PHARMACOLOGICAL USES OF SIMAROUBA GLAUC A: A REVIEW

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ABSTRACT

Simarouba glauca is an evergreen floral tree plant that is endemic to Florida, Lesser Antilles, South America, and the United States. Bitterwood, dysentery barks, Laxmi Taru, and Paradise tree are common names. It produces edible oils from its seeds. Various tree sections are used to treat different ailments. The plant contains many essential phyto constituents of major pharmacological significance. The pharmacological review of SG has proven its medicinal value and has different therapeutic qualities such as analgesic, antimalarial, antimicrobial, antitumor, antilucre, hypoglycaemic, insecticidal, stomachic, and vermifuge. Several medically active compounds have been found in the plant. A group of triterpenes called Quassinoids is by far the most active compound. Further research into these plants can be concluded that these new pharmacophores can be beneficial for the improvement of mankind’s health and also helps in combating several other disorders. The purpose of this paper is to showcase the pharmacological importance of Simarouba glauca and it can provide a good forum for future researchers to carry out numerous studies on this particular plant species.

Keywords: Laxmitaru, Edible oil, Medicinal value, Antitumor, Quassinoids

INTRODUCTION

Since human life started, man has understood and applied plants in a wide range of forms over the ages (Shakya, 2016). Plants are quite excellent models of diverse bioactive substances used specifically or indirectly to manage a variety of human diseases. Human cultures have explored and utilized complex plants and medicinal ingredients in the treatment of fatal diseases since time immemorial (Kuldip et al., 2015). Humans relied on the soothing powers of plant species before adding chemical substances. Many people respect these plants because of the old belief that plants are designed to provide nutrition, medicinal care, and other benefits for mankind (Ahvazi et al., 2012). Herbal medicines are classified as indigenous health-care medicine that identifies, inhibits, and manages mental and physical conditions differently from allopathic theories, views, and concepts (Jima et al., 2018)2015, in Berbere district of Oromia region, Ethiopia. The study focused on documentation of medicinal plants used to treat various human diseases in the study area. Ethnobotanical data were collected using semistructured interviews, group discussion, guided field walks, and observations with participants. Preference ranking, paired comparison, direct matrix ranking, and informant consensus factors (ICF. Owing to the broader faith in fewer harmful effects and the simpler access to medicinal plants, the use of plants to cure any illness has grown exponentially over the past few decades (Singh et al., 2020). The earliest records on tile tablets in cuneiform dated from about 2600 BC come from Mesopotamia; Cedar, Cypress, Liquorice, Myrrh, and Poppy oils, are being used currently for the prevention of illness from colds, poisons, infections of parasites, and inflammation (Dar et al., 2017). The WHO says the best supply of several medicines will be medicinal plants. Herbal substances have contributed significantly to public health. This is because traditional remedies have tremendous curing power (Obeidat et al., 2012). Medicinal plants in India are used extensively by all groups of the population as folk remedies or in various indigenous medical systems or indirectly in modern medicinal products’ pharmaceutical preparations(Srinivasan et al., 2001).

Phytoconstituents are chemical compounds that are found in plants inherently. Phytochemicals have recently become more common because of their various therapeutic applications. Unlike synthetic chemicals, these phytochemicals have no adverse effects and are important against a variety of respiratory disorders, arthritis, tumor, and other diseases. Phytochemicals come from various plant sections including leaves, buds, stems, pulp, seeds, and so on (Priya, 2017). More than 170 species of 32 genera pantropical trees and brooks belong to the Simaroubaceae family. Its quality is distinguished by bitter substances which are mainly accountable for its medicinal properties (Fernando & Quinn, 1992; Muhammad et al., 2004) namely, orinocinolide (1. Simarouba glauca (SG) is an evergreen, multifunctional edible oil reservoir, commonly popular as Shorgum Maram, Simaba, Robleceillo, Pitomba, Palo Amargo, Dysentery bark, Bitterwood, and Aceituno. In India, SGis famous as Paradise tree, Shorgum Maram, or Laxmitaru which belongs to the Simaroubaceae family (Manasa et al., 2019). This plant is renowned for
its pharmacological and therapeutic properties of various kinds. SG’s pharmacological qualities are anticancerous, anti-dysenteric, anthelmintic, antimalarial, antimicrobial, antiparasitic, antipyretic, and hemostatic (Pawar et al., 2019). SG leaves, seeds, pulp, and fruit are considered to be emmenagogue, antiviral, astringent, antimicrobial, vermifuge, and stomachic (CK et al., 2018). SG extracts were used to treat gastrointestinal disturbances in Guatemala (Caceres et al., 1990). The bark, leaf, leaf litter, pulp of fruits, roots, seed, shell, stem, and unwanted branches of plants generate food, fuel, fertilizer, wood, and medicines (Santhosh et al., 2016) useful goods. Studies suggested that the SG water extract promotes the division of skin keratinocytes and increases skin moisture and hydration. SG products in the form of skin lotion and dry leaf powders are currently being sold for treating skin disorders (Jose et al., 2019).

