

## *Cassia fistula* is a Miraculous Medicinal Plant: A Brief Review

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**Abstract:** There are many *Cassia* species which are used in preparing diverse range of herbal products. As per the necessity the present review study reports that *Cassia fistula* used as medicinal plant for curing various critical diseases. *Cassia fistula* belong Caesalpinaceae family, commonly known Bandarlati or Sondal. The plant generally grows in India, Bangladesh, Sri Lanka, China, Nepal, Malaysia, Afghanistan, Indonesia, Bhutan and Thailand. From ancient time it is used in various traditional medicinal systems. It is used as anti-cancer, anti-pyretic, anti-diabetic, and analgesic agent. The plant parts are the vital source of plant secondary metabolites such as polyphenols, flavonoids, terpenoids, saponins, anthraquinones, tannin, alkaloid and steroids. The fruits, flower, seed, stem, and leaves of the plant carry these bioactive compounds. These phytochemicals are effective for the medicinal properties of the plant. The entire plant or its important parts are used for treating the multiple diseases like COVID-19, oxidative stresses, cancer, tumour, microbial infections, swellings, and HIV. The focus of this review article is to highlight the several important botanical, phytochemical and medicinal aspects of *Cassia fistula* to the entire research communities.

**Keywords:** *Cassia fistula*, Bandar Lathi, Phytochemicals, Pharmacological Activity, Ethnobotany.

### INTRODUCTION

Worldwide, 80% plants are used to treat diseases in daily life. As a result of the recognition of the validity of several traditional claims natural products in healthcare system, medicinal plants have become increasingly popular. Around 1200 BC, the Atharva Veda provided a summary of conventional medical knowledge with an emphasis on a huge number of herbaceous medicinal plants. Around 80% of the populations in underdeveloped nations, used plant derived products as the major source of medicinal substances (Konar, *et al.*, 2022; Duraipandiyam and Ignacimuthu, 2007). It is also known as the golden shower tree and in West Bengal it is called as Bandar lathi or Sondal. It is used as tonic (Ali, 2014) and has been reported to treat many intestinal disorders like healing ulcers (Biswas and Ghosh, 1973). Various tribes live in remote forest areas and use different plants for medicinal purposes (Mondal, 2022). Tribal people utilise this plant to treat ringworm and other fungal skin problems. The tribe of India uses it to cure nose infections. In India, leaves are treated in inflammation, the flowers as purgative, and the fruit as an anti-inflammatory, anti-pyretic, abortifacient, demulcent, purgative, and refrigerant. The plant is beneficial for

treating chest complaints, eye conditions, heart and liver conditions, and rheumatism (Duraipandiyam and Ignacimuthu, 2007). The entire plant is used as a purgative, as well as a treatment for impetigo, ulcers, and helminthiasis. The leaves and seeds are astringent, laxative, anti-periodic, anthelmintic, liver tonic, cardiogenic, and expectorant (Singh and Yadav, 2013). Leprosy, ringworm, flatulence, colic, dyspepsia, constipation, cough, bronchitis, and heart diseases can all be treated with the leaves and seeds (Pawar and Killedar, 2017).

**Taxonomical Position:** (Pawar and Killedar, 2017):

**Kingdom:** Plantae

**Sub-Kingdom:** Tracheobionta

**Super Division:** Spermatophyta

**Division:** Mangoliophyta

**Class:** Magnoliopsida

**Sub-Class:** Rosidae

**Order:** Fabales

**Family:** Fabaceae

**Genus:** *Cassia*

**Species:** *Fistula*

**Botanical Name:** *Cassia fistula* Linn.



**Figure 1:** *Cassia fistula* Linn.

#### Names in Vernacular

Bengali: Sondal, Bundaralati, Sonalu, Soondali (Danish et al., 2011)

English: Golden Shower, Indian Laburnum (Danish et al., 2011)

Telegu: Kondrakayi, Koelapenna, Raelachettu, Aragvadhama (Danish et al., 2011)

Sanskrit: Nripadruma (Ali, 2014)

Urdu: Amaltaas (Danish, et al., 2011)

Guajarati: Garmala (Danish, et al., 2011)

Kannad: Kakkemara (Danish, et al., 2011)

Oriya: Sunaari (Danish, et al., 2011)

#### Morphological Features

**Habitat:** The plant is 6-9 m high with trunk straight. Bark smooth with pale grey coloured as it is young, rough, and dark brown when old (Danish, et al., 2011). It has thin branches which spread out (Hafez, Othman, et al., 2019).

