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Cassia Occidentalis: Unlocking Weed's Phytochemicals, Bioactivities, and Future Potential

Nancy Srivastava[1], Umesh Pratap Singh[2], Priyanka Pal[3], Purnendra Gupta[4]

[1,3]M. Pharm 2nd Year, Rameshwaram Institute of Technology and Management, Lucknow, India
[2]Phd., Rameshwaram Institute of Technology and Management, Lucknow, India
[4]Assistant Professor, Rameshwaram Institute of Technology and Management, Lucknow, India

Abstract

Cassia occidentalis, traditionally regarded as a weed, is gaining recognition for its pharmacological significance. Despite its ethnomedicinal history, it remains underexplored in pharmaceutical research. This review synthesizes its phytochemical profile, therapeutic applications, and potential in drug development. Studies reveal diverse bioactivities, including neuroprotective, hepatoprotective, anti-arthritic, and antimicrobial effects, with biosynthesized nanoparticles enhancing its efficacy. Computational studies further highlight its interactions with pharmacological targets, suggesting applications in metabolic and neurodegenerative disorders. However, concerns over hepatotoxicity, particularly in children, necessitate dose standardization and controlled formulations. Future research must focus on standardized extraction methods, pharmacokinetics, and clinical validation to harness its therapeutic potential while ensuring safety.

Keywords: Cassia occidentalis, bioactive compounds, drug development, traditional medicine, phytochemical, therapeutic potential, protective effects, toxicity.

Introduction

Cassia occidentalis (CO), which is often known as a weed, is being recognized for types of weed with astonishing medicinal value. CO, or 'Kasondi' as is it is called in India, can potentially be utilized to treat variety of diseases. It is often seen growing along roads, ditches, and dumping grounds during summer and monsoon seasons but disappears during winter. This plant is used to treat a range of conditions, including inflammation of the eyes, diarrhea, dysentery, constipation, fever, cancer, eczema, rheumatism, diabetes, hematuria, menstrual problems tuberculosis, anemia and even some venereal diseases in traditional time as well as nowadays. The plant's various parts are important for treating specific ailments; roots, leaves, seeds, and pods serve different purposes. CO is also a component of LIV. 52**,** a polyherbal formulation known for its hepatoprotective activity. Additionally, it can be found in Himoliv, an Ayurvedic preparation made of 25 herbal extracts known for liver protection and antioxidant activity. Eating Cassia occidentalis seeds can cause a deadly condition called hepato-myoencephalopathy, damaging the liver, muscles, and brain—especially in children. [1-5, 12] These bioactivities of Cassia occidentalis suggest that it may contain useful compounds that have yet to be investigated in detail. It is the goal of this review to provide evidence, albeit in tabular form, that shows why this plant may be more useful than it is given credit for.

Method

This review thoroughly collected and examined literature on Cassia occidentalis from credible sources such as PubMed, Google Scholar, ScienceDirect, ResearchGate, Scopus, and Web of Science. Additional information from NBRI, USDA, and WHO monographs offered in-depth insights into its phytochemistry and pharmacology. AI tools, including ChatGPT, played a role in synthesizing literature, summarizing findings, and pinpointing new research trends. AI-driven search tools enhanced query refinement and effectively

filtered high-quality peer-reviewed studies.

Botanical Description: -

Table I- Botanical Description of Cassia occidentalis

Family	CAESALPINIACEAE (Pea or Bean Family) Family (Hindi name): IMLI FAMILY LEGUMINOSAE (as per The APG System III) Subfamily: Caesalpinioideae [1,2]
Species Name	Senna occidentalis (L.) Link [1,2]
Native	Tropical America [1,2]
World Distribution	Pantropical weed [1,2]
Flower, Fruit	July-February [1,2]
Habitat	Margins of scrub forests, occasional in low elevations and roadsides [1,2]
Distribution	Africa, Asia, the Americas, and Australia In India- Andhra Pradesh, Vishakapatnam, Telangana, Kerala, Maharashtra, Odisha, Tamil Nadu, Western Uttar Pradesh [6-9]
Morphological Characteristics	Erect, branched plant reaching 0.8 to 1.5 meters in height, 4 - 6 pairs pinnate compound leaves and distinctive dark olive-green seeds (6mm long and 4mm wide), pods (10-13 cm long and 0.8 cm wide) [6-11]
Common name: **Vernacular name:**	Coffee Weed, Negro Coffee, Stinking weed, Coffee Senna, Foetid senna, Septicweed Kasondi, Kasandi (Hindi); Kola thagache (Kannada); Paayavarai, Thagarai, Nattamtakarai (Tamil); Pedda kasivinda, Cashanda, Kashindha (Telugu); Kusundra, Kasinda, Chakunda, Kola chakunda (Oria); Kasamarga (Sanskrit); Rantakla (Marathi); Karinthakara, Mattanthakara, Natharamthakara, Peyaviram, Ponnari, Ponnariveeram, Ponnionthakara (Malayalam) [1,7,9]

