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Sapindus mukorossi: A review article

Surender Singh and Methab Ali

Abstract
Sapindus mukorossi, well known as soapnut, belong to family Sapindaceae. It is popular ingredient of ayurvedic preparation such as shampoo, cleansers and medicine for treatment of eczema, psoriasis and for removing for removing freckles and also have gentle insecticidal property and traditionally used for removing lice from the scalp. The species is widely grown in upper reaches of the Indo-Gangetic plains, Shivaliks and sub-Himalayan tracts at altitudes from 200m to 1500m. It is also called as Soapnut or Aritha tree, it is most valuable trees of tropical and sub-tropical region of Asia.

Keywords: *Sapindus mukorossi*, antifungal, antibacterial

Introduction
Sapindaceae is one of the important family of plant kingdom consisting about 150 genera and 2000 species [1]. The genus *Sapindus* includes both deciduous and evergreen species widely grown in upper reaches of Indo-Gangetic plains, Shivaliks and sub-Himalayans track at altitude from 200m to 1500m. The soapberry family comprises nearly 2000 species, which are primarily tropical. Also known as soapnut tree (Reetha), it is one of the most important trees of tropical and subtropical regions of Asia. It flower during summer. The fruits appears in July – August and ripens by November – December. The genus *Sapindus* includes two major species *S. mukorossi* and *S. emarginatus* in north and south India. *S. mukorossi* is one of the most important sources for saponins. The pericarps contain 10-11% soapnut and are locally used for protection of petsts and micro-organisms. Other species of genus have been investigated for their astringent and pharmacological uses.
The major compounds isolated from genus *Sapindus* are saponins, triterpenoids, fatty acids and flavonoids are well known for their antimicrobial, antidiabetic, cytotoxic, molluscicidal, fungicidal and anti-inflammatory activities. However several other compounds isolated from this genus may contribute important biological activities in their crude extract.

History
Sapindus mukorossi is an acient fruit, leving some clame the origin in China, while other states in India. Ancient Indian text make references to soapberries. The book "saint Heritage of India" points out the Hatha yoga founder Machindranath was converted under a soapnut tree some time during his life in the 9th to 10th century. The "Chronological Dictionary of prehistoric India" explains that the paper title "Some Notes on the History of Soapnut, Soap and washermen of India – between 300 BC and AD 1900" hints at even earlier roots [2].

Traditional uses of *Sapindus* Species
The member of genus *Sapindus* are well known for their folk medicinal values. Pericarp of *S. mulorossi* have been traditionally used as an expectorant as well as a source of natural surfactant [3]. Due to presence of saponins, soapnut is well known for its detergent and insecticidal properties and traditionally used for removing lice from the scalp and used in dental carries [4]. The seeds of *S. mukorossi* are used to remove tan and freckels from the skin. The fruits are of considerable importance for its medicinal value for treating a number of diseases like common cold. pimples, epilepsy, constipation, nausea etc [5]. The leaves are used in bath to relieve joint pain and the roots are used in the treatment of rheumatism.
Since acient times *S. mukorossi* has been used as a detergent for shawl and silks. The fruits of *S. mukorossi* was utilized by Indian jewellers for restoring the brightness of tarnished ornaments made of gold, silver and other precious metals [6]. The fruit of *S. saponaria* is used by local population as soap for washing cloths, for curing ulcers and external wounds [7]. Fruits of *S. trifoloatus* have been considered as a tonic, stomachic, alexipharmic, astringent and

sedative to the uterus and also useful in chronic dysentery, diarrhoea, cholera, hemicranias, tubercular glands, paralysis and epileptic fits of children. The root of *S. trifoliatus* used as a collyrium in sore eyes and opthalmia. The seeds of *S. trifoliatus* are used to stimulate the uterus in child birth and to increase menstruration [8]. Pericarp of *S. delavayi* are also used as natural surfactants, being exported from China to Japan as a substituted of *S. mukorossi* [9]. Seeds of *S. emarginatus* contains anti-inflammatory oil, traditionally used to purify the blood.

Species Information [10-12]

Species	Commom Name	Geographical Region
Sapindus mukorossi	Chinies Soapberry, Reetha	India, Southern China
Sapindus emarginatus	-	Southern Asia
Sapindus trifoliatus	South India Soapnut, Three-leaf Soapberry	Southern India, Pakistan
Sapindus delavayi	-	India, China
Sapindus oahuensis	Hawaii Soapberry, Lonomea	Hawaii
Sapindus rarak	-	Southern Asia
Sapindus saponaria	Wingleaf Soapberry	Caribben, Central America
Sapindus marginatus	Florida Soapberry	Florida
Sapindus tomentosus	-	China
Sapindus drummondii	Western Soapberry	Southern United States, Mexico

Morphology [13-15]

(a) Leaves

30-50 cm long, alternate, paripinnate; common petiole very narrowly bordered, glabrous; leaflets 5-10 pairs, opposite or alternate, 5-18 by 2.5-5 cm, lanceolate, acuminate, entire, glabrous, often slightly falcate or oblique; petioles 2-5 m long. Inflorescence: a compound terminal panicle, 30 cm or more in length, with pubescent branches.

