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BOTANY, ETHNOMEDICINAL, PHARMACOLOGICAL AND THERAPEUTIC APPLICATIONS OF *STRYCHNOS POTATORUM* LINN: A REVIEW

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ABSTRACT

Strychnos potatorum also known as clearing-nut tree is spread throughout the tropical and sub-tropical regions of the world. It has been highly reported in Ayurveda, Siddha and Unani systems of medicine. Some of the chief constituents found in the plant are strychnine, diaboline, isomotioli, sitosterol, stigmasterol and compresterol. The plant has been exclusively used as antimicrobial, nephroprotective, antidiabetic, antiarthritic, anti-inflammatory, antidiarrhoeal, hepatoprotective, antiulcerogenic, antinociceptive, antipyretic and contraceptive. Traditionally, it has been also used as stomachic, demulcent and emetic. The plant is also utilized for the treatment of various eye diseases, respiratory diseases, kidney complaints, and gonorrhoea. The seeds of the tree are commonly used in traditional medicine as well as purifying water in India and Myanmar. This review paper briefly discusses the botany, ethnomedicinal, pharmacological and therapeutic applications of *Strychnos potatorum* with an attempt to compile the document and highlight the need of research and development.

Keywords: Strychnous potatorum, nephroprotective, hepatoprotective, antidiarrhoeal, antinociceptive

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INTRODUCTION:

In the earlier times, herbs have been prized for their pain-relieving and healing abilities and today we still rely largely on the curative properties of plants. According to World Health Organization, 80% of the people living in rural areas depend on medicinal herbs as primary healthcare system. Medicinal plants played an important role in Indian culture since Rig Veda (5600 BC) where about 67 medicinal plants were recorded. Out of 250,000 higher plants, more than 80,000 have medicinal value and India occupies unique position among world's 12 biodiversity centers. *Strychnos potatorum* Linn. is an important medicinal plant, used in Ayurveda, Unani, Siddha, and in folk medicine for treating several ailments including microbial infections, diarrhoea and diabetes^{1,2}.

Strychnos potatorum Linn.: THE PLANT

Strychnos potatorum Linn. (Family: Loganiaceae), commonly referred to as “clearing nut tree” or Nirmali is a medium sized glabrous deciduous tree having a height of 6-18 meters. It is a native of India and found distributed in the deciduous forests of West Bengal, central and south India up to 1,200 meters. It is also found in south tropical African countries such as Malawi, Zambia, Zimbabwe, Botswana, and Namibia and in Sri Lanka and Myanmar³.



Figure 1. *Strychnos potatorum*: The plant

Botanical classification⁴

Domain:	Eukaryote
Kingdom:	Plantae
Subkingdom:	Viridiaeplantae

Phylum:	Tracheophyta
Subphylum:	Euphyllophytina
Infraphylum:	Radiatopses
Class:	Magnoliopsida
Subclass:	Lamiidae
Superorder:	Gentiananae
Order:	Gentianales
Family:	Loganiaceae
Genus:	<i>Strychnos</i>
Species:	<i>potatorum</i>
Botanical name:	<i>Strychnos potatorum</i> Linn.

Vernacular names^{5,6}

Sanskrit:	Nirmali, Payahprasadisa
Bengali:	Nirmali
English:	Clearingnut
Gujrati:	Nirmali
Hindi:	Chillikavi
Kannada:	Katakam, Tetramabaral
Malayalam:	Katakam
Marathi:	Nirmal
Punjabi:	Nirmali
Tamil:	Kottai
Telugu:	Chilli

Cultivation⁷***Climatic conditions***

Altitude (m):	1000 – 1200
Rainfall (mm):	1100 - 2500
Temperature (°C):	5-10, 35-40, 25-30
Climate:	Hot Climate
Sunlight:	Full Sun

Soil features

Soil Type:	Alluvial Soil, Black Soil, Red Soil, Lateritic Soil
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Soil Depth (m): 1.0 - 2.0
Drainage: Well Drained

Propagation

Time of propagation: Monsoon

Irrigation

Crop Type: Rain fed

Soil reaction

Soil reaction (pH): Slightly acidic to neutral (6.3 - 7.3)

