

PHYTOCHEMICAL AND PHARMACOLOGICAL REVIEW ON *CASSIA FISTULA* LINN. – “THE GOLDEN SHOWER”

PL. Rajagopal^{1*}, K.Premaletha², S.S. Kiron³, K.R.Sreejith⁴

¹Department of Pharmacognosy, Academy of Pharmaceutical Sciences,
Pariyaram Medical College, Kannur, Kerala, India.

²Department of Pharmaceutics, Academy of Pharmaceutical Sciences,
Pariyaram Medical College, Kannur, Kerala, India.

³Department of Pharmacy Practice, Academy of Pharmaceutical Sciences,
Pariyaram Medical College, Kannur, Kerala, India.

⁴Department of Pharmaceutical Chemistry, Academy of Pharmaceutical Sciences,
Pariyaram Medical College, Kannur, Kerala, India.

ABSTRACT

Cassia fistula (Aragvadhah) is an important drug used in the Indian system of medicine. It is a medium sized deciduous tree with long and cylindrical fruits containing pulp and also with a bright yellow coloured flower. The tree is found throughout India in all deciduous forests and hilly tracts. The present article gives an account of updated information on its phytochemical and pharmacological properties. The review reveals that wide numbers of phytochemical constituents have been isolated from the plant which possesses activities like antiperiodic, diuretic, purgative, laxative, antiasthmatic, hepatoprotective, anti-allergic and various other important medicinal properties. Phytochemical and Pharmacological reviews on plants will give valuable information which will assist the scientists in getting more advanced knowledge about a plant species.

Keywords: *Cassia fistula*, Phytochemistry, Pharmacology.

INTRODUCTION

Nature has provided abundant plant wealth, which possess medicinal virtues for all living creatures. The essential values of some plants have long been published but a large number of them remain unexplored as yet. So there is a necessity to explore their uses and also to conduct pharmacognostic and pharmacological studies to ascertain their therapeutic properties. The knowledge of medicinal plants must have been accumulated in the course of many centuries. There is no authentic record of medicines used by the primitive man. But the Rig-Veda, which is the oldest book in the library of man, mentioned the use of medicines, in the treatment of diseases and for revitalizing body systems in most ancient civilization like the Indian, Egyptian, Chinese and even the Greek and Roman civilization.

Cassia fistula is a deciduous, medium sized tree up to 24m in height and 1.8m in girth, cultivated almost throughout India. The tree is one of the most wide spread in the forest in India, usually occurring in deciduous forests throughout the greater part of India, ascending up to an altitude of 1,220 m in the sub Himalayan tract and outer Himalayas. It is common throughout Gangeetic valley, particularly abundant in Central India and South India (Chatterjee T.K.1996). The plant is also seen in the hilly tracts of Srilanka and Burma (Sivarajan V.V.1994).

Chemical review on *Cassia fistula*

In this review an attempt has been made to compile all most all chemical investigations which are made on the plant *Cassia fistula*. The inventions are mentioned along with the inventor and year of invention.

Presence of a yellow substance in fruit pulp, which changes to red on addition of alkali was found out. (Liptak and Szentgali. 1937).

Rhein, volatile oil, waxy and resinous derivatives were isolated from the fruit of the plant (Liptak and Szentgali.1937).

A major anthraquinone derivative called rhein is isolated from the fruit pulp of the plant (Modi and Khorana. 1952).

A compound called 1,8-dihydroxy-3-anthraquinone derivative in fruit pulp of the plant was isolated (Modi and Khorana.1952).

Fistucacidin, an optically inactive leucoanthocyanidin, which is a phenolic compound was isolated from the heart wood of the plant (Padmanabha Rao and Venkateswala. 1965).

A bianthoquinone glycoside, fistulin, together with kaempferol and rhein has been isolated from the ethanolic extracts of the flowers of the plant (Kumar et.al.1966).

Lupeol, β -sitosterol and hexacosanol are isolated from the stem bark of the plant (Sen and Shukia. 1968).

The structure of a new coloring matter, fistulic acid, an anthraquinone acid was elucidated from the pods of the plant (Agarwal et. al. 1972).

