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Review Article

Pharmacognosy, Phytochemistry and Pharmacology of *Cassia occidentalis* Linn.

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ABSTRACT

Cassia occidentalis Linn. is an important member of plant family Leguminosae. Commonly known as kasundi or Negro coffee, it is generally found growing in India, Burma, Sri Lanka, Australia, United States of America; and many African countries. Its roots, leaves, flowers, and pods contain anthraquinones either in the free form or as glycosides. Pharmacological investigations have revealed the presence of several activities - antioxidant, analgesic, antipyretic, anti-inflammatory, hepatoprotective, antimalarial, antidiabetic, anticancer and antidepressant activities. This plant is also an ingredient of a commercially available formulation (Liv-52 produced by Himalaya Drugs, India) and used in treatment of liver disorders. This article is an attempt to present the overview of pharmacognostical, phytochemical, pharmacological and antimicrobial studies reported on *C. occidentalis*.

Keywords: *Cassia occidentalis* Linn. , Leguminosae, Antioxidant, Hepatoprotective, Anthraquinones.

INTRODUCTION

Cassia Linn. is an important genus of Leguminosae. There are more than 500 species in this genus. Medicinally important species in this genus are *Cassia angustifolia, C. acutifolia, C. occidentalis, C. javanica, C. tora, C. biflora, C. fistula, C. sophera* etc. These species are rich in phytoconstituents particularly phenolics exemplified by flavonoids and anthraquinones. Leaves and pods of several species possess laxative and purgative action apart from other effects on gastro-intestinal tract. These species possess antioxidant, analgesic, antipyretic, anti-inflammatory, hepatoprotective, antidepressant, muscle relaxant, immunosuppressant and anticancer activities[1].

Cassia occidentalis Linn. (Fig. 1) belongs to the family Leguminosae[2]. The taxonomic status of the plant has been well defined[1] (Table 1).

Botanical Synonyms[3]:

- *Senna occidentalis* Roxb.
- *Senna occidentalis* (L.)
- *Cassia foetida* Pers.

Common Names

The plant has a number of common names in English language[4]. Some of them are as follows:

- Coffee senna
- Negro coffee
- Rubbish cassia
- Stinking weed
- Foetid cassia.

Regional & Vernacular Names: The plant is known by several regional and vernacular names[4] (Tables 2-3).

Plant part used: Leaves

Geographical sources: *C. occidentalis* grows throughout the tropical and subtropical United States (from Texas to Iowa eastward), Africa, Asia and Australia. It is a common weed found throughout the India[5].

Morphological Description: *C. occidentalis* is an annual herb or under shrub. It reaches 60-150 cm in height. It grows at altitudes till 1,500 m. It bears compound leaves - 15-20 cm long and lanceolate or ovate-lanceolate in shape. Each compound leaf has 3 pairs of leaflets. The leaflets are membranous and ovate-lanceolate. The plant bears yellow flowers in short racemes. The mature plants produce characteristic pods. Pods are glabrous and recurved. They are 10-13 cm long and 0.8 cm wide. Pods carry numerous dark olive green-coloured seeds. The seeds are up to 6mm long and 4mm wide. They are hard in texture and have lustrous appearance[4].

Microscopy: The diagnostic microscopical characters of this plant[6] are as follows:

Leaves

- Trichomes: Glandular and non-glandular trichomes towards the leaflet margin.
- Midrib: Midrib prominent. Collenchyma adjoining the lower epidermis.
- Crystals: Prismatic and rosette calcium oxalates in palisade and parenchyma.

Stem:

- Endodermis: Distinct young and mature.
- Epidermis: Ruptured off in mature stem.
- Cork: Present.
- Cortex: Inner layers of parenchyma and 1-2 inner collenchyma layers.
- Pericycle: Ring of fiber and stone cells.

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Fig. 1: Cassia occidentalis Linn. growing in Mohali.