Leaves of Reetha

(b) Fruit

The fruit is a small leathery-skinned drupe 1-2cm (0.39-0.79 in) in diameter, yellow ripening blackish, containing one to three seeds.

Fruits of Reetha

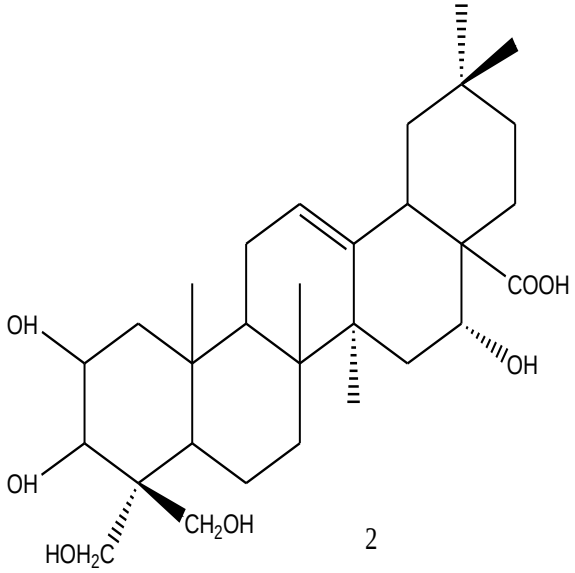
(c) BARK

Bark is dark to pale yellow in colour, fairly smooth and having many vertical lines of lentioels and fine fissure exfoliating in irregular wood scales