A major carbohydrate called galactomannan consisting of 8 different type of sugar moieties are reported from the seeds of the plant (Lal and Gupta.1976).

The presence of 31% of crude proteins like globulin and albumin was reported from the seeds of the plant (Niranjan and Katiyar.1979).

The plant has reported as a pest control agent (Jaipal et.al.1983).

The anthraquinones like Rhein, Chrysophanol and Physcion were isolated from the leaves of the plant (Mahesh et. al. 1984).

9-(-)-epiafzelechin, 3-O-B-D-Glucopyranoside, 7 bioflavonoids and two triflavonoids together with (-) – epiafzelechin, (-)-epicatechin and procyanidin B-2 from the leaves of the plant was isolated (Morimoto et. al.1988).

A certain amount of alkaloids have been reported in the flowers of the plant (Asseleh et. al.1990).

The edible fruit tissue of the plant was reported to be a rich source of potassium, calcium, iron and manganese than fruits like apple, apricot, peach, pear and orange (Barthakur et. al.1995).

Proanthocyanidins containing flavan-3-ol units with abnormal 2S configuration have also been observed in the pods of the plant with the common flavan-3-ols and proanthocyanidns like catechin, epicatechin, procyanidin B-2 and epiafzelechin (Kashiwada et. al.1996).

An isoprenoid compound which possess an antibacterial activity was isolated from the pods of the plant (Misra et al.1996).

A new diterpene, 3B-hydroxy-17-norpimar-8(9)-en-15-one from the pods of the plant was isolated (Misra et. al.1997).

The first report on the isolation and characterization of 3-formyl-1-hydroxy-8-methoxy anthraquinone was made in the pods of the plant (Rani and Kalidhar.1998).

The young and old leaves of the plant contain highest amount of phenolic, flavonoid and proanthocyanidin contents (Luximon-Rama et.al. 2002).

A new bioactive flavone glycoside 5,3',4'-tri-hydroxy-6-methoxy-7-O-alpha-L-rhamnopyranosyl-(1- \rightarrow 2)-O- β -D-galactopyranoside was isolated from the acetone soluble fraction of the defatted seeds of the plant shows an antimicrobial activity (Yadava R N et. al.2003).

Pharmacological Review on *Cassia fistula*

In pharmacological review the therapeutic utility of *Cassia fistula* is clearly mentioned, which will be more helpful in the further research activities on this plant. Here also the therapeutic utilities have been mentioned along with the inventor and year of invention.

The plant has a high therapeutic value and it exerts an antipyretic and analgesic effect (Patel et. al.1965).

The plant is very effective in treating the intestinal disorders like Ulcer (Biswas et. al.1973).

The extract of the plant is used as an antiperiodic agent and in the treatment of rheumatism (Biswas et.al.1973).

Seed diet produced marked hypoglycemic effect on normal albino rats but caused no hypoglycemic effect on alloxan diabetic albino rats (Singh K.N et. al.1975).

The ulcer healing power of *Cassia fistula* was reported (Kirtikar and Basu.1975).

Aqueous extract of the root bark exhibits anti-inflammatory activity (Nair et. al.1977).

The plant is reported to be a strong purgative due to the waxy aloin content (Satyavati et.al.1989).

The plant are used as a therapeutic agent in the treatment of hypercholesterolemia particularly their fiber and mucilage content (El-Saadany et. al.1991).

The leaf extract of the plant was reported as an antitussive agent along with its wound healing properties (Bhakta et.al.1998).

The plant has reported with its antibacterial action against *Escherichia coli*, *Bacillus mycoides*, *Bacillus subtilis*, *Mycobacterium smegmatis*,

Klebsiella aerogenes, *Pseudomonas aerogenes* and *Proteus vulgaris* (Perumal et. al.1998).

The methanol extract of the seeds of the plant was tested for different pharmacological actions in mice. The methanol extract significantly potentiated the sedative actions of sodium pentobarbitone, diazepam and chlorpromazine and was also found to be significantly potentiating the analgesia induced by morphine and pethidine in a dose dependent manner (Mazumder U.K et. al. 1998).

