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Sansevieria roxburghiana Schult. & Schult. F., Agavaceae: phytochemistry, traditional uses and its pharmacological activities - a review

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ABSTRACT

Sansevieria roxburghiana is a stem less evergreen perennial plant commonly known as "Indian bowstring-hemp". It has various traditional uses and recently various pharmacological uses are pursuing. Traditionally it is used as a cardiotonic, expectorant, febrifuge, purgative, tonic in glandular enlargement and rheumatism etc. The plant is known to possess antitumor, antibacterial, antidiabetic, antimicrobial, anticancer, antioxidant and analgesic activity. It contains carbohydrates, alkaloids, flavonoids, tannins, saponins, carotenoids gallic acid, palmitic acid, caftaric acid, isorahmnitin-3-O-β-D-glucopyranoside, buphanidine, diethyl phthalate, 6-methyl-1-octanol, 3,3-dimethylhexanal, proteins, and phytosterols. It also contains a rare homoisoflavonoid Cambodianol. Peer-reviewed articles on *S. roxburghiana* were acquired on Scopus, scholar, Researchgate, ScienceDirect and SciFinder, there was no specific timeline set for the search. A focus group discussion was held with different communities in satkhira to further understand ethnobotanical uses of the plant. This review is an attempt to provide a comprehensive overview of the ethnobotany, phytochemistry and biological activity of *Sansevieria roxburghiana* in a succinct form so that curious researchers get all about the medicinal properties of *Sansevieria roxburghiana* at a glance and possibly make recommendations for further research.

***Keywords*:** *Sansevieria roxburghiana*; cardiotonic; antidiabetic; Homoisoflavonoid; Cambodianol; Corrosion Inhibition

1. INTRODUCTION

Plants are the sources of medicine from the ancient time. Bangladesh has a great treasure of medicinal plants. More than 500 plants have been reported to possess medicinal properties. Various plants have various medicinal properties which are traditionally used in the treatment of various disorders. The advantage of herbal medicine derived from plants is normally known free from side effects, toxicity as well as economically important. *Sansevieria roxburghiana* is one of them which are a species in the genus Sansevieria in the family Agavaceae (Asparagaceae).

The specific epithet honors the discoverer of the species the Scottish botanist and physician William Rexburg. [1] The whole plant is traditionally used as a febrifuge, cardiotonic, purgative, expectorant, tonic, in glandular enlargement and rheumatism [2-4]. The mucilaginous rhizomes are used in long-lasting chronic persistent coughs, for quick relief of a common cough and cold, in ear pain, in consumptive complaints etc. [5-7]. The juice of tender shoots is administered to children for clearing viscid phlegm from throats. The roots are used as a febrifuge in snake bite and hemorrhoids [6-8].

Several experiments on specific parts of *Sansevieria roxburghiana* plant showed various pharmacological activities such as rhizomes showed antitumor [9], antibacterial [10], antidiabetic [11], antimicrobial properties [12] whereas the roots have antibacterial and antifungal properties [13]; leaves exhibited anticancer [14] and antioxidant property [15]; the whole plant also possesses antifungal [16], antioxidant [17], analgesic [17], antibacterial [18] and antimicrobial activity [19].

Taxonomical Hierarchy: [20]

Kingdom- Plantae

Subkingdom- Tracheobionta

Superdivision- Spermatophyta

Division- Magnoliophyta

Class- Liliopsida

Subclass- Liliidae

Order- Liliales

Family- Agavaceae

Genus- Sansevieria Thunb.

Species- *Sansevieria roxburghiana* Schult. & Schult. F.

Synonyms: [21]

Acyntha roxburghiana (Schult. & Schult.f.) Kuntze

Cordyline roxburghiana (Schult. & Schult.f.) Merr.

Sansevieria zeylanica Roxb., nom. illeg.

Common Names:

English - The Bowstring Hemp

Hin - Marul

Hindi - Marul

Irula - Manji

Tamil- Mottamanji, Marul

Bangladesh -Lankh hi pang.

