
- *Mus'hil-e-Balgham wa Sauda* (Purgation of black bile & phlegm) [12]
- *Badirqa* (Medium/Vehicle) [12, 16]

***Mawaq-e-Istemaal* (Therapeutic uses in Unani Medicine)**
As per the classical Unani literature *Gond-e-Katira* is indicated in the following disorders:
- *Sual-e-Muzmin Yabis* (Chronic dry cough) [2, 11, 12, 13, 14, 15]
- *Nafs-ud-dam* (Haemoptysis) [2, 5, 12, 13, 14, 15]
- *Jiryan-ud-dam* (Haemorrhage) [5, 12, 13, 15]
- Khushunat-e-halaq (Sore throat) [2, 4, 5, 11, 12, 13, 15]
- *Bahat-us-Saut* (Hoarseness of voice) [2, 4, 11, 13]
- *Qarha-e-Riya* (Lung abscess) [2, 12, 15]
- *Zat-ur-riya* (Pneumonia) [4, 13]
- *Qarha-e-Ama* (Intestinal ulcer) [2]
- *Sozish-e-Ahsha* (Bowel inflammation) [5]
- *Quruh-e-Mujra-e-Bol* (Urinary tract ulcers) [2, 12]
- *Waja-ul-Kuliya* (Renal colic) [11, 12]
- *Hirqat-e-Bol* (Burning micturition) [11, 12, 13]
- *Bars* (Vitiligo) [12]
- *Behaq* (Pityriasis) [12]
- *Hirq* (Burns) [16]
- *Tazeeniyaat* (Cosmetics) [12]
- *Ashob-e-Chashm* (Conjunctivitis) [5, 12]
- Corneal Ulcer [5]
- Used for weight gain [5]

***Miqdar-e-Khurak* (Therapeutic dose)**
1. 2.25gm to 3gm & can be increased up to 7-17 gm [5, 12]
2. 0.5 – 5gm [2, 13, 15]

***Muzirat* (Adverse Effects)**
Prolonged and excessive use of *Gond-e-katira* may have adverse effects on lower alimentary tract or anal canal and may cause Sudda i.e. obstruction [12],[14],[15]

***Musleh* (Corrective)**
Following drugs have been recommended by Unani scholars which may be used along with *Gond katira* so as to avoid its adverse effects:

Musleh	Condition
i) *Anisoon and Maghz tukhm-e-kaddoo* ii) *Tukhm-e-karfas*	i) Lower alimentary tract /anal canal disorders [12, 14, 15] ii) Obstruction (*Sudda*) [12]

***Badal* (Substitute)**
Certain drugs *viz*. *Gond-e-Babul* (Gum Acacia) or , *Maghz Tukhm-e-Kaddu* or , *Roghan-e-Badam* have been mentioned in classical Unani literature as its substitutes. [5],[12],[15]

***Murakkabat* (Compound Unani formulations)**
Gond-e-katira is an ingredient of various compound Unani formulations *viz*. *Dayaqooza, Lauq-e-Sapistan, Sharbat-e-Aijaz, Lauq-e-Moutadil, Lauq-e-Nazli, Shayaf-e-Abyaz, Shayaf-e-Akhzar, Safoof Gond Kateera*. [2],[5],[13],[17]

Evidence based pharmacological activities

Antibacterial activity

Methanolic extract of leaves of *C. religiosum* was effective against Staphylococcus aureus while other bacteria were not affected [18]. Ethanolic extract obtained from the leaves of *C. religiosum* displayed concentration dependent inhibition of *Staphylococcus aureus* and *Escherichia coli*. *S. aureus* was more susceptible than *E. coli* [19]. The acetone and ethanolic extract obtained from the stem of *C. religiosum* were effective against gram positive and gram-negative bacteria. Chloroform extract was not effective. [20] Bai *et al*. showed antibacterial activity of methanol extract of *C. religiosum* leaves against human and plant pathogenic gram positive and gram-negative bacteria [21]. The study carried out by Ponnamma *et al*. revealed concentration dependent antibacterial activity of solvent extracts of *C. religiosum* leaves. Among extracts, marked antibacterial activity was shown by ethyl acetate extract. Marked inhibitory activity was observed against *E. coli*. At concentration 25 and 50µg, chloroform extract did not cause inhibition of any of the test bacteria. [22] Kawde *et al*. evaluated antibacterial potential of various solvent extracts of stem bark of *C. religiosum*. Solvent extracts displayed concentration dependent inhibition of test bacteria with marked activity against gram positive bacteria. [23] Recent study showed the efficacy of methanolic extract of flower of *C. religiosum* to inhibit gram positive and gram negative bacteria [24].