Hepatoprotective activity of n-heptane extract of the leaves of the plant was investigated in rats by inducing hepatotoxicity with carbon tetrachloride: liquid paraffin (1:1). The extract at a dose of 400mg/kg showed significant hepatoprotective activity which was comparable to that of a standard hepatoprotective agent (Bhakta.T et.al. 1998).

The presence of glycerides with linoleic, oleic, stearic and palmitic acids as major fatty acids together with traces of caprylic and myristic acids in the seeds of *Cassia fistula* was reported (Abu Sayeed et. al. 1999).

Anti-inflammatory activity of aqueous extracts of the bark was studied in sub-acute models of inflammation in male albino rats. The extracts were administered at dose levels of 150, 300, 450 mg/kg body weight. The extracts were found to possess significant anti-inflammatory effects in air pouch granuloma and cotton pellet granuloma models (Rajeswari.R et. al.2001).

Effects of methanolic extract of the seed on the growth of Ehrlich ascites carcinoma and on the life span of tumor bearing mice were studied. Methanolic extract treatment showed an increase of life span, and a decrease in the tumor volume and viable tumor cell count in the Ehrlich ascites carcinoma tumor hosts (Gupta.M et.al.1998).

Hepatoprotective activity of the n-heptane leaf extract of the plant was investigated in rats by inducing hepatotoxicity with carbon tetrachloride: liquid paraffin (1:1). The extract has been shown to possess significant protective effect by lowering the serum levels of transaminases, bilirubin, and alkaline phosphate. The extract at a dose of 400mg/kg showed significant hepatoprotective activity which was comparable to the standard hepatoprotective agent (Bhakta T et.al.2001).

The antioxidant properties of 90% ethanol extracts of leaves, and 90% methanol extracts of stem bark, pulp and flowers from the plant were investigated. The antioxidant activity power was in the decreasing order of stem bark, leaves, flowers and pulp and was correlated with the total polyphenolic content of the extracts (Siddhuraju.P et.al.2002).

Oral administration of aqueous extract of the seeds to mated female rats from day 1-5 of pregnancy at the doses of 100mg and 200mg/kg body weight resulted in 57.14% and 71.43% prevention of pregnancy, respectively, where as 100% pregnancy inhibition was noted at 500mg/kg body weight. In the uterine bioassay test carried out in immature bilaterally ovariectomized female rats, aqueous extract of the seeds increased the uterine weight and luminal epithelial cell height but did not induce premature opening of the vagina. This suggests a mild estrogenic activity of the extract. However, when the extract was administered conjointly with estradiol valerate, it is significantly prevented the estrogen induced uterotrophic effect, thus showing an ant estrogenic nature of the extract in the presence of a strong estrogen (Yadav.R et.al.2002).

Antioxidant activities of the phenolic, proanthocyanidin and flavonoid component in the various extracts of the plant was studied which shows that the antioxidant activities were strongly correlated with total phenols (Luximon R.A et. al.2002).

Three lectins purified from the seeds were tested for their antibacterial activity against 14 pathogenic bacteria using 30 microgram disc. It was found to be effective against all of the bacteria strains and showed strong activity against *Bacillus magisterium*, *Streptococcus haemolyticus* and *Shigella boydii* (Ali M..A et. al.2003).

Toxicity potentials of fruits as laxative with reference to Sennawas studied. LD50 of the drug is 6600mg/kg without any pathological effects on the organs examined microscopically (Akanmu M.A et. al.2004).

Crude methanol extract of the leaves were investigated for their antifungal activities on three pathogenic fungi like *Microsporium gypseum*, *Trichophyton rubrum* and *Penicillium marneffeii*. The plant was found to possess significant anti-fungal activity against them (Souwalak Phongpaichit et. al. 2004).

The pharmacological and toxicological studies of the aqueous infusions of the pods of the plant were studied in rodents. The aim of the study was to estimate medium lethal dose after oral administration. Results showed that the extract of pods possess significant dose dependent laxative activity between 100 and 500 mg/kg, in rats (Akanmu M.A et. al.2004).

Cassia fistula is used extensively in various parts of the world against a wide range of ailments, the synergistic action of its metabolite production being most probably responsible for the plant's beneficial effects. This paper reviews the primary and secondary metabolite

composition of vegetative and reproductive plant parts and cell cultures thereby derived, with emphasis on potent phenolic antioxidants such as anthraquinones, flavonoids and flavan-3-ol derivatives. This paper also appraises the antioxidant and free radical properties of the plant parts and cell culture extracts (Thee Shan Bahorun et. al. 2005).