Apart from them, it is also called Godu Manji and espada (Portuguese, Brazil) [21,22].

This review would helpful for researchers to understand the medicinal benefits of this plant and also serve as a lead for further drug development using *S. roxburghiana* Schult. & Schult. F.

Fig. 1(a). *Sansevieria Roxburghiana*

Fig. 1(b). *Sansevieria Roxburghiana*

2. MATERIALS AND METHODS

Peer-reviewed articles on S. roxburghiana were acquired on Scopus, scholar, Researchgate, ScienceDirect and SciFinder, there was no specific timeline set for the search. A focus group discussion was held with different communities in satkhira to further understand ethnobotanical uses of the plant.

3. DISTRIBUTION

Sansevieria roxburghiana Schult. & Schult. F. (Agavaceae) is an herbaceous perennial plant with short fleshy stem and stout rootstock, occurring in the Eastern coastal region of India, also found in Sri Lanka, Indonesia, Bangladesh, tropical Africa [5] and Myanmar [23]. In Bangladesh, Sansevieria roxburghiana are wildly distributed in Gazipur, Savar and Tangail. Sometimes *Sansevieria roxburghiana* is confused with the Sri Lankan species *Sansevieria zeylanica*, which differs in the shorter and lighter colored leaves contain numerous darker lines on the back [24].

4. MORPHOLOGY

Sansevieria roxburghiana is a Stem less, with a creeping rootstock evergreen perennial plant, producing succulent, erect, rigid leaves 45-75cm or more long and 25mm wide from a rhizomatous rootstock [25]. Leaves 10-20 x 2-4 cm flat, strap-shaped or narrowly lanceolate, with a subulate point up to 2.5 cm long. The inner or adult leaves ascending and slightly recurving, thick, deeply concave, channeled down the face, rounded or very obtusely keeled on the back, green, transversely marked with darker green lines on both sides. The leaf surface is smooth, the lower contrast, slightly rough. A fiber is obtained from the leaves .The Raceme spike-like flowering stem grows 30-75 cm long [25]. Flowers are borne in clusters of 4, Pedicels 6-9 cm long and jointed. The bract is narrowed 3 to 4 millimeters long and lanceolate. The flower tube is 6 to 7.5 millimeters long. The lobes are 8.5 to 9.5 millimeters in size [24,26].

5. TRADITIONAL USES

Plants are the main source of treatment from the ancient ages due to its availability to the ethnic groups. The whole plant of *S. roxburghiana* traditionally used as a cardiotonic, expectorant, febrifuge, purgative, tonic, in glandular enlargement and rheumatism [2-4]. The rhizomes are mucilaginous and used in consumptive complaints, long lasting chronic persistent coughs, for quick relief of a common cough and cold, in ear pain, etc. [5-7]. The juice of tender shoots is administered to children for clearing viscid phlegm from throats. The roots are used as a febrifuge in snake bite and hemorrhoids [6-8]. In Bangladesh, juice from young leaves applied topically to ear infections [27].

6. PHYTOCHEMISTRY AND PHARMACOLOGY

The *Sansevieria roxburghiana* reported several chemical compounds such as Root juice contain alkaloids, flavonoids, tannins, saponins, carotenoids [13]; rhizome contain palmitic acid, 6,4,dihydroxy-3-propen chalcones, 4-propenoxy-7-hydroxy anthocyanidines, caftaric acid, isorahmnitin-3-O-β-D-glucopyranoside, di-(2-ethylhexyl) phthalate, buphanidine, gallic acid and di-iso butyl phthalate [28]; leaves and rhizomes contain carbohydrates, glycosides, saponins, phenols, flavonoids, alkaloids, anthocyanin's, proteins and phytosterols [19]; Several compounds have been identified from chromatographically separated leaves fractions like dodecanoic acid, diethyl phthalate, 6-methyl-1-octanol, 2-propyldecan-1-ol, 2(4H)-benzofuranone, 3,3-dimethylhexanal, di-isobutyl phthalate, 3,4-dimethoxy benzoic anhydride, 1,2-benzene dicarboxylic acid BIS (2-ethylhexyl ester), palmitaldehyde diallyl acetal, 1-butyl 2-(8-methylnonyl) phthalate, delta undecalactone, n-hexadecanoic acid, 6,10,14-trimethyl-2-pentadecanone, methyl hexadecanoate and 2,5-dimethoxy benzhydrazide [18].