**Plant Profile**

**Common name:** Aceituno, Paradise tree, Simaba, and Bitter wood tree.

**Malayalam:** Lakshmi tharu
**Tamil:** Shorgum Maram
**Hindi:** Laxmitaru
**Kingdom:** Plantae
**Order:** Sapindales
**Family:** Simaroubaceae
**Genus:** Simarouba
**Species:** Simarouba glauca

**Figure 1:** Represents the leaves of *Simarouba glauca*

**Distribution**

It grows from Mexico to Panama, South Florida, and the Caribbean Islands under tropical conditions in Central America. In both Kenya and Burundi, SG was introduced in 1957 (Patil & Gaikwad, 2011). SG, in Mexico, Cuba, Haiti, and Central America, is native to the rainforest and other tropical regions. In some parts of India, SG is cultivated. In the 1960s, it was introduced in India by Genetic Resources in the Amravati research station in Maharashtra and 1986 (Vasait & Khandare, 2017). In the wastelands of Orissa, Karnataka, and Gujarat, healthy plant growth is observed in India. Also, Andhra Pradesh, Bihar, Maharashtra, and Tamil Nadu have effectively improved their growth rate (Ramya et al., 2019). In tropical America, the largest source of family diversity and in Western Africa as a secondary centre (Thomas, 1990). Now the SG culture extends over semi-arid dry and salty regions of other Indian regions such as Tamil Nadu, Maharashtra, Karnataka, Gujarat, and Andhra Pradesh. Even in marginal wastelands or dry soil with degraded soil, SG trees can grow well (Govindaraju et al., 2009).

**Physical Characteristics**

It is an evergreen tree of medium height (7-15 m). It has been formed in areas with an annual rainfall of 250 mm to 2500 mm and temperatures as high as 45°C, and grows well up to 1000 m above sea level in all kinds of well-drained soils since it is dry and semi-arid, it can be widely cultivated where no other economically-efficient plants can be cultivated. During December, the tree begins to bloom and bears fruit in January and February. In May, the fruit is ready for selection (Dash et al., 2008) namely, dimensions, 1000 unit mass, fruit part fraction, arithmetic mean diameter, geometric mean diameter, surface area, sphericity, aspect ratio, bulk density, true density, porosity and angle of repose. The kernel had 8.51% (w.b.). It’s a medium plant, normally reaching about 20 meters high and about 50-80 cm in diameter, and about seven years in life. The soil was ideal for the temperature range of 10 – 40 °C, and soil pH was predicted to be 5.5 – 8. Under a large variety of agro climate conditions including mild humid and tropical areas (Mishra et al., 2012). The root system for mountainous soil is weak. The stem has a height of 9 m and a diameter of 40-50 cm. It has a thin, gray outer bark while the inner bark is creamy (Thomas, 1990). The leaves are oblong and sometimes notched or smooth with 3-21 leaflets; alternate, uniform blue, green oily. Bisexual flowers are inconspicuous, the green calyx is colored, and the dome shapes differ with sepals. Single-whorl creamy greenish or yellowish creamy petals are available. The staminated flowers have gynophores, but no single ovule carpel (Patil & Gaikwad, 2011). Since maturing, the seeds are 1.5 to 2 cm long pinkish or yellowish. There are two varieties: one produces a greenish fruit and the
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other distinct violet or almost black fruit depending on fruit colour (Osagie-Eweka, 2018). Figure 1 represents the leaves of SG while figure 2 represents the plant itself.

### Chemical Constituents

Mostly, alkaloids with elevated cytotoxicity and quassinoids with influential antifungal properties were extracted from these plants with a variety of constituents. Triterpenes, useful in the cure of amoebiasis, diarrhea, and malaria, are in the SG bark and leaves. Quassinoids have demonstrated positive anti-tumor activities, the bitter values of the plant family of Simaroubaceae (Mathew et al., 2019). SG has the active ingredients in the plant and 11 therapeutically essential quassinoids. The presences of alkaloids, cardenolides, flavonoids, fixed oil, glycosides, phenolic compounds, saponins are noted by SG extract. Tirucalla, sitosterol, simarubolide, simarolide, simaroubidine, melianone, holacanthone, glaucarubolone, glaucarubinone, dehydroglaucarubinone, canthin, benzoquinone, and ailanthine are major active components in the SG (Jach et al., 2000). Normal SG qualitative studies have had positive effects on alkaloids, carbohydrates, flavonoids, and triterpenoids (Table 1) (Dinesh et al., 2017).

