DEV SANSKRITI: Interdisciplinary International Journal (2021) • Volume 18 • 40-45

Review Article

Medicinal Potential of Laxmi Taru (Simarouba Glauca DC)

Sunita Garg[1] and Lalit Raj Singh[2]*

[1]Former Emeritus Scientist, Chief Scientist (Scientist G), CSIR-NISCAIR, Dr K. S. Krishnan Marg, New Delhi, India
[2]Assistant Professor, Dept. of Medicinal Plants Sciences, Dev Sanskriti Vishwavidyalaya, Shantikunj, Haridwar, India
*Corresponding author email: lalitraj.singh@dsvv.ac.in
https://doi.org/10.36018/dsiij.v18i.220

Abstract. Cancer is becoming a high-profile disease throughout the world and for its treatment most prevalent technique is chemotherapy which has its limitations due to many toxic or side effects on healthy or non-cancerous body parts. Therefore, there is a demand for alternative and supportive anticancer agents for treatments which are naturally-derived with minimal side effects. This review paper highlights the therapeutic importance, safety, and efficacy of the Laxmi Taru along with their active constituents used either as single plant-decoctions, extracts, or in combinations especially in some traditional herbal medicines. World Health organization (WHO) is promoting this concept as 'Save plants to save lives.' Among the key health issues, WHO have also said that, cancer is the second leading cause of death globally. The plethora of secondary metabolites (therapeutic agents) found in the plant are the rich source to find the alternative safe anti-cancer agents.

Keywords. Laxmi Taru, Simarouba Glauca, Anti-Cancer Potential, Glaucarubinone (GLU)

Introduction

World Health Organization (WHO) has remarked that cancer is a generic term for a large group of diseases which can affect any part of the body and most common cancers are lung, breast, colorectal, prostate, skin and stomach. Ample of researches has shown plants possess anticancer properties. Among them popularly known plants are as following: *Acacia Catechu* Wild. (Catechu; Khair), *Acorus Calamus* L. (Sweet Flag; Gorbach), *Actinidia Chinensis* Planch (Chinese gooseberry), *Aloe vera* (L.) Burm. f. (Burn plant), *Calotropis Gigantea* R. Br. (Giant milkweed), *Camptotheca Aacuminata* Decne (Happy tree), *Curcuma longa* L. (Turmeric), *Ginkgo Biloba* L. (Maidenhair tree), *Nothapodytes Foetida* (Wight) Sleumer (also known as *Mappia Foetida* Miers), *Panax Ginseng* Mey (Asian ginseng), *Podophyllum Hexandrum* Royle, (Himalayan May-apple), *Silybum Marianum* Gaertn. (Milk thistle), *Simarouba Glauca* DC (LaxmiTaru), *Taxus Baccata* L. (European Yew Tree), *Taxus Brevifolia* Nutt. (Pacific Yew Tree), *Taxus Wallichiana* Zucc. (Himalayan Yew Tree), and *Taxus Yunnanensis* Cheng (Yunnan Yew Tree) (1-2). The present review emphasize Laxmi Taru for its medicinal and commercial utility based on its vast chemical constituents present in the plant which are

also commonly found in family members of Rutaceae, Sapotaceae, Fabaceae, Rosaceae, and Simaroubaceae (3).

Morpho-physiological Description

Botanical name	*Simarouba Glauca* DC syn. *Simarouba Amara* Aubl, *Quassia ImarubaL* F., and *Quassia Glauca* DC Spreng
Vernacular name	Laxmi Taru
Common name	Paradise tree, Bitter ash, Bitter damson princess tree, and Dysentery bark Family: Simaroubaceae
Plant part used	Leaves (mainly for anti-cancerous activity), roots, and bark

Origin of the plant and Introduction to India

This is indigenous to Brazil and Guiana. It was first introduced in India by National Bureau of Plant Genetic Resources (NBPGR) in the Research Station at Amravathi, Maharashtra in 1966 and at University of Agricultural Sciences, Bangalore in 1986 for its beautiful flowers (4).