It also Contains an active constituent the alkaloid sansevierine [27]. The higher dose (2000 mg/kg) showed mild toxic characteristics and identified as Category 5 based on Globally Harmonious System [29].

6. 1. Antitumor Activity

Pallab Kanti Haldar et al., studied on a hydroalcoholic extract of *S. roxburghiana* rhizome (HASR) and showed that HASR possesses antitumor activity against Ehrlich ascites carcinoma (EAC) in Swiss albino mice [9].

They administered HASR at 50 and 100 mg/kg body weight for nine consecutive days after Twenty-Four hours of intraperitoneal inoculation of tumor (EAC) cells in mice. HASR showed a significant ($p < 0.001$) decrease in tumor volume, packed cell volume and viable cell count and increased the life span of EAC-bearing mice. Hematological and serum biochemical profiles restored to normal levels in HASR treated mice as compared to EAC control. HASR treatment also significantly ($p < 0.001$) decreased lipid peroxidation and recovered glutathione (GSH) superoxide (SOD) and catalase (CAT) towards normal as compared to EAC control [9].

Therefore, it can be concluded that the hydro alcoholic extract of Sansevieria roxburghiana rhizome demonstrated remarkable antitumor activity against Ehrlich ascites carcinoma in mice plausibly by modulating lipid peroxidation and augmenting endogenous antioxidant defense systems.

6. 2. Analgesic Activities

Jimuty Roy et. al., found that whole plant of the ethyl acetate soluble fraction of the crude methanolic extract have significant ($p < 0.001$) pain relieving activity at the oral dose of 100 mg/kg body weight.

Analgesic activity of the crude methanol extract and it's all Kupchan fractions were tested by acetic acid induced writhing model in mice. The ethyl acetate, the chloroform and the petroleum ether soluble fraction of a crude methanolic extract of S. roxburghiana demonstrated significant analgesic activity with writhing inhibition of 62.5%, 60% and 56.66% respectively compared to 66.66% exhibited by standard diclofenac sodium [17].

6. 3. Cytotoxic Activities

Jimuty Roy *et al.*, reported the cytotoxic effect of an aqueous soluble fraction of the unrefined methanolic extract of *S. roxburghiana* assessed by brine shrimp lethality bioassay .In brine shrimp lethality bioassay, the aqueous soluble fraction exhibited maximum toxicity towards the shrimp with LC50 value of .735 µg/mL compared to 0.544 µg/mL exhibited by standard vincristine [17].

Roy et al. isolated an uncommon homoisoflavonoid cambodianol from the carbon tetrachloride soluble fraction of a methanol extract of the entire plants of *Sansevieria roxburghiana* (Agavaceae) by broad spectroscopic studies, including high field NMR analyses [8].

Liu, Jian, et al reported that Cambodianol exhibited significant cytotoxic activities against K562 and SGC-7901 with the IC (50) values of 1.4 and 2.9 micro g/ml, respectively. [30]

