

Sapindus trifoliatus: A review on ethno-medicinal uses, phytochemicals and pharmacological potentials

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Abstract

Sapindus trifoliatus Linn. belongs to family Sapindaceae is commonly known as Reetha. It is a deciduous tree with medium-to-large in size, and some species exist as shrub too. This tree is an important forest tree species. *Sapindus trifoliatus* is commonly known as soapberries and soapnuts since the fruits are used to make soap and acting as natural detergent. Being a good source of saponins, Sapindus species have a significant role in economical value as well as in medicinal industry. It has been used by Unani physicians since antiquity as surfactant and for cleaning hair. Reetha is the ingredient of various herbal formulations and shampoos. It has valuable role in the treatment of lice and dandruff. Different pharmacological studies reported its potential as anti-epileptic, spermicidal, anti-inflammatory, anti-helminthic, anti-ulcer, anti-cancer, anti-diabetic, anti-migraine, antioxidant activity etc. This review summarizes the information described in classical Unani text and scientific research conducted on different parts of *Sapindus trifoliatus* plant.

Keywords: herbal, reetha, *Sapindus trifoliatus* Linn, saponins, Soapnut, Unani

1. Introduction

Sapindus trifoliatus Linn is one of the oldest cultivated plants in the world. It belongs to family Sapindaceae. Deciduous and evergreen both species are included in the plant genus [1]. Sapindus is a genus of about five to twelve species of shrubs and small trees in the Lychee family, Sapindaceae, native to warm temperate to tropical regions. They are well-known as soap berries or soap nuts, as pulp of the fruit is used to make soap and hence the generic name is derived from the Latin words *Saponins* which means soap and *Indicus* meaning "of India" [2].

Sapindus trifoliatus is a deciduous medium sized tree, found mainly in the coast of Uttar Pradesh West Bengal, Madhya Pradesh, Bihar, and South India. It is developed for ornamental purposes and in streets. Around 11.5% saponin, 45% fixed oil and 10% glucose are found in seeds. Aqueous

extract of the fruit of *Sapindus trifoliatus* has been used for isolating saponin glycoside emarginoside, while hederagin-3-O-(3-O-acetyl-beta-D-xylose) was isolated from pericarp [3].

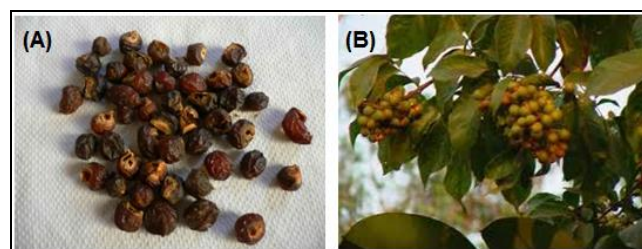


Fig 1: (A) Soapnuts; (B) Tree of *Sapindus trifoliatus*

Table 1: Different Species of *Sapindus*

Species	Common name	Traditional use
<i>Sapindus saponaria</i>	Western soapberry, Cherrioni, Jaboncillo	Curling ulcer, External wounds, Inflammation [4].
<i>Sapindus mukorossi</i>	Soapnut, Soapberry, Washnut, Reetha, Aritha, Dodan, Doadni	Expectorant, natural surfactant, Insecticidal, excessive-salivation, pimples, epilepsy, chlorosis, migrane, eczema, psoriasis, dental caries, arthritis, common cold, constipation, nausea, joint pain, gout [5].

1.1 Taxonomical Classification [3]

Kingdom: Plantae

Sub kingdom: Tracheobiota

Division: Magnoliophyta

Super division: Spermatophyta

Class: Magnolipsida

Sub class: Rosidae

Family: Sapindaceae

Genus: Sapindus

Species: *S. trifoliatus*

Parts used: Fruits, soap nut shells

Habitat: Grows wild in south India

1.2 Vernacular Names ^[6]

Sanskrit: Arishtak, Phenila, Aristam

Hindi: Ritha

Bengali: Rithe, Reetha

English: Soap nut (south India)

Kannada: Kookatakayi

Malayalam: Urugani

Marathi: Aritha

Oriya: Ritha

Tamil: Manipungan maram

Telugu: Kunkudu chettu

1.3 Parts Used ^[7]

Whole plant (Leaves, Fruit, Seed, Kernel and Roots)

1.4 Temperament ^[7, 8]

Hot 2, Dry 2

1.5 Recommended Dosage of Reetha ^[7, 8]

Reetha Powder: ½-1 teaspoon

1.6 Toxicity ^[7, 8]

Hot Temperament

1.7 Corrective ^[7, 8]

Almond Oil

1.8 Taste ^[7, 8]

Bitter, Pungent

1.9 Method to Use**1.9.1 Reetha powder**

1. Take ½-1 teaspoon of the powder.
2. Add some rose water to it and massage gently over the skin.

3. Wash thoroughly with fresh water.
4. Use this remedy 1-2 times a day for effective cleansing of skin.

1.9.2 Reetha, Amla & Shikakai Paste

1. Take Reetha, Amla and Shikakai powder.
2. Add some water to form a paste.
3. Apply this paste on hair and wait for 5-6 hours.
4. Wash your hair thoroughly with plain cool water.
5. Regular use for 1-2 times a week, and continue for 2-3 months for silky, dandruff and lice free hairs.