MACROSCOPY⁶

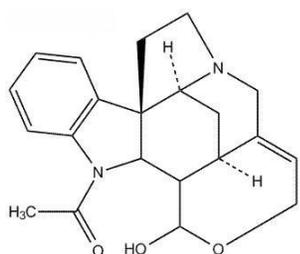
- Trunk:** Irregularly fluted.
- Bark:** Cracked and scaly black.
- Leaves:** Opposite; elliptic or ovate; 10 to 18 cm long; 6 to 7.5 cm wide; pointed at the tip and rounded at the base.
- Flowers:** White; small; borne on compound inflorescences in the axils of the upper leaves.
- Fruit:** Rounded; bright orange red; purple-black when ripe; 3 to 4 cm in diameter; contains one flat seed.
- Seed:** Upto 8 mm in diameter; circular; bluntly lenticular; shiny with short; appressed silky hairs; cream-white; a slightly prominent ridge round the border; bitter less.
- Seed powder:** Creamish-yellow; oily; shows fragments of testa, trichomes, endosperm cells and oil globules.

PHYTOCHEMISTRY

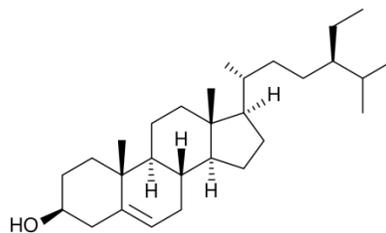
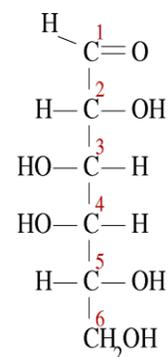
Constituents

Singha AK, *et al.* isolated alkaloids, flavonoids, lignins, glycosides, phenols, saponins, sterols and tannins. β -sitosterol, oleanolic acid, 3 β -acetoxyoleanolic acid, a saponin glycoside, having oleanolic acid as aglycone and D-galactose and n-mannose as sugar moieties from the extracts of roots, stem bark and seeds yielded. B-galactose and n-mannose as free sugars.

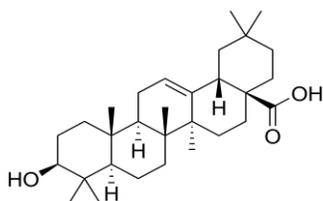
Mallikarjuna PB, *et al.* worked on in vitro antimicrobial screening of alkaloid fractions and isolated alkaloids mainly strychnine, diaboline, and four triterpenes viz., isomotioli, sitosterol, stigmasterol and campesterol from the leaves and seeds of *S. potatorum*. Isomotioli was isolated from the leaves, whereas seven alkaloid fractions (PB-I to PB-VII) were isolated from seeds^{8,9,10}



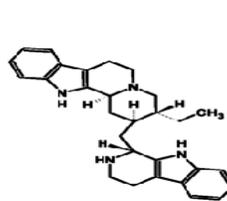
Diabolone (PB-IV)

 β -sitosterol

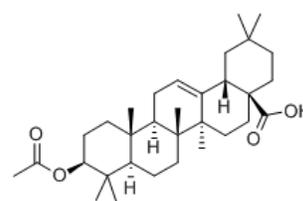
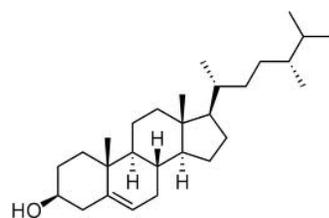
D-galactose



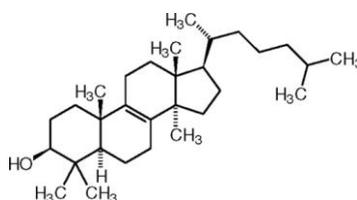
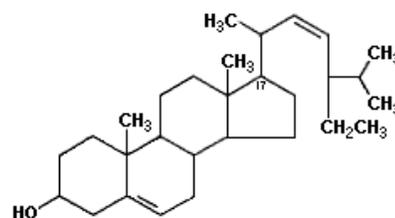
Oleanolic acid



