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Phytochemical and Biological Properties of *Sapindus trifoliatus* A Systematic Review 1970-2024

Sarita Rawat[1]*, Prashant Kumar Dhakad[1], Ritu Gilhotra[1], Gaurav Gupta[1]

[1]Gyan Vihar School of Pharmacy, Suresh Gyan Vihar University, Jaipur, Rajashthan, India.

*Corresponding Author: Sarita Rawat

E-mail: saritarawat700@gmail.com

Abstract

Sapindus trifoliatus Linn., (Reetha) is a member of the Sapindaceae family. It's a medium-to-large deciduous tree, though some species may grow as shrubs. This tree belongs to a significant species of forest tree. Fruits, fruit skin, seeds, and leaves are all applied topically and orally in medicine. Because the fruits of *Sapindus trifoliatus* are used to manufacture soap and serve as a natural detergent, they are also referred to as soapberries and soapnuts. The pharmaceutical industry promotes the Sapindus species because they are an excellent source of saponins and other important phytochemical. Numerous studies have shown its biological potential as an anti-inflammatory, anti-helmintic, anti-epileptic, anti-ulcer, anti-cancer, anti-diabetic, anti-migraine, and antioxidant agent. This review focused on phytochemical and pharmacological properties conducted on different parts of *Sapindus trifoliatus* plant.

Key words: Sapindus, soapberries, saponins, anti-inflammatory, anti-ulcer, anti-diabetic.

Introduction

Sapindus trifoliatus Linn., is a member of the Sapindaceae family commonly known as Reetha. It includes both deciduous and evergreen species in the genus of plants. Sapindaceae is the largest family in the plant kingdom, comprising more than 2000 species and more than 150 genera(1). Deciduous and evergreen species of the genus sapindas are commonly grown at heights between 200m and 1500 m in the higher portions of the Indo-Gangetic plains, the Shivaliks, and the sub-Himalayan region. It is one of the most significant plants in Asia's tropical and subtropical regions and is sometimes referred to as the soapnut tree (Reetha). As per some report a significant amount of sugars and saponins has been found in the plant.The main compounds identified in the Sapindus genus are triterpenoids, fatty acids, flavonoids, and saponins(2).These chemical compounds are well known for their cytotoxic, anti-inflammatory, molluscicidal, antibacterial, and antidiabetic propertie.However, the crude extract of a few additional substances that have been identified from this species may contain significant biological activity(3).

The medium-sized, deciduous *Sapindus trifoliatus*tree mostly grows along the coastal areas of Uttar Pradesh, West Bengal, Madhya Pradesh, Bihar, and South India. Seeds consist of around 11.5% saponin, 45% fixed oil, and 10% glucose(4).The fruit of *Sapindus trifoliatus*was extracted using water to yield the saponin glycoside emarginotoside, while the pericarp yielded the isolation of hederagin 3-O-(3-O- acetyl-beta-D-xylose)(5)(6).

Table no 1: About Sapindus trifoliatus

Taxonomical Classification	Kingdom: Plantae Family: Sapindaceae Habitat: Grows wild in south India Genus: Sapindus Species: S. trifoliatus Synonyms: Gaspenela Parts used: Fruits, soap nut shells
Scientific names	Sapindus laurifolius, Sapindusacutus Sapindus abstergens, Sapindus mollis
Common Names	Hindi: Ritha Sanskrit: Arishtak, Aristam English: Soap nut (south India)

Parts Part Used	Whole plant, including the roots, leaves, fruit, and seed
Taste	Bitter, Pungent

Macroscopic features of *Sapindus trifoliatus*

Tree: -This large, deciduous tree has a globose crown and relatively fine leathery leaf. Its height is normally between 12 and 25 metres, but it can occasionally reach 20 metres with a girth of 1.8 metres(7).

Leaves: -The terminal leaflet is frequently missing and has a very finely edged petiole that is 2–5 m long and glabrous. Compound leaves are 30–50 cm long, pinnately paired, and have five to ten leaflets per pair(8).