Antifungal activity

Methanolic and aqueous extracts of leaves of *C. religiosum* were screened for three phytopathogenic fungi of *Gossypium herbaceum* against *Alternaria alterna*ta, *Chaetomium globosum* and *Fusarium oxysporum*. The extracts caused concentration dependent inhibitory activity against fungi. Overall, methanol extracts were more inhibitory than aqueous extracts [25]. Antifungal efficacy of methanolic extract of flower to inhibit mycelial growth of two molds namely *Curvularia* sp. and *Rhizopus* sp. was reported. [24]

Antioxidant activity

A bioactive flavonoid compound Isorhamnetin-3-glucoside isolated from the leaves of *C. religiosum* was shown to exhibit concentration dependent scavenging of superoxide radicals. [25] Katira gum was shown to exhibit weaker inhibitory activity against DPPH radicals with a scavenging activity of 11.6% at 1% w/v concentration. [26] Kawde *et al*. revealed scavenging of DPPH radicals by methanolic extract of stem bark with an IC_{50} value of 50µg/ml. [23] Ponnamma *et al*. screened antiradical activity of various solvent extracts of *C. religiosum* leaves by DPPH assay. The extracts were shown to inhibit DPPH radicals in a dose dependent manner. [22] In a recent study, Swathi *et al*. reported the antioxidant activity of flower extract of *C. religiosum* as evaluated by DPPH and ABTS radical scavenging assays and ferric reducing assay. The extract was effective in scavenging DPPH radicals, dose dependently with EC50 values 2.72 and 1.50µg/ml, respectively. [24]

Insecticidal activity

Flower extract of *C. religiosum* was shown to possess insecticidal activity (in terms of larvicidal activity) in a recent study by Swathi *et al*. methanolic extract of flower was effective in causing 100% mortality of I, II and III instar larvae of *Aedes* sp. and *Anopheles* sp. at 1mg/ml concentration [24].

Bioactivities of gum katira

The gum katira is obtained from *C. religiosum* and is one of the economically valuable non-timber forest products obtained from the stem bark of the plant. It is shown to exhibit following biological activities.

Wound healing activity

Girotra and Singh evaluated wound healing activity of katira gum (an exudate) in terms of period of epithelialization and percent wound contraction in Wistar rats. Gels formulated with katira gum alone and combination of katira gum and silver sulphadiazine were tested for wound healing potential. The animals treated with the combination of gum and silver sulphadiazine showed marked wound contraction and the period for epithelialization taken was also significantly lesser [27].

Effect on α-glucosidase activity

The study carried out by Hongsing *et al*. revealed no inhibitory effect of katira gum against the activity of the enzyme α-glucosidase [26].

Effect on tyrosinase activity

Katira gum was screened for its effects on tyrosinase enzyme. The gum, at 1% w/v concentration, had a slight inhibitory activity against tyrosinase. At lower concentrations, the gum was shown to exhibit activation of tyrosinase enzyme [26].

Effect on lipase activity

At concentration 0.25%, the Katira gum was shown to exert lipase inhibitory activity with an inhibition of 16.2%. [26]

Effect on glucose diffusion

Hongsing *et al*. studied the effect of Katira gum on the glucose diffusion by using dialysis tubing method, which is an *in-vitro* method mimicking the conditions in the lumen of jejunum. At 2% polysaccharide gel concentration, Katira gum revealed 60.8±0.2% of glucose releasing indicating the ability of the gum to retard glucose absorption across the intestinal lumen [26].

Effect on cholesterol solubility

Hongsing *et al*. determined the effect of Katira gum on cholesterol inhibition through its solubility. Katira gum showed a slightly inhibitory effect (16±0.04%) [26].

Immunological evaluation of gum Katira

Puskuri *et al*. carried out immunological evaluation of three grades of gum Katira (KG-I, KG-II and KG-III) in terms of its ability to elicit delayed type of hypersensitivity. Interestingly, the KG-III grade elicited immunological response in the animals and was related to the presence of impurities. However, grades *viz*. KG-I and KG-2 were not able to cause delayed type of hypersensitivity [28].

Bioremediation of toxic metals by *C. religiosum* gum

Sashidhar *et al*. evaluated the efficacy of gum katira to remove uranium (VI) from aqueous, simulated nuclear effluents and studied the adsorption characteristic of the gum towards uranium (VI). The result obtained was

promising and maximum adsorption was found at 0.1% concentration of gum and pH 4.0 with the contact time of 60 minutes. [29] Vinod and Sashidhar determined the bioremediation potential of gum katira in terms of its adsorptive removal of toxic metal ions. The gum was able to competitively biosorb toxic metal ions namely cadmium, copper, iron, lead, mercury, nickel and zinc. [30] The study of Vinod *et al*. also revealed the efficacy of gum katira in the bioremediation of nickel and chromium. [31] Vinod *et al*. reported competitive adsorption of heavy metals by gum katira. It was inferred that the amorphous nature of the gum facilitate metal biosorption [32].

Conclusion

Cochlospermum religiosum has been in use since ancient times in Unani system of medicine. Various parts of the plants have edible, aesthetic as well as medicinal applications. In the present review, we referred primary and secondary data to compile the information based on taxonomy, distribution, morphological description, phyto-chemical constituents, and pharmacological claims. The plant is reported to display antibacterial, antioxidant, antifungal, insecticidal, wound healing and other pharmacological properties. Though traditionally the plant used widely for the treatment of various ailments, but scientifically only few of them were screened out. Thus more scientific studies must be conducted to investigate the unexploited potential of *C. religiosum.* Moreover the plant is being listed as threatened species due to overexploitation for the gum and medicinal uses. It is very much necessary that the plant has to be conserved and grown in larger scale due to its therapeutic benefits.

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