1.9.3 Medicated herbal shampoo

These are used as per advice by physician.

2. Botanical Description**2.1 Habitat**

It grows in India at an altitude range from 200 to 1500 m. It grows in Indo-Gangetic plains, Shivaliks and Sub-Himalayan tracts ^[3]. This plant needs clay loamy soil with an annual rainfall of 200mm. The plant is usually cultivated in acidic Soil, lateritic Soil, red Soil, black Soil, with a humid and hot climate. It grows upto a height of 25m. Height of tree differs in different species and sometimes it goes upto 35 m with 1.8 m belt ^[9].

2.2 Macroscopic features

Sapindus trifoliatus soapnuts are also known as three-leaf Soapberry. It mainly grows in South India ^[10]. While *Sapindus mukorossi* (Himalayan) is the soapnut tree that grows in North India. Fruits and seeds of Southern variety are slightly smaller than North Indian variety. The shell is of red colour and turns darker after they are harvested and dried ^[11]. The tree grows upto to a height of 12 meters. Detailed information is discussed in Table 2.

Table 2: Macroscopic features of *Sapindus trifoliatus* ^[6]

Tree	Large, deciduous tree, height usually up to 12-25 m, sometimes attaining a height of 20 m and a girth of 1.8 m, with a globose crown and rather fine leathery foliage.
Leaves	Leaves are 30-50 cm long, alternate and pinnate with 5-10 pairs of leaflets; terminal leaflet is often absent, having very narrowly bordered petiole, 2-5 m long and glabrous.
Fruit	Globose, fleshy, 1-seeded drupe, sometimes 2 drupels together, about 1.8-2.5 cm across, velvety when young and turns hard and smooth on maturing, appear in the month of July-August.
Seed	Seeds are 0.8-1.3 cm in diameter, globose, smooth, black in colour in dry form.
Flower	Flowers are small and greenish white in colour. Nearly 5 mm across, polygamous, subsessile, numerous, mostly bisexual, 5 Sepals, each with a woolly scale on either side above the claw. Inflorescence in form of a compound terminal panicle, 30 cm or more in length, with pubescent branches. They are usually seen in the month of November, December and January.
Bark	Bark if dark to pale yellow coloured, fairly smooth, with many vertical lines of lenticels and fine fissures exfoliating in irregular wood scales.

3. Phytochemistry

The major constituents of the fruits are Saponins (10-11.5%), Sugars (10%) and Mucilage ^[9]. Seeds contain 11.5% Saponins, 45 % Fixed oil and 10 % Glucose ^[10]. The kernel contains 30% of a fatty acid, approximately 85% of triglycerides and sterol ^[11].

Various steroids, carbohydrates, flavonoids, triterpenoids and saponins are found in aqueous and methanolic seed extracts of *Sapindus trifoliatus*. Seeds are also found to contain fatty acid mainly of arachidic acid, Behenic,

Linoleic, Oleic, Palmitic, Stearic, Oleanolic and Sapindic acid. Glucopyranosides of Stigmasterol, Kaempferol, quercetin, β-sitosterol, Hederagenin, protein, carbohydrate and Starch are also found to be present in the plant ^[8].

Tetra-cyclic tri terpenoid saponins, bacosides A and B, hersaponin, alkaloids viz herpestine and brahmine and flavonoids are present in the plant ^[12]. Phenolic acids such as protocathechuic acid, cis-p-coumaric acid, p-hydrobenzoic acid and Cinnamic acid are present in all parts of the *Sapindus trifoliatus* ^[13].

