CHEMICAL CONSTITUENTS AND BIO ACTIVITIES OF GENUS SAPINDUS
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Received on: 17/01/2011 Revised on: 25/02/2011 Accepted on: 10/03/2011

ABSTRACT
The genus Sapindus has been reviewed for its chemical constituents and biological activities together with traditional
importances. Trees of genus Sapindus are cultivated in many parts of India for ornamental purposes. The present
review is based on chemical constituents and biological activities of known species of Sapindus. The different species
of Sapindus are used for curing various diseases and commercially important. Over 103 compounds have been
identified from the genus Sapindus and many of them have been evaluated for their biological activities. The overall
activity of the extract is based on the interaction between its components. Therefore, the safety and efficacy of the
extract cannot be fully imitated by individual constituent. The aim of present review is to summarize the different
phytochemical and pharmacological work together.
KEYWORDS: Sapindaceae; Saponins; Triterpenoids; antidiabetic; cytotoxic

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INTRODUCTION
Sapindaceae is one of the important family of plant
kingdom consisting about 150 genera and 2000 species1. The genus Sapindus includes both deciduous and
evergreen species widespread over Himalayan range. The soapberry family comprises nearly 2000 species,
which are primarily tropical. The soapnut tree commonly known as soapberry (Reetha) by Indians and found over
most of the hilly region of Garhwal Himalaya. In China and Japan it has been used as a remedy for centuries. In
Japan pericarp is called "enmei-hi", which means "life
prolonging pericarp" and In China "wu-huan-zhi", the
non-illness fruit"2. 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% soapnuts and are locally used for protection of
pests 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.

Traditional uses of Sapindus Species
The members of genus sapindus are well known for their
folk medicinal values. Pericarps of S. mukorossi have
been traditionally used as an expectorant as well as a
source of natural surfactant3. Due to the 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
makes4. The seeds of S. mukorossi are used to remove
tan and freckles 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 etc5. The leaves are used in
a bath to relieve joint pain and the roots are used in the
treatment of gout and rheumatism.
Since ancient times S.mukorossi has been used as a
detergent for shawl and silks. The fruit of S.mukorossi
was utilized by Indian jewelers for restoring the
brightness of tarnished ornaments made of gold, silver
and other precious metals6. The fruit of S. saponaria is
used by local population as soap for washing clothes,
for curing ulcers, and external wounds7. Fruits of Sapindus
trifoliatus have been considered as a tonic, stomachic,
alexpameric, astringent and sedative to the uterus and
also useful in chronic dysentery, diarrhoea, cholera,
hermicrania, tubercular glands, paralysis and epileptic
fits of children. The root of S. trifoliatus used as a collyrium
in sore eyes and ophthalmia. The seeds of S. trifoliatus...
are used to stimulate the uterus in childbirth and to increase mensuration⁹. Pericarps of *S. delavayi* are also used as natural surfactants, being exported from China to Japan as a substitute of *Sapindus mukorossi*⁹. Seeds of *S. emarginatus* contains anti-inflammatory oil, traditionally used to purify the blood.

**SOLUBILIZING PROPERTIES OF SAPONINS ISOLATED FROM SAPINDUS**

Mukurozi - sapinons [8, 9] and bisdesmoside from pericarps of *Sapindus mukorossi*, greatly increased the water solubilities of the co-occurring monodesmosides. The mode of solubilizing properties of these saponins was investigated. These bisdesmosides also increased the solubilities of yellow OB and progesterone in phosphate buffer⁹. Kimata and coworkers was observed the solubilising properties of monodesmosides [15-17] and bisdesmosides [11,12,14] isolated from pericarps of *S.mukorossi*. It was observed that the monodesmosides [15-17] were sparingly soluble in water in pure state with tremendous yield and these monodesmoside [15-17] showed remarkable promotion of absorption of an antibiotic, sodium ampicillin, from rat intestine or rectum, while the bisdesmoside 5-7 did not.¹⁸

**BIOLOGICAL ACTIVITIES**

**Anti-Inflammatory Activity**

Takagi and coworkers examined the anti-inflammatory activity of hederagenin and crude saponin isolated from *S. mukorossi*, utilising carrageenin-induced edema, granuloma pouch and adjuvant arthritis in rats. The effects of these agents on vascular permeability and acetic-acid-induced writhing in mice were also examined. Anti-inflammatory activity on carrageenin edema was observed after intraperitoneal and oral administration of crude saponin, whether hederagenin and the other agents showed activity only when administered ¹⁰. The aqueous extract of *S.emarginatus* leaves for four different solvents such as Aqueous, 1,4-dioxan, methanol and acetone showed antibacterial activity against Pseudomonas testosteroni NCIM\#098 and Proteus morgani NCIM\#040. The maximum inhibitory activity was shown by TDi (1,4-dioxan extract) where as minimum activity was shown by TMe (methanol extract) and TAc (acetone extract) and TAq (water extract)⁹.