Anti-inflammatory and Antioxidant activities of the aqueous and methanolic extracts of the bark were studied in wistar albino rats. The extracts were found to possess significant anti-inflammatory effect in both acute and chronic models (Raju Ilavarasana et .al.2005).

Wound healing potential of the plant on infected albino rat models was evaluated. The extract of the plant treated rats showed, better wound closure, improved tissue re-generation at the wound site, and supporting histopathological parameters pertaining to wound healing (Muthusamy Senthilkumar.2005).

Antidiabetic and Hypoglycemic activity of the flowers of the plant was studied successfully in normal and diabetic rats (John Wiking Einstein M.H.2006).

Wound healing potential of *Cassia fistula* on infected albino rat model was evaluated. The extract showed better wound closure and improved tissue regeneration at the wound site (Kumar M.S et. al. 2006).

Bio efficacies of cassia fistula, a review on the plant covers the hepato protective, wound healing and antioxidant properties and the review also conclude by saying that these properties of the plant are due to the presence of total phenolic content, proanthocyanidin and flavonoid content. (Moshahid M et. al. 2009).

The aqueous extract was evaluated for the hepatoprotective activity against Carbon tetra chloride induced liver damage. The extracts exhibited dose dependent reduction in total bilirubin, ALP, SGOT, SGPT, AST, ALT and increase in total protein levels. The extract treated groups shows mild hepatocytic damage compared to the carbon tetra chloride treated group (Parthasarathy.G and Prasanth V.V. 2009).

The potential of aqueous and isolated fraction from the leaves were evaluated as an antibacterial agent. The alcoholic extract of the plant showed antimicrobial activity against *S.aureus*, *P.aeruginosa*, and *E.coli* (Deepa vasudevan. T et. al. 2009).

Antibacterial effect of *Cassia fistula* extract on pathogenic bacteria of veterinary importance was studied successfully. (Ranjith Vimalraj T et al., 2009).

Hepatoprotective activity of the leaves and barks of the plant was evaluated against carbon

tetrachloride induced hepatotoxicity. The study demonstrated that the liver damage in rats can be ameliorated by treatment of the leaf and bark extracts (Wasu S.J et. al.2009).

Preliminary studies on the phytoconstituents and extracts of petroleum ether, chloroform, ethanol, methanol and aqueous extracts of *Cassia fistula* leaves were studied for antifungal activity using agar cup and broth dilution methods. All the extracts have shown promising antifungal activity.(Panda S.K et. al.2010).

Protective effect of *Cassia fistula* on diethyl nitrosamine induced hepatocellular damage and oxidative stress in ethanol pretreated rats were evaluated and found that the extract was very effective. The results were compared with standard hepatoprotective drug Silymarin. (Kannapalli Pradeep et. al. 2010).

Fruit pulp of *Cassia fistula* was investigated for its antioxidant activity both in vitro and in vivo. Preliminary phytochemical analysis showed high phenolic and flavone content (22mg/kg and 4mg/kg respectively) in pulp. A concentration dependent, increase in FRAP value obtained; suggest high antioxidant property of the extract. In vivo study in young adult mice fed fruit pulp powder extract (100mg/kg body weight daily for 30days) one hour prior to combination of stress (immobilization followed by swimming type) of 2hours duration daily up to 30days, showed significant increase in superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) and reduced glutathione (GSH) levels in brain, gastronomies muscle, heart, kidney, lung and stomach of these mice as compared to mice given only stress. Levels of malondialdehyde (MAD) were significantly lowered after the drug treatment in all the tissues in stress group mice as compared to control. High antioxidant activity of the fruit pulp of *Cassia fistula* may be contributed to its high phenolic and flavonoid content (Bhatnagar.M et. al. 2010).

Attempts have been made to study anthelmintic activity of fruit pulp and seeds of the plant. Both extracts were found not only paralyzed, also killed the *Pheretima posthuma*. The concentrations of 100mg/ml of extracts caused more significant paralysis as well as death of worms as compared to reference drug Piperazine Citrate at dose of 10mg/ml. The study was concluded that the fruit pulp and seed can be used as an anthelmintic (Irshad M et. al. 2010).

