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Review Article

A Review On Medicinal Properties Of Simarouba Glauca DC

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ABSTRACT

The review explores the medicinal properties of Simarouba glauca, a plant with a rich history in traditional medicine. Focusing on its morphology, distribution, cultivation, commercial uses and phytochemical composition. Also, the paper delves into the diverse bioactive compounds present in various plant parts, emphasizing their potential therapeutic applications. Simarouba glauca exhibits notable anti-inflammatory, antioxidant, anticancer and antimicrobial activities, attributing to compounds like quassinoids, flavonoids, alkaloids, triterpenes, steroids, anthraquinones and coumarins. These bioactive constituents contribute to the plant's efficacy in treating various ailments, including infections, inflammation-related disorders, oxidative stress-related conditions and few other pharmacological actions. The review consolidates findings from in vitro and in vivo studies, shedding light on the plant's pharmacological evaluation and exploring its potential in drug development. Moreover, the paper addresses the plant's role in traditional medicine across different cultures, underscoring its historical significance. The synthesis of scientific evidence underscores Simarouba glauca as a promising source for novel Pharmaceuticals and Nutraceuticals. Overall, the comprehensive analysis presented in this review highlights the need for further research and clinical trials to unlock the full therapeutic potential of Simarouba glauca in modern medicine.

INTRODUCTION

THE PARADISE TREE- SIMAROUBA GLAUCA.

Simarouba glauca DC belonging to family Simaroubaceae, is generally known as paradise tree. Simaroubaceae family includes 32 genera and further 170 species of trees. It is a medium sized

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evergreen tree (1). *Simarouba glauca* DC stands for De Candolle pertaining to Augustin Pyramus De Candolle, a Swiss botanist who made significant benefactions in describing and classifying the below plant. It's one of the important herbal medicines used against dysentery hence its bark is also known as dysentery bark. It's a popular plant in several Nations due to its medicinal qualities and whose medicines are safe to use with no serious side effects (2). It's an evergreen tree showing a great eventuality as energy crop and medicinally significant factory. It has presently created great enthusiasm as miraculous tree of solace for cancer cases. It's also generally known by the names Paradise Tree, Aceituno, and Bitter wood (3).

PLANT DESCRIPTION

The mature tree attains a height of (25- 27 m) and a stem periphery of (40- 50 cm), frequently with a clear, spherical bole to 9m. The crown is narrow, with a range averaging (4- 6 m). *Simarouba glauca* develops a shallow root system frequently suitable to mountain soils (4). Leaves are dark green above, oblong, and frequently notched or smooth at the apex. The specific name 'glauca' means covered with a bloom, which refers to the bluish-green leafage. It is deduced from the Greek work 'glaukos'(bluish). The tree is dioecious, with both androgynous and bisexual flowers. It's pollinated by bees (5).



Fig No. 1. Young Leaves Of Simarouba Glauca



Fig no. 2 Paradise tree

Geographical distribution

The tree has been brought from evergreen timbers of Central America in mid-1960's to India and presently this Paradise Tree also called as "Lakshmi Taru ", has flourished in numerous states like Maharashtra, Orissa, Karnataka, Tamilnadu, Kerala and have recently been planted in other states like Andhra Pradesh, Gujarat, Rajasthan, and West Bengal (6).

Cultivation

The tree grows well in tropical regions. The cultivation relies on several factors like-rainfall and soil humidity. The tree can grow in hot climate up to 50 °C. It grows in plateaus of 3300 feet from ocean position. The maximum height of the tree is 40 to 50 feet. The flowers are yellowish with purplish fruits (7).

Commercial uses

All parts of this tree serve as promising agents in manure, timber, food, energy, medicinal diligence, etc. The tree has been well suited for all the geographical regions of India. It prevenst soil corrosion, support soil microbial life, reclaim wastelands, and increase ground water situations. Apart from its current popular benefits similar as product of oil painting galettes, biofuel, compost etc., this tree was traditionally consumed to cure malaria and gastrointestinal diseases. Literature

of cancer (8). The usage of the kernels of *Simarouba glauca* as an implicit resource of vegetable oil painting was first noted in 1939. These kernels induce up to 66 edible oil during the commercial extraction processes.

