Pharmacogn. Res., 2025; 17(2):326-347.
https://www.phcogres.com

Review Article

A Comprehensive Review of Phytochemical and Pharmacological Appraisal of *Cassia fistula* Linn.

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ABSTRACT

The health of individuals living in developed and developing countries remain at risk due to the current global environmental pollution scenario, which is alarmingly leading to the rise in infectious and chronic diseases. Also, the health of living communities worldwide is seriously threatened by the rise in antibiotic-resistant strains of bacteria. Because of their adverse impacts on patients, the medications now used in the modern medical system aren't able to treat diseases, especially those that are resistant, in a way that is both economical and long-lasting. This has made it necessary to keep doing research in order to adequately address the health issues. Hence, medicinal plants are an indisputable asset in the treatment of a wide range of ailments because of its efficiency, low side effect rate and affordability. Due to their ability to alter the body's immune system and increase resistance to complicated illnesses, medicinal herbs offer a sustainable and environmentally friendly approach to managing humanity's health issues. The Ayurvedic medical system makes considerable use of *Cassia fistula* Linn. as one of its therapeutic herbs to treat a wide range of diseases. It is widely practiced in India's traditional medical system. The tree, which goes by the name "Yellow Shower," is a medium-sized deciduous tree with elongated, rod-shaped fruits that are packed with pulp and vivid yellow blooms. An updated version of its botanical description, traditional uses, phytochemical constituent and pharmacological properties-such as antidiabetic, antioxidant, hepatoprotective, anti-fertility, hypolipidemic, immunomodulatory, anticancer, laxative, anti-inflammatory, antipyretic, antimicrobial, antifungal and antiparasitic effects-are provided in this review. Reviews of pharmacological properties of medicinal plants will yield useful information; hence, *Cassia fistula* Linn. may yield significant bioactive natural product discoveries that will aid in the development of new pharmaceutical products.

Keywords: *Cassia fistula* Linn., Medicinal plants, Pharmacological properties, Phytochemicals constituents, Secondary metabolites, Traditional uses.

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Received: 09-10-2024;
Revised: 03-12-2024;
Accepted: 22-01-2025.

INTRODUCTION

India represents one of the wealthiest countries in the world when considering access to the genetic assets of medicinal plants utilized in Ayurvedic or Siddha systems.

These therapeutic plants have a number of chemical active ingredients that have distinct physiological effects on the bodies of humans and animals. The golden shower tree is referred to as aragvadha, or "disease killer," in medicine of Ayurveda. It is Thailand's national tree and its blossoms are the country's national flower. It is extremely significant to the Malayali community and the state flower of Kerala in India.[1]

The medium-sized tree *Cassia fistula* Linn., also known as Hindi-Amaltas, English-Golden Shower, or Indian Laburnum, is a member of Caesalpiniaceae family and widely grown as an attractive plant and for its medicinal qualities throughout India.[2]

The herb *Cassia fistula* Linn. is found naturally in many different regions of the world, including China, South Africa, Brazil, India, Pakistan and the West Indies.[3] West Indian tropical woods and Caribbean islands are *Cassia fistula* Linn.'s primary habitats.[4]

The plant is known by several common names in different languages, in English (purging *fistula*, pudding pipe tree, Indian laburnum, golden shower cassia and golden shower), in Greek (kassia-the generic name), in Bengali (sonalu, soondali, sondal, sonal, bandarlathi, amaltas), in Chinese/Taiwan" (sausage tree), in Gujarati (garmalo), Hindi (amaltas, bendra lathi), in Japanese (Kanji), Khmer (reachapreuk), Kannada (kakke), Marathi (bahava), in Sanskrit (aragvadha, chaturangula, kritamala, suvarnaka, nripadruma), in Tamil (konai, irjviruttam), in Telegu (raela, raelachettu, aragvadhamu, koelapenna), in Punjabi (amaltaas, kaniyaar) and in Urdu (amaltaas).[1]

DOI: 10.5530/pres.20251970

Botanical profile

Cassia fistula Linn. can reach a height of 10 m with upright trunk, spreading branches, smooth, greenish-grey bark that turns rough and dark brown as it ages. Leaflets are opposite, oval and paired in 4-8 pairs; leaves are pinnately alternating, 30-40 cm long. Leaflets span 7.5-15 cm. Racemes of brilliant yellow flowers droop. Fruit is an indehiscent pod that is cylindrical, 40-60 cm long and pendulous, with 25-100 seeds within. Lenticular, light brown, glossy seeds.[5,6]

The plant produces pendulous racemes of glabrous, thin, pubescent blooms that have a diameter of 5-7 cm. A tall, pubescent calyx that is separated from the base, with yellow corolla, oblong and obtuse segments and antheriferous stamens. The plant bears a fruit that is a legume and has many seeds that release an overpowering smell. After the blossoms are shed, the long, immature green pods eventually turn black. The pulp of this species is dark brown, sticky, mucilaginous, sweetened and has a peculiarly terrible smell.[7]

According to reports, the plant can withstand 480-2720 mm of precipitation, 18-28.5°C of yearly temperature and a pH range of 5.5-8.7. It grows best in environment with annual temperature range of 18 to 29°C, a average annual rainfall of 480 to 720 mm, also a pH of 5.5-8.7.[1]

Taxonomic Position

Kingdom: Plantae.

Subkingdom: Tracheobinota.

Super Division: Spermatophyta.

Division: Mangoliophyta.

Class: Magnoliopsida.

Sub Class: Rosidae.

Order: Fabales.

Family: Fabacae.

Genus: *Cassia*.