Bark of Reetha

Phytoconstituent

Plant part used	Chemical constituents
Fruit husk	Hederagenin [1]; platycodigenine [2]; salikogenim [3]; oleanolic acid [4]
Pericarps	Hederagenin-3-O-α-L-arebinopyranosyl(1→3)-α-L-rhamnopyranoside [5]; Hederagenine-3-O-α-L-arabinopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-β-D-xylopyranoside [6]; Hederagenine-3-O-α-L-arabinopyranosyl-(2→1)-α-L-rhamnopyranosyl-(3→1)-β-D-xylopyranosyl-[(2→1)gluco-pyranoside]-(5→1)-rahmnopyranoside [8]; Hederagenine-3-O-α-L-arabinopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arbinopyranoside [15]; Hederagenine-3-O-α-L-arabinopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arbinopyranosyl [16]; Hederagenine-3-O-α-L-arabinopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-β-D-xylopyranosyl-4-acetyl [17]; Hederagenine-3-O-(3,4-di-O-acetylr-β-D-xylopyranosyl)-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside [18]; Hederagenin-28-di-O-glycosides [19]; 1-O-α-L-rhamnopyranosyl-(1→2)-[α-L-rhamnopyranosyl-(1→3)-β-D-glucopyranosyl-12-O-α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranoside [20]; Hederagenine-12-O-α-rhamnopyranosyl-(1→2)-β-glucopyranoside-1-O-α-rhamnopyranosyl-(1→2)-[α-rhamnopyranosyl-(1→3)]-β-glucopyranoside [21]; Hederagenine-1,12-bisglycoside-O-α-L-rhamnopyranosyl-(1→3)]-β-D-glucopyranoside [22]; Hederagenin-1,12-bisglycoside-O-α-rhamnopyranosyl-(1→2)-[α-rhamnopyranosyl-(1→3)]-β-glucopyranoside [23]; 1-O-α-L-rhamnopyranosyl-(1→2)-[α-rhamnopyranosyl-(1→3)]-β-D-glucopyranoside-12-hydroxy-all-trans-farnesol [24]; 1-O-α-rhamnopyranosyl-(1→2)-[α-rhamnopyranosyl-(1→3)]-β-glucopyranoside-12-hydroxyfarnesol [25]; 12-hydroxy-all-tans-farnesol [26]; 1-hydroxylinalool [27]; GoshonosideF1 [28]; 8-hydroxygeraniol [29]; β-glucosidegeraniol [30]; 11(S)(E,E)-2,6-dodecadiene-3,7,11-trimethyl-1,12-diol [31]; 11(S)-2,6(E,E)-dodecadinene-3,7,11-trimethyl-1,12-diol-1,12-bis-O-α-L-rhamnopyranosyl-(1→2)-[α-L-rhamnopyranosyl-(1→3)]-6-O-acetyl-β-D-glucopyranoside [40]; Hederagenin-3-O(2,4-O-di-acetyl-α-L-arabinopyranoside)-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside [41]; Hederagenin-3-O-(3,4-O-di-acetyl-α-L-araninopyranosyl)-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside [42]; Hederagenin-3-O-α-L-arabinopyranoside [43]
Fruits and galls	Hederagenin-3-O-α-L-arabinopyranosyl-(2→1)-α-L-rhamnopyranosy-(3→1)-β-D-xylopyranosyl-(4→1)-glucopyranoside [7]; Hederagrnin-3-O-α-L-arabinopyranosyl-(2→)-α-L-rhamnopyranosyl-(3→1)-β-D-xylopyranosyl28-arabinopyranosyl-(2→1)-α-L-rhamnopyranosyl-(3→1)-xylopyranosy(4→1)gllucopyranosyl-[(6→1)rhamnopyranosyl]-(2→1)-glucopyranoside [9]; Stigmasterol [10]; 3-O-{α-L-arabinopyranosyl-(1→2)-α-L-arabinopyranosyl-(3→1)-α-L-rhamnopyranosyl}-hederagenin [32]; 3-O-{β-D-xylopyranosyl-(1→2)-α-L-arabinopyranosyl-(3→1)-α-L-rhamnopyranosyl}hederagenin [33]; Eupha-7,24-dien-3tetradecanoate [34]; Eupa-7,24-dien-3-heptadecanoate [37]; Eupha-7,24-dien-32-nonadecanoate [38]; Eupha-7,24-dien-3-heneicosanoate [39]; 3β,7β,20(S),22-tetrahydroxydammar-24-ene-3-O-α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranoside [44]; 3β,7β,20(S),22,23-pentahydroxydammar-24-ene-3-O-α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranoside [45]; 3β,7β,20(S),22,25-prntahydroxydammar-24-ene-3-O-α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranoside [46]; 25-methoxy-3β,7β,20(S),22-tetrahydroxydammar-23-ene-3-O-α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranoside [47]; 25-methoxy-3β,7β,20(R),trihydroxydammar-23-ene-3-O-α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranoside [48]; 4-allyl-2-methoxyphenyl-6-O-α-L-arabinopyranosyl-(1→6)-β-D-glucopyranoside [50]; Hederagenin-3-O-(3-O-acetyl-α-L-arabinopyranosyl)-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside [57]; Hederagenin-3-O-(4-O-acetyl-α-L-arabinopyranoayl)-(1→3)-α-L-rhamnopranosyl-(1→2)-α-L-arabinopyranoside [58]; Hederagenin-3-O-(2,3-O-diacetyl-β-D-xylopyranosyl)-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside [59]; Hederagenine-3-O-(2,4-O-diacetyl-β-D-xylopyranosyl)-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside [60]; Hederagenin-3,7,20(S)-trihydroxydammar-24-ene-3-O-α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranoside [61]; 3,7,20(R)-trihydroxydammar-24-ene-3-O-α-L-rhamnopyranosyl-(1→2)-β-D-glucopyranoside [62]; 21β-methoxy-3β,21(S),23(R)-epoxytirucalla-7,24-diene-3-O-α-L-rhamnopyranosyl-(1→6)-β-D-glucopyranoside [63], 21β-methoxy-3β,21(R),23(R)-epoxytirucalla-7,24-diene-3-O-α-L-rhamnopyranosyl-(1→6)-β-D-glucopyranoside [64]; 21β-methoxy-3β,21(R),23(R)-epoxytirucalla-7,24-diene-3-O-α-L-dirhamnopyranosyl-(1→2,6)-β-D-glucopyranoside [66]; 21α-methoxy-3β,21(R),23(R)-epoxytirucalla-7,24-diene-3-O-α-L-dirhamnopyranosyl-(1→2,6)-β-D-glucopyranoside [67]; 21α-methoxy-3β,21(R),23(S)-epoxytirucalla-7,24-diene-3-O-β-D-glucopyranosyl-(1→2)-β-D-glucopyranoside [70]; 21α-methoxy-3β,21(R),23(S)-epoxytirucalla-7,24-diene-3-O-α-L-rhamnopyranosyl-(1→6)-β-D-glucopyranosyl-(1→2)-β-D-glucopyranosside [71]
Leaves	4-allyl-2-methoxyphenyl-3-O-α-L-rhamnopyranosyl-(1→6)-β-D-glucopyranoside [49]
Roots	3-O-α-L-arabinopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-[α-Laradinopyranosyl-(1→3)]-β-D-glucopyranosyl-21,23R-epoxyltirucalla-7,24-diene-21β-ol [51]; 3-O-β-D-xylopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-[β-L-arabinopyranosyl-(1→3)]-β-D-glucopyranosyl-21,23R-epoxyltirucalla-7,24-diene-21β-ethoxy-3β-ol [52]; 3-O-β-D-xylopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-[α-L-arabinopyranosyl-(1→3)]-β-D-glucopyranosyl-21,23R-epoxyltirucall-α-7,24-diene-21β-methoxy-3β-ol [53]; 3-O-α-L-arabinopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-[α-L-rhamnopyranosyl-(1→3)]-β-D-glucopyranosyl-21,23R-epoxyltirucalla-7,24-diene-21β-ethoxy-3β-ol [54]; 3-O-α-L-arabinopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-[α-L-rhamnopyranosyl-(1→3)]-β-D-glucopyranosyl-21,23R-epoxyltirucalla-7,24-diene-21β-methoxy-3β-ol [55]; 3-O-α-L-rhamnopyranosyl-(1→6)-β-D- glucopyranosyl-21,23R-epoxyltirucalla-7,24-diene-21β-ethoxy-3β-ol [56]; 3-O-α-L-rhamnopyranosyl-(1→2)-[α-L-rhamnopyranosyl-(1→3)]-β-D-glucopyranosyl-21,23R-epoxyltirucalla-7,24-diene-21S-ethoxy-3β-ol [68]; 3-O-α-L-rhamnopyranosyl-(1→2)-[α-L-rhamnopyranosyl-(1→3)]-β-D-glucopyranosyl-21,23R-epoxyltirucalla-7,24-diene-21S-methoxy-3β-ol [69]