Phytochemical Profile

The aerial parts of Cassia occidentalis contain essential minerals such as iron (Fe), calcium (Ca), potassium (K), manganese (Mn), magnesium (Mg), zinc (Zn), copper (Cu), sodium (Na), phosphorus (P), and sulfur (S), contributing to its nutritional benefits. [3, 13]

Table II- Major chemical constituents table present in their parts

S. No.	Part of Plant	Chemical Constituents	References

	Leaves	Flavonoids (Apigenin, Kaempferol, Chrysin, Pectolinargenin), Sterols/Triterpenes β-Amyrin, β-Sitosterol, Stigmasterol, Lupeol), Anthraquinones (Chrysophanol, Emodin (and their glycosides), Rhein, Physcion, Bianthraquinones), Polyphenols, Phenolic Compounds (Gallic acid, Caffeic acid, Ferulic acid, Chlorogenic acid), Alkaloids (Cassine, Choline), Other Compounds (Proteins, Reducing sugars, Carbohydrates, Fatty acids, Coumarins, Triterpenes, Volatile oils), Additional Groups- Tannins (Ellagic acid, Gallic acid), Saponins (Diosgenin, Hecogenin), Glycosides, Terpenoid	[6, 7, 11-16,19]
	Seeds	Anthraquinones: Chrysophanol, Physcion, Aloe-emodin, 1,2,5-Trihydroxy Anthraquinone, Sterols/Triterpenes: Isojaspisterol, Camphor, β-Amyrin, β-Sitosterol, Stigmasterol, Lupeol, Fatty Acids: Stearic acid, Palmitic acid, Oleic acid, Linoleic acid, Other Compounds: Alpha-Tocopherol, Protein, Oil, Galactomannan, Petroleum ether (PET): Steroids, Acetone (ACE): Flavonoids, Phenols/Tannins, Amino Acids, Glycosides, Steroids, Methanol (MeOH) and Water (H_2O): Flavonoids, Phenols/Tannins, Amino Acids, Saponins, Glycosides, Steroids, Steroids: Present in all extracts	[6,7,8,20,27]
	Fruits/Pods	Sennosides and anthraquinones	[6]
	Roots	Anthraquinones and Their Glycosides: Pinselin (Cassiallin), Rhein, Aloe-emodin, Chrysophanol, Physcion, Emodin, Islandicin, Helminthosporin, Xanthorin, 1,8-Dihydroxyanthraquinone, α-Hydroxyanthraquinone, Xanthones: 1,7-Dihydroxy-3-methoxyxanthone, Sterols: Sitosterol, Campesterol, Stigmasterol, Flavonoids: Quercetin, C-Glycosidic Flavonoids, Cassia occidentalins A, B, and C Anthracene Derivatives: Bis (tetrahydro) anthracee derivatives, Other Compounds: Occidentalol-I, Occidentalol-II, Questin, Germichrysone, Methylgermitorosone, Singueanol-I, Pinselin	[6, 19, 22, 23]
	Stem	Polyphenols: aqueous, methanolic, ethyl acetate, and hexane extracts, Flavonoids (aqueous, methanolic, ethyl acetate, and hexane extracts)	[24,25]
	Callus	Flavonoids- kaempferol, quercetin, apigenin, and rutin (callus culture)	[26]
	Flowers	Alkaloids- (Chrysophanol, Emodin, Physcion, Tetrahydroanthracene derivative, Germichrysone, Occidentalins A and B), Phenolics/Tannins, Flavonoids, Other Compounds: N-Methyl-morpholine, α-Glucosides of Campesterol & β-Sitosterol, Galactomannan	[6, 27]