Species: *fistula*.[1]

Traditional Medicinal applications

Bark paste, rose water and misri are used in traditional medicine to deliver painlessly.[8] The bark has antidysentric and tonic qualities; it is also used to treat skin conditions. The powdered or decoctioned bark is used to treat heart disease, syphilis, leprosy, jaundice and other conditions.[9,10]

Typhoid was treated by the Rajasthani tribes and people by infusion of *Cassia fistula* pods three times a day. Excessive consumption of hen eggs is advised during treatment in order to get quick remission from the illness. Children's coughs can be treated with pod ash and honey,[11] and heated pods can be applied to neck edema brought on by cold.[12]

The leaves are used to treat rheumatic ulcers, eczema, piles, jaundice and external skin eruptions. They also have laxative and anti-periodic qualities. Pustules and insect bites are treated with a mixture of oil and leaves.[12] *Cassia fistula* leaf paste was used as a treatment for skin conditions and leprosy by the Mulu Kurma tribe. People from Khampits utilize leaf extract to treat dyspepsia.[13]

The seeds have a mild sweetness, laxative, cooling, carminative, appetite-improving and antipyretic properties. They help with skin conditions, swelling throats, jaundice and biliousness.[12] By selectively inhibiting the emergence of decaying bacteria in coconut toddy, *Cassia fistula* seed powder was utilized by people to prepare fermented food products, such as in wine.[14] For three days, the dry seed was ingested twice daily and diluted with 200 to 250 mL of water or either a cup of tea to treat diarrhoea.[11]

The Malamasar tribe uses the roots of *Cassia fistula* to stimulates neurological system when alcohol consumption paralyzes it.[15] The roots are utilized as a laxative, analgesic, antipyretic, hematemesis, pruritus, intestinal problems and diabetes.[16] According to Ben, *et al*. (2009), the root is also utilized for wounds, boils, hemorrhages, rheumatism, heart problems and a variety of skin conditions.[10]

Phytochemical constituents

Fistucacidin, an optically inactive leucoanthocyanidin (3,4,7,8,4 pentahydroxyflavan) was first extracted from the heartwood.[17] According to Abu Sayeed, *et al*. (1999) and Lal and Gupta (1976), the seeds are high in glycerides, linoleic, oleic, palmitic and stearic acids being the principal fatty acids and traces of caprylic acids and myristic acids. They are also excellent sources of phospholipids like lecithin and cephalin, as well as carbohydrates like galactomannan.[18,19] According to Rastogi and Mehrotra (2004), oil from seeds includes cyclopropenoid fatty acids, mainly vernolic, stetculic and malvalic acids.[20]

The seeds of *Cassia fistula* contains 5-(2-hydroxyphenoxymethyl)furfural, (2′S)-7-hydroxy-5 -hydroxymethyl-2- (2′-hydroxypropyl) chromone, benzyl 2-hydroxy-3,6-dimethoxybenzoate, benzyl 2β-O-D-gluco-pyranosyl-3,6- dimethoxybenzoate, 5-hydroxymethylfurfural, (2′S)-7-hydroxy-2- (2′-hydroxypropyl) -5-methylchromone and two oxyanthraquinones, chrysophanol and chrysophanein[21] and also contain a new bioactive flavone glycoside 5,3',4'-trihydroxy-6-methoxy-7-O- alpha -L-rhamnopyrano syl-(1 -> 2)-O- beta -D-galactopyranoside.[22]

Free rhein glucoside, rhein, sennosides A and B[23] and (-)-epiafzelechin 3-O-B-Dglucopyranoside, as well as seven biflavonoids and two triflavonoids, are present in the leaves, along with procyanidin B-2, (-)-epicatechin

and chrysophanol,[24,25] and a steroidal compound called β-sitosterol.[26] Hentriacontanoic, triacontanoic, nonacosanoic and heptacosanoic acids are present in the cuticular wax of leaves.[20] The plant's roots are rich in betulinic acid, 7-methylphyscion, βsitosterol, rhamnetin 3-O-gentibioside.[20,27,28] Phlobaphenes, tannins and oxyanthraquinone chemicals are found in root bark.[29,30]

Hexacosanol, ß-sitosterol and lupeol found in *Cassia fistula* stem bark.[31] Moreover, it includes two flavonol glycosides; 5,7,4'-trihydroxy-6,8,3'-trimethoxyflavone-3-O-α-L-rhamnosyl(1→2)-O-β-Dglucopyranoside (C30H36O18) and 5,7,3',4'-tetrahydroxy-6,8-dimethoxyflavone-3-O-α-arabinopyranoside (C22H22O13), a xanthone glycoside, 1,8-dihydroxy-3,7-dimethoxyxanthone-4-O-α-L-rhamnosyl(1→2)-O-β-D-glucopyranoside(C27H32O16).[20] Additionally, according to Daisy, *et al.* (2010), there contains (+)catechin (3,5,7,3'4' pentahydroxy-flavan).[32]

Compared to fruits like apples, apricots, peaches, pears and oranges, the tissue of edible fruit of the Indian laburnum is a richer source of potassium, iron, calcium and manganese.[33] Proteins (19.94%) and carbohydrates (26.30%) were found in fruit pulp, along with arginine, methionine, leucine, phenylalanine, aspartic and glutamic acids, tryptophan and a novel dimeric proanthocyanidin CFI that was isolated along with (-) epiafzelechin, (+) catechin, kaempferol, dihydrokaempferol and 1,8-dihydroxy-3-methylanthraquinone.[20] Additionally, volatile oil, resinous and waxy derivatives, Rhein, volatile oil were also present.[34] The pods are the source of 1,8-dihydroxy-3-anthraquinone carboxylicacid,[35] 3-formyl-1-hydroxy-8-methoxy anthraquinone,[36] and 3B-hydroxy-17-norpimar-8(9)-en-15-one.[37]

Bianthraquinone glycoside fistulin, kaempferol, rhein and leucopelargonidin tetramer with free glycol are all present in *Cassia fistula* flowers.[38,39] The *Cassia fistula* aril contain twenty seven compounds which includes eight long chain hydrocarbons, "1-hexacosanol, 1-octacosanol, palmitic acid, stearic acid, oleic acid, linoleic acid, heptacosyl eicosanate, glyceryl-1-tetraeicosanoate"; three sterols, "beta -sitosterol, stigmasterol, beta -sitosteryl-3-O-D-glucopyranoside"; one triterpene, "lupeol"; eight anthraquinones, "chrysophanol, emodin, physcion, citreorosein, rhein, rhein methyl ester, ziganein, 1,4,5- trihydroxyanthraquinone"; two coumarins, "isoscopoletin, scopoletin"; two chromones, "2,5- dimethyl-7-hydroxychromone, 2,5-dimethyl-7-methoxychromone"; three aromatic compounds, "isovanillic acid, vanillic acid and 2,4-dihydroxybenzaldehyde".[40]

Luximon-Ramma, *et al.* (2002) examined and described the total proanthocyanidin, phenolic and flavonoid contents of *C. fistula's* vegetative and reproductive organs.[41]

Pharmacological properties

The main pharmacological characteristics of this plant are displayed in the Table 1 the plant's various activities are arranged in the table based on the year of publication, the plant part used for treatment, the type of extract used, the doses used, the mode of administration, the length of the experiment, the study model and the effects observed.