**Cytotoxic Activity**

Kuo and co workers tested the cytotoxic effect of saponins isolated from the galls of *S.mukorossi*. The preliminary bioassay data revealed that saponins [39, 41-43] showed moderate cytotoxic activity (ED₅₀=9–18μg/ml) against human tumor cell lines (Hepa59T/VGH, NCl, HeLa and Med).²²

**Molluscidal Activity**

Huang and coworkers checked the mollusscidal activity of hederagenin saponins [6,19,20,43-45] isolated from *S. mukorossi* against golden apple snails including bacteria like Pomacea and Canalicula.²³

**Anti-Platelet-Aggregation Activity**

Huang and coworkers demonstrated that five new tirucallane type saponins, sapinmusaponins [66-70] from the galls of *S. mukorossi* showed moderate activity in a 12-O-tetradecanoylphorbol- 13-acetate (TPA)-induced Epstein- Barr virus early antigen (EBV-EA) activation assay²⁷.

**Anti-diabetic Activity**

In 2009 S. Jeyabalan and coworkers studied the antihyperglycemic effects of alchoholic extract of *S.emarginatus* at different doses in glucose-loaded hyperglycemic and normal fasted rats. The study also showed that the level of total hemoglobin, glycosylated-hemoglobin, serum urea, serum creatinine, and lipid profiles measured in alloxan induced diabetic rats which show Antidiabetic activity.²⁸

**Anti-hyperalgesic activity**

*S. trifoliatus* had studied the effect of aqueous pericarps extract of fruits in an *in vivo* migraine hyperalgesic model. They suggested that antagonism to dopamine D₂ might underlie the mechanism involved in the anti-hyperalgesic activity of the plant extract³⁹.

**CONCLUSION**

The main objective of this review is to present the whole research carried out with species of the genus *Sapindus*, in order to organize the data produced. Many species of this genus have been used as traditional medicines for various ailments. The earlier reports on chemical investigation and pharmacological evaluation showed that the members of genus *Sapindus* contain a number of bio-active novel compounds of different nature like saponins and sesquiterpene oligoglycosides etc. As literature illustrates that, many biological and pharmacological activities were shown by fractions of crude extracts and isolated substances. Furthermore, the chemically unknown species may have become a souce of novel drugs; therefore detail chemical analysis is required to isolate bio-active constituents from genus *Sapindus* and to trace out their biological activities. Thus, it can be concluded that the genus Sapindus can play an important role in modern medicinal system in near future.

