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A REVIEW ON PHYTOPHARMACOLOGICAL PROPERTY OF: *SENNA OCCIDENTALIS* (*L.*)

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ABSTRACT

Senna occidentalis L. (Fabaceae), commonly known as coffee senna, chakunda, wild senna, is a plant with a significant presence in traditional medicine, particularly in various parts of Africa, Asia, and the Americas. The plant has long been utilized for its therapeutic properties, including its use as a purgative, antimicrobial, and anti-inflammatory agent. This review explores the ethnobotanical applications, phytochemical composition, and pharmacological potential of *S. occidentalis*, highlighting its therapeutic significance. Phytochemical analysis has revealed the presence of bioactive components such as alkaloids, flavonoids, saponins, and tannins, which contribute to its medicinal effects. The pharmacological activities of *S. Occidentalis*, including its anti-inflammatory, analgesic, antidiabetic, and anticancer properties. Despite its promising therapeutic value, further research is necessary to better understand its mechanisms of action and to evaluate the safety and efficacy of its use in modern medicine. This review emphasizes the importance of preserving traditional knowledge while encouraging scientific investigation into the potential of *Senna occidentalis* as a source of novel therapeutic agents.

KEYWORDS: Bioactive components, Pharmacological potential, *Senna occidentalis L.*, traditional medicine.

INTRODUCTION

Plants are a vital source of pharmaceuticals, particularly in traditional medicine.[1] According to WHO, more than 70 percentage of the global population depends on medicinal plants for primary health care.[2] Infectious diseases from bacteria, fungi, viruses, and parasites continue to be a major public health threat, especially in developing countries with limited access to medication and growing drug resistance.[3] Medicinal plants are rich in bioactive compounds, or phytochemicals, which are secondary metabolites. These compounds are not essential for the plant's basic functions but

are used in many plant-derived drugs for their therapeutic properties.[4] The medicinal properties of phytochemicals stem from their ability to produce specific physiological effects in the human body. Examples include alkaloids, tannins, saponins, glycosides, flavonoids, and essential minerals like phosphorus and calcium, which support cell growth, repair, and development.[5] In the past twenty years, drug resistance and side effects from antibiotics have driven the search for new antimicrobial agents, especially from plant extracts, to discover novel chemical structures that can tackle these challenges.[6] It has antibacterial, antidiabetic, antioxidant, and antimalarial properties, and demonstrates notable hepatoprotective and anti-inflammatory activities.[7] *Senna occidentalis* is an upright, branched herb that grows 2 to 3 meters tall, with both annual and perennial varieties. It has alternate, paripinnate compound leaves, and the petiole features a dark purple-brown, oval gland near the stem junction.[8] The leaves of Senna occidentalis typically come in pairs of three to five, with larger lanceolate or oblong-ovate leaflets and smaller ovate ones with short stalks. The leaflets have acuminate tips and emit a foul odor. The yellow flowers appear in short axillary racemes or at the terminal leaf axils. The flat, thin, slightly curved pods contain 30 to 40 pale brown, dull-seeded.[9]

Taxonomical Classification

The taxonomical classification of senna occidentalis (L.) is describe in following table(1)

Table-1.

Kingdom	Plantae (Plants)
Phylum	Streptophyta
Class	Equisetopsida
Subclass	Magnoliidae
Order	Fabales
Family	*Fabaceae* (Legume family)
Subfamily	Caesalpiniaceae
Genus	*Senna*
Species	*Senna occidentalis (*L.*)*
Synonym	*Cassia occidentalis (*L.)

Morphological study

Senna occidentalis (Coffee Senna or Chakunda) is a tropical plant from the Fabaceae family, typically a short-lived perennial or annual herb that can grow up to 2 meters tall, although it usually stays between 50 cm and 1 meter. It has a taproot and emits a distinct unpleasant odor from its leaves. The leaves are alternate, compound, and paripinnate, 10 to 15 cm long, with oval to elliptical leaflets that range from 3 to 8 cm long and 15 to 40 mm wide. Small, triangular stipules (2 to 4 mm long) are found at the base of the petiole. The flowers are 1.5 to 3 cm in diameter and either solitary or in small clusters of 2 to 5 at the branch tips. Each flower has 5 green, elliptical sepals, 5 yellow oval petals (about 13 mm long), 10 stamens (6 fertile), and a linear, curved, hairless ovary with a recurved, hairy stigma. The fruit is a curved, flattened pod (10 to 15 cm long and 7 to 8 mm wide) that turns beige when ripe. It contains 20 to 30 oblong, brown seeds, each about 4 mm long and 3 mm wide. When shaken, the seeds rattle inside the pod.[10]



