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Review Article

PHARMACOLOGICAL PROFILE OF CASSIA OCCIDENTALIS L – A REVIEW

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ABSTRACT

Cassia occidentalis L. is an Ayurvedic medicinal plant used as a traditional medicine for the treatment of various diseases. This plant extracts are known to have antibacterial, antifungal, antimalarial, anti-inflammatory, antioxidant, hepatoprotective and Immunosuppression activity. Phytochemical constituents include achrosin, aloeemodin, emodin, anthraquinones, anthrones, apigenin, aurantiobtusin, campesterol, cassiollin, chryso-obtusin, chrysophanic acid, chrysarobin, chrysophanol, chrysoeriol etc. have been investigated in *Cassia occidentalis*. This review summarizes the ethnopharmacological, phytochemical, bioactivity and toxicity studies of *C. occidentalis* plant.

Keywords: *Cassia occidentalis*, Phytochemical, Pharmacological, Bioactivity, Toxicity studies

INTRODUCTION

Plants have been used as a traditional medicine and pharmacopoeial drugs from ancient times. Most of world's population is depend on plant due its medicinal value and scarcity [1, 2]. Medicinal plants have been used for the treatment of illness since ancient period [3]. Numerous plant-derived therapeutic agents for the modern medicine have been provided by medicinal plants [4, 5]. Most of the plants exhibit a variety of phytopharmaceuticals, which has important applications in the fields of agriculture, human and veterinary medicine. This plays a major role in developing novel drugs for the treatment and prevention of diseases [6]. Therefore it is very important to have sufficient knowledge regarding herbs not only because of their widespread uses, but also because they have the potentials to cause toxic reactions or interact with other drugs [7]. Although in traditional medicine *Cassia* species have been well known for their laxative and purgative properties and for the treatment of skin diseases [8]. *Cassia occidentalis* Linn. has been used as a folklore medicine for hepatotoxicity treatment [9]. There is now an increasing body of scientific evidence demonstrating that the plants possess many other beneficial properties.

Plant Description

Cassia occidentalis Linn, usually grows in the southern part of India which is known as Kasmard in Sanskrit, Kasondi in Hindi and Coffee Senna in English. The plant belongs to Caesalpiniaceae family. The common name is Ponnavarai in Tamil. The roots, leaves and seeds are the parts of the plant used. It is an erect herb, commonly found by road sides, ditches and waste dumping sites. *Cassia occidentalis* has been widely used as traditional medicine. Entire parts of the plant have medicinal values [10].

Chemical Constituents

Phytochemical screening of the plant showed the presence of carbohydrates, saponins, sterols, flavonoids, resins, alkaloids, terpenes, anthraquinones, glycoside and balsam. Presence of these metabolites strongly concluded the great potential of the plant as a source of phytomedicines. As the flavonoids and resins are present, it might be responsible for its anti-inflammatory properties. Chinese folkloric medicine contains flavonoids which has anti-inflammatory effect on both acute and chronic inflammation [11, 12]. Alkaloids are known for decreasing blood pressure, balancing the nervous system in case of mental illness and antimalarial properties [13]. Tannins help in wound healing and anti-parasitic. Presence of terpenes suggests possessing anti-tumor and anti-viral properties.

Eudesmane sesquiterpenes have been reported to contain antibacterial properties. Saponins are believed to have antioxidant, anti-cancer, anti-inflammatory, and anti-viral properties. The anthraquinones, emodin and chrysophanone have been reported to possess wound healing properties. Other compounds reported in literature include, 1,8-dihydroxyl-2-methyl anthraquinone, 1,4,5-trihydroxy-3-methyl-7-methoxy anthraquinone, cassiaoccidentalin A, B and C, which are C-glycosides, achrosine, anthrones, apigenin, aurantiobtusin, campesterol, cassiollin, chryso-obtusin, chrysophanic acid, chrysarobin, chrysoeriol, essential oils, funiculosin, galactopyranosyl, helminthosporin, islandicin, kaempferol, lignoceric acid, linoleic acid, linolenic acid, mannitol, mannopyranosyl, matteucinol, obtusifolin, obtusin, oleic acid, physcion, quercetin, rhamnosides, rhein, rubrofusarin, sitosterols, and xanthorin [14, 15].