Habit

It is an evergreen tree, grows up to a height of 12-15 meter with large circular crown. Its leaves are unequally pinnate with broadly winged rachis. Leaflets obovate-oblong having prominent nerves; drupes 1-5, purple black, 12-13 mm long, and seeds globular (5). LaxmiTaru is tropical tree, grows upto 1000 meter above sea level and in all types of well drained soils, with an average annual rainfall of 1,769 millimeter in central region and 1,833 millimeter in eastern region (6). It has immense reclamation potential in all types of problematic soils by sustenance and improvement of the microbiota (7).

Phenology

It flowers during July to September. The fruits are purple in color having sweet edible pulp but slightly astringent in taste after ripening. The seeds are 1.5 to 2 centimeter long, pinkish or yellowish in color after ripening (8).

Cultivation and Propagation

It is cultivated in Orissa, Maharashtra, and also under commercial plantation in other states like Gujarat, Rajasthan, Andhra Pradesh, Karnataka, Tamil Nadu, West Bengal, and Orissa. It is propagated by seeds, and other vegetative methods (grafting, air layering, cutting, and tissue culture) of propagation (9). Its hard seed coat imposes the physical dormancy, and results in to less seed emergence and germination. Several mechanical and chemical treatments are applied for breaking the dormancy of its seed such as scarification, soaking the seeds in 100 ppm plant growth regulators (PGRs), GA (Gibberellic acid), CCC (Chlormequat chloride), SA (Salicylic acid), 6-BA (6-Benzylaminopurine) and by applying various priming techniques (10).

Commercial utility of seeds and fruits of Laxmi Taru

The seeds could be used for extracting oil (60-75%) by traditional methods because a grown up tree yields 15 to 30 Kg nutlets which provide 2.5-5 Kg oil and about the same quantity of oilcake. The oil cake being rich in nitrogen (8%), phosphorus (1.1%) and potash (1.2%) is good organic manure (5). The oil is highly useful, largely in the preparation of bakery products in Central America. In India too it is used in the manufacture of vegetable oil and margarine. The oil is free from harmful cholesterol. The oil is safer for edible purpose similar to groundnut oil, while saturated, mono-unsaturated, and poly-unsaturated fatty acids contents are equivalent to palm oil (11). Moreover, the oil of its seeds is mixed with oil of Mahua (*Madhuca Indica* Gmel.) for the formation of efficient biodiesel,

which is very comparable to diesel (12). It is also taken for industrial applications especially in the manufacture of soaps, detergents, lubricants, varnishes, cosmetics, pharmaceuticals, etc. The shells can be used in the manufacture of particle board, activated charcoal or as fuel. Wild animals like, jackals, porcupines, squirrels, cuckoos, mynas, bulbuls and other animals eat sweet pulp of druplet and help in natural regeneration and seed dispersal (13). The fruit pulp, rich in sugars (about 11%) is sometimes mixed in the preparation of beverages. Its pulp along with leaf litter is an economic material in preparing vermicompost, which is used for nourishing the soil in amounts of about 3 tons/acre/year to 8 tons/acre/year. Its wood is generally insect resistant hence used in the preparation of quality furniture, toys, in match industry, as pulp (in paper making) and as fuel (14).

Chemical Constituents of Laxmi Taru

The combinations of secondary metabolites (therapeutic agents) are found in Laxmi Taru plant including alkaloids (quassinoids, quassin), glycosides, flavonoids, phenolic compounds, tannins, cardenolides, and saponins (15). More specifically triolein (triglyceride), scopoletin (phenolic comp.), fraxidin (hydroxyl-coumarin), canthin-6-one (alkaloid), glaucarubinone (quassinoids), and free fatty acids (FFA) have also been evaluated from it (16). These active chemical compounds are naturally found in *Garcinia Indica* (Thouars) Choisy, *Trigonella Foenum-graecum* L., *Artemisia Annua* L., *Jatropha* sp., *Murraya Koenigii* (L.) Spreng., and *Madhuca Indica* Gmel respectively (17).