**REFERENCES**


<table>
<thead>
<tr>
<th>Name of species</th>
<th>Plant part used</th>
<th>Chemical constituents</th>
<th>Ref</th>
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<tr>
<td><em>S. mukorossi</em></td>
<td>Fruit husk</td>
<td>Hederagenin[1]; platycodigenin [2]; saikogenin [3]; oleanolic acid [4]</td>
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<tr>
<td>Pericarps</td>
<td>Hederagenin3-O-α-L-arabinopyranosyl(1→3)-α-L-rhamnopyranosyl [5]; Hederagenin3-O-α-L-arabinopyranosyl(1→3)-α-L-rhamnopyranosyl(1→2)-β-D-xylopyranoside [6];</td>
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<td>hederagenin3-O-α-L-arabinopyranosyl(2→1)-α-L-rhamnopyranosyl(3→1)-β-D-xylopyranosyl(4→1)glucopyranoside [7];</td>
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<tr>
<td>Fruits and galls</td>
<td>sitamasterol [10],</td>
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<td>hederagenin3-O-α-L-arabinopyranosyl(1→3)-α-L-rhamnopyranosyl(1→2)-α-L-rhamnopyranosyl,28-di-O-glycoside [11]; hederagenin3-O-α-L-arabinopyranosyl(1→5)-α-L-rhamnopyranosyl(1→2)-β-D-xylopyranosyl,28-di-0-glycoside [12]; hederagenin3-O-α-L-arabinopyranosyl(1→3)-α-L-rhamnopyranosyl(1→2)-α-L-arabinofuranosyl,28-di-O-glycosides [13]; hederagenin3-O-α-L-arabinopyranosyl(1→3)-α-L-rhamnopyranosyl,28-di-O-glycoside</td>
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<td>3-O-[α-L-arabinopyranosyl(1→2)-α-L-rhamnopyranosyl(3→1)-α-L-rhamnopyranosyl]</td>
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<td>Eupha 7,24-dien-3-tetradecanoate [34]; eupha 7,24-dien-3-pentadecanoate [35]; eupha 7,24-dien-3-hexadecanoate [36]; eupha, 7,24-dien-3-heptadecanoate [37]; eupha, 7,24-dien-3-nondecanoate [38]; eupha, 7,24-dien-3-heneicosanoate [39];</td>
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<td>Fruits</td>
<td>4-Allyl-2-methoxyphenyl-3-O-α-L-rhamnopyranosyl(1→6)-α-L-glucopyranoside [49]</td>
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<td>Roots</td>
<td>3-O-α-L-arabinopyranosyl(1→3)-α-L-rhamnopyranosyl(1→3)-β-D-glucopyranosyl,21,23R-epoxypiraculla,7,24-diene-21-β-ethoxy-β-ol [51]; 3-O-β-D-xylopyranosyl(1→3)-α-L-rhamnopyranosyl(1→2)-β-β-L-arabinopyranosyl(1→3)-β-D-glucopyranosyl,21,23R-epoxypiraculla,7,24-diene-21-β-ethoxy-β-ol [52]; 3-O-β-D-xylopyranosyl(1→3)-α-L-rhamnopyranosyl(1→2)-α-L-rhamnopyranosyl(1→3)-β-D-glucopyranosyl,21,23R-epoxypiraculla,7,24-diene-21-β-methoxy-β-ol [53]; 3-O-α-L-arabinopyranosyl(1→3)-α-L-rhamnopyranosyl(1→2)-α-L-rhamnopyranosyl(1→3)-β-D-glucopyranosyl,21,23R-epoxypiraculla,7,24-diene-21-β-ethoxy-β-ol [54]; 3-O-α-L- rhamnopyranosyl(1→3)-α-L-rhamnopyranosyl(1→2)-α-L-rhamnopyranosyl(1→3)-β-D-glucopyranosyl,21,23R-epoxypiraculla,7,24-diene-21-β-methoxy-β-ol [55]; 3-O-α-L-glucopyranosyl,21,23R-epoxypiraculla,7,24-diene-21-β-ethoxy-β-ol [56]</td>
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<td>hederagenin3-O-3-O-acetyll-α-L-arabinopyranosyl(1→3)-α-L-rhamnopyranosyl(1→2)-α-L arabinopyranosyl [57]; hederagenin3-O-4,4-Di-acetyl-α-L-rhamnopyranosyl(1→3)-α-L-arabinopyranosyl(1→2)-α-L-rhamnopyranosyl(1→3)-β-D-glucopyranosyl [58]; hederagenin3-O-2,3,4-Diacetyl-β-D-xylopyranosyl(1→3)-α-L-rhamnopyranosyl(1→2)-α-L-arabinopyranosyl [59]; hederagenin3-O-2,4-Diacetyl-β-D-xylopyranosyl(1→3)-α-L-rhamnopyranosyl(1→2)-α-L-arabinopyranosyl [60]; hederagenin, 7,20(S)-trihydroxydammar-24-ene-3-O-α-L-rhamnopyranosyl(1→2)-β-D-glucopyranoside [61]; 7,20(R)-trihydroxydammar-24-ene-3-O-α-L-rhamnopyranosyl(1→2)-β-D-glucopyranoside</td>
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<td>Roots</td>
<td>3-O-α-L-rhamnopyranosyl-(1→2)-[α-L-arabinopyranosyl-(1→3)]-β-D-glucopyranosyl [21,23R]-epoxyl Tuckerila [7,24-diene-3-O-α-L-rhamnopyranosyl-(1→6)]-β-D-glucopyranoside [64]; 21α-methoxy-3β,21(R),23(R)-epoxyl Tuckerila [7,24-diene-3-O-α-L-rhamnopyranosyl-(1→2)]-β-D-glucopyranoside [65]; 21α,24α-dimethoxy-3β,21(R),23(R)-epoxyl Tuckerila [7,24-diene-3-O-α-L-rhamnopyranosyl-(1→6)]-β-D-glucopyranoside [66]; 21α-methoxy-3β,21(R),23(R)-epoxyl Tuckerila [7,24-diene-3-O-α-L-rhamnopyranosyl-(1→2)]-β-D-glucopyranoside [67]</td>
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<td>Oleandric acid D-3-O-α-L-arabinopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside [72]; monodesmoside [73]; oleandric acid D-3-O-β-D-xylpyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside [74]; 3-O-β-D-xylpyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside-3-acyetyl [75]; 3-O-α-L-arabinopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→2)-β-D-arabinopyranosyl-3,5,6-triacyetyl [76]</td>
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<td>S. saponaria Fruit peel</td>
<td>3-O-α-L-rhamnopyranosyl-(1→3)-β-D-glucopyranosyl-hederagenin [82]</td>
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<td>hederagenin 3-O-α-L-arabinopyranoside [83]; hederagenin 3-O-(2-acetyl-β-D-xylpyranosyl)-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside [84]; 3-O-(4-O-acetyl-β-D-xylpyranosyl)-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside [85]; oleandric acid D-3-O-(4-O-acetyl-β-D-xylpyranosyl)-(1→3)-α-L-rhamnopyranosyl-(1→2)-α-L-arabinopyranoside [86]</td>
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