Pharmacognistic analysis of the plant showed 10% moisture thus less sensitive for microbial attack and 7.4% total ash value indicates the low amount of inorganic substance. It contained 5.3% of acid insoluble ash value suggested that the soluble inorganic component is small. The alcohol and water extractive values were 7.7% and 15.1% respectively showed that water is a better solvent of bulk extraction than alcohol.

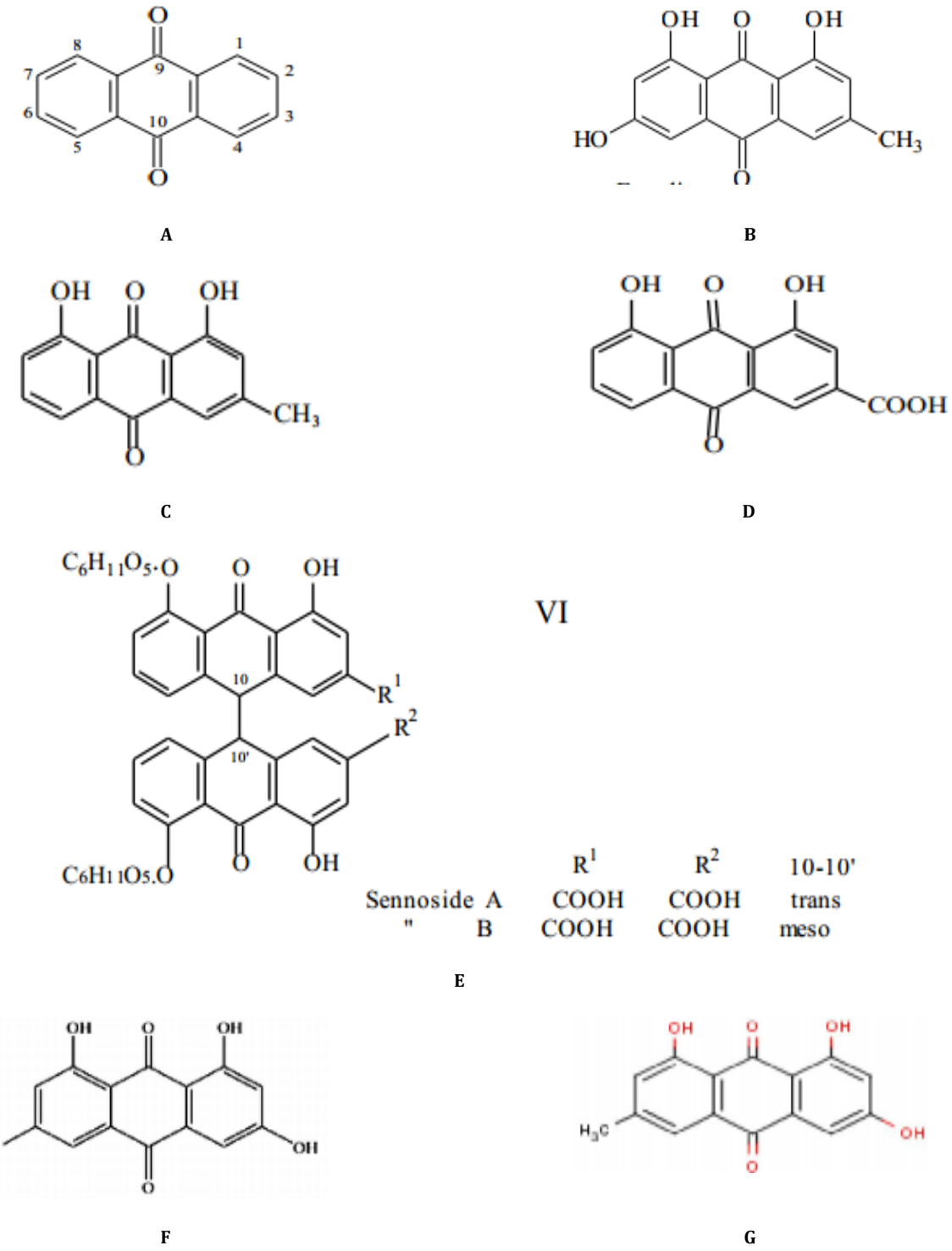

Fig. 1: Phytochemicals constituents present in *Cassia occidentalis* extract. (A) Anthraquinone (B) Emodin1,6,8-trihydroxy-3-methylanthraquinone (C) Chrysophanol 1,8-dihydroxy-3-methylanthraquinone (D) Aloe-emodin 1,8-Dihydroxy-3-hydroxymethylanthraquinone (E) Rhein 1,8 Dihydroxy-3-carboxylic acid anthraquinone (F) Chrysophanic acid (G) Emodin

Pharmacological Activities

Antimicrobial activity

A study was carried on *Cassia occidentalis* antimicrobial properties [16]. Test was conducted with four different extracts such as methanol, aqueous, benzene, petroleum ether and chloroform extract. Among which methanol extract showed positive against *P. aeruginosa, K. pneumoniae, P. mirabilis, E. coli, S. aureus* and *S. epidermidis*; aqueous extract was effective against *P. vulgaris, K. pneumoniae* and *P. aeruginosa*; benzene and petroleum ether extracts was active against *P. mirabilis* and *E. coli;* chloroform extract was found to be very inactive against all tested strains. Another study [17] reported maximum activity against *Salmonella typhi* and minimum with *Shigella spp.* This study concluded that antibacterial activity of *Cassia occidentalis* leaves of ethanol and water extract were increase with higher concentration.

