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Cochlospermum religiosum (Linn): A Phytopharmacological Review.

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ABSTRACT

The objective of this review is to form a short compilation of phytochemical screening, pharmaceutical and pharmacological profile of the plant *Cochlospermum religiosum*. Although the plant is of importance and is widely used in traditional system of medicine, a review article based on the phytochemical and pharmacological screening of *Cochlospermum religiosum* is not upto date not reported. The various histochemical studies revealed that this plant contains numerous primary and secondary metabolites as its constituents such as flavanoids, steroids, tannins, glycosides, alkaloids, phenols, starch grains and crystals. The gum Katira obtained from the stem bark of *Cochlospermum religiosum* has wide variety of applications in pharmaceutical industry as adjuvant in colon targeted drug delivery formulations like Azathioprine, as a matrix coating polymers, suspending agent and sustain release adjuvant for nimusulide and Etodalac formulations respectively. The silver nanoparticles biosynthesized from this plant are found to possess antimicrobial activity against various pathogenic microbes. Moreover, many research studies have been conducted to prove the plant's potential as antimicrobial agents. The bioactive secondary metabolite Myricetin which has wide array of biochemical properties, such as antineoplastic, anti-carcinogenic, antioxidant activity and anti-inflammatory effects has been identified and isolated from leaf and callus by using different techniques such as IR spectra and HPTLC. This review focuses on the phytochemistry, pharmaceutical and pharmacological actions of *Cochlospermum religiosum*.

Keywords: *Cochlospermum religiosum,* Myrcetin, Yello silk tree, Gum Katira.

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INTRODUCTION

Cochlospermum religiosum(L) Alston is a scarcely branched small tree, belonging to the family *Cochlospermaceae*. It is commonly called as Yellow Silk Cotton because of flowers are large, bright golden yellow and seeds covered with silky hairs.It is also called as Buttercup Tree and Torchwood. *Cochlospermum religiosum* is a flowering plant is found in tropical regions of Southeast Asia and the Indian Subcontinent. In India it is commonly found in Andhra Pradesh, Maharashtra, Madhya Pradesh, Uttar Pradesh and Bihar (RCDC). It is a small tree growing to a height of 7.5 m and usually found in dry deciduous forests. It derived its name as *religiosum* from the fact that the flowers are used as temple offerings. It is also known as Silk-Cotton Tree because the capsules containing the seeds have a fluffy cotton-like substance similar to kapok. It is very common and conspicuous tree, characteristic of the hottest, driest and stoniest slopes. It frequently founds in Telangana forests. Plant can be identified by deeply furrowed bark, palmately 5-lobed leaves and bright golden yellow bisexual flowers[1].

The stem bark and root powder of*C. Religiosum* are traditionally used for fertility and ash of fruit mixed with coconut is used for the treatment of scabies [2]. The unani medicinesQurs-e-SartaanKafoorwhich is used as Styptic, Antipyretic, Phthisis, Tuberculosis, Hectic fever and Qurs-e-Suzak used as Cicatrizant, Diuretic, Gonorrheacontains gum of *C. religiosum* as one of the ingredient. These formulations of *C. religiosum* were found to possess good Antibacterial and Antifungal activity [3]. Several studies have been carried out on preliminary phytochemical screening and identification of various secondary metabolites of *C. religiosum* revealing its potential antimicrobial activity [4, 5, 6]. *Cochlospermum* is a quick growing tree yielding a gum known as gum katira from the bark. In comparison with Tragacanth due to its low price and stable property has led to new uses and e application in pharmaceutical industry. A lot of other uses of Katira have been reported likein calico-printing, polishing paper and leather dressing. It is also used for polishing tusser silk. It is exported to many countries of Latin America to use in cigar and Ice cream industries[1].