A B

Figure 1 (A-B). A) Dried seeds, and B) Dried leaves of Laxmi Taru (Simarouba Glauc DC).

Ethno-medicinal uses

Its bark had been used for longer time as a natural medicine for amebic dysentery in the tropics. In the Guyana rain forest, bark is still used as an effective treatment for malaria, dysentery, and as a haemostatic agent to stop bleeding. It is also used as a tonic for anemic people and is applied on wounds, and sores.

For making a traditional preparation for diarrhea or dysentery, a teacup full decoction of leaves is taken 2-3 times daily. However, it showed side effects at high dosages including increased perspiration and urination, nausea and vomiting (13). The Honey may be recommended as safer adjuvant for the purpose to increase the therapeutic index of the preparation.

Anti-cancer & other medicinal properties of Laxmi Taru

Laxmi Taru's wood contains the alkaloids, quassinoids and quassin which have been reported to possess, potential anti-tumor and anticancer activities. Good yields of quassin can also be obtained through callus cultures and suspension cultures (18). Quassinoids, which is having picrasane carbon skeleton and a side chain at C-15 and is carrying water solubilizing agent like glycine, may possess anticancer, antiviral and herbistatic properties. These properties are helpful against solid tumours, and in human immune deficiency virus infected cells (14). In addition, the anti-protozoal, anti-amebic and anti-malarial properties of this plant are due the presence of these chemical compounds. Clinically their active cancer-killing properties have been confirmed (8).

Early cancer screening performed by the National Cancer Institute in 1976 indicated that an alcohol extract of Simarouba root and a water extract of its seeds had inhibitory effects against cancer cells at very low dosages (less than 20 mcg/ml). Subsequently, scientists discovered that there are many derivatives of the quassinoids present in Simarouba (glaucarubinone, ailanthone, and dehydroglaucarubinone), which have anti-leukemic effects against lymphocytic leukemia *in vitro* (18,7). The therapeutic profile of plant is very broad not only covering the anti-cancerous (colon, breast, stomach, rectal, pancreatic, and lungs) activity (19), but also found to be efficacious in curing diabetes, leishmaniasis (parasitic disease), cardiovascular disorders, asthma, and hyperacidity. It showed *in-vitro* anti-fungal, anti-bacterial, and anti-oxidant activities (4). It promotes general body immunity, and act as a wonderful immune-modulator also (20).

Novel Drug Discovery and development

Scientists have found anti-malarial property of water extract of Laxmi Taru bark and root against resistant strains of malaria for existing anti-malarial drugs during preclinical trials in chickens (*Gallus domesticus*). In the study it was found that the doses of only 1 mg of bark extract per kg of body weight exhibited strong anti-malarial activity (21).

Anticancer *in vitro* activity of crude leaf extract on leukemic cancer cell lines exhibited effective activity against three leukemic cell lines viz., K-562, MOLT-3 and KG-1 (22). The Glaucarubinone (GLU) triggers apoptosis in multidrug resistant cell line KB cells through the activation of pro-apoptotic proteins including caspase-9, Bax, and p-53. Further, it suppresses the ROS-dependent ABC transporters (23). The polyphenolic compounds of LaxmiTaru may also check the over expression of mammalian target of rapamycin (mTOR), a protein kinase regulating several cellular activities, including, cell growth, development, differentiation, cellular biosynthesis, maturity, and cell death (24). These studies are indicating a strong potential of leaves of Laxmi Taru for leukemia treatment.