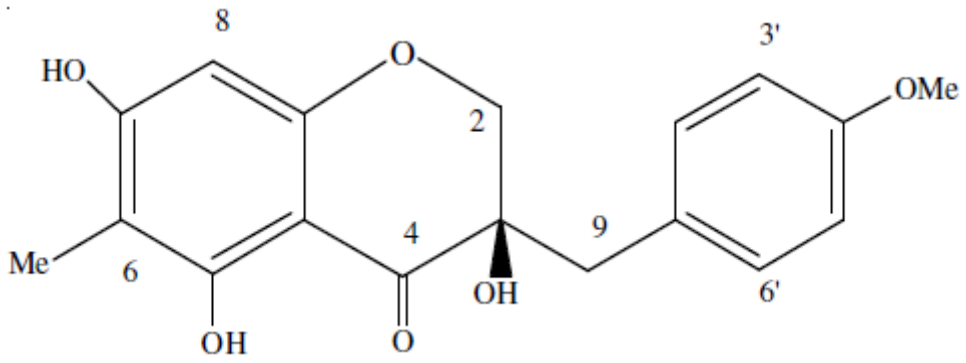

Fig. 2. Cambodianol [8].

6. 4. Antioxidant Activities

Jimuty Roy et al. showed the anti-oxidant activity of methanol extract of *S. roxburghiana* alongside its all partitionates revealed mild to moderate free radical scavenging activity. [17] Antioxidant effect was measured by 1,1-diphenyl-2-picrylhydrazyl–hydrate (DPPH) free radical scavenging assay estimated by the method established by Brand-Williams et al [31]. Kaleena et al., reported antioxidant effect and strong free radical scavenging effects of methanol, acetone and ethyl acetate extracts of *Sansevieria roxburghiana* leaves on free radicals and oxidants (DPPH, NO) in a dose-dependent manner with BHT (butylated hydroxytoluene) as a standard reducing agent. Methanol extract showed better antioxidant potential compared to acetone and ethyl acetate leaf extracts due to the presence of high content of alkaloids, sterols, flavonoids and saponins [15].

6. 5. Anticancer Activity

Bala A et al. reported the methanol extract of *Sansevieria roxburghiana* in male Swiss albino mice transplanted with Ehrlich Ascites Carcinoma cell line showed significant dose-dependent anticancer activity. [32] Philip et al also reported the cytotoxic and anticancer activity of *Sansevieria roxburghiana* [14].

6. 6. Antidiabetic Activity

Haldar, Pallab K. et al., examined hydroalcoholic extract of *S. roxburghiana* rhizome (HASR) and demonstrated that hydroalcoholic extract possesses antidiabetic activity in normal, glucose-loaded and in streptozotocin-induced diabetic rats. They induced hyperglycemia in rats by streptozotocin (STZ, 65 mg/kg body weight) and after three days HASR administrated to diabetic rats orally at 50 and 100 mg/kg body weight daily for 15 days against Glibenclamide (0.5 mg/kg, orally) reference Each fifth day Blood glucose levels was measured during 15 days. Serum biochemical parameters viz. SGPT, SGOT, SALP, cholesterol, triglycerides, and total protein were estimated. Hepatic and renal lipid peroxidation, reduced glutathione (GSH) and catalase (CAT) also assessed and HASR significantly ($P < 0.001$) and dose-dependently normalized blood glucose levels, serum biochemical parameters; decreased lipid peroxidation and recovered GSH and CAT as

compared to those of STZ controls. The potential antidiabetic action is plausibly due to its modulation of endogenous antioxidant status [11].