**Leaves:** Plants in this species generates compound leaves with 20-40 cm long, ovate or ovate-oblong, with bright green coloured (Danish, et al., 2011; Mwangi, et al., 2021). The main rachis is pubescent. Deciduous leaves with three to eight pairs of leaflets (Mwangi, et al., 2021). Midrib densely pubescent, cuneate base. Leaflets 4-8 pairs, ovate or ovate-oblong, acute (Danish, et al., 2011).

**Flowers:** Flowers are yellowish in colour, contain 5 petals, drooping racemes, 30-60 cm long (Pawar and Killedar, 2017).

**Calyx and Corolla:** Calyx is approximately 1 cm long, divided into the base, pubescent; segments oblong, obtuse (Danish, et al., 2011). Approximately 3.8 cm

Corolla long, obovate with narrow clawed petals (Danish, et al., 2011).

**Fruit:** Fruits are cylindrical pod with numerous tasty seeds, dark pulp that are divided by transverse divisions. Seeds are ovate and thick. The embryo is immersed in a whitish endosperm which is present in the seed (Pawar and Killedar, 2017; Danish, et al., 2011).

#### Traditional Uses

*Cassia fistula* plays a vital role in the preclusion of diseases. Some of the parts act as an antibacterial and antioxidant agent as well as others parts showed therapeutic implications for protecting cancer by modifying genetic pathways (Rahmani, 2015). Plant parts such as seed, bark, leaves, and flower contain various kinds of substances, and these are used for healing many disorders of human. The root is well known as tonic, febrifuge, astringent, and effective purgative (Danish, et al., 2011; Gupta, et al., 2008). In *Escherichia coli*, the leaf sup reduced the mutagenicity. The roots are useful for migraine, blood dysentery and backbone pain. The blood sugar level was decrease by the root decoction up to 30% (Danish, et al., 2011). Fruits are utilized to cure snake bites. The fruits of the plant have anti-pyretic, demulcent, and other biological properties which decrease swelling and body heat.

The plants fruits can cure breathing disorders. In albino rats, the floral decoction suppresses ovarian activity while stimulating uterine function. *Cassia fistula* leaves have laxative and anti-periodic activity. Leaf decoction of the plant used to protect the skin health. The powder or decoction of the stem is taken for curing leprosy, jaundice and heart disorders. It also heals skin disorders

as well as anti-dysenteric qualities. *C. fistula* is used to treat malaria and fever and is also used as analgesic and antipyretic (Pandey, et al., 2015). Stem bark is used to treat inflammation, chest pain, and amenorrhea (Kumar, et al., 2017).

### Phytochemistry

Pod pulps of *C. Fistula* have phytochemicals like pectin and tannin. Pectin and tannin holds butyric acid, sennosides A and B, glucoside, formic acid, barbaloin, anthraquinone glycosides, and oxalic acid. Seeds produced sugar free galactomannan and amino acids etc. Flower of *C. Fistula* produced bianthraquinone glycoside, called fistulin. The fruit of *C. fistula* are the high source of good quantity of amino acids. In addition to free rhein, leaves also generate sennosides A and B (Danish, et al., 2011). Alkaloids, terpenoids, reducing sugars, tannins, saponins, carbonyl, phlobatanin, and steroids are found in the results (Kuo, et al., 2002). The laxative and purgative effects of the plant are attributed to a class of well-researched chemicals known as anthraquinones. Anthraquinones make up of crude protein, crude fat, crude fibre and carbohydrates. The composition of the seeds includes carbohydrates, crude protein, crude fat, crude fibre, and anthraquinones. *C. Fistula* comprises 15.88% crude protein, 20% crude fibre, 6.65% crude fat and 39.86% carbohydrates (Ali, 2016). *C. fistula* seeds contain three lectins and important phytochemical components (Duraip and iyan and Ignacimuthu, 2007; Ali, 2016). In addition to tannins, root bark contains phlobaphenes and oxyanthraquinones. This plant comprises sennoside A and B, rhein, fistulic acid, and rhein. Plant root comprises of 7-methylphyscion, betulinic acid, and sitosterol (Danish, et al., 2011). Fruit pulp contains proteins and carbohydrates. Dimeric proanthocyanidin CFI was isolated along with catechin, kaempferol, dihydrokaempferol and 1, 8-dihydroxy-3-methylanthraquinone (Pandey, et al., 2015; Kuo, et al., 2002).