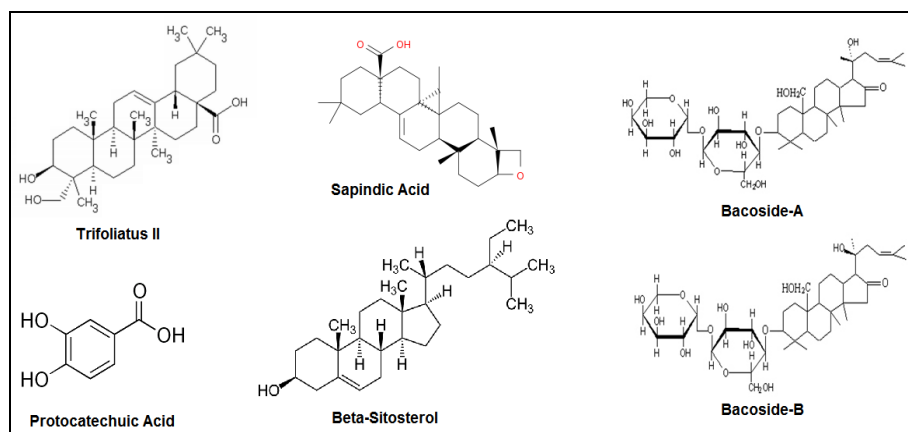


Fig 2: Chemical structures of few important chemical constituents present in *Sapindus trifoliatus*

4. Pharmacological Actions ^[6, 14, 15]

Tonic (fruit)
 Digestive (fruit in low dose)
 Anti-flatulence (fruit in low dose)
 Detergent (fruit)
 Absorbent (fruit)
 Purgative (fruit)
 Laxative
 Anti-helmintic
 Blood purifier (fruit)
 Emetic (kernel and fruit)
 Aphrodisiac (seed kernel)
 Emmenagogue (fruit)
 Uterine stimulant (fruit)
 Abortifacient
 Astringent (fruit pericarp and root)
 Mushil-e-akhhlatsauda, balgam and safra Expectorant (fruit and root)

5. Pharmacological Uses

For many decades *Sapindus trifoliatus* has been used to relieve symptoms from fever caused by infection, inflammation and also it was prescribed for treating different types of malignancies ^[16].

Powder of soap nut has very well anti-bacterial and anti-fungal activity. To get relief from joint pains, the affected portion was applied with poultice of soap nut powder. Pericarp of the fruit is reported to have various medicinal properties like tonic, stomachic, spermicidal and it was also reported to be useful in the treatment of migraine, hysteria, etc ^[17].

For the relief of Hemi crania, a thick watery solution of the mesocarp is introduced into the nose of the patients ^[12]. The plant was reported for its anti-spermatogenic, anti-androgenic and anti-rheumatic activities ^[18]. Leaves of *Sapindus trifoliatus* can be used as expectorant, eczema, aphrodisiac, abortifacient, psoriasis and freckles, inflammation [19]. Commercially soap nuts are used in cosmetics as cleaning agents, and will not cause any toxic effects on human skin and eyes. To restore the lost brightness of ornaments made of precious metals like gold, silver etc, the jewelers in India use this plant extract [13].

Rind of fruit posses' antifertility activity (antiimplantation activity). Fruit and seed have analgesic and anti-inflammatory activity (rectified spirit extract). Ethereal extract of the pericarp shows activity against *Staphylococcus aureus* (fruit pericarp), and *Escherichia coli*. Saponins from plant are used as an adjuvant for

development of vaccine against foot and mouth disease virus in guinea pigs. They are pesticidal and enhance the mortality of *Callosobruchus chinensis* ^[6].

6. Pharmacological Studies

6.1 Anti-inflammatory activity

DK Arulmozhi *et al.*, 2005 have reported the anti-inflammatory activity of aqueous extracts of *Sapindus trifoliatus* in various anti-inflammatory in vitro and in vivo models. It was concluded that *Sapindus trifoliatus*, a phytomedicine was traditionally used in the treatment of hermicrania. The results suggest that cyclo-oxygenase and lipoxygenase pathways could be involved in the anti-inflammatory activity of *Sapindus trifoliatus* ^[2].

Arul *et al.*, 2004 reported the anti-inflammatory activity of ethanol extract of seeds of *Sapindus trifoliatus* by inducing paw-edema and pleurisy leading to carrageenan and granuloma formation. The extract produced decrease in paw edema and in pleural sweating volume and had an inhibitory effect on leukocyte migration. A decrease in granuloma weight was also reported ^[20].

6.2 Anti-cancer activity

D. Pradhan *et al.*, 2010 reported the anti-cancer effect of *Sapindus trifoliatus* on human breast cancer cell lines, SKBR3 AND MDA-MB435. One of the fractions of the extracts of *Sapindus trifoliatus* was found to have an inhibitory growth effect on these cell lines. That particular fraction could inhibit the proliferation of human breast cancer cell lines, SKBR3 and MDA-MB435 ^[21].