A report [18] with *Cassia occidentalis* flower extract showed maximum inhibition against *Klebsiella pneumonia and* no activity against *Staphylococcus aureus, Streptococcus pneumoniae,* and *Pseudomonas aeruginosa. Thus the* flower extract of *Cassia occidentalis* can be used to treat *Klebsiella* associated ailment such as pneumonia, bronchitis and other diseases known to cause by *K. pneumonia.* A report [19] states that the *E. coli* was sensitive to methanol, hexane, chloroform and aqueous extract of leaves of *C. occidentalis*. Similarly, Jain and his coworkers [20] observed that the metabolite rich fraction of (anthraquinones) leaves, pods, flowers and callus were effective against *E. coli*. Yet other study showed that the petroleum ether and ethanolic extract of leaves of *C. occidentalis* was active against *E. coli*. With Chloroform and aqueous extract the inhibition was not observed against *E. coli*. Based on these experiments we can clearly say that changes in the activities of plant extracts might be due to spatial and temporal variations. *P.aeruginosa* showing multidrug resistance is highly challenging to treat by conventional antibiotics. A study [21] tested the efficiency of leaf extract of *C. occidentalis* against the growth of *P.aeruginosa* and found that the microbial growth was highly inhibited. And the crude extracts was effective on some microbes such as *Staphylococcus aureus, Escherichia coli, Bacillus subtilis* and *Candida albicans* which was a common causative agent of urinary tract infection and diarrhea diseases [22]. As this plant has potential antimicrobial activity but invivo studies with the extract should be carried out to confirm that the zone of inhibition is not only by the sensitivity of the microbes also the concentration is highly essential when using for treatment.