### Pharmacological Activities

#### Antioxidant Activity

The substances known as antioxidants counteract the onslaught of free radicals and lower the risk of disorders (Rice-Evans, et al., 1996). *C. fistula* stem, fruit and flower extracts in 90% ethanol and 90% methanol were studied for their antioxidant capacities. The antioxidant property was characterized in the decoction of total phenolic contents and well connected with the decreasing order of stem, leaves and flowers decoction. In terms of reducing power, peroxidation inhibition, and the capacity to scavenge O<sub>2</sub> and DPPH radicals, the stem extracts shown more antioxidant property. Proanthocyanidins and total phenolics were accordingly connected with antioxidant property in reproductive parts, including fruits (Pandey, et al., 2015). Antioxidant property of natural source has showed therapeutic effects in prevention of pathogenesis. Medicinal plant contains chemical components like flavonoids, polyphenols and essential amino acids and this chemical used for health protection. Phenolics, such

as bioflavonoids, are an excellent source of antioxidants and play the vital role in scavenging free radicals (Rahmani, 2015; Hertog, et al., 1995; Anwikar, et al., 2010). *C. Fistula* flower showed antioxidant effects in mice with diabetes caused by alloxan (Pandey, et al., 2015).

#### Anti-Inflammatory Activity

During swellings, the body eliminates the spread of harmful agents and removes necrosed cells and tissues. While inflammation can be unpleasant, as an inflamed throat, skin, or soft tissue can be very uncomfortable (Hafez, et al., 2019; Anwikar, et al., 2010). The phytochemical analysis of the extract contains amino acids, carbohydrates, proteins and glycosides. T. Bhakta, et al., (1999) used carrageenan, histamine, and dextran-induced paw oedema experiments in mice to investigate the extract of leaves and compared those to those of phenylbutazone. Strong anti-inflammatory action was shown against all phlogistic agents (Bhakta, et al., 2019). In a different experiment, the anti-inflammatory and antioxidant capacity of the stem on Wistar albino rats were evaluated using water and methanolic decoction. In both acute and chronic diseases the extracts has considerable anti-inflammatory impact. By preventing the lipid peroxidation, *Cassia fistula* stem decoction demonstrated radical scavenging. In liver and kidney homogenates, both extracts demonstrated a dose-dependent protective effect against lipid peroxidation and free radical production, comparing the anti-inflammatory effect of barks extracts (150 mg/kg body weight) to that of the common medication diclofenac (5 mg/kg body weight) (Pandey, et al., 2015). In Indian medicinal system plant provides relief of pain and swelling. Flavonoids content shown that reactive oxygen species (ROS) generated either endogenously or exogenously are implicated in the pathogenesis of various diseases, including atherosclerosis, diabetes, cancer, arthritis, and the aging process (Ilavarasan, et al., 2005; Naseer, et al., 2020).

#### Antibacterial Activity

In developing countries, microbe-related diseases are main cause of mortality. At present scenario antibiotic based treatment is successful in controlling diseases, but it also creates drug resistance. But it is proven that plants have pivotal role in the control of infectious diseases and breakdown of bacterial cell wall (Rahmani, 2015). Plants have a wide range of genetic variability in terms of proteins, vitamins, coenzyme intermediates, phenols, flavonoids, and carbohydrates (Naseer, et al., 2020). The flower contains chloroform, ethyl acetate, hexane, and methanol. The process of Zn ions forming ZnO nanoparticles is thought to be mediated by flavonoids and phenolic compounds. All this extract inhabited antibacterial activity against Gram positive, Gram negative human pathogenic bacteria and fungi (Ayo, et al., 2010). In various kinds of decoctions including hexane, chloroform, ethyl acetate, methanol, and water from the flower, antibacterial activity was observed against bacteria (Rahmani, 2015).