Table 1: Various pharmacological properties of *Cassia fistula* Linn

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
Antidiabetic activity	Bark	Hexane extract	0.15, 0.30, 0.45 g/ kg b.wt/day, orally for 30 days.	STZ- induced diabetic rats	When the extract administration, abnormal levels of HbA_{1c} and blood glucose were significantly reduced, also there's noticeable elevation in plasma insulin level. Furthermore, the lipid profile showed a noticeable improvement as a result of the extract intake.	[42]
	Leaves	Ethanolic extract	300 mg/kg b.wt./ day, orally, for 45 days.	STZ induced diabetic rats	The extract markedly decreased glucose and glycosylated haemoglobin levels, while raising total haemoglobin, liver glycogen and plasma insulin levels, in blood. It also corrected anomalies in the carbohydrate-metabolizing enzymes activity in diabetic rats.	[43]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Leaves	70% Hydroalcoholic extract	200 and 400 mg/ kg b.wt./day, orally, for 10 days.	ALX induced diabetic rats.	After seven days of diabetes, the blood glucose levels of the extract-treated diabetic rats were much lower and after sixty min, they performed better on the Oral Glucose Tolerance Test (OGTT). Extract raised liver glycogen levels, decreased intestinal glucose absorption and improved PSO muscle glucose uptake. Additionally, it demonstrated free radical scavenging activity both *in vitro* and, in the liver and both kidney of the rats.	[44]
	Bark (Catechin)	Methanolic extract	5, 10, 20 mg/kg b.wt/day, orally for 6 weeks.	STZ-induced male rat.	Without changing plasma insulin or C-peptide levels, catechin at 20mg/kg reduces glucose level in plasma, considerably boosted tissue glycogen and 14C glucose oxidation. It also restored the altered levels of glucokinase, glucose-6 phosphate, glycogen synthase, glycogen phosphorylase to near-typical ranges. In addition, GLUT4 mRNA and expression of proteins were raised by administration of catechin.	[32]
	Bark	Ethanolic extract and Ethyl acetate fraction	200 mg/kg b.wt./ day, orally for 14 days.	ALX- induced diabetic rats.	The ethyl acetate portion significantly reduced blood glucose levels in diabetic rats as comparison with the alcohol extract. It was also effective in restoring levels of total cholesterol and triglyceride in comparison with diabetic control group.	[45]
	Bark	Ethanolic extract	250 and 500 mg/ kg b.wt./day, orally Acute study.	ALX- induced diabetic rats.	Following 2, 6, 16 and 24 hr of therapy, the diabetic rats' blood sugar levels were significantly reduced compared to the diabetic control rats with the most notable decrease occurring between 60 and 90 min during the glucose tolerance test(orally).	[46]
	Flower	Ethanolic extract.	100 mg/kg, b.wt./ day, orally for 30 days.	STZ induced diabetic rats.	Significant increases in plasma insulin and decreases in glucose and glycosylated haemoglobin were observed in diabetic rats. The extract also has antioxidant action.	[47]
	Bark	Aqueous extract and synthesized gold nano particle.	60 mg/kg, b.wt./ day, orally for 30 days.	STZ induced diabetic rats.	Gold nanoparticle-treated rats showed notable reduction in serum biochemistry markers like serum glucose, HbA_{1c}, ALT, ALP and AST levels. Additionally, there was an increase in body weight, total protein levels and HDL.	[48]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Bark	Ethanolic extract.	250, 500 mg/kg, orally for 21 days.	ALX induced diabetic rats.	The amounts of glucose, serum cholesterol, triglycerides all decreased significantly in diabetic rats, along with notable improvements in serum albumin, creatinine, total protein and body weight.	[49]
	Leaves, Bark, Flower and Pods	Methanolic extract, Aqueous extract.	250, 500 mg/kg b.wt./day, orally for 21 days.	STZ Nicotinamide induced diabetic rats.	In normoglycemic rats, the methanolic extracts of bark and leaves were more effective in causing hypoglycaemia. These extracts significantly reduced glucose level in blood and HbA_{1c} levels, raised insulin levels towards normal and enhanced glucose uptake. Furthermore, the bark methanolic extract restored histopathological changes in the pancreas induced by diabetes.	[50]
	Flower	Aqueous, ethanol, Petroleum, Chloroform, Acetone extract.	200, 400 mg/kg, b.wt./day, orally for 7 days.	ALX- induced diabetic rats.	When the ethanolic extract and water-soluble fraction were administered in diabetic rats, increased biochemical markers such as blood glucose, triglycerides, cholesterol, Haemoglobin (Hb) and HbA_{1c} were restored to normal.	[51]
	Roots	Ethyl acetate, Hexane and ethanol extract.	200, 400, 600, 800 and 1200 µg/mL for 3 for 3 min.	*In vitro* studies.	The ethanol root extracts significantly inhibited alpha-amylase activity, with an IC_{50} value of 1200 µg/mL and glucose diffusion assay confirmed its antidiabetic potential. Flavonoids and glycosides were found in high concentrations according to phytochemical study.	[52]
	Pod	Ethanol extract	100,250,500 mg/kg, b.wt./day, orally for 60 days.	STZ induce diabetic rats.	The extract showed significant improvements in serum insulin levels, total protein concentration, pancreatic weight and the average diameter of the islets of Langerhans compared with diabetic rats.	[53]
	Stem bark	Ethyl acetate, Hexane, methanol extract.	20 mg/kg, b.wt./ day, orally for 60 days.	STZ induced male albino rats.	The novel triterpenoid compound prevented hyperglycemia by activating the IRS-1/Akt-mediated insulin signaling pathway and regulating carbohydrate metabolic enzymes in muscle, skeletal and the liver.	[54]
	Flowers	Tea extract, ICF (Iron Oxide Nanoparticles)		Yeast cells.	ICF exhibits a potent anti-hyperglycemic mechanism by inhibiting alpha-amylase and improves glucose absorption.	[55]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Fruit wall	Chloroform, n-hexane and methanol extract.	200 mg/kg, b.wt./ day, orally for 7 days.	STZ-induced diabetic rats.	The study shows that *C. fistula* L. fruit wall possess anti-diabetic potential (anti-diabetic property of the n-hexane extract was significantly higher than that of the methanol and chloroform extracts) as the extract treated groups showed a striking decrease in the serum glucose level.	[56]
Antioxidant activity	Leaves, Bark, Flower and Fruit pulp	90% Ethanolic of leaf and 90% Methanolic extract of stem bark, pulp and flower.	-	*In vitro* studies.	The highest antioxidant activity was shown by the stem bark, which also exhibited lipid peroxidation inhibition, scavenging of O2- and DPPH radicals and reducing power. The antioxidant potency followed the order: bark of stem, leaf, flowers, pulp and was positively connected with the total polyphenolic content of the extracts.	[57]