Synonyms [7]:*Bombax gossypium, Cochlospermum gossypium, Maximilianea gossypiu*m

Scientific Classification [7]:

Kingdom: Plantae
Order: Malvales
Family: Bixaceae
Genus:Cochlospermum
Species: *C. religiosum*
Binomial Name:*Cochlospermum religiosum*

Vernacular Names [7]:

Other Common Name: Yellow silk cotton tree, Golden silk cotton tree ™
Hindi: Galgal ™
Tamil: Kattupparutti ™
Malayalam: Cempanni ™
Kannada: Arasinaburuga ™

Telugu: Konda gogu ™
Bengali: Sonalisimul ™
Marathi: Ganeri

Histochemical Studies [8]:

The localization of chemical compounds within the cells by means of specific colors of the compounds can be studied with the help of Histochemistry or cytochemistry.The use of histochemistry in solving critical biosystematic problems is as popular as the use of other markers. In this method the cells are stained with different stains or dyes, which render the compounds visible under the microscope, by making the specific color reaction compounds. According to botanical literatures, the use of histochemical characters in taxonomic conclusions is now a common practice.

Histochemical color reactions were carried out through transverse sections of leaf, stem and bark of *Cochlospermum religiosum*. The resultswere showed in Table-1.

The leaf showed the presence of various secondary metabolites after treatment of different reagents. The presence of tannins was indicated by the development of bluish black colour, when treated with ferric chloride (FeCl3). The tannins were found mainly in the parenchyma tissue of the midrib region. The starch grains were located in the mesophyll and parenchymatous region of midrib. The polyphenols were found surrounding the vascular bundle sheath. The crystals were present in the midrib region and vascular bundles.

The histochemical studies of stem showed the presence of tannins.The tannins were present in endodermis and cortex region. The starch grains were found in epidermis, cortex and vascular bundles. The polyphenols were found mainly in the endodermis and cortex region. The crystals were presentmainly in the cortex.

The histochemical analysis of bark showed the presence of tannins and these were found in cortex and vascular bundle region. The polyphenols were found mainly in the cortex region. The crystals were present mainly in the cortex. The starch grains were present mainly in the cortex and vascular bundle region.

The pharmacognostical studies and histochemical studies and behavior analysis of fluorescence studies of *Cochlospermum religiosum* are useful to supplement the information with regard to its botanical identification and drug standardization. Moreover, it also helps in distinction from other allied species and adulteration.

Table 1: Histochemical analysis of leaf, stem and bark of *Cochlospermumreligiosum*

Sl.No.	Reagent	Colour			
		Leaf	Stem	Bark	Constituents
1.	Toluidine blue	Bluish green	Bluish green	Bluish green	Polyphenols are present
2.	$FeCl_3$	Bluish black	Bluish black	Bluish black	Tannins are present
3.	Iodine	Blue	Blue	Blue	Starch grains are present
4.	HCl	Dark Blue	Dark Blue	Dark Blue	Crystals are present

Secondary Metabolites

Cochlospermum religiosum is reported to contain many primary and secondary metabolites like proteins, lipids, starch, sugar, phenols, alkaloids, flavanoids, tannins and steroids. Highest amount of phenols of secondary metabolites were found to be rich in leaves and bark of *Cochlospermum religiosum*[9].

Pharmaceutical Applications

Katira gum is an insoluble gum derived from the bark of *Cochlospermum religiosum*. The gum is sweet, semi-transparent, insoluble in water, but swells into a pasty transparent mass with water[10].Gum Katira is a novel heteropolysaccharide consists of D-galactose, D-galactouronic acid and L-rhamnose in a molecular ratio 2:1:3 respectively together with traces of a ketohexose. [11]. Katira gum has been used as a gelling agent in microbial tissue culture media [12] (comparative study) and its drug release retardant in the matrix tablets has been established. Katira gum has been reported to possess extensive degree of swelling[13].

Studies have been carried out to investigate the suitability of katira gum as a suspending agent in nimesulide suspension in comparison with acacia. The suspensions were evaluated in terms of sedimentation volume, viscosity, particle size analysis and in vitro drug release studies. The effect of storage on the stability of the suspension was also investigated. When compared with conventional suspending agent, it was found that lower concentrations of katira gum were showing adequate suspending agent properties for formulating suspensions. The parametric tests of suspensions proved that katira gum to be a better suspending agent compared with acacia gum and was concluded that katira gum can be employed as stabilizer and thickener of choice when high viscosity is desired especially in cosmetic, pharmaceutical and food industries [14].

Gum Katira was selected as the matrix forming material because of its well-established biocompatibility, non toxic and safe material for the use in food and pharmaceutical industries. [15].