Bark: - The bark has a dark to pale yellow tint and is quite smooth. It has numerous vertical lines containing lenticels and small cracks that exfoliate in uneven wood scales(8,9).

Fruit: - Globose, fleshy, one-seeded drupes (occasionally two drupels together), 1.8–2.5 cm in diameter, velvety when immature, hard and smooth as they mature, appear during July and August(8).

Seeds: -When dry, seeds are globose, smooth, and black in colour, with a diameter of 0.8–1.3 cm(10).The dried fruit has loose, smooth, black, spherical seeds. The fruit turns from a yellow-orange to a dark brown colour when it is mature(5).

Fig no 1: - (A) Tree of *Sapindus trifoliatus* **(B) Soapnuts and leaves**

Other species of Sapindaceae family

Sapindus mukorossi:Common names, Soapnut, Soapberry, Washnut, Reetha, Aritha, Dodan, Doadni; widely used as a natural surfactant, insecticidal, and treatment for psoriasis,

eczema, migrane, excessive salivation, epilepsy, chlorosis, dental caries, arthritis, common cold, constipation, nausea, joint pain, and gout; found in Southern China and India(11,12)(13)

Sapindus Saponaria: common name Western soapberry, Cherrioni, Jaboncillotradetionaly used as Curling ulcer, External wounds and Inflammation found in found in a certain geographic area of Caribben and Central America(5).

Sapindus oahuensis: -common name Hawaii Soapberry, Lonomea found in Geographical Region of Hawaii(14).

Sapindus drummondii: common name Western Soapberry found in Geographical Region of Southern United States, Mexico(14).

Phytochemical properties

Fruits part of *Sapindus trifoliatus*are mostly made up of mucilage, saponins (10–11.5%), and sugars (10%). Seeds include 10% glucose, 45% fixed oil, and 11.5% saponins. The kernel contains 30% of the fatty acids, nearly 80% of the triglycerides, and sterol(15).

The seeds of *Sapindus trifoliatus*contain a variety of steroids, carbohydrates, flavonoids, triterpenoids, and saponins in both aqueous and methanolic extracts. In addition, it has been shown that seeds contain fatty acids, primarily behenic, oleic, linoleic, palmitic, stearic, oleanolic, and sapindic acid(16). Additionally, it is discovered that the plant contains glucopyranosides of protein, carbohydrates, starch, ß-sitosterol, kaempferol, quercetin, and Hederagenin(2). The plant contains flavonoids, bacosides A and B, hersaponin, alkaloids such as herpestine and brahmine, and tetra-cyclic tri terpenoid saponins(17). All sections of *Sapindus trifoliatus*contain phenolic acids, including cis-p-coumaric acid, protocatechuic acid, p-hydrobenzoic acid, and cinnamic acid(5).