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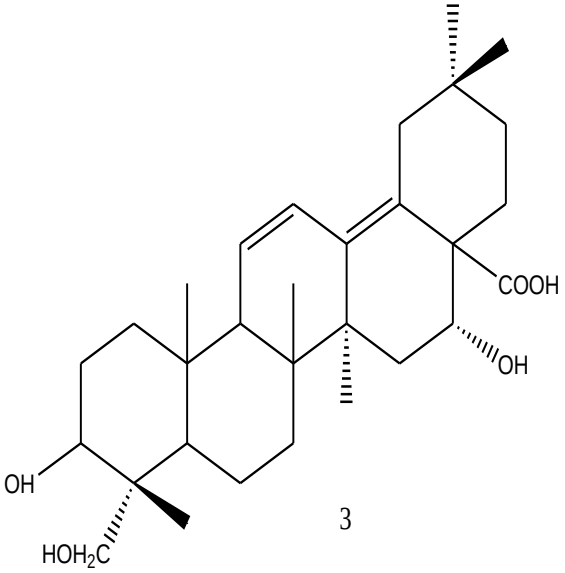

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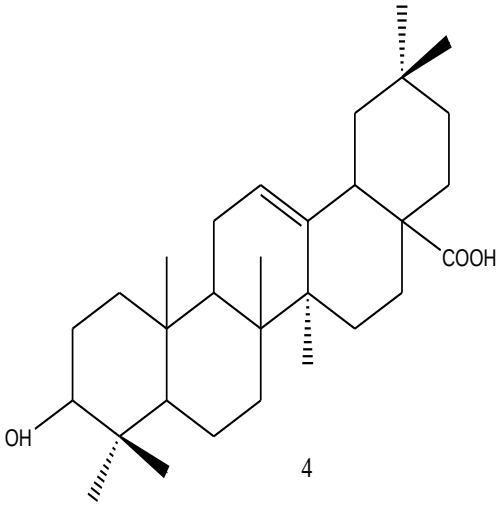

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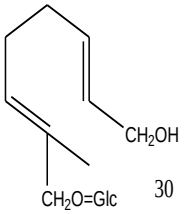

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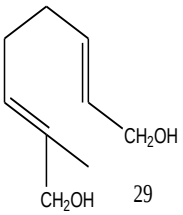

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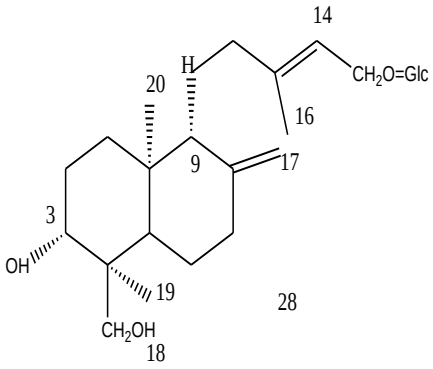

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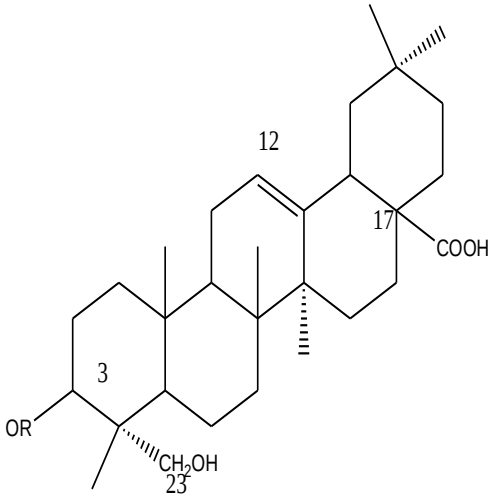


23

R

1 H

15 -ara(p)-rham-ara(p)

6 -ara(p)-rham-xyl

16 -ara-rham-ara(f)

5 -ara(p)-rham

17 -ara(p)-rham-xyl-Ac

18 -ara(p)-rham-xyl (3-Ac, 4-Ac)