6. 7. Antimicrobial Activity

Philip, Deepa, et al., indicated antimicrobial activity of different various solvent and aqueous extracts of the leaves and rhizome of *Sansevieia roxburghiana* against a panel of clinically significant bacterial and fungal strains. Susceptibility tested by disc diffusion assay revealed significant antimicrobial activity of methanol and acetone extracts of leaves against Gram-positive bacteria such as *Micrococcus luteus, Bacillus cereus, Enterococcus spp., Staphylococcus aureus,* Gram-negative bacteria such as *Proteus vulgaris, Pseudomonas aeruginosa, Pseudomonas fluorescence, Salmonella typhi, Salmonella paratyphi, Klebsiella pneumoniae, Shigella sonnei and Escherichia coli, fungal strains Cryptococcus* spp. and *Candida albican*. Ethyl acetate extracts of rhizomes also exhibited appreciable antimicrobial activity against most of the pathogens tested. The minimum inhibitory concentrations (MIC) of the various extracts by Agar Dilution method ranged from 1.0 to 8.0 mg/ml. The leaf extracts exhibited better antimicrobial activity than rhizomes [20]. Kingsley, Danie, *et al*. reported antimicrobial activity of methanol and acetone extracts of leaves against Gram-positive bacteria as well as gram negative bacteria *Streptococcus aureus and Pseudomonas aeruginosa. Sanseviveria roxburghiana* leaves possess 50% antimicrobial effect against *streptococcus aureus* combined with norflaxacin.

Sethi *et al.*, revealed the antibacterial activity of ethanolic extract of rhizome of S. roxburghiana against the four pathogenic bacteria; *S. Typhi, P. fluorescens, P. aeruginosa and E. coli* were assessed by the zone of inhibition. All the microbes were sensitive to the ethanolic extract of the plant and showed a potential activity. Maximum activity was seen in the case of *P. fluorescens* where the zone diameter was 32 mm (300 µg/ml). The minimum inhibitory concentration study revealed that the value for the S. Typhi and E. coli as 80 and 60 µg/ml for *P. fluorescens* and *P. aeruginosa* [10]. Moideen, M. M. J et al., reported the antibacterial activity of S. roxburghiana root sap against both gram-negative and gram-positive organisms except Streptococcus faecalis but no antifungal activities .The antimicrobial susceptibility studies conducted against gram (-) bacteria such as *Escherichia coli, Klebsiella pneumonia, and Pseudomonas auroginosa*, gram (+) bacteria such as *Staphylococcus aureus, Streptococcus faecalis* and fungi such as *Aspergillus niger* and *Candida albicans*.

The Gram-negative bacterium is more susceptible to the *S. roxburghiana* root than gram-positive bacteria potential source of food nutrients and nutraceuticals [13]. Philip, D et al., revealed the antibacterial activity of chromatographically separated pure fractions of leaves of *Sansevieria roxburghiana*. Two fractions out of the three showed pronounced activity at 1 mg/ml against gram positive and gram negative bacteria's responsible for various infections [18].

These results lend credence to the folkloric use of this plant in treating microbial infection. Researchers performed generalized research, no specific research performed to identify the active compounds. All of these research prove that this plant contain active constituents which shown antimicrobial activity specific research is necessary to identify the active compounds from this plant to discover new bio friendly drugs.

7. COMMERCIAL ASPECTS

Baula, Ferlien Mae G. et al., showed that the *Sansevieria roxburghiana* (SR) extract – Zn^{2+} system control the corrosion of carbon steel in 60 ppm chloride environment by weight loss method.6 ml *Sansevieria roxburghiana* (SR) extract, 100 ppm of sodium potassium tartarate(SPT) and 300 ppm of Zn^{2+} mixture offered 97% inhibition efficiency. sansevieria roxburghiana (SR) – Zn^{2+} system also possess synergistic, controls the anodic reaction predominantly and a protective film is formed on the metal surface. A good quality fiber is obtained from the leaves. The fibre is pliant, soft, and silky. It suitable for making bowstrings due to its natural elasticity. The fibre is used for the preparation of cordage and matting and in Europe for making ropes used in deep-sea dredging. It has been also used for making paper but is too expensive a fibre for this use. Researchers should focus on the exploitation of eco-friendly fibers from natural recourses like sansevieria roxburghiana that have the potential for use in diversified fields.

8. CONCLUSION

Sansevieria roxburghiana is a glorious medicinal plant source of medicine from the ancient ages used by the ethnic groups. It is an effective drug for various diseases So; it requires ex-situ and in-situ conservation to understand the mechanism of action of this outstanding plant. Such studies are crucial for clinical experimentation and in the development of novel drugs.

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