D. Pradhan *et al.*, 2014 investigated the inhibitory growth effect of *Sapindus trifoliatus* in two different breast cancer cell lines SKBR3 and MDA-MB435. The effect of the fruit of the plant on Ehrlich Ascited carcinoma tumor bearing mice was established. The results clearly demonstrate the tumor inhibitory activity of the plant extract against transplantable murine tumor cell line ^[22].

6.3 Anti-migraine activity

Arulmozhi *et al.*, 2005 conducted the pharmacological study of aqueous extract of fruit pericarp on central nervous system, and was found to have anti-migraine activity. They reported that the plant has neuroleptic properties ^[19].

Arulmozhi *et al.*, 2004 reported the effect of the aqueous pericarp extract of fruits of *Sapindus trifoliatus* in an in vivo migraine hyperalgesic model. The results showed that antagonism to dopamine D₂ might underline the mechanism involved in the anti-hyperalgesic activity of the plant ^[23].

6.4 Diabetic neuropathic pain

P. K. Sahoo *et al.*, 2010 studied the ethanolic extract of *Sapindus trifoliatus* in various in vivo models to study its effect on diabetic neuropathic pain and it was concluded that the ethanol extract showed significant effectiveness in model of neuropathic pain and protection produced by adenosine was via stimulation of adenosine A₁ receptors [24].

6.5 Anti-ulcer activity

Kishore D.V *et al.*, 2010 studied the anti-ulcer activity of the extract of *Sapindus trifoliatus* Linn in rats. It was found that methanolic and aqueous extracts showed significant reduction in the pylorus ligation induced ulcers in rats. It was found that methanolic and aqueous extracts containing flavonoids and sterols effectively reduced gastric lesions produced by ethanol [25].

G. Surendra *et al.*, 2012 used ethanol induced ulcer model for evaluating the anti-ulcer activity of of aqueous and methanolic seed extracts of *Sapindus trifoliatus*. It was found that maximum ulcer protective activity was shown by aqueous extract when given orally at a dose of 400mg/kg body weight [3].

6.6 Anti-epileptic activity

T. Jayasree *et al.*, 2011 evaluated the anti-epileptic activity of aqueous extract of pericarp of *Sapindus trifoliatus* in Swiss albino rats. Evaluation was made by electroshock using corneal electrodes after 1 hr of administration of extract. The extract showed maximum inhibition against MES induced seizures [26].

6.7 Anti-diabetic and anti-oxidant activity

P. K. Sahoo *et al.*, 2010 explained anti-oxidant potential by seeing its effect on glycosylation of haemoglobin in rat. They also described the anti-hyperglycemic activity and in vitro peripheral utilization of glucose of the ethanolic extract of the aerial parts of *Sapindus trifoliatus*. Results indicated that the extract produced decrease in the blood glucose level when compared with standard drug Glibenclamide. The ethanolic extract of the plant is reported to be rich in saponins. Saponins are reported to possess anti-oxidant and anti-diabetic activity [24].

6.8 Anti-helmintic activity

Sravanthi *et al.*, 2011 investigated the anthelmintic activity of the seeds of *Sapindus trifoliatus*. The methanolic extract of *Sapindus trifoliatus* seed extract was shown to be effective at all the concentrations tested against the standard drug albendazole in causing the death of the worms [27].

6.9 Anti-dandruff activity

Savanta *et al.*, 2008 evaluated that plant extract of *Sapindus trifoliatus* was found to be an effective remedy for *Pityriasis capitis* in- vitro [28].

7. Compound Formulations Available

Rasayan-e-badan in dose of 2-3 gram, Vatariguggulu, Zul-amlamla powder, Zulfi powder.

8. Precautions

To be used in recommended dose and duration otherwise lead to burning sensation in stomach due to its hot temperament. It is contraindicated in breastfeeding and pregnancy or to be used under medical supervision. Use Reetha (Soapnut) powder after diluting with plain water if

skin is hypersensitive. Avoid use of Reetha on sensitive parts like eyes because it may cause redness and swelling of the eyelids.

9. Conclusion

This review reveals that the plant of *Sapindus trifoliatus* has effective pharmacological activities. The plant was found to have promising Antihelmintic, Anti-epileptic, anti-diabetic, antiulcer, antimigraine, antioxidant and anticancer activities etc. The plant is traditionally claimed to be useful in the treatment of fever caused by infection, inflammation, for treating different types of malignancies, herniasis, migraine, hysteria etc. Leaves of *Sapindus trifoliatus* can be used as expectorant, eczema, aphrodisiac, abortifacient, psoriasis and freckles, inflammation etc. Further investigations are needed to isolate the various phytoconstituents present to get a clear idea of the mechanism of action of the plant and effectiveness of *Sapindus trifoliatus* in clinical practice.

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