42 -ara(p)-rham-ara (3-Ac, 4-Ac)

R

32 -ara(p)-ara-rham

33 -xyl-ara-rham

43 -ara(p)

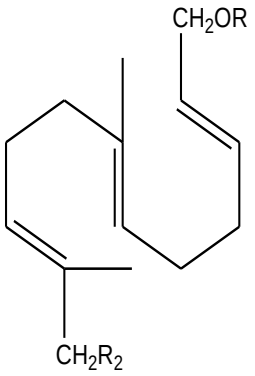
57 -ara-rham-ara-OAc

58 -ara-rham-ara-OAc

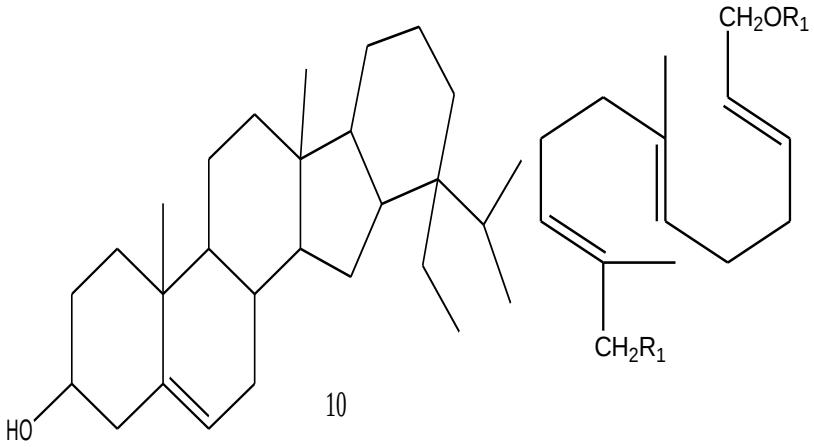
41 -ara(p)-rham-ara (2-Ac, 4-Ac)

59 -ara(p)-rham-ara (2-OAc, 3-OAc)

60 -ara(p)-rham-xyl (2-Ac, 4-Ac)



	R1	R2
21	-Glc(2-Rha, 3-Rha)	O-Glc(2-Rha)
23	-Glc(2-Rha, 3-Rha)	-Glc(2-Rha, 3-Rha)
25	-Glc(2-Rha, 3-Rha)	OH
26	H	OH
27	H	H



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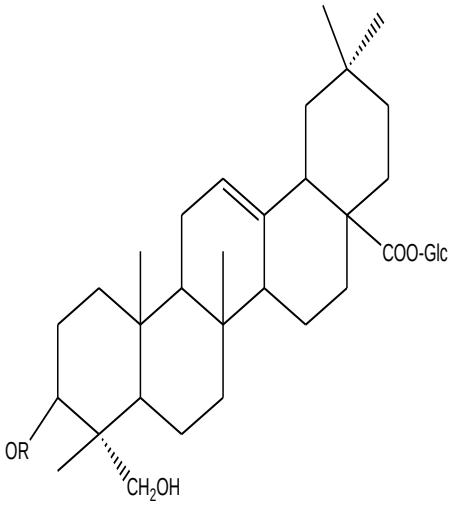
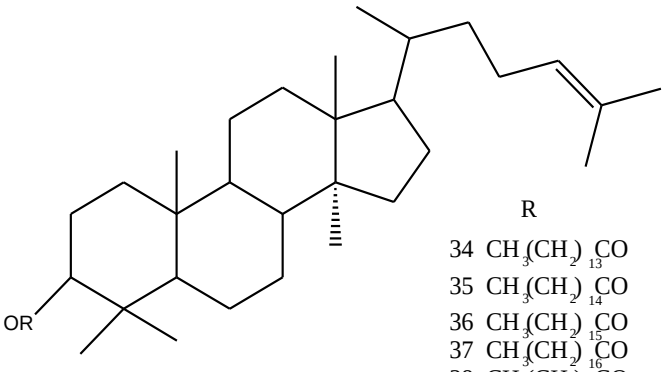
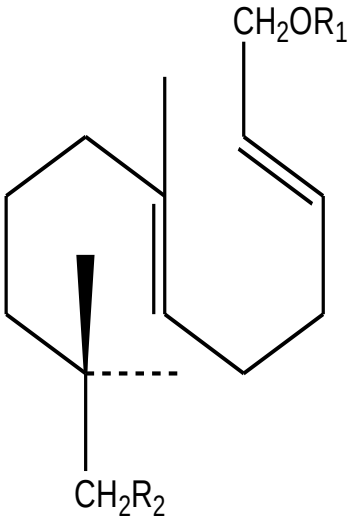
	R1	R2
21	-Glc(2-Rha, 3-Rha)	O-Glc(2-Rha)
23	-Glc(2-Rha, 3-Rha)	-Glc(2-Rha, 3-Rha)
25	-Glc(2-Rha, 3-Rha)	OH
26	H	OH
27	H	H