	Flower	Aqueous extract.	10 mL/kg b.wt./ day, orally for 15 days.	ALX induced diabetic rats.	The heart tissues of diabetic rats after treatment showed a notable decline in TBARS, conjugated dienes and hydroperoxides. In addition, after extract therapy, the decreased activities of GR, CAT, GSH, GPx and SOD were returned to almost typical levels.	[58]
	Seed and Pulp	Methanolic and Hexane extract	-	*In vitro* studies	The methanolic extract demonstrated the highest antioxidant activity, which is quantified by Fe^{3+} reducing power, DPPH scavenging, hydrogen peroxide and FRAP scavenging activity. The antioxidant activity in the decreasing order as methanolic extracts (pulp), methanolic extracts (seeds), hexane extracts(pulp) and hexane extracts(seeds). There was a strong correlation found between the extracts' antioxidant potential and phenolic concentration.	[59]
	Stem bark	Ethyl acetate, Hexane and methanol extract.	-	*In vitro* studies.	The following was the sequence of antioxidant activity: ethyl acetate extract>methanol extract>hexane extract, with respective activities of 65.98%, 58.19% and 32.66% at 5 hr. These amounts correspond to those of the typical synthetic antioxidant BHT. There is a correlation between the extract's total phenol concentration and its antioxidant capacity.	[60]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Leaves, Bark, Stem and Root	70% Methanolic extract.	-	*In vitro* studies.	When compared to extracts from other portions of the tree, bark extracts showed higher Total Tannin Content (TTC), Total Phenolic Content (TPC) and antioxidant activity. Even though, leaf, stem and root extracts also displayed significant TPC, TTC and antioxidant activity. The variations in TPC, TTC and antioxidant activity were primarily impacted by the different tree portions (bottom, middle and top) rather than by age classes (2-3, 5-10 and 10-15 years).	[61]
	Flower	Ethyl acetate, Hexane and Dichloromethane extract.	-	In vitro	Qualitative results indicate that ethyl acetate extract exhibits the greatest antioxidant activity. This is demonstrated by its, superoxide radical scavenging, DPPH radical scavenging and lipid peroxidation inhibitory activities. The higher concentration of phenolic chemicals in the extracted ethyl acetate is probably the cause of this increased action.	[62]
	Bark	Ethanol extract	150, 300 mg/kgb. wt./day, orally	Male Wistar rats	The extract had radical scavenging activity with IC_{50} of 10.613 µg/mL lower than that of ascorbic acid (4.716 µg/mL).	[63]
	Leaves and fine stems	Methanol extract	100, 200, 300 µg/ mL	C. elegans	The extract enhanced stress resistance and enhanced stress response genes expression, while simultaneously decreases HSP stress genes expression.	[64]
	Leaves	Acetone extract	-	Bacteria species	The acetone extract exhibited antioxidant activity, which is demonstrated by its Ferric Reducing Antioxidant Power (FRAP), hydrogen peroxide scavenging ability and Fe^{2+} chelating capacity.	[65]
	Stem bark	Ethanolic and aqueous extract.	5, 10, 15 ppm of sodium arsenite.	Zebra fish	When treated with the aqueous solution, arsenic-exposed embryos showed a notable decrease in reactive oxygen species (ROS); however, no such effect was noted when treated with the ethanol extract.	[66]
	Bark	Bark extracts	Exposure of CYP (0.41 µg/L) for 30 days.	Catla catla	Dietary supplementation of *Cassia fistula* bark extract lowered lipid peroxidation also markedly enhanced its antioxidant activity.	[67]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Leaf	Crude extracts	200, 400 mg/kg of extract dissolved in DMSO orally for 14 days.	Albino rats.	The crude extract from the plant mitigates injuries, improve histopathological lesions, restore haematological and biochemical parameters and prevent the overproduction of Reactive Oxygen Species (ROS).	[68]
Hepatoprotective activity	Leaves	n-heptane extract	400 mg/kg b.wt./ day, orally for 8 weeks with CCl_4	CCl_4 intoxicated rats.	When the extract was administered, the CCl_4-induced raise in the SGPT, SGOT and ALP levels, serum or plasma bilirubin concentration was significantly reduced. A significant decrease in necrosis and fatty changes in the liver was one of the clearest signs of a major enhancement in hepatocellular structure in the histological investigation of the livers from rats given extract.	[69]
	Leaves	n-heptane extract	400 mg/kg,b. wt/day, orally (7 days) prior to paracetamol intoxication.	Paracetamol intoxicated rats.	On comparison with the paracetamol (alone) treated groups, pretreatment with the extract and the standard liver tonic (Neutroset) significantly prevented the rise in SGOT, SGPT, ALP and bilirubin levels in rats intoxicated with paracetamol. Histologically, necrotic lesions were absent in the livers of extract-treated rats, which were comparable to those of the control group.	[70]
	Leaves	Ethanol extract	500 mg/kg, b.wt./ day, orally (7 days) followed by CCI4 from day 8 till day 14.	CCl_4 intoxicated rats.	Lipid peroxidation was totally reversed by pretreatment with the extract, also the liver tissue's catalase and glutathione reductase activity were returned to normal. This treatment also reversed the raised serum ALT, AST, ALP, LDH and γ-GT enzymes levels. Histopathological studies revealed a reduction in necrosis and fatty alternations in the liver.	[71]
	Fruit pulp	Aqueous extract	200 mg/kg b.wt./ day, orally (5 days) and CCL_4 for 2^{nd} and 3^{rd} day.	CCl_4 intoxicated rats.	The aqueous extract as well as Silymarin group demonstrated a significant reduction in blood levels of AST, ALT, ALP and overall bilirubin and a rise in total protein when compared with untreated CCl_4 groups. Additionally, the extract offered protection against hepatic necrosis, fibrosis and fatty alterations as well as other histological harm.	[72]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Bark	95% Ethanol extract	200 and 400 mg/ kg, b.wt./day, orally for 14 days; CCL_4 for 10 days.	CCl_4 intoxicated rats.	After receiving the extract, the harmful effects of CCl_4 were significantly lessened and the levels of triglycerides, ALT, ALP, AST and total protein were restored.	[73]
	Seeds	Methanolic extract and Aqueous extract.	200 and 400 mg/ kg b.wt./day, orally for 7 days prior to paracetamol intoxication.	Paracetamol intoxicated rats	Treatment with the methanolic extract significantly decreased the levels of SGPT, SGOT, ALP and bilirubin in a dose-dependent manner when compared to those rats which were treated with paracetamol alone. Histopathological investigation revealed the liver exhibiting minimal evidence of hepatotoxicity.	[74]
	Leaves	Ethanol extract	400, 500 mg/kg, b.wt./day, orally (30 days) with INH/RIF.	INH/RIF intoxicated rats.	Total bilirubin, AST, ALP and ALT levels in blood were all markedly lowered after extract administration. Histopathology, high dose of *Cassia fistula* extract revealed vascular congestion and signs of regeneration with few apoptotic bodies observed.	[75]