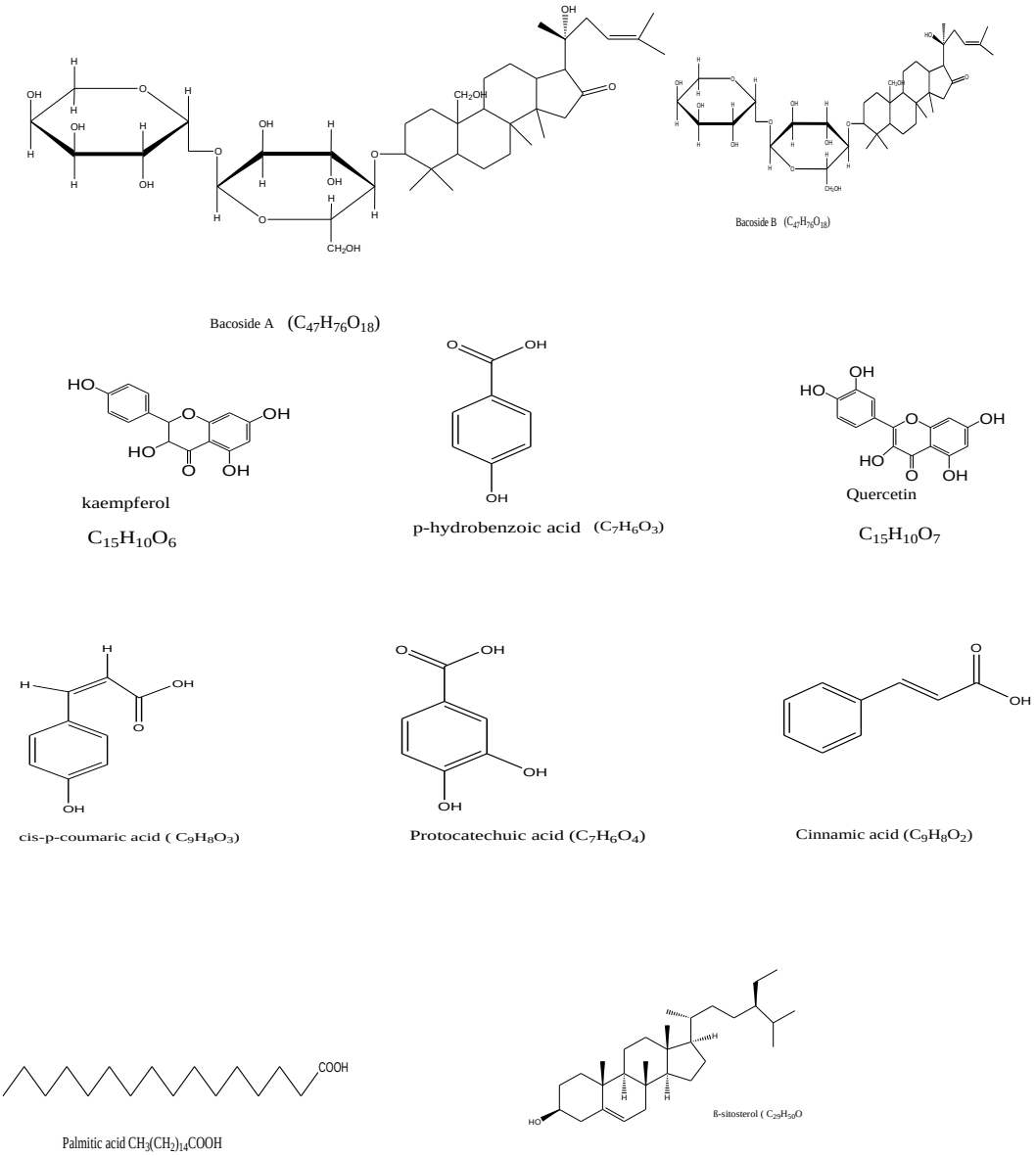

Fig no 2: Chemical Structure of some important phytochemical present in Sapindus trifoliatus

Biological properties of Sapindus trifoliatus

Anti-Cardiovascular

Saponins are beneficial for the cardiovascular system because they share structural similarities with cardioactive plant sterols and have significant pharmacological activities such as hemolysis or permeabilization of cell membranes, lowering blood cholesterol, and anticoagulants.Saponins have demonstrated a reduction in cholesterol levels in humans as well as animals(18). The amount of cholesterol that is absorbed from the intestine is known to be decreased by saponins.Regular consumption of saponins increases the excretion of

cholesterol in the faeces, which helps the liver convert cholesterol to bile acids very effectively(19). In addition, adding saponins to the diet improves the liver's capacity to metabolise cholesterol to bile acids, which raises the excretion of cholesterol in the faeces significantly. Because they can lower serum cholesterol in the intestinal tract by blocking cholesterol absorption, some phytosterols, such as diosgenin and its derivatives, are referred to as cardioprotective agents(20).

Anti-microbial activity

Numerous investigations have shown the antibacterial qualities of Sapindus species both in vitro and in vivo. The antimicrobial efficacy of leaf extracts from Sapindus species against bacteria has been reported(5). The methanolic and aqueous extracts showed considerably different bactericidal potentials against Escherichia coli and Psuedomonas aeruginosa(21).

Anti-cancer activity

Due to their significant structural variability, saponins usually exert their anti-tumorigenic effects via many anti-tumor pathways. A selection of the over eleven distinct types of saponins include steroids, lanostanes, cucurbitanes, cycloartanes, oleananes, hopanes, dammaranes, and tirucallanes(9).