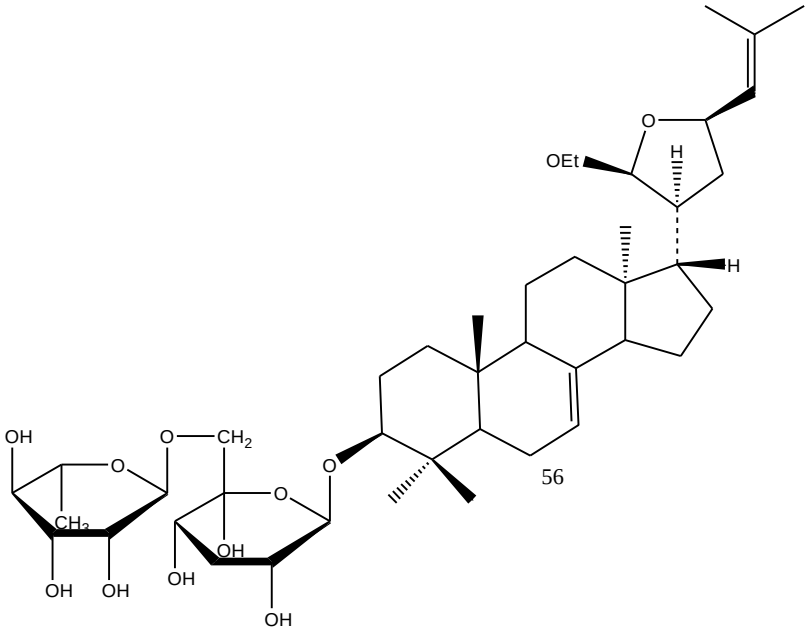
	R
19	H
11	-ara(p)-(2)-rham-(3)-ara(p)
12	-ara-(2)-(p)-rham-(3)-xyl
13	-ara-(2)-rham-(3)-ara(f)
14	-ara(p)-(2)-rham

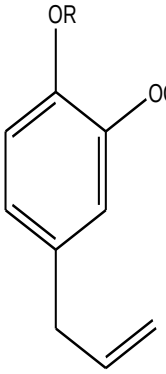


	R
34	$CH_3(CH_2)_{13}CO$
35	$CH_3(CH_2)_{14}CO$
36	$CH_3(CH_2)_{15}CO$
37	$CH_3(CH_2)_{16}CO$
38	$CH_3(CH_2)_{18}CO$
39	$CH_3(CH_2)_{20}CO$