	Leaves	Ethanol extract	500 mg/kg, b.wt./ day, orally for 30 days after pretreated with alcohol for 15 days than DEN induced	DEN- intoxicated rats	Administration of the extract noticeably decline raised serum AST, ALT, ALP, LDH, γ-GT and bilirubin levels. It also led to a significant reduction in Lipid Peroxidation (LPO) and an increase in the activities of SOD, CAT, GSH, GR and GST in liver tissue. Histopathological analysis revealed that sections of liver from extract treated rats indicate better hepatocellular structure and signs of recovery.	[76]
	Root	Ethanol extract	200, 400 mg/ kg b.wt./day, intra-peritoneal for 4 days with CCl_4	CCl_4 intoxicated rats.	Rats treated with extract had significantly lower levels of SGOT, SGPT, ALP and Total Bilirubin (TBL) than the CCl_4 group that was left untreated. Histological examination of the liver revealed that treatment with the extract restored the injured liver to a nearly normal state, without fibrosis and minimal inflammation.	[77]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Pod	70% Ethanol extract	250, 500 mg/kg b.wt./day, orally (7 days), prior CCl_4 intoxication.	CCl_4 intoxicated rats.	Extract pretreated rats had higher levels of protein, glycogen and cholesterol liver than rats treated with CCl_4. Additionally, it significantly inhibited the elevation in CCl_4-induced serum levels of bilirubin, AST, ALT and ALP. Along with these modifications, the extract decreased lipid peroxidation and increased ascorbic acid, GSH and SOD antioxidant levels. Moreover, extract pre-treatment minimized the adverse histological alterations in the liver caused by CCl_4.	[78]
	Bark	Ethanol extract (70%).	150, 300 mg/kg b.wt./day orally.	Paracetamol treated male rats.	The extract showed hepatoprotective effect by declining serum SGPT and SGOT levels (LD_{50}: 14.528 mg/kg in male rats and 16.528 mg/kg in female rats).	[63]
	Leaves	Aqueous extract (ethanolic extract).	400mg/kg. b. wt / day orally for 6 weeks.	Acetaminophen treated albino mice.	A significant (p<0.05) decrease in elevated serum ALT and AST levels, suggesting that *Cassia fistula* extract from leaves had hepatoprotective effects.	[79]
	Leaves	Ethyl acetate extract	Pretreatment with CaLE of 50,100,200 mg/kg b.wt. for 12 days orally.	Thioacetamide induced male Wistar rats.	In addition to increasing antioxidative enzyme activity, treatment with the extract decreased the thioacetamide carcinogen's conversion through phase II metabolism to its reactive metabolites. In addition, expression levels of p-PI3K, p-Akt and p-MTOR have decreased in liver fractions, suggesting that it has chemo preventive potential. Histopathological studies revealed restoration of the normal architecture in the damaged liver, further indicating its hepatoprotective nature.	[80]
	Leaves	Aqueous extract	200,400,600 mg/ kg b. wt/day orally (28 days).	CCl_4 induced wistar rats.	Treatment showed relative raised body weight, while, relative weights of the liver and kidney reduced compared to CCl_4-treated rats. Additionally, it also demonstrated restoration of histoarchitecture of liver.	[81]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
Antifertility activity	Seeds	Aqueous extracts.	100, 200, 500 mg/ kg, b.wt./day, orally (1-5 days) of pregnancy.	Fertile female rats.	Laparotomy on day 15 of pregnancy showed a dose-dependent decrease in the number of live foetuses, uterine implants and fertility index. Young bilaterally ovariectomized female rats received the extract (100 mg/ kg body weight) alone, had a weak estrogenic effect; but, when mixed with 0.1 mg/kg of estradiol valerate, it demonstrated a small antiestrogenic effect.	[82]
	Leaves	Ethanol extract	60 mg/kg, b.wt./ day, orally (48 days).	Normal male rats.	Sperm counts, sperm vitality and sperm motility all significantly decreased and sperm abnormalities significantly increased. The weights of the testicles and epididymis were also considerably decreased. Testicular histology showed the presence of vacuoles of different sizes and degenerating germ cells.	[83]
	Dry fruits	Dry extract	500,1000, 2000 mg/kg of dry extract administered orally.	Female Wistar rats.	*Cassia fistula* at a dosage of 1000 mg/kg was associated with protective effects on offspring weight and height. Higher doses led to raised ALT levels, but no abnormalities or abortions were seen in the medicated groups.	[84]
Hypolipidemic activity	Legume	50% Ethanolic extract.	100, 250, 500 mg/ kg, b.wt./day, orally (90 days).	Cholesterol fed rats.	In dose dependent way, administration of different dosages of the extract in conjunction with cholesterol substantially inhibited the rise in blood total cholesterol and LDL cholesterol, phospholipids and triglycerides. Furthermore, in comparison to control rats given cholesterol alone, it increased the serum ratio of HDL cholesterol to total cholesterol.	[85]
	Leaves	Ethanol extract	200 400 and 600 mg/kg, b.wt./ day, orally, immediately, 24 and 44 hr after triton induced.	Triton-X100 induced hyperlipidemic rats.	As compared to the hyperlipidemic control group, the extract (600 mg/ kg body weight) and atorvastatin significantly decreased TG, TC, LDL and VLDL cholesterol, while raising HDL cholesterol.	[86]
	Leaves	Methanolic extract, Aqueous extract	200, 400 mg/kg, b.wt./day, orally (21 days).	High fed diet induced atherogenic rats.	A noticeable dose-dependent decline in lipid peroxidation, HDL Cholesterol (HDL-C), Triglycerides (TG), Total Cholesterol (TC) and other indices was shown by both *Cassia fistula* extracts; however, these effects were not as strong as those of the common medication atorvastatin. At various extract dosages, histopathological examination showed a decrease in fat globules inside hepatocytes.	[87]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Bark	Ethyl acetate, Methanolic extract	500 mg/kg, b.wt./ day, orally (21 days)	High fed diet induce atherogenic rats.	When comparing to the high-cholesterol control group, the extract's administration markedly decreased the increased serum levels of VLDL, triglycerides, LDL cholesterol and total cholesterol while raising HDL levels. A reduction in myocardial deterioration and inflammation was found in the heart's histopathological analysis.	[88]
	Fruit pulp	Aqueous extract	500 mg/kg, b.wt./ day, orally (8 weeks).	High fed diet induced hyperlipidemic rats	The levels of Malondialdehyde (MDA), triglycerides, LDL cholesterol, and total cholesterol in blood, all significantly decreased after taking the extract. On the other hand, there was a notable rise in the amount of HDL cholesterol, Catalase (CAT), and Super Oxide Dismutase (SOD) levels.	[89]
	Leaf	Ethanolic (alcoholic and aqueous extract)	200 mg/kg b.wt./ day, orally for both extracts.	High fed diet induced wistar albino rats.	Anti-obesity capabilities of *Cassia fistula* leaves were confirmed when both extracts showed a significant decrease in the weights of the kidneys and heart when compared to rats fed a cafeteria diet. Furthermore, the extracts led to a reduction in serum levels of triglycerides, VLDL cholesterol and total cholesterol.	[90]