Antioxidant activity/hepatoprotective activity

The aqueous–ethanolic extract of leaves of *C. occidentalis* was tested for hepatoprotective activity on liver damage in rat which was induced by paracetamol and ethyl alcohol by monitoring serum transaminase, alkaline phosphatase, serum cholesterol, serum total lipids and histopathological alterations. They found that the leaf extract had shown significant hepatoprotective activity [23]. Some other observations had found that the seed extracts of *C. occidentalis* limits the DNA degradation caused by iron (II)-driven Fenton reaction. It is notable that inhibition of DNA damage may be due to their capability of strong ferrous ion chelation. Further, they proposed that the scavenging activity towards free radicals might be the reason. *C. occidentalis* is an ingredient in Himoliv, a polyherbal ayurvedic formulation. It is also proved that it prevents the carbon tetra chloride induced hepatotoxicity in rats [24]. Based on the observation they suggested that Himoliv increases the protective enzymes superoxide dismutase (SOD) and catalase in liver homogenate of rats [25]. It is also present in other polyherbal formulation Liv.52 tablet and syrup extensively used for Hepatitis A (HA). For the preparation of this syrup, other plants included *Capparis spinosa, Cichorium intybus, Solanum nigrum, Terminalia arjuna, Achillea millefolium* and *Tamarix gallica* etc along with *C. occidentalis* are present. A study with 50 clinical samples over 30 years with 4490 patients was performed to identify the efficacy with short and long term safety of Liv.52 in Hepatitis A [26]. This study concluded that Liv.52 tablets and syrups are potential and safer for hepatitis A.

Antimalarial activity

C. occidentalis plant extract was proved to have effective antimalarial activity[26,27,28]. A study with ethanolic, dichloromethane and lyophilized aqueous extracts of *C. occidentalis* root bark was tested for antimalarial activity against *Plasmodium berghei* ANKA. They tested its toxicity by treating the orally and found that there was no toxic effect or mortality in mice with a single dose, of 500 mg/kg of body weight, or same dose given twice weekly for 4 weeks. The extracts produced significant chemo suppressions of parasitemia with 200 mg/kg dose when administered orally. *C. occidentalis* was found to be potential with 60% chemo suppression. They also found that the ethanolic extract is more active than the lyophilized aqueous extract. *C. occidentalis* leaf extract with ethanol and chloroform was found to possess better antimalarial activity. When tested with 6 µg/ml concentration more than 60% inhibition was observed against the parasite.

Larvicidal Activity

The larvicidal and pupicidal potential of *Cassia Occidentalis* was analyzed in a study [29] against the larvae of *Anopheles Stephensi.* The ethanol extract of *Cassia Occidentalis* were found to be more effective against larva and pupa respectively. The smoke toxicity study was also conducted and identified that it was more effective against the *Anopheles stephensi*. Smoke exposed gravid females oviposited fewer eggs when compared to those that were not exposed. Yet another study [30] reveal that seed oil creates increase in mortality of *C. maculatus* eggs. Based on numerous trials with pure compounds suggested that fatty acids (linoleic, oleic and stearic) are responsible for *C. occidentalis* toxicity. The oviposition of *C. maculatus* was not reduced by *C. occidentalis* seed oil at 10 ml/kg seed.

Immunosuppression

To determine the Immunosuppression [31], cyclophosphamide (CP) was administered intraperitoneally in a single dose of 50 mg/kg b.w. Body weight, relative organ weight, lymphoid organ cellularity, hemagglutination titer (HT); plaque forming cell (PFC) assay and quantitative hemolysis of SRBC (QHS) were analyzed in animals. It has suppressive effects on lymphoid organ weight and cellularity and other parameters of humoral immunity. The CP-exposed animals were administered with plant extract and showed better humoral responses. The plaque forming cells were found to be more in CP-treated animals after *C. occidentalis* administration. In QHS assay, also *C. occidentalis* showed protection in CP-treated animals. They also found out that the bone marrow cell counts were much higher in plant extract treated animal which were reduced in CP-treated animals. They suggest that modulating the hepatic drug metabolizing enzymes might be the mechanism for hematotoxic and immunotoxic responses of cyclophosphamide.

Anti-inflammatory activity

Cassia occidentalis leaf powder was tested for anti-inflammatory activity and *Cardiospermum halicacabum* aerial parts with ethanol extract was assayed in male albino rats using carrageenan-induced rat paw edema. At 2000 $^{mg/kg}$ dose the *C. occidentalis* was found to be active at maximum level and 500 $^{mg/kg}$ was found to be the minimal active dose for *C. halicacabum*. The efficiency was tested in cotton pellet granuloma assay and observed that the transudative, exudative and proliferative components of chronic inflammation were suppressed by these drugs. Lipid peroxide content and γ-glutamyl transpeptidase and phospholipase A_2 activity in the exudate of cotton pellet granuloma was lowered with the usage of these drugs. In normalized cotton pellet granulomatous rats, increased alkaline phosphatase activity with decreased $^{A/G}$ ratio of plasma were found after the treatment. *C. occidentalis* powder and *C. halicacabum* extract were able to stabilize the human erythrocyte membrane against hypotonicity-induced lysis. It is likely that these drugs may exert their anti-inflammatory activity by inhibition of phospholipase A_2, resulting in the reduced availability of arachidonic acid, a precursor of prostaglandin biosynthesis, and/or by stabilization of the lysosomal membrane system [32].