	Whole plant	p-Dimethyl Amino-Benzaldehyde, Alkaloids, Flavonoids, Tannins, Saponins, Glycosides, Hydrocarbons: 9-Dodecyl-Tetradecahydro-Anthracene (48.97 %), 9-Dodecyl-Tetradecahydro-Phenanthrene (14.43 %), Fatty Acids: Palmitic Acid (50 %), Linoleic Acid (16.06 %), Undecanoic Acid, Ethanolic Extract Components: Flavonoids, Tannins, Saponins, Glycosides, Phenols, Steroids,)	[6, 28, 29]

Medicinal Properties

Cassia occidentalis is a medicinal plant with various therapeutic properties. It has shown effectiveness against certain bacterial strains, such as Salmonella typhi, where its ether leaf extracts exhibited some antimicrobial activity, albeit less than chloramphenicol. [30] Furthermore, biosynthesized silver nanoparticles from its leaves exhibited strong antibacterial and antioxidant activity. [31] The plant also affects Aedes aegypti larvae, reducing survival rates and impacting adult oviposition. [32] It contains various bioactivities, which are outlined below based on the best available knowledge.

Table III: Bioactive Properties of Cassia occidentalis

S. No.	Biological Activities	Part of plant	References
	Antioxidant Activity	Leaf extract (Leaves), Biosynthesized silver nanoparticle, Organic and aqueous extracts (Leaves), Polyphenol-rich fraction (Flowers), Whole plant, Crude extract (Leaves, seeds, stems, and roots), Ethanolic extract [leaves or aerial parts]	[13, 18, 25, 29, 33-35]
	Anti-microbial	Ethanolic leaf extract (Leaves), Methanolic leaf extract (Leaves), Proton NMR (^{1}H NMR) and LC-MS analyzed leaf extract (Leaves), Aqueous and methanolic leaf extracts (Leaves), Hydroalcoholic leaf extract (Leaves), Methanolic and ethyl acetate leaf extracts (Leaves).	[13, 28, 36-39]
	Anti-bacterial	Aqueous extract (leaf), Petroleum ether, ethanol and water extract (leaf), Methanolic leaf extract (Leaves), silver sulfide (Ag_2S) nanoparticles (leaves), Ether leaf extract (Leaves), Biosynthesized silver nanoparticles (Leaves), Ethanol, methanol, and combined seed extracts (Seeds), Biosynthesized silver nanoparticles (Seeds),	[11, 17, 20, 31, 33, 34, 35, 39, 40]

		Polyphenol-rich fraction (Flowers), Vegetable Extract (Flowers), n-Hexane fraction (NHX-leaves), ethyl acetate fraction (leaf and seed), Emodin (Roots)	
	Hepatoprotective Activity	Leaves (aqueous-ethanolic extract (50 %, v/v), ethanolic extract, aqueous and methanol leaf extracts, ethyl acetate fraction), Aqueous root extract combined with Hygrophila spinosa, Methanolic extract- seed (combination), ethanolic extract (root)	[41-46]
	Laxative Activity	Leaves (with other genus), Aqueous leaf extract	[47, 48]
	Hypoglycemic Activity	Seeds (Ethanolic Extract), Root (ethanolic extract, all extract), Whole plant (Ethanolic Extract, aqueous), Leaves (Likely Ethanolic or Methanolic Extract)	[45, 49-53]
	Antipyretic Activity	Methanolic seed extract, ethanolic and water extract (leaves)	[54, 55]
	Analgesic	Ethanolic and water extract (leaves)	[55]
	Anti-allergic	Ethanolic extract of the whole plant	[56]
.	Anti-inflammatory	Leaves (Methanol Extracts), whole plant ethanolic extract	[56, 57]
.	Anti-helminthic Activity.	Leaves and Seeds (ethanolic extracts	[58]
.	Immunomodulatory Activity	Seed (Rhein- Anthraquinone Moiety), leaves (aqueous extract, ethanolic extract)	[59, 60]
.	Anti- trypanosomal, trypanosome-induced Anemia	Ethanolic leaf extract Methanolic leaf extract	[61]
.	Antifungal Activity	Silver sulfide (Ag_2S) nanoparticles (leaves), Ethanolic extract (Leaves), Crude extract (Whole plant)	[31, 60, 62]
.	Insecticidal Activity	Leaf powder and crude extract	[63, 64]
.	Anti-malarial Activity	Leaf (crude extract, methanolic and aqueous leaf extract), root (methanolic and aqueous extracts), in silico analysis	[64-66]
.	Cardioprotective (Anti-hyperlipidemic	Leaves (aqueous extract), roots (ethanolic extract), computational analysis, seed (crude extract)	[56, 67-71]