Not only bark or leaves, its seeds also possess active anti-amebic activities in humans and ability to kill the most common dysentery-causing organism, *Entamoeba histolytica*, as well as two diarrhea-causing bacteria, *Salmonella* and *Shigella*. The extract of bark elucidated the *in-vitro* antiviral properties against herpes, influenza, polio, and vaccinia viruses (25).

Conclusion

The seeds of Laxmi Taru are very similar in color and size to *Murrayakoenigii*(L.) Spreng., and

*Sapindusmukorossi*Gaertn.. There is a need for proper pharmacognostic and taxonomic identification for appealing benefits from it. The large numbers of medicinal plants and their complex secondary metabolites have received attention of scientific fraternity not only for their therapeutic activities but also for their safety and potency in multiple diseases and disorders as well. However, there is high time for conducting further systematic research based on the available data in order to guide researchers, scientists, social servants, farmers, and many more segments of the society. The present review paper comprehensively attempted to present integrated view of Laxmi Taru on Seed-science, Agronomy, Taxonomy, Pharmacognosy, Natural chemistry, Ethnomedicine, Modern medicine, Pharmacology, Organic farming-Vermicomposting-Rural-development-utility and commercial prospects.

Further, this review may be found useful in scientific exploration of pharmaceutical potential of the plant simultaneously envisaging the mandates of economic potential, biodiversity conservation (ameliorates the soil biology, improves the soil fertility, checks soil erosion, and accelerates the water recharges), and overall empowering the integrated sustainable development in a large sphere.

Conflict of Interest

There is no potential conflict of interest related to this scientific work.

Acknowledgements

We would like to express our deepest appreciation to honorable Dr. Chinmay Pandya (Pro Vice-Chancellor, Dev Sanskriti University, Haridwar) for his unwavering support, motivation, and facilitation of the resources. Further, we express our gratitude to Professor Karan Singh (Head of Department of Medicinal Plants Sciences, Dev Sanskriti University, Haridwar) for the guidance of this work.

References

1. Singh DLR, Singh DK. Mandukparni Centella Asiatica L. Urban and Indigenous Medicinal and Aromatic Plants Potential through Biopesticides: A Review. Int J Trend Sci Res Dev. 2019;Volume-3(Issue-2):811-4. https://doi.org/10.31142/ijtsrd21473

2. Dwivedi T, Kanta C, Prakash Sharma I, Ishwar Prakash Sharma C, Raj Singh L. A list of some important medicinal plants with their medicinal uses from Himalayan State Uttarakhand, India. ~ 106 ~ J Med Plants Stud. 2019;7(2):106-16.

3. Pr K, S SP, Thirumal M, Tj M. Anticancer Potential Of Indian Medicinal Plants - A Review. Int J Pharm Biol Sci. 2017.

4. Sharma R. Simarouba Glauca- A wonder Tree. Agriculture and Food e-newsletter. 2019 Sep 24.

5. Dash AK, Pradhan RC, Das LM, Naik SN. Some physical properties of simarouba fruit and kernel. Int Agrophysics. 2008.

6. O'Brien JJ, Oberbauer SF, Clark DB, Clark DA. Phenology and stem diameter increment seasonality in a Costa Rican wet tropical forest. Biotropica. 2008. https://doi.org/10.1111/j.1744-7429.2007.00354.x

7. Shyamsundar J, Joshi S. SIMAROUBA GLAUCA DC (Paradise Tree) (brochure). Dep Agric Econ. 2008.

8. Varada SL, Veetil JE, Nair GC. Antimicrobial Efficacy of Simarouba glauca (Lakshmi Taru) Plant Extract against Enterococcus faecalis Biofilm: An in vitro Study. Conserv Dent Endod J. 2017. https://doi.org/10.5005/jp-journals-10048-0025

9. Shibata S, Nishikawa Y, Tanaka M, Fukuoka F, Nakanishi M. Antitumour activities of lichen polysaccharides. Z Krebsforsch. 1968 Feb 1;71:102-4. https://doi.org/10.1007/BF00524509

10. Oil OF, Plant Y, Glauca S, S PAMA, Aikwad GDK. Effect of Plant Growth Regulators on Seed Germination. Sci York. 2011.