- Cambium: 2-6 layers wider
- Crystal fibers: Present in xylem
- Vessel: Radially arranged

Root:

- Primary structure: Tetrarch stele
- Cork: 7-12 layers
- Phelloderm: 3-5 layers
- Phloem fibers: Present
- Medullary rays: Less dilated 10-20 µm wide
- Cambium: 2-4 distinct layers
- Ray cells: Difficult to distinguish from xylem parenchyma
- Crystals: Absent
- Vessels: Radially arranged

Phytoconstituents: Several Phytoconstituents have been reported from various parts of the plant.

Leaves: Leaves contain chrysophanol, emodin and their glycosides, physcion, metteucinol-7-rhamnoside; jaceidin-7-rhamnoside and 4, 4, 5, 5-tetrahydroxy-2,2-dimethyl-1,1-bianthraquinone[4] and flavonoid glycosides[1].

Root: Roots have been reported to contain pinselin (cassiallin), rhein, aloe-emodin and their glycosides; chrysophanol, physcion, emodin, islandicin, helminthosporin, xanthorin, sitosterol, campesterol, stigmasterol, 1,8-dihydroxyanthraquinone; 1,7-dihydroxy-3-methoxyxanthone; α-hydroxyanthraquinone and quercetin, questin, germichrysone, methylgermitorosone, singueanol-I, pinselin; bis(tetrahydro)anthracene derivatives[4]; occidentalol-1 and occidentalol-II, C-glycosidic flavonoids; and cassiaoccidentalins A, B and C flavonoids[2].

Seeds: Seeds contain anthraquinones, 1,8-dihydroxy-2-methylanthraquinone; 1,4,5-trihydroxy-7-methoxy-3-methylanthraquinone; physcion & its glucoside, rhein, aloe-emodin, chrysophanol & its glycoside, N-methyl-morpholine; α-glucosides of campesterol & β-sitosterol; and a galactomannan[4].

Flowers: Flowers contain the phytoconstituents: β-sitosterol, emodin, physcion, physcion-1-β-D- glucoside[4].

Pods: The fruits (pods) contain 3,5,3,4-tetrahydroxy-7-methoxyflavone-3-O-(2-rhamnosyl glucoside); 5,7,4-trihydroxy-3,6,3-trimethoxyflavone-7-O-(2" -rhamnosylglucoside)[4].

Traditional uses[4]

Whole plant: The herb is used as condiment; and in perfumes. The leaf is reported to act as a prophylactic against leucorrhoea. All plant parts have purgative, febrifugal, expectorant and diuretic actions. The plant is used in treatment of sore eyes, haematuria, rheumatism, typhoid and leprosy. Decoction of the whole plant is used for treating hysteria, dysentery and GIT problems including inflammation of the rectum. "Liv-52" a formulation of *C. occidentalis* shows beneficial effect in the early patients of hepatic cirrhosis having steatorrhoea. An infusion of the stem is used in treating diabetes mellitus.

Roots: The roots are bitter, purgative, anthelmintic and diuretic. Roots are given with lime to treat dysentery and diarrhoea associated with malaria. They are used for relief in cramps, itches and sore throat. The rootbark is also used cure malaria. Rootbark decoction is an effective remedy against gonorrhoea and hepatic malfunction.

Leaves: The leaves posses purgative, febrifugal, diuretic and stomachic properties. Leaves are also used in management of cough and hysteria. The leaves provide relief in skin problems (itching, yaws, scabies and ringworm). A mixture of the fresh leaves, salt and onions is applied as a poultice to cause expulsion of guinea worm. Leaves are also useful in the inflammatory swellings, rheumatism, jaundice, pleurisy, headache and toothache.

Seeds: The seeds result in weight loss and cause toxicity in animals. The seeds are bitter and have febrifugal and purgative properties. They are used as blood tonic and excellent diuretics. They are beneficial in ordinary as well as whooping cough. Seed powder is externally applied for treating skin problems[4].