	Pods	Fruit extract	0.5, 1.0 g/kg, b. wt/day (30 days) through gavage.	HFD induced hyperlipidemic female rats	Rats with hyperlipidemia showed reductions in LDL cholesterol, HDL, TC and TG, indicating that the extract had anti-hyperlipidemic actions. Additionally, these rats showed a dose-dependent decrease in inflammatory necrosis and fat storage.	[91]
Immunomodulatory activity	Fruits	Aqueous extract	10 µg/mL on day 0, day 1. 5 µg/ mL on day 2, intraperitonially.	Immunized mice.	By stimulating a substantial amount of anti-RBC-producing cells within the spleen, the fruit and amoxycassia extract boosted the immune system. On days 4, 6, 8 and 10 after vaccination, medicated animals showed rise in hemagglutinating antibodies level.	[92]
	Leaves	Petroleum ether and Ethanolic extract	100, 200 mg/kg, b.wt./day, orally (7 days).	Immunized rats.	The extract administered orally induced a delayed-type hypersensitivity reaction and a marked increase in neutrophil adhesion, but had no effect on the humoral action to sheep RBC's.	[93]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Leaf	Chloroform and hydro-alcoholic extract	250, 500 mg/kg b. wt/day of both extracts.	Collagen-II induced arthritis rats.	TNF-α, IL-6, prostaglandin E2, Total Leukocyte Count (TLC), erythrocyte sedimentation rate and interleukin-1β(IL-1β), all declined whereas IL-10 levels increased after treatment with the extracts. Furthermore, the extracts reduced the levels of Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST). Moreover, the extract preserved bone and cartilage and enhanced joint architecture.	[94]
Anticancer activity	Seeds	Methanolic extract.	100, 200, 300 mg/kg, b.wt./day, intraperitoneally (9 days).	Ehrlich Ascites Carcinoma (EAC) and Tumor bearing mice.	In EAC tumor-bearing hosts, administration with the Methanolic Extract (ME) results in decreasing the number of viable tumor cells, a decrease in tumor volume and an improvement in lifetime. Cytological analyses of treated tumor cells showed the formation of intracytoplasmic vacuoles and membrane blebbing in addition to a decrease in mitotic activity. Furthermore, the tumor-bearing mice exhibited improvements in hematological parameters, including hemoglobin content, RBC's and bone marrow cell count.	[95]
	Flower	Ethyl acetate extract (Rhein)	-	Human colon adeno-carcinoma cell line (COLO 320 DM).	Rhein's cytotoxic effects on COLO 320 DM cells were concentration- and time-dependent, whereas his effects on normal cell lines were non-existent. After being treated with Rhein for 24 hr at doses of 6.25 and 12.5 μg/mL, COLO 320 DM cells exhibited apoptotic signals.	[96]
	Whole plant	Methanolic extract	-	Human prostate cancer cells line.	The acridine- orange test verified the extract's anticancer characteristics in the MTT experiment. It dramatically raised the activity of caspases 3, 7, 9 and 10 by a factor of two to five, in contrast to the untreated groups. Furthermore, it was noted that the cancer cells that had received the extract had fragmented genomic DNA.	[97]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Fruit and seed.	Ethyl acetate, n-butanol extract	-	Cell lines of Human cervical cancer (SiHa) and breast cancer (MCF-7).	Treatment with seeds and pulp led to elevated activity of caspases 3, 7, 9 and 10, reduced levels of the Bcl-2 and overexpression of the p53 and Bax genes in both cell lines. Furthermore, both extracts treated SiHa, MCF-7 cells showed apoptosis evidence through fragmented genomic DNA.	[98]
	Leaves	Leaf extract (chloroform)	100,200, 300 µg/ mL for 48 hr.	*In vitro* study (HepG2 cells).	Apoptotic signals were verified by elevated levels of caspases, or cysteine-aspartic proteases, measured in treated cells, which also corroborated the results of the DNA fragmentation experiment. Furthermore, it was shown that cells that received *Cassia fistula* leaves chloroform extract had low Bcl-2 gene expression, which may indicate that mitochondrial proteins play a role in HepG2 cells' programmed cell death.	[99]
	Leaves	Oil and methanol extract	15,55 µg/mL of both extracts.	Brine shrimp's larva.	The mortality of brine shrimp that were subjected to *Cassia fistula* extract was shown to be concentration-dependent and the oil extract were effective in stopping the growth of HepG2 cancer cell lines. By preventing DNA synthesis, the extracts' phenolic acids caused tumor cells to undergo apoptosis.	[100]
	Bark	Ethyl acetate extract.		*In vitro* study (HT-29 cells).	Apoptotic characteristics, such as chromatin condensation, DNA breakage, membrane leakage and increased depolarization of the membrane of the mitochondria, were demonstrated by extract-derived compounds Cpd1 and Cpd2. Arrestment of cell cycle in the S and G2/M phase followed this. Additionally, the two substances declined the expression of ERK-2 and raised the expression of p53.	[101]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Leaves	Methanolic extract.		*In vitro* study (MG-63 cells).	The *Cassia fistula* leaf extract fraction, which is well-known for having strong antioxidant properties, produced epiafzelechin (CFF-1), which significantly inhibited cell proliferation and caused MG-63 cells to undergo apoptosis. Changes in morphology, elevated ROS levels, lowered Mitochondrial Membrane Potential (MMP) and arrest of the cell cycle at the G0/G1 phase were indicators of this. Moreover, CFF-1 reduced the expression of CDK-2 and β-catenin genes but upregulated the expression of p-Akt (protein kinase B), p-GSK-3β and Bcl-xL proteins. On the other hand, it caused the p53 and caspase-8 genes to express more in MG-63 cells.	[102]
	Fruit	n-hexane extract		*In vitro* study (Hela, MG-63, IMR-32 and PC-3 cells).	Treatment of the fraction showed chromatin condensation, membrane blabbing, DNA breakage and the development of apoptotic structures. Moreover, it exhibits elevated ROS levels, depolarization in mitochondria, arrestment of G0/G1 phase cell cycle suppression of Bcl-2 gene expression, upregulation of p53, Bad and Caspase3 gene expression.	[103]
	Leaves	Methanolic extract		*In vitro* study (Hela and MCF-7 cells).	The *Cassia fistula* leaf extract fraction externalized phosphatidylserine in HeLa cells, which caused death. It also showed strong suppression of mutagenicity caused by 2-aminofluorene.	[104]
	Leaves and fruit	Ethanolic extract		*In vitro* study (HEK 293 and HepG2 cells).	After being treated with ethanolic extract, the HEP-G2 cells' cytokine gene expression decreased (IL-6, IL-8, IL-1β, TGF-β1 and TNF-α). Cells also began to lose their integrity, developed blebs and grew circular, which were signs of apoptosis and cell death.	[105]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