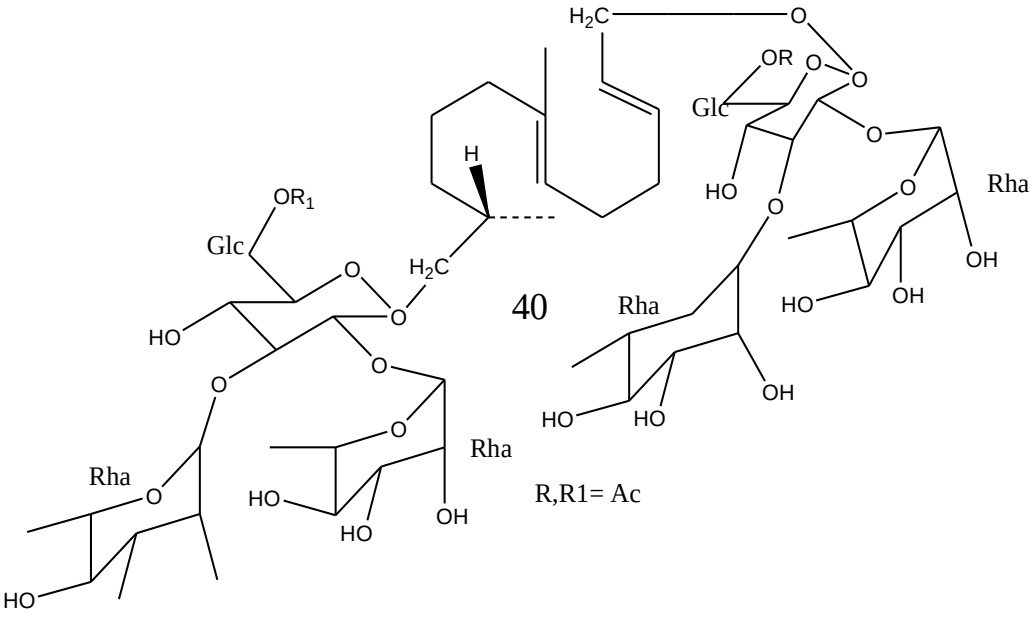


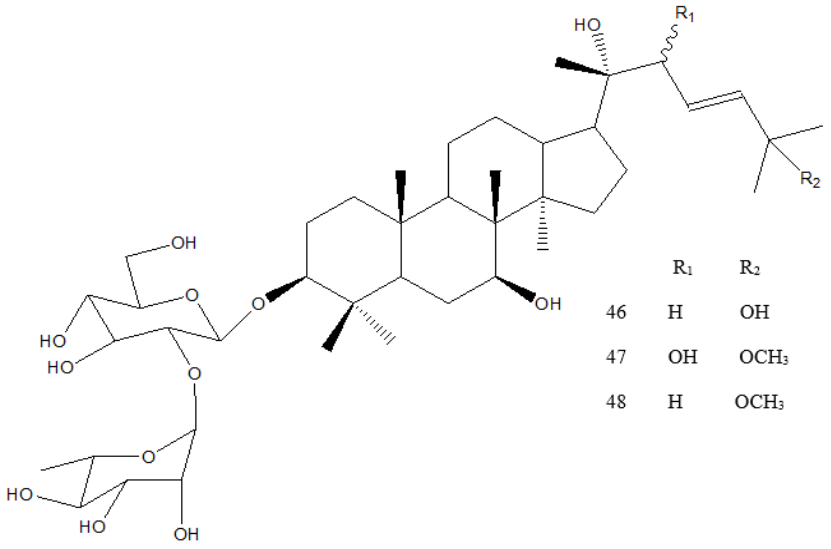
	R1	R2
20	-Glc(2→Rha, 3→Rha)	O-Glc-Rha
22	-Glc(2→Rha, 3→Rha)	Glc(Rha, Rha)
24	-Glc(2→Rha, 3→Rha)	OH
31	H	OH