According to M. A. Ali, *et al.*, (2006), three lectins, CSL-1, CSL-2, and CSL-3, separated from the seeds. Lectins have antibacterial effects against various pathogenic bacteria, including *Bacillus subtilis*, *Streptococcus haemolyticus*, *Streptococcus aureus*, *Sarcina lutea*, *Shigella sonnei*, and *Escherichia coli*. All bacterial strains were susceptible to CSL-3, but it was particularly effective against *B. megaterium*, *Streptococcus haemolyticus*, and *Shigella boydii*. But, Only *Streptococcus haemolyticus* showed strong antibacterial activity against CSL-2 (Danish, *et al.*, 2011). Gram-positive and Gram-negative bacteria were both fairly well-tolerated by *C. fistula*. This plant is rich in tannin and phenolic compounds that shown antimicrobial effects against various microorganism (Rahmani, 2015).

#### Anti-Tumour Activity

The majority of primary metabolite research has concentrated on the seed, pollen, fruit, leaf, and pod of the plant (Sharma, 2017). Seeds contain glycerides and fatty acids and also contain proteins and globulins (Tanveer, *et al.*, 2019). A reduction in tumour volume and a rise in viable tumour cells were caused by the plant methanol extract treatment (Upadhyya, 2020; Saeed, *et al.*, 2020).

#### Anti-Diabetic Activity

Estimates of the prevalence of diabetes in people aged 20 to 79 worldwide in 2035 range from 8.3% in 2013 to 8.8% (Wandell and Carlsson, 2014). Kidney failure or blindness is very general micro vascular consequences, yet existing treatments only slow the course of the disorder. Decreased filtration rate is a signal of kidney dysfunction which raised the significant risk for macro vascular phenomenon like cardiac arrest or strokes. Micro vascular disorder and macro vascular disease are two terms used to describe the issues that come from diabetes (Forbes and Cooper, 2013). Most plants include a variety of components that includes terpenoids, alkaloids, phenolics and other plant secondary metabolites, that are highly connected to anti-diabetic effect. From ancient time plant showed anti-diabetic activity (Rahmani, 2015; Malviya, *et al.*, 2010). The anti-diabetic activities of *C. fistula* were tested, and its mode of action was measured (Tanver, *et al.*, 2019).

According to a study, diabetic rats increased glucose levels that were reduced by plants bark extracts in hexane at a dose of 0.15 to 0.30 to 0.45 g/kg body weight over the course of 30 days (Rahmani, 2015). In the STZ nicotinamide-induced DM rat model, methanolic extract of bark and leaves at 500 mg/kg dose shown significantly greater anti-hyperglycaemic and anti-lipidemic action than 250 mg/kg and the serum glucose level and other diabetes-related problems were significantly reduced by the extract and fraction investigated for anti-diabetic activity (Rahmani, 2015; Einstein, *et al.*, 2013; Jarald, Joshi, *et al.*, 2013).

In an experiment, the anti-diabetic effects of roots were evaluated by utilising glucose diffusion test and alpha-

amylase inhibition as in vitro mechanisms. Root extracts made from n-hexane, ethanol, and ethyl acetate were developed for this purpose. The capacity of this ethanol root extract to inhibit alpha-amylase property produced exceptional results. In comparison to ethyl acetate and n-hexane extracts, ethanol root extracts also examined considerable anti-diabetic activity in the glucose diffusion assay (Rahmani, 2015; Jarald, *et al.*, 2013). The liver is essential for preserving the equilibrium of blood sugar levels. Insulin controls the livers capacity to process glucose by promoting glycolysis, limiting gluconeogenesis, and boosting glycolysis (Balraj, *et al.*, 2016; Jangir, *et al.*, 2017). Medicinal plant has significant participation in the treatment of type 2 diabetes. In an earlier investigation it was conducted to determine the stems ability to prevent type 2 diabetes. Results showed that stem bark has significantly decrease blood glucose without side effect on creatinine and urea levels (Rahmani, 2015; Mangai, *et al.*, 2018).

#### Anti-Hepatotoxic Activity

*C. fistula* leaf have significant role in treatment of liver damage. Albino rats was used as a model for examine hepato-protective activity. For 30 days ethanolic leaf extracts of was orally used for Albino rats. Results showed that the leaves are effective in treating liver lesions and damage (Tanveer, *et al.*, 2019). Rats exposed to CCl<sub>4</sub> were elevated in plasma enzyme and bilirubin levels; however, treatment with water extract of the leaves and stem of greatly decreased this effect (Rahmani, 2015).