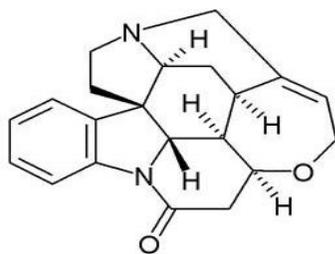
Ochrolifumamine A

3 β -acetoxyoleanolic acid

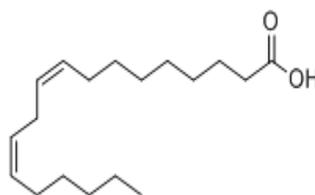
Campesterol

8-en-3 β -ol

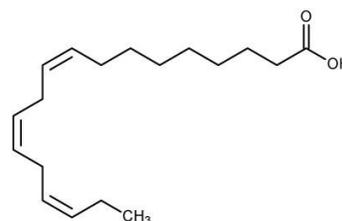
Stigmasterol



Strychnine



Linoleic acid



Linolenic acid

Phytochemical Parameter

Foreign matter: Not more than 2 %.

Total ash: Not more than 3 %.

Acid-insoluble ash: Not more than 1 %.

Alcohol-soluble extractive: Not less than 20 %.

Water-soluble extractive: Not less than 74 %.

TLC PROFILE

The TLC profile of various phytoconstituents present in the plant has been mentioned in Table 1.

Table No.1: TLC Profile of *Strychnos potatorum*

Extractive	Adsorbent	Solvent system	Viewing medium
Alkaloids	Silica gel	Chloroform : methanol (15:1)	Ultraviolet (254nm)
Dragendorff's reagent	Silica gel	Chloroform : methanol (19:1)	Ultraviolet (254nm)
Glycosides	Silica gel	Ethyl acetate : methanol : water (80:10:10)	Ultraviolet (254nm)
Phenols	Silica gel	Chloroform : methanol (27:0.3)	Folin-Ciocalteu's reagent
Saponins	Silica gel	Glacial acetic acid : methanol : water (64:34:12.8)	Iodine vapours
Sterols	Silica gel	Glacial acetic acid : methanol : water (64:34:12.8)	Anisaldehyde-sulphuric acid reagent

ETHNOMEDICINAL / TRADITIONAL USES

According to Ayurveda, seeds are acrid, alexipharmic, lithotriptic and cure strangury, urinary discharges and head diseases, stomachic, demulcent, emetic, against diabetes, diarrhea, and gonorrhoea and are also applied successfully in eye troubles. Roots cure leucoderma whereas fruits are useful in eye diseases, thirst, poisoning and hallucinations. The fruits are emetic, diaphoretic and alexiteric. According to Unani system of medicine, seeds are bitter, astringent to bowels, aphrodisiac, tonic, diuretic and good for liver, kidney complaints, gonorrhoea, etc. The hepatoprotective and antioxidant activities of the seed powder and aqueous extract of *Strychnos potatorum* seeds against acute hepatic injury. The methanol extract of the seeds possess an effective hypernatraemic, hyperchloremic and hyperkalemic diuretic activity^(3,11).

Eye diseases

The plant is useful in the treatment of various eye diseases cataract, diabetic retinopathy, dry eye syndrome, chalazion (stye)¹².

Respiratory diseases

In Siddha system of medicine, some respiratory diseases such as asthma, chronic obstructive pulmonary disease (COPD) and bronchitis are treated by the seeds and fruits of *Strychnos potatorum*¹³.

PHARMACOLOGICAL ACTIVITIES

Antimicrobial activity

Mallikarjuna PB, *et al.*, examined the antimicrobial activity in the alkaloid fractions of seeds of *Strychnos potatorum* which exhibited considerable activity against the tested bacteria and fungi. Inhibition of gram positive bacterium *Staphylococcus aureus* and gram negative bacteria *Proteus*

vulgaris, *Salmonella typhimurium*, and *Vibrio cholerae* by the fractions including diaboline (PB-IV) was observed. Further, they have exhibited significant ($P < 0.05$) antifungal activity at higher concentration (200 $\mu\text{g/mL}$) especially against *Aspergillus niger* and *Candida albicans*. Their alkaloid fractions showed considerable minimum inhibitory concentrations (IC_{50}) against *Mycobacterium tuberculosis* (clinical isolate) at 100 $\mu\text{g/mL}$ concentration¹⁰.

Nephroprotective activity

Ruby V, *et al.* proved by experiments that the alcoholic extract of the plant possesses significant nephroprotective activity in rats. Dose level of 200 mg/kg body weight was found to normalize the raised blood urea, blood protein and serum creatinine levels³.