Ethnobotanical aspects

Leaves and bark of *Simarouba* have been used as a natural drug in tropical areas. *Simarouba* bark as an effective treatment for malaria and dysentery. Other indigenous lineage throughout the South uses bark for complications, dysentery and malaria as a haemostatic agent to stop bleeding and as an alcohol. It's used externally for blisters and injuries (9). The bark (and sometimes the root) is boiled in water to yield an important tangy and alcohol used to wash skin blisters and to treat dysentery, diarrhoea, stomach and bowel diseases, haemorrhages and internal bleeding. *Simarouba* excerpt is used for reducing patchy skin saturation. *Simarouba* is subject of one US Patent, whereby its water excerpt was set up to increase skin keratinocyte isolation and to ameliorate skin hydration and moisturization. The seeds extracted in alcohol are used against snakebites. An infusion of the bark is used against malaria, rheumatism, shingles and fever (10).

Taxonomy of *Simarouba glauca* (11)

Kingdom	Plantae
Subkingdom	Tracheobionta
Super Division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Sapindales
Family	Simaroubaceae
Genus	<i>Simarouba</i>
Species	<i>glauca</i>

Chemical ingredients in *Simarouba glauca*.

The significant bioactive groups of chemicals that have been reported in *Simarouba* are the quassinoids, flavonoids, alkaloids (12). These composites are responsible for antiprotozoal and antimalarial properties which have been proved veritably long time ago (13). The quassinoids

constituents found abundantly in all species of *Simarouba*, namely ailanthinone, glaucarubinone, and holacanthone are honoured as the main medicinal ingredients which are also recorded for anticancer properties (14). The splint, seed, dinghy and fruit of *S glauca* are used as tangy, analgesic, and emmenagogue, antiviral, antimicrobial, and vermifuge due to the remedial value of its phytochemicals. The water excerpt of *Simarouba glauca* increased the skin keratinocyte isolation, bettered the skin hydration, moisturization and reduced the patchy saturation in the skin (15).

Therapeutic significance of *Simarouba glauca*.

1. Antibacterial activity

Extract of SG leaves has possible antibacterial activity against both Gram-positive and Gram-negative. Microorganisms such as *Bacillus subtilis* (BS), *Escherichia coli* (EC), *Pseudomonas aeruginosa* (PA), and *Staphylococcus Aureus* (SA) are inhibited by fresh and dried extracts of SG leaves *Simarouba Glauca* (16). Soxhlet instruments were used to collect the ethanol and the methanol excerpts of dried and fresh SG leaves. Extracts of SG were shown averagely successful in inhibiting BS, EC, PA, and SA. Studies showed that the crude methanol and ethanol excerpts made from dried and fresh SG leaves have inhibited BS, SA, PA, and EC progress. Numerous studies have proved the antimicrobial exertion of *simarouba glauca* plant (17).

2. Antifungal activity

Methanolic and ethanolic extracts of both fresh and dried leaves were tested for their inhibitory exertion against the pathogenic fungi such as *Fusarium oxysporum* and *Aspergillus parasiticus*. Testing of the crude extracts for the antifungal exertion using well prolixity assay showed strong inhibition against the tested fungus (18). Ethanolic extracts of both the fresh and dried leaves were set up to be more effective as compared to methanolic extracts against the growth of the fungi. Other



studies also showed that the extracts of *Simarouba glauca* is more effective against *Aspergillus parasiticus* as compared to *Fusarium oxysporum* (19).

3. Antioxidant activity

Simarouba glauca leaves are having antioxidant characteristics (20). Extracts of SG leaves has been linked to have an association with antioxidants. SG chloroform excerpt was able of scavenging H_2O_2 . Chloroform, ethanol and methanol excerpts of *S. glauca* leaves have shown the free revolutionary scavenging capability according to dose dependent manner (21). Excerpts were highly effective in scavenging free radicals, DPPH and chelating radical iron with high circumstance of scavenging like chelating ferrous iron and DPPH. Thus, SG excerpts retain good antioxidant action (22).