### Nutritive value

SG is a good source of carbohydrates, fatty acids, lipids, and proteins. The kernels have edible fat made of oleic, palmitic, and stearic acids while the seeds contain oil. The kernel is rich in essential amino acids, namely leucine, lysine, and valine. Additionally, the average protein content is 51.8g/100g. Alkaloids, calcium, sodium, triterpenoid aglycone, phenolics, phytic acids, and saponins are present in the food supply. The leaves contain flavonoids, phenolics, and tannins that help to battle conditions like cancer, diabetes, and other diseases (Jose et al., 2019)

### Pharmacological Uses

#### Antiamoebic Activity

In vitro tests, the presence of crystalline glycosides isolated from the SG indicated that the SG was active against Entamoeba histolytica and had an in-vitro amoebicidal character (VAN ASSENDELFT et al., 1956). The in vitro approach and laboratory animals showed that glaucarubin has an amoebicidal characteristic (Del Pozo, 1956).

#### Antibacterial Activity:

Extract of SG leaves has possible antibacterial properties, both Gram-positive and Gram-negative Micro-organisms such as Bacillus subtilis (BS), Escherichia coli (EC), Pseudomonas aeruginosa (PA), and Staphylococcus Aureus (SA) are inhibited by fresh and dried extract SG leaves (Rajurkar, 2011). *Simarouba Glauca* and *Psoralea corylifolia* (Babchi). Soxhlet instruments were earlier used to record the ethanol and the methanol extracts of dried and fresh SG leaves. Extracts of SG were shown averagely successful in inhibiting BS, EC, PA, and SA (Jangale et al., 2012). Ganesh et al showed that the crude methanol and ethanol extracts made from dried and fresh SG leaves have inhibited BS, SA, PA, and EC progress (Hussain et al., 2020). Many studies have documented the antimicrobial activity of many plants. Studies of Laxmi Taru’s antimicrobial activity therefore was restricted to antimicrobial activities of few bacteria (Karthekeyan et al., 2019).

#### Anticancer Activity

There is a notable anticancer activity in several species within the family of the Simaroubaceae. SG contains compounds with properties that suppress tumors. The herb’s antileukemic and antitumor role has been linked to four Quassinoids namely Ailanthinone, Glaucarubinone, Dehydroglaucarubinone, and Holacanthone (Jach et al., 2000). In vitro cytotoxicity has been shown against KB cells, such as glaucarubin, glaucarubinone, glaucarubol, and glaucarubolone by several components in Quassinoids SG seeds (Polonsky et al., 1978). Quassinoids SG seed constituents Bruceantin, Bruceantinol, glaucarubinone and simalikalctone D are among the strongest Quassinoids with this form of antitumor action (Guo et al., 2005).

<table>
<thead>
<tr>
<th>PHYTOCHEMICAL</th>
<th>TEST</th>
<th>RESULT</th>
<th>INERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaloids</td>
<td>Mayer’s test</td>
<td>Pale creamy precipitate</td>
<td>Positive</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>Molish test</td>
<td>Reddish-violet ring</td>
<td>Positive</td>
</tr>
<tr>
<td>Cardiac glycosides</td>
<td>Keller -Kiliani test</td>
<td>No greenish-blue color</td>
<td>Negative</td>
</tr>
<tr>
<td>Flavanoids</td>
<td>Shinoda test</td>
<td>Reddish-brown color</td>
<td>Positive</td>
</tr>
<tr>
<td>Phenols</td>
<td>FeCl₂ test</td>
<td>No dark green/blue color</td>
<td>Negative</td>
</tr>
<tr>
<td>Saponins</td>
<td>Frothing test</td>
<td>No stable froth</td>
<td>Negative</td>
</tr>
<tr>
<td>Tannin</td>
<td>FeCl₂ test</td>
<td>No bluish-green or blue-black color</td>
<td>Negative</td>
</tr>
<tr>
<td>Triterpenoids</td>
<td>Salkowski test</td>
<td>Reddish-brown color</td>
<td>Positive</td>
</tr>
</tbody>
</table>

Table 1: Qualitative phytochemical analysis of *Simarouba glauca* (Dinesh et al., 2017)
<table>
<thead>
<tr>
<th>COMMON NAME</th>
<th>USES</th>
<th>PATENT NUMBER</th>
<th>REFERENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLAUCARUBOLONE</td>
<td>Antineoplastic, antiviral, and herbistatic activity</td>
<td>US6573296</td>
<td>Dou et al., 1996)</td>
</tr>
<tr>
<td>CANTHIN-6-ONE</td>
<td>Inflammatory Ailments Psoriasis Mycobacteria-linked pathologies Trypanosomiases Extensive Cancer</td>
<td>US2016051553, US9095606, US2011059977</td>
<td>(Reynertson et al., 2011)</td>
</tr>
</tbody>
</table>

Table 2: Phytochemicals isolated and patented from *Simarouba glauca*
Antifungal Activity

Antifungal properties of SG against several fungus. However, extracts from this plant were considered more productive compared to Fusarium oxysporum against Aspergillus parasiticus. Ethanolic extracts from fresh leaves are found to be more effective against the growth of fungi through the agar well diffusion process compared to the methanol extracts from fresh leaves (Mikawlrawng et al., 2014).