	Activity and anti-atherosclerogenic, anti-hypertensive, in angina)		
.	Anti-diarrhea	Biosynthesized zinc oxide nanoparticle from leaf	[72]
.	Antiretroviral activity against HIV/AIDS	Ethanol extract of leaf	[73]
.	Diuretic Activity	Aqueous leaf extract	[74]
.	Asthma	Anthraquinones, hydroalcoholic extracts of Cassia occidentalis seeds	[75, 76]
.	Antispasmodic Activity	Hydroalcoholic extract (whole plant), ethanaolic extract (roots)	[76, 77]
.	Anti-arthritic Activity [osteopenia]	Methanolic extract and fractions of Whole plant	[78]
.	Anti- cancer-	Whole aerial flowering part (lung carcinoma), whole plant	[79, 80]
.	Wound healing	Leaves (Methanol Extracts), ethanolic extract (leaf)	[57, 81]
.	Nutritional Value	Aerial parts, seed	[12, 82]
.	Protective effect (anti-mutagenic)	Hydro-alcoholic extract (roots)	[83]
.	Anti-tussive	Methanolic root extract	[84]
.	Neuroprotctive	Ethanolic extract	[85]
.	Myleoprotective	Crude methanolic leaf extract	[86]

Toxicological Studies

Cassia occidentalis poisoning is a significant cause of fatal hepatomyoencephalopathy (HME) in children, highlighting its severe neurotoxic and hepatotoxic effects. Toxicological evaluations confirm its potential risks, including reproductive toxicity, dose-dependent liver damage, and immune-related toxicity. While the aqueous root extract shows hepatoprotective effects, chronic intoxication impairs mitochondrial metabolism, leading to muscle toxicity and myopathy. The plant's anthraquinones interact with DNA and glutathione, contributing to oxidative stress, metabolic dysfunction, and hepatic toxicity. Acute toxicity tests showed that high doses were not lethal, but a minimum diarrhea is observed,

and LD50 > 5 g kg^{-1}. During long-term exposure [60 days], liver and kidney damage have been established to be induced because of the presence of tannin and alkaloids in it. Additionally, its pro-inflammatory compounds suggest potential therapeutic applications, but its toxicity concerns remain a priority. Though the plant is considered safe for moderate and short-term use, high doses or long periods of exposure could lead to more severe health complications, hence requiring further research and careful application. [87-96]

Challenges and Limitations

Research on Cassia occidentalis faces several challenges, including fragmentation across various fields, outdated studies, and inconsistent findings on its pharmacological and toxicological effects. Variability in its phytochemical composition due to geographical differences and extraction methods further complicates comparisons. Most research relies on animal and in vitro studies, with limited human clinical trials, making it difficult to confirm its therapeutic potential. There are also gaps in between ancient medicinal uses and scientific validation. Others are the problem of plagiarism, duplicative researches, and language barriers with non-English publications, and inability to meet the very strict requirements of high-impact journals. All these obstacles combined slowly the scientific understanding and application of Cassia occidentalis to modern medicine.

Conclusion

There are several bioactive substances in Cassia occidentalis that have important therapeutic potential. A variety of substances, including flavonoids, alkaloids, anthraquinones, phenolics, steroids, terpenoids, fatty acids, and saponins, have antioxidant, neuroprotective, hepatoprotective, anticancer, and antimicrobial properties. Toxicological assessment, sustainable farming, genetic advancements, and clinical validation for medication development should be the main areas of future study. Standardizing extraction techniques and evaluating the effects of climate change can improve its therapeutic potential and establish it as a viable herbal treatment for a range of illnesses which are unexplored including treatment on respiratory and cardiac diseases.

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