4. Anticancer activity

Simarouba decoction prepared has been traditionally used for the treatment of cancer and their tumours. There's a notable anticancer action in several species within the family of the *Simaroubaceae*. The quassinoids (ailanthinone, glaucarubinone, and holacanthone) set up in *Simarouba* showed the anticancer action in P388 lymphocytic leukaemia and cytotoxic effect of the plant against KB cells (23). Leaf excerpt with different detergents have shown cytotoxicity in a many cancer cell lines. In vitro cytotoxicity has been shown against KB cells, by quassinoids such as glaucarubin, glaucarubinone, glaucarubol, and glaucarubolone. Quassinoids SG seed ingredients Bruceantin, bruceantinol, glaucarubinone and simalikalctone D are among the strongest Quassinoids with antitumor action. In vivo study has proved that the composites isolated from *Simarouba* own anticancer action in different cell lines (24).

5. Anti-proliferation and pro-apoptotic activity

Studies were conducted to evaluate the anti-proliferative and pro-apoptotic activities of

simarouba glauca on prostate cancer cell lines PC-3. A cross-sectional study was conducted, the evaluation was designed through apoptotic and membrane depolarisation assays. Methanol excerpt of SG at 0.29 $\mu\text{g/ml}$, 29 $\mu\text{g/ml}$ and 290 $\mu\text{g/ml}$ doses were used, while rifampicin acted as the positive control and dimethyl sulfoxide acted as the negative control. Results showed that the methanol excerpt inhibited 50% of the PC-3 cells at a mean attention of $35.24 \pm 0.23 \mu\text{g/mL}$ compared to $15.31 \pm 1.83 \mu\text{g/mL}$ for positive control. The excerpts pushed PC3 cells significantly into early apoptosis compared to the positive control. Results suggested anti proliferative action of the plant extract (25).

6. Anti-inflammatory activity

Studies were conducted to estimate the anti-inflammatory effect of isolated Squalene (SQ), a triterpenoid from *Simarouba glauca* in carrageenan-induced acute inflammation. Squalene (SQ) was characterized by FT-IR and NMR and in-vitro studies were done on experimental creatures (26). SQ at a dose of 5.0 mg/kg body weight was set up to be the minimum dose for maximum oedema inhibition. Antioxidant labels such as SOD, Catalase and GPx were increased significantly. These results suggested that the anti-inflammatory action of SQ and its multi-targeted medium of action, earning its importance in remedial efficacy in various inflammatory conditions (27).

7. Anti-microbial activity

Studies were designed to analyse the phytochemical profile of the methanol excerpt of *simarouba glauca*, and bioactive composites were identified using chromatography, FTIR and GCMS. Antimicrobial action and minimal Inhibitory Concentration (MIC) were determined against 14 bacterial and 6 fungal strains (28). The ethanolic and methanolic excerpts showed exclusive action against *S. aureus* and profound action against *E. coli* and *S. marcescens*. Upon



comparing breakpoints, methanolic excerpt demonstrated advanced antimicrobial action with a MIC value of 3.2 mg/ mL against the test pathogens (29).

8. Anti-malarial activity

Studies have shown that three potent Quassinoids in SG are in vitro as well as in vivo active against malaria. Some Quassinoids in SG have demonstrated strong inhibitory action of a *Plasmodium falciparum* strain which is resistant to chloroquine. 6 α - tigloyloxychaparrinone, ailanthone, eurycomanone, isobrucein B, orinocinolid, neosergeolide, pasakbumin B and C, and simalikalactone D have been linked to be major antimalarial Quassinoids. These ingredients significantly reduced parasites in *Plasmodium berghei*-infected mice. Dichloromethane fractions were screened for their cytotoxicities on *Artemia salina* (Neptune shrimp) larvae, and 50% inhibitory concentrations were determined for *Plasmodium falciparum* in in-vitro studies. Both chloroquine-susceptible and resistant strains of *P. Falciparum* were significantly inhibited by these excerpts. Out of all dichloromethane excerpts, only the *S. glauca* cortex excerpt was considered to be poisonous to *A. salina* in the Neptune shrimp test (30).