Fig.(A) **Fig. (B)** **Fig.(C)**

***Senna Occidentalis L.* Plant and its Parts (fig. A: Plants, B: Flowers, C: Seeds.)**

Phytochemistry

Fluorescence spectrophotometry analysis shows that Senna occidentalis is rich in minerals, particularly Fe, Ca, K, Mn, Mg, Zn, Cu, Na, P, and S. A deficiency in Ca and P can cause bone-related issues like rickets, while Mg is vital for body structure and function. Fe, Zn, Cu, and Mn are essential for boosting the antioxidant system.[11] Zinc supplementation has been found to support the growth of stunted children and decrease the occurrence of specific childhood illnesses like diarrhea. Zinc deficiency is expected to be a major public health concern, particularly in developing nations.[12] According to the Food and Agriculture Organization (FAO), about 20% of the global population may be at risk of zinc deficiency, with an average daily intake below 70 mg/d. To address this, large-scale cultivation of Senna occidentalis has been promoted to help combat iron and zinc deficiencies. Additionally, the plant species contains lead (Pb) concentrations between 2 and 6 mg/L.[13] Preliminary phytochemical analysis of an organic extract from *S. occidentalis* has indicated the presence of alkaloids, carbohydrates, flavonoids, phenolic compounds, tannins, and lignins in the aerial portions of the plant.[14] A study on *S. occidentalis* indicates that the nature and concentration of its phytochemical compounds vary with the climate. For example, in Ivory Coast, the stems, leaves, and root bark of the plant contain only a small amount of saponins, with no alkaloids, sterols, triterpenes, quinine, tannins, or flavonoids. In contrast, in Ethiopia, significant quantities of alkaloids have been detected in the stems, leaves, and fruits.[15,16,17]

Whole plant

The 3,2-dihydroxy-7,8,4-trimethoxy flavone-5-βD-allopyranoside compounds (fig.1) were extracted from the entire plant using ethanol. Chemical analysis and spectroscopic methods were employed to establish the chemical structures. Additionally, three new flavonoids, classified as C-glycosidics and named Cassia occidentalines A, B, and C, containing 3-keto sugar, were isolated from the aerial parts of the plant.[18]

Root

Researchers have found that the roots of *S. occidentalis* contain approximately 1.9-4.5% free anthraquinones.[19] Emodine, 1,8-dihydroxyanthraquinone, and the flavonoid quercetin have also been identified in the roots.[20] It has been noted that young root samples lack chrysophanol. Moreover, sennosiolline, which was initially misidentified, was later confirmed to be epinelin, as established by Kudav et al. in 1947.[21] Rheine's study further identified the presence of 1,7-dihydroxy-3-methyl xanthone.[22] Two sterols, β-sitosterol and campesterol, were found simultaneously in the plant.[23]

Seeds

Later, a derivative of 1,4-oxazine N-methyl morpholine was synthesized using samples from the grains of *S. occidentalis*.[24] Researchers have also reported the presence of heterosides of physciondianthrone and physcion, which condense into homodianthrone, along with a mixture of anthraquinones[25], 1-glucoside of physcion (0.018%) and physcion (0.0068%) in the seeds of *S. occidentalis*. Additionally, two new anthraquinones were discovered: 1,8-dihydroxy-2-methyl anthraquinone and 1,4,5-trihydroxy-3-methyl anthramethanox[26], in addition, aglycoside forms of these compounds have also been isolated from the seeds of *S. occidentalis*.[27]

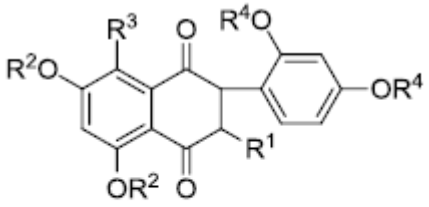
Leaves

The leaves of *S. occidentalis* have been shown to contain a mixture of flavonoid C and apigeninn **(**fig.2). In addition to these compounds, the researchers also identified vitexin, 7-vexin heteroside, chrysophanol, emodine, glycosides, and free physcion.[28]

Bianthraquinone 1,1-bi-4,4′, 5,5′-tetrahydroxy-2,2′-dimethyl anthraquinone, as well as the flavone meterucinol-7-O-α-L-rhamnoside, were also isolated from samples of *S. occidentalis* leaves. Other substances found in *S. occidentalis* leaves include alkaloids, flavonoids, tannins, phlobatannins, chrysophanol, emodine, physcion, tetrahydroanthracene derivatives, germichrysone, and westernins A, B, and C. These compounds are known to have potent anticancer properties.[29] Ethanolic and aqueous extracts from Nigerian *S. occidentalis* leaves have shown the presence of alkaloids, tannins, saponins, and phlobatannins.[30]