Furthermore, a study was carried out to evaluate Gum Katira obtained from the plant *Cochlospermum religiosum* as a matrix forming pharmaceutical excipient for a novel drug delivery system. Gum Katira was used for the drug release retarding material in microsphere formulation using Etodolac as a model drug. Etodolac was found to be compatible with the matrix material Gum Katira by conducting the various physiochemical and instrumental analysis. Etodolac loaded Gum Katira microsphere (ELGKM) was compared with Etodolac loaded sodium alginate microsphere (ELSAM) and blank microsphere (without gum matrix), which subsequently revealed that the drug release rate of ELGKM was better for sustained and controlled release. In this study, it was found that the drug release mechanism best fitted in Korsmeyers Peppas model on comparing the correlation coefficient values of different mathematical models. The result of this study indicates that ELGKM (1% w/v Gum Katira) would be desired formulations in delivering the drug with controlled and sustained release pattern. [16].

In this above investigation an acute toxicity study was also conducted on mice with the gum katira which revealed no behavioral changes and also no mortality was observed even at a dose level of 2.0 g/kg body weight, after 24 hours of per-oral administration. Subacute toxicity study was conducted on rat whose haematological analysis showed no significant variance in the level of hemoglobin, RBC, WBC, neutrophil, eusinophil, monocyte, lymphocyte, SGOT, SGPT and platelets in treated animals as compared to that of the control group animals. Also, the histopathological studies of treated animals revealed no significant tissue damage of the kidney and liver and were comparable to that of the control group. So, no abnormalities in histopathological studies were found. Based on this toxicity study it was concluded that the gum katira is safe to be used in the formulation.

Priti Girotra et al investigation was undertaken to design Katira gum oral colon targeted matrix tablets containing azathioprine, in order to maximize its therapeutic efficacy. Central composite design (software design expert v. 8.0.7.1) was employed to optimize the formulation for maximum drug release in colon. The optimized batch tablets obtained were further coated by Eudragit S100 to minimize the drug release in upper part of GIT. The uncoated matrix tablets released around 20-50% of the drug in the physiological environment of stomach and small intestine but released all its contents in the colon. The coated optimized formulation exhibited a release of only 5-35% in stomach and small intestine and almost all drug in simulated colonic dissolution media. The drug release kinetics followed Korsmeyer-Peppas model, indicating the drug release mechanism through combined diffusion and erosion mechanism. The results suggested that Katira gum can be a good carrier for colon targeting owing to its moderate viscosity, biocompatibility and biodegradability which could be successfully degraded by the microbial flora in the colon[17].

The biogenesis of silver nanoparticles using medicinal plants was found to be highly toxic against different pathogenic bacteria of selected species. The tested concentrations of plant extract are 10 µg ml^{-1}.

The silver nanoparticles synthesized from the leaf extract of *Cochlospermum religiosum* showed effective inhibitory activity against *Bacillus, E.coli, Pseudomonas, Klebsiella*, and *Staphylococcus*. They are highly toxic to *E.coli*and *Staphylococcus*, moderately toxic to *Bacillus*, *Pseudomonas*, and *Klebsiella* [4].

The antimicrobial activity of silver nanoparticles was carried out against various pathogenic microbes such as gram negative and gram positive bacteria of *Staphylococcus, E. coli, Proteus vulgaris, Pseudomonas aeruginosa, and Bacillus subtilis,* fungal species of *Aspergillus niger, Aspergillus flavus, Fusarium, Curvularia, and Rhizopus* using disk diffusion method. The extraction without silver nanoparticles served as control. Bark aqueous extract of *C. religiosum* showed broad spectrum of antimicrobial activity. The diameter of inhibition zone around each disk. The bark extract of *C. religiosum* showed highest antibacterial activity against *Staphylococcus, followed by Pseudomonas, E. coli, Bacillus,* and lowest activity toward *Proteus* and maximum inhibition zone was observed against fungal species of *Aspergillus flavus* followed by *Rhizopus, Fusarium Curvularia,* and minimum inhibition zone was observed against *Aspergillus niger*[18].