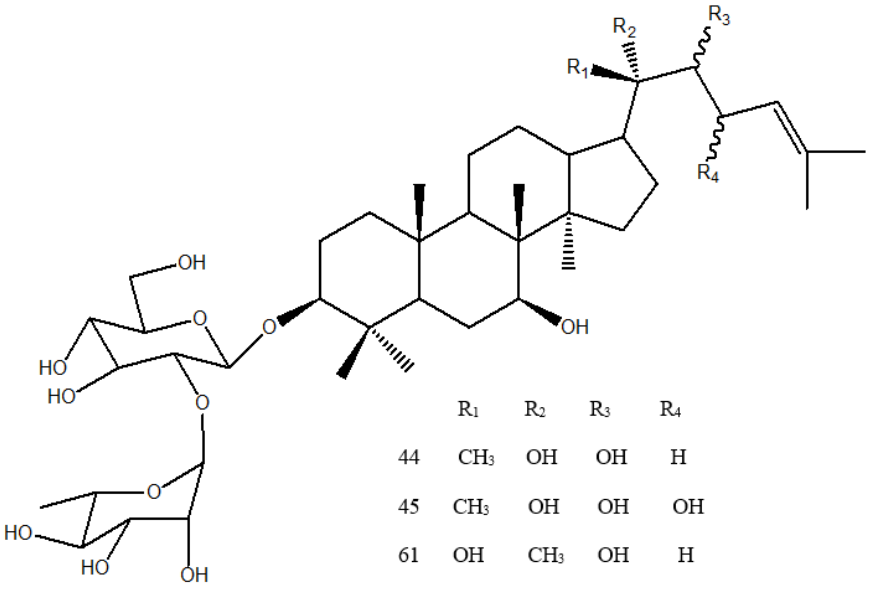


	R
49	Glc(6→1)-Rha
50	Glc(6→1)-Ara

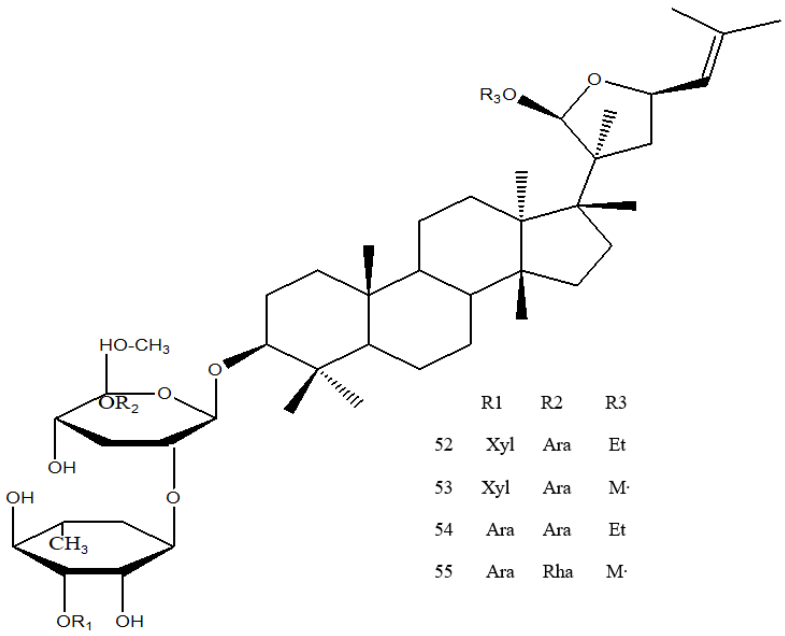




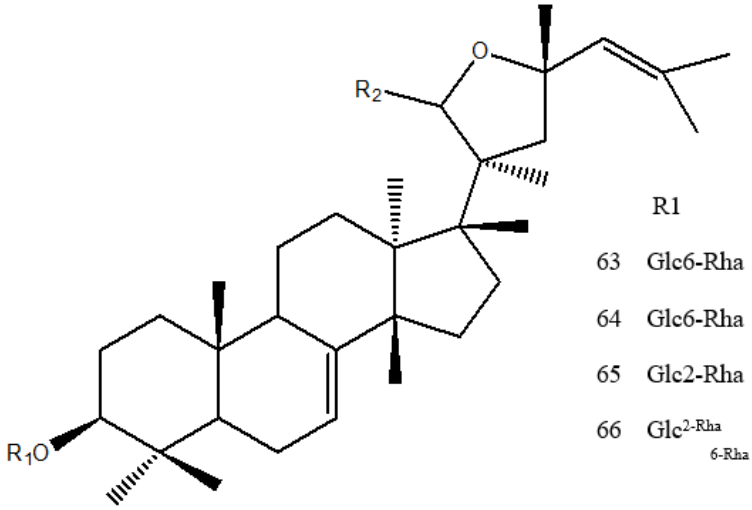
	R_1	R_2
46	H	OH
47	OH	OCH_3
48	H	OCH_3



	R_1	R_2	R_3	R_4
44	CH_3	OH	OH	H
45	CH_3	OH	OH	OH
61	OH	CH_3	OH	H
62	CH_3	OH	H	H



	R1	R2	R3
52	Xyl	Ara	Et
53	Xyl	Ara	M·
54	Ara	Ara	Et
55	Ara	Rha	M·



	R1	R2
63	Glc6-Rha	β-OCH3
64	Glc6-Rha	α-OCH3
65	Glc2-Rha	α-OCH3
66	Glc$^{2\text{-Rha}}_{6\text{-Rha}}$	β-OCH3
67	Glc$^{2\text{-Rha}}$	α-OCH3

Pharmacological Activity

S.no.	Author	Activity	Methods used	Part used
1	Ibrahim *et al*. [16]	Anti-Bacterial activity	Ethanolic and chloroform extracts.	Leaf
2	Garg *et al*. [17] Rastogi *et al*. [18]	Spermicidal Activity	Saponins	Fruit Pericarp
3	Tiwari *et al*. [19]	Anti-Trichomonas Activity	Mixing of *Sapindus* and saponin	
4	Geyter *et al*. [20]	Insecticidal Activity	Ethanolic extract	
5	Chakraborty *et al.* [21]	Anxiolytic Activity	Metanolic extract	
6	Man *et al*. [22, 23, 24]	Anticancer Activity	Saponin from galls extracts	Galls
7	Ibrahim *et al*. [25]	Hepatoprotective Activity	Fruit pericarp extract	Fruit
8	Upadhyay and Singh *et al*. [26]	Molluscicidal Activity	Extract	Fruit
9	Virdi *et al*. [27]	Piscicidal Activity		Fruit pericarp
10	Tsuzuki *et al*. [28]	Fungicidal Activity	Crude extract	Pericarp
11	Takagi *et al*. [29]	Anti-Inflammatory Activity	Crude extract / isolated saponin and hederagenin	Plant
12	Huan *et al*. [30]	Anti-Platelet Aggregation Activity	Isolation of compounds	Gall
13	Chen *et al*. [31]	Tyrosinase Inhibition and Free Radical Scavenging	Methanolic extract	Seed

Uses & Benefits of Reetha

- Reetha is used as the main ingredient in soaps and shampoos for washing hair, as it is considered good for the health of hair [32].
- The jewelers in India use this plant to bring back the lost brightness of ornaments made of precious metals like gold, silver, etc [33].
- The herb is also used in the treatment of extra salivation, migraine, epilepsy and chlorosis [32].
- It has been placed as a popular herb in the list of herbs and minerals in Ayurveda and is used as an important ingredient in cleansers and shampoos.
- It is used for the treatment of eczema, psoriasis, and for removing freckles [35].
- It is also used for removing lice from the scalp, as it has gentle insecticidal properties [34].
- The plant is known for its antimicrobial properties that are beneficial for septic systems [37].
- It is an important herb that is used in the treatment of contaminated soil. Moreover, it has also been used for washing and bleaching cardamoms, further helping in improving the latter's color and flavour [36, 38].

Conclusion

In present study, a set of pharmacognostical standardization parameter studies were studied on *Sapindus mukorrossi* as per pharmacopoeia and WHO guidelines. These methods may help in standardization, identification and in carrying out further research in *Sapindus mukorrossi* based drugs which are used in Ayurveda and modern pharmacopoeia.

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