Pharmacological activities: The plant possesses a number of pharmacological activities:

Hepatoprotective activity: The aqueous extract of *C. occidentalis* seeds (100, 200 and 400 mg / kg body weight) was orally administered to rats in paracetamol(PCM) - induced hepatotoxcicity. This extract decreased PCM - induced injuries in rat liver in a dose - dependent manner. This activity was presumably attributable to the presence of phenolics such as anthraquinones[7]. Methanolic fraction of leaves (200 mg / kg) and chrysophanol (50 mg / kg) were evaluated in PCM-induced hepatotoxic model in male Albino Wistar rats by oral route. The elevated liver enzymes were restored to normalcy[8]. Ethanolic extract of leaves (100 mg/kg) has been found to be effective against carbon tetrachloride- and thioacetamide - induced hepatotoxicity in rats[11]. Aqueous-ethanolic extract (50% v/v) of leaves has shown protection against PCM-induced and ethanol-induced hepatic injuries in rat models[10]. Chrysophanol and methanolic extract of leaves were tested in male Albino Wistar rats against PCM – induced hepatotoxicity. Oral administration of chrysophanol and extract were able to reduce elevated levels of SGOT, SGPT and alkaline phosphate[8].

Antioxidant activity: Ethyl acetate fraction of whole plant has shown antioxidant activity in a number of models on DPPH radical, nitric oxide and hydrogen peroxide

Table 1: Taxonomical Status of *Cassia occidentalis* Linn.

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliophyta
Subclass	Rosidae
Order	Fabales
Family	Leguminosae
Subfamily	Caesalpinioidae
Tribe	Cassieae
Subtribe	Cassieae
Genus	*Cassia* L.
Species	*Cassia occidentalis* L.

Table 2: Regional names of *Cassia occidentalis* Linn.

Region	Regional name
Bihar	*Chakwar*
Bombay	*Hikal*
Delhi	*Ban bhates, dhadial*
Haryana	*Kasunda*
Jammu	*Badde haedma*
Rajasthan	*Chakundra, talka*
Tripura	*Eski, kalkashunda*
Uttar Pradesh	*Bara chakwar, bara pawar*

scavenging assays. This fraction tested positive for presence of phenolics such as flavonoids and tannins[11]. Methanolic extract of seeds exhibited free radical scavenging activity in several *in vitro* models such as DPPH free-radical scavenging, lipid peroxidation and reducing power assays. This activity is possibly due to the presence of polyphenolic group of phytoconstituents exemplified by flavonoids and tannins[12]. Whole plant ethanolic extract (250 mg / kg) exerts significant inhibitory effect on rat liver microsomal peroxidation. This effect may also be involved in the anti-inflammatory action of the extract[13]. The efficacy of chrysophanol (50 mg / kg) and methanolic fraction of leaves in antioxidant assay has been proven. Chrysophanol (200 mg /kg) and leaf extract were able to decrease lipid peroxidation and result in reduction of level of enzymes such as superoxide dismutase, catalase, glutathione peroxidise[8].

Analgesic and Antipyretic Activities: Ethanolic and aqueous extract of leaves (150 and 300 mg / kg) exhibited significant dose - dependent antinociceptive and antipyretic effects in rats/mice models[14].

Antimicrobial activity: Aqueous extract of leaves (30 and 60 mg/ml) exhibited significant inhibitory activity against *Escherichia coli* and *Salmonella typhi*. Aqueous and ethanolic extracts were not able to inhibit the growth of *Staphylococcus aureus*[15]. Chloroform and aqueous extracts of leaves exhibited no activity against *E. coli*. Aqueous extract was able to remarkably inhibit the growth of *Pseudomonas aeruginosa*[18]. Methanolic, hexane, chloroform and aqueous extracts of the leaves were able to inhibit growth of *E. coli*[17]. Methanolic and aqueous extracts of the leaves showed activity against e.g. *P. aeruginosa*, *P. mirabilis* and *Candida albicans*[18]. Hydroalcohlic extract of whole plant showed significant effects against *Bacillus subtillis*. This extract however; could not inhibit the growth of *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*[19]. Aqueous extract of the plant failed to exhibit activity against *Aspergillus niger*, *A. flavus*, *A. fumigates* and *Candida albicans*[20]. Leaves, seeds and pods were found to have antifungal activity against *Candida albicans, Aspergillus clavatus and A. niger* [21].