Antimalarial 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 (Valdès et al., 2008). 6a-tigloyloxychaparrinone, ailanthone, eurycomanone, isobrucine B, orinocinolide, neosergeolide, pasakbumin B and C, and simalikalactone D have been identified to be major antimalarial production Quassinoids (Chan et al., 2004; Houël et al., 2009; Kuo et al., 2004; Muhammed et al., 2004; Okunade et al., 2003; Rocha E Silva et al., 2011).

Antioxidant Activity

SG leaves are having antioxidant characteristics (Santhana Lakshmi et al., 2014). Extract of SG leaves has been identified to have an association with antioxidants. SG chloroform extract was capable of concentration all scavenging $\text{H}_2\text{O}_2$. In scavenging free radicals, including DPPH and chelating radical iron, extracts were highly effective. The extracts have also shown possible antioxidant characteristics (Umesh, 2015).

Reducing Patchy Skin Pigmentation

SG extract showed ingredients capable of reducing patchy skin pigmentation (US Patent dated 14 October 1997), with its water extract found to improve skin differentiation and to enhance moisture and hydration (Jach et al., 2000).

Antiulcer Activity

The chloroform extract 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 extract of SG also showed dose-dependent inhibition of indomethacin-induced 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 decreased the acidity and increased the mucosal secretions, thus SG exhibiting antiulcer activity (D. S. Sharma & Sriram, 2014).

Hepatoprotective Activity

SG has hepatoprotective action in chloroform and ethanol extracts. Some research suggests that the leaf extract of SG can be applied to produce a new hepatoprotective remedy (John et al., 2016).

Others

SG leaves and bark have long acted in tropical areas as a natural remedy. SG bark for successful malaria and dysentery treatment (Mikawlrawng et al., 2014; Polonsky et al., 1978). Another South indigenous tribe uses bark as a hemostatic agent to avoid bleeding, and as a tonic to deal with fever, dysentery, and malaria. Externally, it is used for wounds and cuts (Valdès et al., 2008). The bark is boiled in water and is occasionally used to give a strong astringent and tonic to cleanse your skin and cure dysentery, diarrhoea, bowel, blood bleeding, and internal bleeding (R. Sharma & Dwivedi, 2016). SG is a multipurpose powerful and versatile, diococious oil crops plant with a production capacity of 2000-2500 kg of oil/ha/year, apart from being medicinal. A kernel of SG produces about 75 percent of oil and has an excess of both unprocessed and saturated fats that are sufficient for domestic as well as industrial consumption (Choudhary et al., 2020). SG seeds are rich in edible fat (almost 60% w/w) used in tropical countries for cooking. The cake from the oil extraction contains proteins that are used in cattle feed after poisonous and bitter compounds have been extracted (Monseur & Motte, 1983). Oleic acid, a powerful and versatile unsaturated fatty acid, used for the manufacture of soaps, detergents, and lubricants, etc is found in SG seed oil for 59-65 percent (Jayashanthini, S. K. S. Rathinam et al., 2019). Given the reporting of the acute cytotoxicity, phytotoxicity, and efforts to large-scale SG propagation of the Simarouba quassinoids as an alternative oilseed crop, it is also warranted that the oil is routinely tested for human consumption (Rout et al., 2014). Table 2 includes the list of compounds of SG that are patented for the different-different conditions.

CONCLUSION

In the ethno pharmaceutical region, the Simaroubaceae family is of great significance because many of its members are commonly used in the tradition of folk medicine of several nations and form part of the authorized compendium. In addition to its insecticide, curing, and tonic operations, various genera of this family are used for managing diabetes, diarrhoea, gastritis, inflammation, malaria, tumors, ulcer, viruses, and worms. Ethnobotanical studies have played an important role in the prevention and treatment of disease in living organisms in recent years and various known and unknown herbal medicinal products have been developed. Plants of the Simaroubaceae family can be emphasized for their chemical richness in addition to ethnopharmacological uses as the existence of alkaloids, anthraquinones, coumarins, flavonoids, mono- and sesquiterpenes, Quassinoids, steroids, and terpeneshas been determined. The pharmacological review of SG has proven its...
medicinal value and has different therapeutic qualities such as analgesic, antimalarial, antimicrobial, antitumor, antielcer, hypoglycaemic, insecticidal, stomachic, and vermifuge. Further studies into these species can be inferred that certain new pharmacophores can be useful for the betterment of human health and also to cure many other diseases.

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