Pharmacological Review

Anti-carcinogenic Activity[19]:

The bioactive secondary metabolite myricetin was identified and isolated from *in vivo* and *in vitro* tissue of *Cochlospermum religiosum* a critically endangered medicinal plant. Myricetin is a naturally occurring flavonol found in many plants like grapes, berries fruits, vegetable, herbs as well as other plants. Myricetin has wide array of biochemical properties, such as antineoplastic, anti-carcinogenic antioxidant activity, anti-inflammatory effects. Myricetin was isolated and identified from leaf and callus by using different techniques such as IR spectra and HPTLC.

The purity of myricetin bands in the sample extracts was confirmed by comparing the absorption spectra at start, middle and end position of the band. Under the chromatographic condition described above, the Rf'svalue of myricetin as determined to be approximately 0.63 for *Cochlospermum religiosum*. Variation in myricetin content in in vitro and in vitro samples in *Cochospermum religiosum* was observed, leaf had maximum amount of total myricetin (0.1224 %) while minimum amount of myricetin was present in callus (0.0731%). IR spectral peaks were found to be superimposible with those of their respective standard references compound of myricetin confirming presesnce of myricetin in all samples.

Antimicrobial activity

A study was carried out to screen the methanolic extract of the leaves and flowers of *C. religiosum for their* antimicrobial activity. The screening showed significant activity against *X. oryzae*pv. *oryzae*and *X. axonopodis*pv. *malvacearum.* The organisms *S. aureus*, *S. typhi*and *E. aerogenes*were slightly inhibited. While the concentrations of the methanolic extract tested werenot enough to inhibit *P. aeruginosa*, *Micrococcus* and *B.cereus.* The methanolic extracts have shown activity against a panel of bacteria such as *S. aureus*, *S. typhi*, *E.aerogenes*, *X. oryzae*pv. *oryzae and X. axonopodis*pv. *malvacearum.* This indicates that the extract of *C. religiosum*has broad spectrum activity and can be used for the treatment of microbial infections. From the results it is revealed that methanolic extract of leaf and flowers have shown similar activity. Goud *et al*., [20]have reported that on *in vitro* screening of ethanol, acetone and chloroform extracts of *C. religiosum*, acetone extract showed antimicrobial activity. Considering these reportsand results, it is clear that the plant possesses antimicrobial property [21].

Apart from the reported activities the gum of *C. religiosum* is used *as* a laxative and considered to be superior to other gums. As an emulsifying agent it is a good substitute for tragacanth. This gum is used in medicine for the treatment of cough, diarrhea and dysentery. The dried leaves and flowers are used as stimulants, antipyretic, laxative and sedative [22]. Root powder mixed with water applied to face reduce wrinkle [23]. The oral gum powder about 20g mixed with ghee works as an aphrodisiac [24]. Katira used in cosmetics and for bookbinding the floss is used for stuffing pillows, mattresses, cushions, life jackets. Seed cakes are used as manure and cattle feed. Bark Powder of tree is used with water during jaundice [25]. *Cochlospermum* is propagated by seed broadcast, seeds are broadcasted in primary beds in June and seedling are pricked out to polythene bags when six months old.

Hepatoprotective Activity

The invitro hepatoprotective activity of various extracts of the plant *Cochlospermum religiosum* on the BRL3A (rat, liver cell line) cell line has been was carried out against paracetamol intoxication and the percentage viability of the cell line was determined. The MTT assay [(3-(4, 5-dimethyl thiazole-2-yl)-2,5-diphenyltetrazolium bromide) assay] was used to evaluate the cytotoxicity of *Cochlospermum religiosum* on rat liver cell line. Out of the various extracts evaluated, ethanolic extract of *Cochlospermum religiosum* gave promising results [26].

FUTURE PERSPECTIVES AND CONCLUSIONS

C. religiosum is a common plant available at various places in India. The plant is widely used in food and pharmaceutical industry and traditionally also. The pharmacological studies reported in the present review confirm the therapeutic value of this plant. Nevertheless there is a lack of phytoanalytical methods available for the estimation of chemical markers, thus the quantitative analysis of the different constituents of *C. religiosum* from its different parts is still under investigation. With the availability of primary information, further studies can be carried out like phytopharmacology of different extracts, standardization of the extracts, identification and isolation of active principles, and pharmacological studies of isolated compounds. Being an endangered plant in my opinion it is advisable to conserve and restore on a large scale plantation and explore its other potential activities in various scientific areas.

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