Laxative activity	Leaves	Methanolic extract	200, 400 and 800 mg/kg b.wt./day, interaperitoneal.	Carrageenan, histamine and dextran induced paw odema rats.	The extract demonstrated suppression of inflammation against every inflammatory mediator. Maximum oedema inhibition of 34.6 percent occurred 4 hr after the inflammatory agent was administered, with the maximum inhibition occurring at 800 mg/kg b. wt. The extract's anti-inflammatory properties are similar to those of the anti-inflammatory drug phenylbutazone.	[106]
	Pods	Aqueous extract	250, 500 and 1000 mg/kg b.wt./day, intraperitoneally for 6 weeks.	Swiss albino mice, Rats and Guinea pigs.	The results obtained from a comparison with the senokot tablets indicated that infusion of pods of *Cassia fistula* have extremely small levels of toxicity (LD_{50} of 6600 mg/kg) (acute study in mice) and no pathological effects observed on the microscopically examined organs (rat liver, testis and kidney). Concluded that the official Senna may be replaced by infusion of a pod.	[107]
	Bark	Aqueous and Methanolic extract	250 and 500 mg/ kg b.wt., orally, 30 min prior to carrageen administration or per day for 7 days.	Carrageenan induced paw odema and cotton pellet granuloma rats.	The volume of the paw edema was significantly reduced at both extract doses. After seven days, the weight of the cotton pellet granuloma in rats was dramatically reduced by dose of 500 mg/kg, b.wt. of both extracts.	[108]
Anti-inflammatory activity	Leaves	Ethanolic extract	50, 100, 250, 500 mg/kg, b.wt., orally/ day (7 days).	Carrageenan induced paw edema and cotton pellet granuloma rats.	In addition to causing a dose dependent reduction in the weight (wet and dry) of cotton pellet granulomas, the administration of extract at 250, 500 and 750 mg/ kg b.wt. resulted in a decrease in the volume of oedema 4, 8 and 24 hr after the administration of carrageenan.	[109]
	Bark and leaves	Ethanolic extract	CFB-200 mg/kg, CFL-100,200 mg/ kg	Carrageenan induced male Wistar rats.	Rats' paw volume (edema) is significantly inhibited ($p<0.05$) by extracts of both bark and leaves. evidence implies that prostaglandin synthesis may have been inhibited by the ethanolic extract.	[110]
	Root	Alcoholic extract and microsphere of aloe-emodin and physcion fraction.	100, 200 mg/kg b.wt./day orally.	Carrageenan induced paw edema rats.	Both dosages of aloe-emodin and physcion microsphere significantly decreased the paw edema brought on by carrageenan, indicating an inhibitory effect on the release of histamine and serotonin.	[111]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Bark	Methanolic extract	200,400mg/kg b.wt./day	Carrageenan induced paw edema rats.	Paw volume was decreased during the first hour and during all phases of inflammation when extract was pre-treated before 1 hr of carrageenan administration.	[112]
Antipyretic activity	Leaves	Ethanolic extract	50, 100, 250, 500 and 750 mg/kg, b.wt. orally.	TAB vaccine induced pyrexia rats.	Rats treated with extract at 250 and 500 mg/kg b.wt. showed less pyrexia 60 min after the TAB vaccination, but at 750 mg/kg, b.wt. It decreased high temperature of the body caused by the vaccination 30 min after it was administered.	[100]
	Leaves and bark	Ethanolic extract	CFB-100,200mg/kg CFL-200mg/kg	Pyrexia induced male Wistar rats	Rat hyperthermia was greatly decreased by ethanolic extracts of CFB and CFL. The extract's potential mode of action may involve blocking the synthesis of nitric oxide, blocking the release of cytokinesis and blocking the release of PGE2 at different stages of inflammation and LPS-induced pyrexia.	[110]
Antimicrobial activity	Stem bark	Aqueous and alcoholic extract.	30 mcg/disc	*In vitro* study, against pathogenic bacteria of veterinary importance.	Both extracts exhibited notable efficacy against *Staphylococcus aureus*, but not against *Escherichia coli* or *Bacillus subtilis*. Inhibition was higher in the alcoholic extract than in the aqueous extract. An alcoholic extract made from *Cassia fistula* was also effective against a field isolate of *Staphylococcus aureus* that was tolerant to chloramphenicol.	[113]
	Leaves	Ethanolic extract	30, 200 µg/mL	*In vitro* study, against pathogenic bacteria.	The extract (200 µg/disc) showed superior activity toward *Bacillus megaterium, Bacillus subtiIis, Streptococcus* β-haemolyticus, *Salmonella typhi, Shigella dysenteriae, Shigella* shiga, *Escherichia coli* and *Pseudomonas aeruginosa*, with a zone of inhibition of 9-18 mm and a maximum zone of inhibition of 19 mm against Shigella dysenteriae. *Staphylococcus aureus* was not susceptible to the extract's effects.	[114]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Leaves	Petroleum ether, Ethyl acetate, chloroform and methanolic extract	50 µL/disc	*In vitro* study, against human pathogenic bacteria.	The results of the screening process for ethyl acetate, chloroform and methanol extracts showed significant activity against both Gram-positive (*Bacillus cereus, Enterobacter faecalis, Staphylococcus aureus*) and Gram-negative (*Salmonella paratyphi, Escherichia coli, Proteus vulgaris, Klebsiella pneumoniae, Pseudomonas aeruginosa* and *Serratia marcescens*) bacteria.	[115]
	Leaves and Pods	Aqueous and Methanolic extract	0.625, 1.25. 2.5, 5 and 10 mg/disc	*In vitro* study	Every extract had dose-dependent antibacterial activity against *Staphylococcus aureus*; at 10 mg/ disc, there was maximum zone inhibition. Additionally, the extract shown dose-dependent antimicrobial activity against *Pasteurella multocida*; at 20 mg/ disc, there was maximum zone inhibition.	[116]
	Pods and Bark	Aqueous and Ethanolic extract	25, 50 and 100 µL/ disc	*In vitro* study, against pathogenic bacteria.	*Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa* and *Salmonella typhimurium* were discovered to be most effectively inhibited by ethanolic extracts of one-month pods, four-month pods, pulp, young bark and old bark, as well as an aqueous extract of old bark. Aqueous pulp and pod extract is only partially effective against the tested microorganisms.	[117]
	Leaf	Aqueous extract		*S. aureus* and *E. coli*	*Cassia fistula* leaves extract exhibited the largest zone of inhibition against *E. coli*. The existence of secondary metabolites may be the cause.	[118]
Antifungal activity	Flower	Different fraction of Methanolic extract.	200 mg/mL/150 µg/mL.	*In vitro* study, skin disease related fungus.	The extract set of Fats and Waxes was proven to be more efficient against *Bipolaris sorokenia* and *Drecheslera tetrameda*. The Terpenoids and Phenolics group extract demonstrated efficacy against both *Bipolaris sorokenia* and *Fusarium cicerg*. It was discovered that alkaloids, quaternary alkaloids and N-oxides were more effective against *Bipolaris sorokenia* and Fusarium cicerg.	[119]