11. Rout P, Rao Y, Jena S, Sahoo D, Ali S. Safety evaluation of Simarouba glauca seed fat. J Food Sci Technol. 2014 Jul 1;51. https://doi.org/10.1007/s13197-012-0636-9

12. Jena PC, Raheman H, Prasanna Kumar G V., Machavaram R. Biodiesel production from mixture of mahua and simarouba oils with high free fatty acids. Biomass and Bioenergy. 2010. https://doi.org/10.1016/j.biombioe.2010.02.019

13. Wealth of India-First Supplement Series (Raw Materials), Vol.-4: J - Q. New Delhi: NISCAIR;2017. 2017;2017.

14. T R S, Reddy MP, Vendrapati RR, Ramakrishna KK, Bhat S. Pharmacognostical Studies on the Leaves of Lakshmitaru (Simarouba Glauca Dc.), a Well Known Anti-Cancerous Plant. World J Pharm Pharm Sci. 2016.

15. Huynh N, Beutler JA, Shulkes A, Baldwin GS, He H. Glaucarubinone inhibits colorectal cancer growth by suppression of hypoxia-inducible factor 1α and β-catenin via a p-21 activated kinase 1-dependent pathway. Biochim Biophys Acta - Mol Cell Res. 2015. https://doi.org/10.1016/j.bbamcr.2014.10.013

16. Ham E, Schafer H, Denkewalter R, Brink N. Structural Studies on Glaucarubin from Simarouba glauca. J Am Chem Soc. 1954 Dec 1;76. https://doi.org/10.1021/ja01652a060

17. Patil M, Gaikwad D. A Critical Review on Medicinally Important Oil Yielding Plant Laxmitaru (Simarouba glauca DC.). J Pharm Sci Res. 2011 Apr 1;3:1195-213.

18. Lavanya A, Muthukumar M, Selvaraj M, Kumaresan V, Senthil Kumar T, Rao A, et al. In vitro micropropagation of Simarouba glauca DC. 2016 Feb 1;15:107-11.

19. Yeo D, Huynh N, Beutler JA, Christophi C, Shulkes A, Baldwin GS, et al. Glaucarubinone and gemcitabine synergistically reduce pancreatic cancer growth via down-regulation of P21-activated kinases. Cancer Lett. 2014. https://doi.org/10.1016/j.canlet.2014.01.001

20. García M, Monzote L, Scull R, Herrera P. Activity of Cuban Plants Extracts against Leishmania amazonensis . ISRN Pharmacol. 2012. https://doi.org/10.5402/2012/104540

21. Hussain MS, M, Khan MD. Pharmacological Uses Of Simarouba Glauca: A Review. Plant Arch. 2021;21:648-55. https://doi.org/10.51470/PLANTARCHIVES.2021.v21.no1.090

22. Wu GGG, Yuan M, Shen S, Ma XXX, Fang J, Zhu LL, et al. Supporting Information. Nature. 2014.

23. Karthikeyan S, Hoti SL, Nazeer Y, Hegde HV. Glaucarubinone sensitizes KB cells to paclitaxel by inhibiting ABC transporters via ROS-dependent and p53-mediated activation of apoptotic signaling pathways. Oncotarget. 2016. https://doi.org/10.18632/oncotarget.9865

24. Tamaddoni A, Mohammadi E, Sedaghat F, Qujeq D, As'Habi A. The anticancer effects of curcumin via targeting the mammalian target of rapamycin complex 1 (mTORC1) signaling pathway. Pharmacological Research. 2020. https://doi.org/10.1016/j.phrs.2020.104798

25. Wealth of India-Second Supplement Series (Raw Materials),Vol.-3, Pi-Z. New Delhi: NISCAIR; 2009.