Metabolic effects

The phytomedicine *Sapindus trifoliatus*(ST), used to treat hemicrania, showed antagonistic effects on dopamine and serotonin in animal models by blocking the behavioural alterations caused by these agonists in receptor radioligand binding experiments(22). ST showed affinity for both 5-HT2A and D2 dopamine receptors in the ligand binding experiments(18).

Anti-diabetic and anti-oxidant activity

There are some researches on how antioxidant potential affects the glycosylation of haemoglobin in rats. Studies on the anti-hyperglycemic properties of *Sapindus trifoliatus*have also been reported. These studies used hyperglycemic, glucose-overloaded rats to examine the effects of an alcoholic extract of Sapindus species leaves(19). The extract showed a potent hypoglycemic effect at different dosages in a dose-dependent manner. Saponins have been reported to be abundant in the plant's ethanolic extract. There are reports that saponins have antioxidant and anti-diabetic properties(23).

Anti-dandruff activity

According to some research, saponin is one of the compounds that has been shown to suppress Malassezia furfur. It was found that Piyriasis capitis may be effectively treated in vitro using Sapindus trifoliatus(14).

Anti-epileptic activity

In a study using Swiss albino rats, the anti-epileptic effects of an aqueous extract of *Sapindus trifoliatus*pericarp were examined(24). After injecting the extract for an hour, evaluation was conducted using corneal electrodes and electroshock. Maximal Electroshock convulsions were effectively avoided by the extract(4,18).

Insecticidal activity

In some study, the cotton leafworm Spodoptera littoralis and the pea aphid Acyrthosiphonpisum's caterpillars were examined(14,21). By either killing or inhibiting the growth of study insects, saponins exhibit an insecticidal action. On the other hand, caterpillars of the Spodoptera species were able to mature into adults that looked normal when fed diets containing 7% saponin, while all of the aphids in the Acyrthosiphonpisum trial died by 0.1% saponin(16).

Anti-ulcer activity

It was found that both the methanolic and aqueous extracts of ST significantly reduced the ulcers caused by pylorus ligation in rats(2). Research indicates that the amount of stomach ulcers caused by ethanol has been significantly decreased by methanolic and aqueous extracts containing sterols and flavonoids(15).

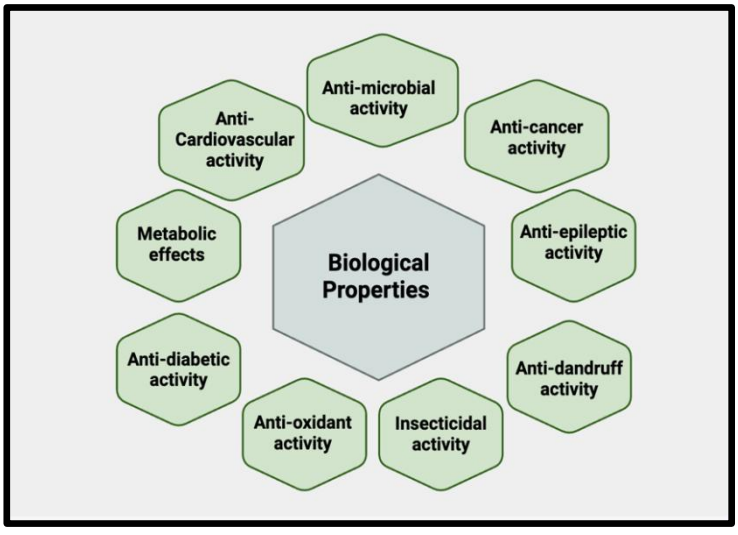

Figure 3: Biological properties of Sapindus trifoliatus

Table no 2: - Literature review 1970-2024

Year	Finding
2021	*E.R.H.S.S. Ediriweera et al.* review on *sapindustrifoliatus*(gaspenela) and its therapeutic