Antidiabetic activity

Dhasarathan P, *et al.*, evaluated the anti-diabetic activity in the ethanol extract of the plant on blood sugar level, which proved to be effective even at a lower dose (100 mg/kg) in decreasing blood sugar level in alloxan treated rats. The plant extract almost brought down blood glucose level by 50% in diabetic animals¹⁴

Antiarthritic activity

Ekambaram S, *et al.*, demonstrated the anti-arthritic activity of *Strychnos potatorum* seed powder and aqueous extract of the seeds at the specified dose level of 200 mg/kg, p.o which showed reduction in rat paw edema volume. Further the histopathological and radiological studies, as reviewed by Arya V, *et al.*, confirmed the anti-arthritic activity of powder and its aqueous extract^{15,16}.

Anti-inflammatory activity

Shanmugapriya E, *et al.*, studied the anti-inflammatory effects of seed powder (100 and 200 mg/kg, p.o) and aqueous extract (100 and 200 mg/kg, p.o) of the plant in carrageenin-induced hind paw edema and cotton pellet granuloma models. Both powder and extract exhibited mild inhibition at 1 hr and maximum inhibition at 2.5 hrs in a dose-dependent manner¹⁷.

Antidiarrhoeal activity

Biswas S, *et al.*, evaluated the antidiarrhoeal activity of the methanol extract of the dried seeds of *Strychnos potatorum* in rats using different doses (100, 200 and 400 mg/kg, p.o) which significantly inhibited the frequency of defecation ($P < 0.001$) and reduced the wetness of faecal droppings in castor oil-induced diarrhoea, decreased the propulsion of charcoal meal through the gastrointestinal tract, and also reduced the PGE_2 -induced entero-pooling¹⁸.

Hepatoprotective activity

Shanmugapriya E, *et al.*, worked on the hepatoprotective and antioxidant activities of the *S. potatorum* seed powder and its aqueous extract against CCl₄-induced acute hepatic injury was achieved by injecting 3 ml/kg, s.c. of CCl₄ in equal proportion with olive oil. The doses at 100 and 200 mg/kg, p.o offered significant (P<0.001) hepatoprotective action by reducing the serum marker enzymes like serum glutamate oxaloacetate transaminase (SGOT) and serum glutamate pyruvate transaminase (SGPT)¹⁹.

Antiulcerogenic activity

Shanmugapriya E, *et al.*, again concluded that the plant seed powder and its aqueous extract of the seeds at doses 100 and 200 mg/kg, p.o prevented ulcer formation by decreasing acid secretory activity and increasing the mucin activity in rats. The powder and extract exhibited anti-ulcerogenic activity by both anti-secretory and mucoprotective actions²⁰.

Antinociceptive and antipyretic activities

The anti-nociceptive and antipyretic activities of seed powder and aqueous extract of *Strychnos potatorum* Linn. seeds in experimental Wistar mice and rats were studied by Shanmugapriya E and coworkers in both chemical and thermal models of inducing nociception. Administration at two dose levels (100 and 200 mg/kg, p.o) significantly (P<0.001) decreased the abdominal contractions in chemical model and significantly (P<0.001) increased the reaction time in thermal model, when compared with the standard drug Aspirin (100 mg/kg, p.o).

The antipyretic activity was studied by injecting typhoid-paratyphoid A and B (TAB) vaccine at the dose of 1 ml/kg by weight, where the pyresis was induced after 6 hrs. Both powder and aqueous extract exhibited dose dependent activity in reducing the pyrexia which is comparable to that of Paracetamol (100 mg/kg, p.o)²¹.

Contraceptive activity

Gupta RS, *et al.*, worked on the contraceptive activity of *S. potatorum* seeds. The aqueous solution of methanolic extract of the plant seed (100/rat/day) was administered orally to male rats of proven fertility for 60 days. Sperm motility, sperm density, serum testosterone level, biochemical analysis and testicular cell population dynamics were carried out to assess contraceptive effect of *Strychnos potatorum*²².

CONCLUSION

This review paper describes the study of the plant *Strychnos potatorum*. The study focussed on the botany, phytochemistry, ethnomedicinal and pharmacological activities of the plant. The

chemical constituents such as alkaloids, flavonoids, lignins, glycosides, phenols, saponins, sterols and tannins were found. The above data would be helpful in further study of the plant parts and research and development in field of medicine and therapeutic significance.

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