9. Antiamoebic activity

Tests were done to detect the antiamoebic action of plant excerpts prepared from the traditional *Simarouba glauca* stems. The exertion was associated with quassinoid- containing fractions (31). The 50% inhibitory concentrations for some quassinoids against amoebae were determined by using the microdilution system. Bruceantin, the most active quassinoid and glaucarubol showed known antiamoebic activity against *Plasmodium falciparum*. The microdilution process will be useful in the discovery for new antiamoebic medicines (32).

10. Antiulcer activity

The chloroform excerpt of SG showed dose-dependent inhibition of ethanol-induced gastric lesions in albino rats, causing 82.63 protection at 400 mg/ kg, and 53.48 protection at 200 mg/kg, Chloroform excerpt of SG also showed dose-dependent inhibition of indomethacin- conviced gastric lesions in albino rats, causing 62.65 protection at 400 mg/ kg and 54.86 protection at 200 mg/ kg, Chloroform Extract of the leaves of SG dropped the acidity and increased the mucosal concealment, therefore SG shows antiulcer action (33).

11. Hepatoprotective activity

A study revealed that the chloroform and ethanolic excerpts of *Simarouba glauca* lowered the increased levels of ALP, SGPT and SGOT and reduced the histological changes caused by paracetamol damage (34).

12. Reducing Patchy Skin Saturation activity

SG excerpt showed constituents with capability of reducing patchy skin saturation (US Patent dated 14 October 1997), whereby its water excerpt was set up to increase skin keratinocyte isolation and also to increase the skin hydration and moisturization and reduced the patchy pigmentation in the skin (35).

13. Haemolytic activity

The three excerpts (chloroform, methanol, ethyl acetate) of *Simarouba glauca* were screened for haemolytic action. The haemolytic action was determined using agar diffusion technique on blood agar plate, thrombolytic action by clot dislocation and phytochemical potential by qualitative analysis (36). The haemolytic action was found to be advanced in ethyl acetate excerpt than methanol, chloroform. The chloroform and ethyl acetate excerpts showed 23.68 and 21.60 clotlytic activity whereas standard streptokinase shows 34.86% in thrombolytic assay. Thus, study shows that all the excerpt of leaves of *Simarouba glauca* has haemolytic activity (37).

14. Acaricidal property



Simarouba glauca seed oils were estimated against Red Spider Mite (RSM) under laboratory conditions. Among the tested treatments, S. glauca at 5ml/ L achieved significant mortality over adult RSM (38). Simarouba glauca seed oils achieved about 90 of egg mortality (39). The oviposition deterrence study reveals that the least number of eggs were laid on the treatments of Simarouba glauca seed oil at 5ml/ L which achieved the highest Discrimination Quotient (DQ) value 0.58. Thus, SG seed oils could be used as an effective alternate source to control RSM due to its good acaricidal, ovicidal and oviposition deterrence action (40).

15. Anti-hypertensive activity

Studies have shown that this plant retain potentiality of lowering the elevated blood pressure. Hence, the study aimed at assessing the hypotensive prospect inherent in the aqueous extract of Simarouba glauca (AESG) on normotensive male Wistar rats (41). The data recorded on a chart, indicated the characteristic dose-dependent hypotensive effect of AESG on normotensive rats at doses of 2.5 mg/ kg and 5.0 mg/ kg, with remarkable diminishments in the systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) from basal leaves of 127.83 ± 1.01 mmHg, 91.00 ± 1.00 mmHg and 103.27 ± 0.99 mmHg independently. The outgrowth of the primary disquisition indicates that the AESG demonstrated a hypotensive effect on the Blood Pressure of normotensive male Wistar rats dependent on varying doses administered (42).