Anti-inflammatory activity: Whole plant ethanolic extract (250mg/kg) showed anti-inflammatory activity in carrageenan induced mouse paw odema model[22].

Anticancer activity: Aqueous and hydro-alcoholic extracts of whole plant had been shown to cause growth inhibition of eight human cancer cell lines viz. HCT-15, SW-620, COLO-205 (colon); OVCAR-5 (ovary), PC-3 (prostate), HOP-62 (lungs), MCF (breast) and SiHa (cervix)[19].

Anti-allergic activity: Whole plant ethanolic extract (250 mg/kg) showed significant inhibitory effects on rat mast cell degranulation and caused stabilisation of human red blood cell membrane. It was observed that the higher doses of the extract offered less protection against rat mast cell degranulation and caused cytotoxicity to the mast cells[22].

Muscle-Relaxant Effect: Aqueous extract of the leaves was found to inhibit aortic ring contractions elicited by noradrenaline and potassium chloride in a dose dependent manner[23].

Anti-diabetic activity: Hypoglycaemic activity of leaves was evaluated in male albino Wistar rats. Methanolic and aqueous extracts of leaves exhibited significant reduction in fasting blood glucose levels and plasma insulin in diabetic rats[23]. Butanolic and aqueous extracts of the leaves were able to exert antidiabetic effects in alloxan-induced diabetes model in mice[24]. Aqueous extract of leaves had shown antidiabetic activity in alloxan-induced diabetic model[25].

Wound healing activity: Chrysophanol extracted from the leaves had shown a wound healing effect in albino Wistar rats. This compound was able to cause decrease in the period of epithelialization and increase rat of wound contraction[26].

Immunosuppressant activity: The aqueous extract of plant (100mg/kg bw) was able to induce suppression of humoral immunity in rats exposed to cyclophosphamide[27].

Anti-inflammatory activity: Oral administration of powdered leaves (200mg/kg) had beneficial effects in carrageenan- induced rat paw odema as well as cotton pellet granuloma models[28].

Cholinergic effect: A quarternary base picrate (mp 242-244º) isolated from the leaves produced contraction of guinea pig ileum and decreased blood pressure in dogs[29].

Antimalarial activity: MALARIAL 5'- a drug composed of leaves of *C. occidentalis* and *Lippie chevalieri* and flowers of *Spilanthes oleracea* was found active against *Plasmodium falciparium*[30].

Antidepressant activity: Ethanolic and aqueous extracts of the leaves possessed anti-anxiety and antidepressant activities[31].

Table 3: Vernacular Names of *C. occidentalis* Linn.

Language	Vernacular name
Hindi	*Badikasondi, chakunda, kasonda*
Sanskrit	*Kasamarda*
Tamil	*Nattamtakarari, ponthagarai, paeravirai, ponnavirai, paeravirai, nattutakarai*
Urdu	*Kasonji*
Bengali	*Kalkashunda*
Gujarati	*Kasodari, kasundari, kasuvayee, hikal*
Kanada	*Doddatagase, anecogate, doddatagache*
Malyalam	*Natramtakara, ponnaviram, natrum-takara, ponnaveeram*
Telu	*Kasinda, peddakasinda*

CONCLUSIONS

Cassia occidentalis Linn. is an important source of anthraquinones and flavonoids. The plant parts have exhibited numerous activities in experimental models. The literature reports have revealed the potential of leaves for drug development.

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