Flower

Chemical analysis of *S. occidentalis* flowers indicated the presence of anthraquinones, emodine, physcion, physcion-1-O-β-D-glucoside, and the sterol β-sitosterol(fig.3).[31] Maillard identified the bioside as a neohesperidoside.The two glycosides were discovered for the first time as natural products.[32] 1,8-Dihydroxy-2-methyl anthraquinone, 1,4,5-trihydroxy-7-methoxy-3-methyl anthraquinone, physcion, rhein, aloe-emodine, chrysophanol, and steroid glycosides have also been reported in *S. occidentalis* pods(fig.4).[33]



1) R^1=R^4 = OH, R^3 = CH_3, R^4 = OCH_3
2) R^2= D-glucose, D-galactose,
3) R^1=R^2=R^4= D-allose sugar

Fig. 1: The isolated Phytochemical compounds.

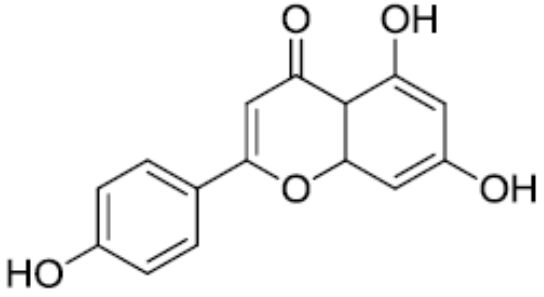


Fig. 2: Chemical structure of apigenin of the Plante of *S. Occidentalis*

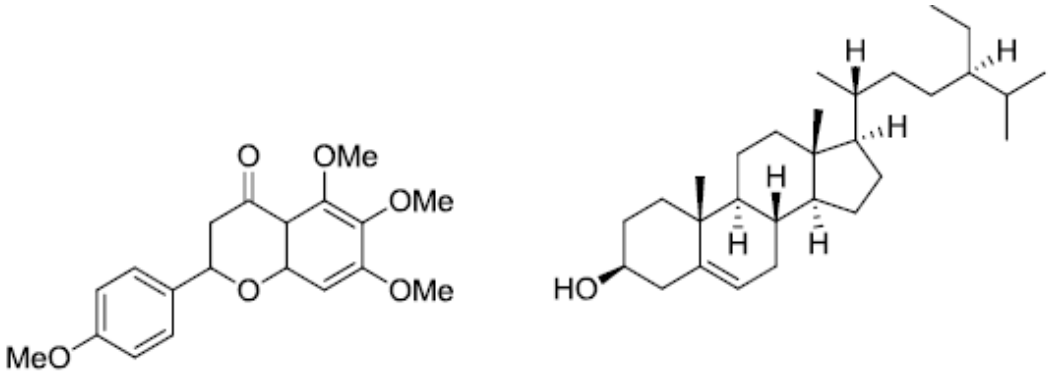


Fig. 3: The chemical structures of β-Sitosterol and Physcion-1-0-β-D-glucoside.

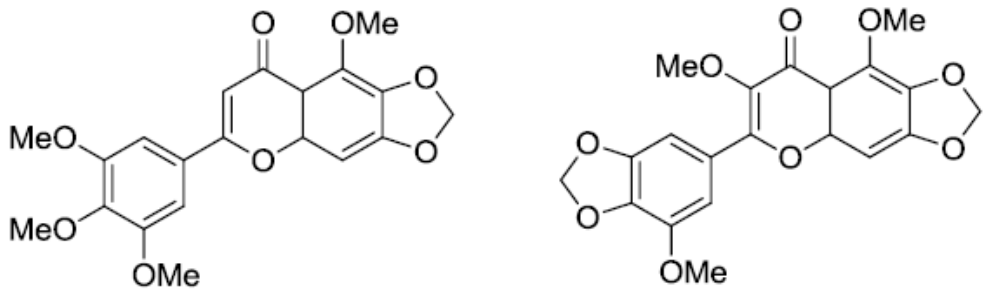


Fig. 4: Chemical structures of flavonoid A and B.

Pharmacological profile

Senna occidentalis has demonstrated significant following properties-

Antioxidant properties

The plant has been found to increase the activity of endogenous antioxidant enzymes such as superoxide dismutase (SOD) and catalase. These enzymes play a crucial role in protecting cells from oxidative damage by neutralizing free radicals and reactive oxygen species (ROS).[34]

Hepatoprotective effect

The research by Jafri and collaborators demonstrated that the organic and ethanol extract of *S. occidentalis* leaves provided significant liver protection in rats with liver damage induced by paracetamol and ethyl alcohol. This was confirmed through serum analysis and histopathological changes. The plant's extracts also reduced DNA degradation caused by the iron-induced Fenton (II) reaction, likely due to its ability to chelate ferrous ions. Additionally, the traditional herbal formulation Himoliv (containing *S. occidentalis*) helped prevent hepatotoxicity induced by carbon tetrachloride, reduced lipid peroxidation (MDA), and increased the activity of protective enzymes like SOD and catalase in rat liver homogenates.[34][35]