Plant activity	Part used	Extract	Dose/Mode/ Duration	Animal Model	Effects observed	References
	Leaf	Aqueous extract of leaf	0.75, 1.0 mg/mL of biosynthesized CFSNP's.	*Aspergillus flavus* and *penicillium* sps. in groundnut.	Antifungal assay proved the effectiveness of CFSNP, preventing the growth of fungal mycelial by 71.5% and 86.25% towards Penicillium sps and 75% and 95.12% against *A. flavus*. leaf extract of cassia had less suppressive efficacy towards *A. flavus* and *Penicillium* sps. when compared to CFSNP's product.	[120]
Antiparasitic activity	Fruit (Biochanin A)	Dichloromethane extract	150 µg/ mL	*In vitro* study	When Biochanin A was tested against *Leishmania-chagasi* promastigotes, the EC_{50} value was 18.96 µg/mL. Furthermore, biochanin A demonstrated anti-Trypanosoma-cruzi properties. (EC_{50}-18.32 µg/ mL) With regard to peritoneal macrophages, this material's cytotoxicity produced 42.58 µg/mL. EC_{50} value.	[121]

CONCLUSION

Herbal treatments have been essential for managing and preventing disease for generations, especially in rural regions where citizens usually depend on herbal medicines for their well-being. *Cassia fistula* is one of the most important of them, particularly in India where it is widely utilized in herbal, folk and traditional medicine. Numerous pharmacological characteristics of this herb are well-known, such as its anti-inflammatory, anti-pyretic, hepatoprotective, anti-fertility, hypolipidemic, immunomodulatory, anti-cancer and anti-parasitic qualities.

ACKNOWLEDGEMENT

We are thankful to Head, Department of Zoology, University of Rajasthan, Jaipur, for providing necessary facilities.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

STZ: Streptozotocin; **HbA_{1C}:** Glycated haemoglobin; **ALX:** Alloxan; **ALP:** Alkaline phosphatase; **DPPH:** 2,2-diphenyl-1-picrylhydrazyl; **TBARS:** Thiobarbituric acid reactive substances; **GR:** Glutathione reductase; **BHT:** Butylated hydroxytoluene; **SGPT:** Serum glutamic pyruvic transaminase; **SGOT:** Serum glutamic oxaloacetic transaminase; **HSP:** Heat shock protein; **LDH:** Low density lipoprotein; **γ GT:** Gamma glutamyl transferase; **INH/RIF:** Isoniazid/Rifampin; **GST:** Glutathione S-transferase; **LDL:** Low density lipoprotein; **HDL:** High density lipoprotein; **VLDL:** Very low density lipoprotein; **LD:** Lethal dose; **PGE2:** Prostaglandin E2; **LPS:** Lipopolysaccharide; **ZOI:** Zone of inhibition; **EC:** Effective concentration; **MTOR:** Mammalian target of rapamycin; **IL:** Interleukin; **TGF:** Transcription growth factor; **TAB:** Typhoid, paratyphoid A, paratyphoid B.

SUMMARY

Cassia fistula Linn., also known as "Yellow Shower," is a therapeutic herb used in the Ayurvedic medical system and India's traditional medical system. Different parts of plant possess various phytochemical constituents like saponin, glycosides, anthraquinone, saponin, steroids and flavonoids, also exhibit pharmacological properties such as antidiabetic, antioxidant, hepatoprotective, antifertility, hypolipidemic, immunomodulatory, anticancer, laxative, anti-inflammatory, antipyretic, antimicrobial, antifungal and antiparasitic effects. This review suggests that *Cassia fistula* Linn. may lead to new bioactive natural product discoveries that will aid in the development of new pharmaceutical products.

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Cite this article: Jangid T, Jain A, Bhardwaj GS, Jangir RN. A Comprehensive Review of Phytochemical and Pharmacological Appraisal of *Cassia fistula* Linn. Pharmacog Res. 2025;17(2):326-47.