The antipyretic potential of different extracts of the bark was evaluated. It was observed that methanol extract at a dose of 300mg/kg body weight showed maximum antipyretic activity

amongst other extracts which is statistically significant (Jana Goutam Kumar et.al. 2010).

The hepatoprotective effect of the leaves of the plant in Isoniazid and Rifampicin induced hepatotoxicity in rodents were evaluated. The result showed that the high dose of ethanolic leaf extract showed better protective effect (Adnan Jehangir A.H et. al.2010).

Methanolic extract of the bark was evaluated for its cardio protective activity. The result showed that the extract treated group shows a decrease in the elevated levels of serum enzymes, histological disturbances and electrocardiogram changes to normal myocardium functioning. The result suggests that the extract has cardio protective effect in Doxorubicin induced myocardial damage rats (Khatib N.A et.al.2010). Anti-inflammatory and anti-pyretic activities of *Cassia fistula* was evaluated using carrageenan induced paw edema and cotton pellet granuloma model, while the antipyretic effect was evaluated using TAB vaccine induced pyrexia. The results suggest that there exists a potential using *Cassia fistula* in treating conditions associated with inflammation and fever. (Gobianand K et. al. 2010).

The evaluation of *in vitro* Antioxidant activity of hydro-alcoholic seed extract was done. The study revealed that the hydro-alcoholic extracts of the seeds have significant radical scavenging activity. In this study *Cassia fistula* was identified as potentially novel source of free radical scavenging compound. The results clearly indicate that *Cassia fistula* is effective against free radical mediated diseases and also helpful to draw special attention for further studies (Nayan R Bhalodia. 2011).

Antimicrobial screening of the seed extract of *Cassia fistula* were evaluated. The aim of the study was to assess the antimicrobial activity and to determine the zone of inhibition of extracts on some bacterial and fungal strains. The results showed that the remarkable inhibition of the bacterial growth against the tested organisms (Nayan R Bhalodia. 2011).

Anticancer activity of the fruit pulp and seeds of *Cassia fistula* and its effect on ergosterol biosynthesis was studied. The activity was determined by minimum inhibitory concentration (MIC), Growth Curve Studies, Cytotoxicity, and Ergosterol estimation assay. The study was concluded that the crude extract of fruit pulp is a promising source of anticancer compounds (Manzoor. N et.al 2011).

Isolation of antileishmanial sterol from the fruit using bio guided fractionation. Hexane extract of the fruit showed antileishmanial activity against

the pomastigote form of *Leishmania L.chagasi* (Patricia Sartorelli et. al. 2007).

The efficacy of a crude hydro-alcoholic extract of *Cassia fistula* (golden shower tree) fruit to protect the kidney against bromobenzene-induced toxicity was studied. Negative control mice received normal saline; positive control mice were given 460 mg/kg of bromobenzene; *Cassia fistula* treated mice received 200, 400, 600 and 800 mg/kg of *Cassia fistula* fruit extract followed by 460 mg/kg bromobenzene (daily by oral gavage for 10 days). On the 11th day, the mice were sacrificed, blood samples were obtained to assess blood urea nitrogen (BUN) and creatinine levels, and kidneys were removed for histological examination. We found that bromobenzene induced significant nephrotoxicity reflected by an increase in levels of BUN and creatinine that was dose dependently prevented by the *Cassia fistula* fruit extract. The nephroprotective effect of the *Cassia fistula* fruit extract was confirmed by the histological examination of the kidneys. To the best of our knowledge, this is the first study to demonstrate the protective effect of *Cassia fistula* in nephrotoxicity (Heibatullah Kalantari et al 2011).

CONCLUSION

The extensive literature survey revealed that *Cassia fistula* is an important medicinal plant with diverse pharmacological spectrum. The plant shows the presence of many chemical constituents which are responsible for varied pharmacological and medicinal property. The evaluation needs to be carried out on *Cassia fistula* in order to uses and formulation of the plant in their practical clinical applications, which can be used for the welfare of the mankind.

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