	value and they report that plant has anti-ulcer, anthelmintic, anti-inflammatory, muscle relaxant, anti-acne, and anti-dandruff properties, according to Ayurvedic medicine, Sri Lankan medical publications, journals, doctors, and online searches.
2015	*N.B. Dangi et al.* conducted a study using *Sapindus trifoliatus*on alzheimer's disease induced by aluminum chloride in rats the finding suggests that improved biochemical and behavioural characteristics are observed when *sapindustrifoliatus*is used to treat AD caused by aluminium chloride. In general, the histopathological results in the hippocampus of brain tissue neurons match those of normal brain tissue when compared to the negative control group.
2011	*D.V. Kishoreet al.* evaluated anti-ulcer effects of methanolic and aqueous leaf extracts of *Sapindus trifoliatus*in healthy rats using the ethanol-induced ulcer technique.At a dose of 400 mg/kg body weight, both of the extracts made from *Sapindus trifoliatus*leaves shown notable anti-ulcer action. The highest level of anti-ulcer activity was observed at 400 mg/kg of aqueous extract, which was almost identical to sucralfate.
2011	*K. C. Sravanthi et al.* used *Sapindus trifoliatus*seed extract to find out the anti-helmintic activity, the result shows positive when compared to the common medication albendazole, the methanolic extract of *Sapindus trifoliatus*seed extract was found to be effective in killing worms at all tested dosages.
2008	*S.V. Raut Dangi et al.* evaluated "Isolation and identification of *Sapindus trifoliatus*antidundruff component" the result suggests that one of the components that has been shown to suppress Malassezia furfur is saponin. It has been discovered that *Sapindus trifoliatus*works well as an in vitro treatment for Piyriasis capitis(dandruff).
2008	*A Krishnaveni et al.* conducted a study titled "Pharacognocal and Preliminary Phytochemical Studies of Sapindus trifoliatus," there are substantial amounts of phenols, tannins, sterols, flavanoids, and saponins in the results of multiple qualitative chemical tests conducted on powder, ethanol extract, and water extract.
2006	*D. K. Arulmozhi et al.*examined effects of *Sapindus trifoliatus*aqueous extract on the central nervous system: potential antimigraine mechanisms Mice who had convulsions with pentylenetetrazole (PTZ) and maximum electroshock (MES) did not exhibit any protection against ST. Research on receptor radioligand binding showed that ST had affinity for muscarnic, adrenergic, and dopaminergic receptors. The findings suggest that ST could have underlying hypotheses that have neuroleptic properties.
2005	*D. K. Arulmozhi et al.* studied Sapindus trifoliatus's effect on in vivo hyperalgesic

	migraine models, the results suggest that dopamine D2 antagonistic effects may be the cause of the S. trifoliatus aqueous extract's antihyperalgesic properties.
2004	*Arul et al.* evaluated the anti-inflammatory properties of the ethanolic extract of *Sapindus trifoliatus*Linn. seeds were in wister rats. With the use of three different models—carrageenan-induced pleurisy, cotton pellet-induced granuloma, and left hind paw edema.The findings indicate that S. trifoliatus plant seeds exhibit strong anti-inflammatory properties in rats.
1976	*J Lal et al.* conducted a study titled "In vitro anthelmintic action of some indigenous medicinal plants on Ascardiagalli worms", A total of eleven native medicinal plants were analysed in parts for their in vitro anthelmintic efficacy against Ascaridiagalli worms of birds. It has been shown that applying preparations of Butea frondosa, Momordica charantia, Carica papaya, and *Sapindus trifoliatus*is more beneficial than using piperazine hexahydrate.

Conclusion

Sapindus trifoliatus, also known as Gaspenela, is a plant with a wide range of therapeutic uses.*Sapindus trifoliatus*roots, leaves, fruits, fruit skins, and seeds parts have medicinal uses and used for medical purposes to cure a variety of diseases, including diabetes, cancer, dandruff, cardiovascular disorder and also have antimicrobial activity. Although saponins are present throughout the entire plant, the fruit contains the majority of them. Furthermore, phenolic acids including cinnamic acid, p-hydrobenzoic acid, cis-p-coumaric acid, and protocatechuic acid are present in *Sapindus trifoliatus*plants.

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