#### Anti-Fungal Activity

Research showed that leaves have an anti-fungal activity. Extract of leaves was prepared by using methanol, acetone, and diethyl ether as solvents. Methanolic extracts of leaves exhibited excellent anti-fungal activity, similar to those available commercially (Tanveer, *et al.*, 2019; Sing and Karnwal, 2006). A good amount of activity was observed in all extracts, especially chloroform, methanol, and water (Singh and Karnwal, 2006; Irshad, *et al.*, 2014).

#### Anti-Cancer Activity

*Cassia fistula* also showed anti-cancer effects in human colon adenocarcinoma cell line at a very low dose. B. Irshad, *et al.*, proved that fruit extracts could inhibit the growth of human cervical cancer cell lines (SiHa) as well as breast cancer cell lines (MCF-7). It can be useful to treat colon cancer studies (Rahmani, 2015; Irshad, *et al.*, 2014; Duraipandiyar, *et al.*, 2012). It also regulated the proliferation of cancer cell lines such as human cervical cancer, breast adenocarcinoma, and hepatocellular carcinoma (Upadhyay, *et al.*, 2020).

#### Anti-HIV Activity

Plant lectins antiviral action was initially described in 1988, when D-mannose-specific plant lectins inhibited HIV binding in vitro. Against human cancer cell lines, fruit extracts have anti-cancer activity. *C. fistula* regulates HIV-1 protease activity and is used in Thai medicine. Some compounds of *C. fistula*, including

piceatannol, chrysophanol, resveratrol, emodin, and rhein, have been isolated from this plant and have shown anti-HIV-1 protease properties (Upadhyay, et al., 2020; Panthong, et al., 2020; Ahmed, et al., 2022). Rhein inhibits angiogenesis and the survival of hormone-dependent and independent cancer cells in vitro under normoxic or hypoxic conditions, whilst chromones and other compounds that shown potent anti-cancer ability (Upadhyay, et al., 2020).

### Anti-COVID-19 Activity

Lectins have potential anti-infectivity capacity for various RNA viruses that includes SARS-CoV-2. Lectins are a broad set of carbohydrate-attaching natural proteins that attach reversibly and with particular to mono and oligosaccharides. Thus, by interacting with viral envelope proteins, lectins can limit viral replication. Such anti-viral lectins have been widely investigated in vitro for their ability to neutralise various encapsulated viruses, including corona viruses (Carneiro, et al., 2022). Antiviral lectins can prevent virus entry by binding to glycans on either the virus or the host cell (Carneiro, et al., 2022; Kumaki, et al., 2011; Das, et al., 2019). Antiviral lectins can bind to the viral Spike protein of SARS-CoV, and lectins such as mannose, glucose and N-acetylglucosamine have been reported to impede the entry of numerous corona viruses, including SARS-CoV (Kumaki, et al., 2011).

### CONCLUSIONS

The present review study focussed on *Cassia fistula* that has the huge capacity for botanical, phytochemical, nutritional, traditional medicinal parameters as well as significant bioactivities. This review highlights to describe the plant in different angles like chemical constituents, and biological activities. Stem contains flavonol glycosides, Fe and Mn, fruits contain glycosides, fistulic acids, sennosides, anthraquinones and other significant phytochemicals. In conclusion, it was a broad-spectrum bactericidal agent, anti-oxidant, anti-cancer, anti-tumour, anti-HIV, anti-COVID-19 and anti-diabetic properties. The plant is widely utilised in Indian traditional medicinal system, and it undoubtedly contains biologically active compounds that might be exploited to manufacture medicines for the pharmaceutical industry (Das C, et al., 2019, Ghosh, et al., 2019; Sarkar, et al., 2020; Ghosh, et al., 2021; Biswas, et al., 2021; Mukherjee, et al., 2022; Ghosh, et al., 2023; Konar, et al., 2023; Poddar, et al., 2020). It is highly effective for broad-spectrum pharmaceutical medications, as well as innovative herbal drugs preparations, and as insecticides or therapeutic agent. Therefore, considering its entire parameters the present review concluded that there is huge opportunity for future research activities on *Cassia fistula*.

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