Antimalerial effect

Different extracts from *S. occidentalis* have shown significant antimalarial activity.[36] Ethanolic extracts of ***S. occidentalis*** bark and root, along with lyophilized dichloromethane extracts, were tested for antimalarial activity in mice over four days against P. berghei Anka. No toxic or fatal effects were observed at a dose of 500 mg/kg**,** either as a single dose or administered twice a week for a month. However, at a 200 mg/kg dose, both the ethanol and dichloromethane extracts from the bark and roots demonstrated significant chemo-suppressive effects**,** reducing

parasitemia by more than 60%. The lyophilized aqueous extract was found to be less potent compared to the ethanol extract.[37] While both the ethanol and chloroformic extracts demonstrated strong antimalarial activity, Tona and co-workers speculated that these extracts inhibited more than 60% of parasitic growth at a concentration of 6 µg/ml, a finding that was later confirmed in their subsequent study.[38]

3. Antiinflamatory effect

Sadique and colleagues demonstrated that isolated compounds from ***S. occidentalis*** leaves exhibited significant anti-inflammatory activity using the carrageenan-induced paw edema test and the cotton ball granuloma model**.** The plant was most effective at a dose of 2000 mg/kg. The extracts also helped reduce lipid peroxide levels. Additionally, the study found that the compounds decreased the activity of gamma-glutamyl transpeptidase and phospholipase A2 in the exudates of the cotton pellet granulomas, leading to a reduced availability of arachidonic acid**,** a precursor for the biosynthesis of prostaglandins, which are involved in inflammation.[39]

4. Antimutagenic / Anticancerous Activity

Kinase inhibitors of the proto-oncogene cellular-Sarcoma (c-Src or simply Src) family have been demonstrated to be involved in multiple signal transduction pathways, which are regulated by oncogenes. A study by Chang et al. examined the activity of *S. occidentalis* (a Chinese anti-tumor medicinal plant) on Src tyrosine kinase Lck (p56lck) and found the plant to exhibit significant activity in this bioassay.[40] A subsequent study by Sharma and colleagues found that Senkot tablets made from ***S. occidentalis*** extracts inhibited the mutagenicity of benzopyrene**,** aflatoxin B1**,** and methyl methanesulfonate in the Ames test**.** The extract interfered with metabolic processes activating procarcinogens and also reduced chromosomal aberrations caused by benzopyrene and cyclophosphamide in mice.[41]

5. Other Activities

S. occidentalis is one of the primary ingredients in Herbolax, an herbal formulation commonly used to treat constipation. The efficacy of Herbolax was confirmed in a study with 30 participants, all of whom reported smooth and effortless stool evacuation. None of the patients experienced purging, pinching, or abdominal pain after treatment. Moreover, none of the subjects complained of watery stools, weakness, lethargy, or cramps, and no recurrence of constipation was observed after two weeks.[42]

Toxicological study:- *Senna occidentalis* has been found to cause toxic effects in animals, primarily affecting the skeletal muscles, liver, kidneys, and heart. The toxicity rate ranged from 0.05% to 0.5% of body weight, with acute atrophy of the liver and muscles observed in animals that received its extracts. Reports have also indicated poisoning in chickens, showing symptoms like weight loss, weakness, diarrhea, hypothermia, occasional ataxia, decubitus, and death after consumption. Macroscopic lesions in these chickens revealed pallor in the skeletal and cardiac muscles, as well as liver congestion.[43,44] Additional signs of toxicity in chickens included focal swelling, fragmentation, and necrosis of muscle fibers in the semi-tendinous muscle observed during histological examination.[45] Poisoning due to *S. occidentalis* in children appears to primarily affect three systems: the liver, skeletal muscles, and the brain.[46] In addition, it has been shown that the leaves of *S. occidentalis* contain phytochemical compounds that can be toxic to humans. A detailed study on shrimp brine exposed to the methanolic and chloroformic extracts from *S. occidentalis* leaves revealed that these extracts were lethal, with an LC50 value as low as 0.995 µg/ml.[47]

CONCLUSION

In conclusion, *Senna occidentalis* is a valuable plant with a wide range of medicinal 1properties, including antioxidant, hepatoprotective, antimalarial, anti-inflammatory, and anticancer effects. Its bioactive compounds, such as alkaloids, flavonoids, and anthraquinones, contribute to its therapeutic potential. However, despite these benefits, the plant also poses toxicity risks, particularly to the liver, muscles, and heart, when consumed in large quantities. Thus, while *Senna occidentalis* holds promise in traditional medicine, its use requires caution, and further research is essential to better understand its safety and efficacy.

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