Toxicity Studies

Acute toxicity test was conducted in a report with *Cassia occidentalis* and found that this plant did not show any hazardous symptoms or death [33]. With the sub acute treatment, the *Cassia occidentalis* doesn't change body weight gain, consumption of food and water and the profiles of hematological and biochemical. Also, no changes were seen in macroscopical and microscopical aspect of organs in the animals. Thus they conclude that acute or sub acute administration of *Cassia occidentalis* is not toxic. Histopathological analysis showed no cell death, necrosis or inflammation of the liver and kidney. The leaves of this plant are thus found to be safe with no adverse effect on the liver and kidney functions at the doses administered. Another study had investigated the effects of *Cassia occidentalis* oral administration during pregnancy in female Wistar rats. They found that there was no statistically significant changes between control and test groups with respect to fetuses, placentae and ovaries weights; number of implantation and resorption sites;

number of corpora lutea in the ovaries and pre- and post-implantation loss rates [34].

Antianxiety and Antidepressant activity

Around 5% of world's population was affected by anxiety and depression a widespread psychiatric disorder. Previously, plants and formulations were used to treat anxiety and depression over decades. A recent report has studied the antianxiety and antidepressant activity of ethanolic and aqueous extracts of *Cassia occidentalis* leaves in rodents. Exposing the rats to unfamiliar aversion in different methods like elevated plus maze model and actophotometer antianxiety activity was tested. Less aversion fear elicits antianxiety activity. Antidepressant activity was analyzed by despair swim test and tail suspension test. Reduced immobility time elicits antidepressant activity. They conclude that ethanolic and aqueous extracts of *Cassia occidentalis* leaves possess antianxiety and antidepressant activity. Ethanolic extract of *Cassia occidentalis* leaves showing more significant activity over the aqueous extract [35].

Analgesic and antipyretic activity

Cassia occidentalis Linn was screened for analgesic and antipyretic activity [36]. Ethanol and water extracts of *Cassia occidentalis* leaves were screened in mice which was induced by acetic acid and tested for hot plate and tail immersion assay, and also in yeast induced pyrexia method in rats. They found that the ethanol and water extracts of *Cassia occidentalis* possess antinociceptive and antipyretic properties. Highest inhibition dose was found to be as 300 mg/kg. The report clearly mentioned that both the ethanolic and water extracts of *Cassia occidentalis* showed significant effect on pyrexia induced by yeast.

Antidiabetic activity

The aqueous extract of *C. occidentalis* was tested for antidiabetic activity and the study [37] proved that there was a significant reduction in fasting blood glucose levels in the normal and alloxan-induced diabetic rats. They also tested for other extracts include petroleum ether and chloroform extracts and concluded that activity from day 14 and activity from 7 days respectively. Specific variations were seen in serum lipid profiles (cholesterol and triglyceride), serum protein, and changes in body weight by aqueous extract treated-diabetic animals, when compared with the diabetic control and normal animals. Histopathological studies have also revealed that pancreas of the animals showed regeneration by extract which were necrosed earlier.

CONCLUSION

Based on extensive literature survey, *C. occidentalis* had numerous potential to consider as useful medicinal plants for various diseases. More information relating to its phytochemical and biological activities of this plant has been discussed in detail in this review which gives scientific approach towards the plant to use as medicine. It is also important to note that the phytochemical and biological effectiveness is majorly depending on its geographical origin. Further in-depth research has to be carried out to use the phytochemicals in pharmaceutical industry as a substitute for medicine.

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