16. Anti-inflammatory Bowel Disorder activity

Trials were conducted to study and estimate the Anti-inflammatory Bowel activity of Ethylacetate extract (EASG) and chloroform (CHSG) extracts of Simarouba glauca on experimentally induced inflammation in wistar rats. The levels of phytochemicals were quantified and HPTLC study was conducted using β - sitosterol as reference. In

vitro antioxidant property of EASG and CHSG was estimated using DPPH and ABTS assay. Evaluation of IBD was done in wistar rats. EASG and CHSG held considerable amount of phytoconstituents such as flavonoid, phenols and β - sitosterol and also significantly scavenged the free revolutionaries making it a potent antioxidant. The results of macroscopic scoring and MPO position exertion suggest that EASG and CHSG at 400mg/ kg significantly reduced the inflammation in IBD induced models. In in-vitro cytotoxicity study, a significant reduction in cell damage was observed when CaCO₂ cells were pretreated with EASG and CHSG excerpts when compared to control. EASG and CHSG at 400mg/ kg significantly reduced lipid per oxidation and increased the Superoxide Dismutase (SOD), Catalase (CAT) and Glutathione peroxidase (GPx). Reduced Glutathione (GSH) situations and produced significant antioxidant activity. Thus, we can conclude that the EASG and CHSG of Simarouba glauca showed significant anti-inflammatory activity due to presence of β - sitosterol and antioxidants such as phenols and flavonoids (43).

17. Anti-dysenteric activity

Studies reported that the plant simarouba glauca has a rich source of medicinals and therefore is one of the important herbal sources to treat certain contagious and non-contagious conditions, like diarrhoea, malaria, oedema, fever haemorrhages, intestinal spongers, and colitis (44). Especially, the leaves and bark of this plant in the form of alcohol are specifically used to treat malaria, fever, dysentery, and to stop bleeding. They studied the phytochemical investigation, metal analysis, and antibacterial activity of water extracts of Simarouba glauca leaves and stem bark samples (45).

18. Analgesic activity

Studies were done to estimate the anti-inflammatory effect of isolated Squalene (SQ), a



triterpenoid from *Simarouba glauca* in carrageenan-induced acute inflammation. Squalene (SQ), a triterpenoid bit was isolated from *Simarouba glauca* and characterized by FT-IR and NMR (46). Experimental creatures were considered and SQ at a dose of 5.0 mg/ kg body weight was set up to be the minimum dose for maximum oedema inhibition. Antioxidant labels such as SOD, Catalase and GPx were increased significantly. These results suggest the anti-inflammatory action of SQ and its multi-targeted medium of action, earning its implicit remedial efficacy in various inflammatory conditions (47).

19. Anti-leukemic activity

There were study designed to estimate anticancer action of crude excerpt of *Simarouba glauca* in three cancer cell lines such as K- 562, MOLT- 3 and KG- 1. Different concentrations (2 to 64 µg/ml) of leaves extract were tested for cytotoxicity using MTT assay. Methanolic extract of *Simarouba glauca* leaves showed significant anticancer action against MOLT- 3 and K- 562 as compare to KG- 1 cell line (48- 49). The methanolic leaf excerpt of *Simarouba glauca* possesses effective action against leukemic cancer cell lines. Leaf of *Simarouba glauca* can be recommended for cancer treatment especially for leukemic cancers (50).

CONCLUSION

In developing world, the trend and utility of natural product of medicinal substances is increased in last decade over synthetic medicine, because of toxic effects. The investigation and research on medicinal plants might bring to the scientific world many useful remedies for the treatment and cure of human sufferings. The bark and leaf extract of *Simarouba* is well known for its different types of medicinal properties which are used in the treatment of infectious and non-infectious diseases such as diarrhoea, malaria, oedema, fever, intestinal parasites, and colitis. The leaf extract of this medicinal plant has potential

antimicrobial, antibacterial, antifungal, antioxidant, anticancer, anti-proliferation, anti-malarial, antimicrobial, anti-amoebic, antiulcer, anti-inflammatory, pro-apoptosis, hepatoprotective, anti-inflammatory irritable bowel activity, haemolytic, antidyseric, analgesic, anti-leukemic, antihypertensive, acaricidal, ovidal and oviposition deterrence properties. It can be concluded that further studies on this plant may be helpful for future researchers to develop some new promising pharmaceutical formulation.

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