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Review Article

SANSEVIERIA HYACINTHOIDES (L.) DRUCE: A REVIEW OF ITS BOTANY, MEDICINAL USES, PHYTOCHEMISTRY, AND BIOLOGICAL ACTIVITIES

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ABSTRACT

Sansevieria hyacinthoides is a succulent perennial herb widely used as herbal medicine. This study is aimed at providing a critical review of the botany, biological activities, phytochemistry, and medicinal uses of *S. hyacinthoides*. Documented information on the botany, biological activities, medicinal uses, and phytochemistry of *S. hyacinthoides* was collected from several online sources which included BMC, Scopus, SciFinder, Google Scholar, Science Direct, Elsevier, PubMed and Web of Science. Additional information on the botany, biological activities, phytochemistry, and medicinal uses of *S. hyacinthoides* was gathered from pre-electronic sources such as book chapters, books, journal articles, and scientific publications obtained from the university library. This study showed that the leaf sap, leaves, rhizomes, roots, and whole plant parts of *S. hyacinthoides* are used as ethnoveterinary medicine, magical purposes, to dilate birth canal and as herbal medicine for fever, respiratory problems, intestinal parasites, worms, rheumatism, swellings, skin infections, sexually transmitted infections, hemorrhoids, toothache, diarrhea, stomach problems, insect and snake bites, earache, and infections. Phytochemical analyses revealed that the leaves, rhizomes, and roots are characterized by alkaloids, flavonoids, and steroids. Pharmacological research revealed that *S. hyacinthoides* crude extracts have anthelmintic, antibacterial, antifungal, and antioxidant activities. Future ethnopharmacological research should focus on carrying out detailed phytochemical, pharmacological, and toxicological studies.

Keywords: Asparagaceae, Ethnopharmacology, Herbal medicine, Indigenous pharmacopeia, *Sansevieria hyacinthoides*.

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INTRODUCTION

Sansevieria hyacinthoides (L.) Druce is a member of the Asparagaceae family [1], a classification system that is in agreement with the Angiosperm Phylogeny Group [2]. *S. hyacinthoides* has also been placed within Agavaceae, Convallariaceae, Dracaenaceae, Liliaceae, and Ruscaceae families [3-18]. According to Plants of the World Online [19], *S. hyacinthoides* is a synonym of *Dracaena hyacinthoides* (L.) Mabb. However, according to the plant list, created and managed by the Royal Botanic Gardens (UK) and the Missouri Botanical Gardens (USA), *S. hyacinthoides* is a valid and accepted name [20]. These observed taxonomical problems associated with *S. hyacinthoides* corroborate observations made by Dauncey *et al*. [21] that there are ambiguities and errors in the use of scientific names mainly because of using older names or an out of date taxonomy. Dauncey *et al*. [21] argued that there is need to use scientific plant names appropriately and unambiguously as a means of ensuring scientific integrity. Therefore, in this study, the name *S. hyacinthoides* and family Asparagaceae have been adopted and will be used throughout the manuscript. *S. hyacinthoides* is native to east, central, and southern Africa, but the species has been introduced to several other countries as an ornamental and fiber crop [18,22]. In Bangladesh and South Africa, *S. hyacinthoides* is grown in home gardens as an ornamental, medicinal, and spiritual plant [23-28]. The leaves and roots of *S. hyacinthoides* are marketed as herbal medicines in the Eastern Cape and KwaZulu-Natal provinces in South Africa [29,30]. *S. hyacinthoides* is also one of the important medicinal plants in South Africa, included in the book "medicinal plants of South Africa," a photographic guide to the most commonly used plant medicines in the country, including their botany, main traditional uses, and active ingredients [31]. Research by Van Wyk [32] showed that the leaves and roots of *S. hyacinthoides* have commercial potential as herbal medicines for ear infections, hemorrhoids, and skin ulcers in South Africa. It is within this context that this review was undertaken aimed at reviewing the botany, medicinal uses, phytochemical, and biological activities of *S. hyacinthoides* so as to provide baseline data required in evaluating the therapeutic potential of the species.

BOTANICAL PROFILE OF *S. HYACINTHOIDES*

The genus *Sansevieria* Thunb. is in honor of an Italian Pietro Antonio Sanseverino, Count of Chiaromonte (1724–1771) in whose garden the plant was growing [33]. The specific name hyacinthoides means resembling a hyacinth [33]. The name *S. hyacinthoides* is associated with the following synonyms: *Aletris guineensis* (L.) Jacq, *A. hyacinthoides* var. *guineensis* L., *Aloe guineensis* L., *A. hyacinthoides* L., *A. hyacinthoides* var. *guineensis* L., *Cordyline guineensis* (Willd.) Britton, *S. angustiflora* Lindb., *S. grandis* var. *zuluensis* N.E. Br., *S. guineensis* (L.) Willd., *S. metallica* Gérôme and Labroy, and *S. thyrsiflora* (Petagna) Thunb. [4,6,9,10,18]. *S. hyacinthoides* is native to Kenya, Malawi, Mozambique, Namibia, South Africa, Tanzania, and Zambia and Zimbabwe [4-7,9,10,12,18], but the species has been introduced in America, Asia, Australia, and Europe as an ornamental and fiber crop [18,22,34-36]. *S. hyacinthoides* has been recorded in all six Dutch Caribbean islands, and it is regarded as a weed [37,38]. *S. hyacinthoides* was introduced to Florida around 1800, and the species has been categorized as an invasive weed since 1951and currently regarded as one of the six "worst plant invaders" in Florida [39,40]. *S. hyacinthoides* is included in the Global Compendium of Weeds [40,41] and currently naturalized in Anguilla, Australia, Bahamas, Barbados, Bermuda, Cayman Islands, Cuba, Florida, Jamaica, Mexico, Puerto Rico, the US Virgin Islands, and West Indies [22,40-46]. Where *S. hyacinthoides* is naturalized, the species has been recorded in a variety of habitats which include disturbed areas, roadsides, secondary forests, coastal forest, and Shrubland in dry, arid, and semiarid ecosystems [22,40,45].

S. hyacinthoides is a succulent, robust, evergreen, stemless, and perennial herb which can grow up to 60 cm in height [9]. *S. hyacinthoides* has fleshy creeping rhizomes that are sturdy, fibrous, and bright orange in color. The leaves are erect, rigid, loosely clustered, fibrous, flat, and arising from a horizontal underground rhizome. The leaves are lanceolate or narrowly elliptic in shape, the apex acute or obtuse, the blade leathery and dull green but mottled transversely with numerous more or less

obscure pale green bands and the margins with a fine reddish line. The inflorescence is a many-flowered raceme, with stalkless flowers that are white, cream-colored or greenish-white to pale mauve in color. The flowers form small berry-like fruits, which are green at first, gradually becoming yellow when they ripen.

MEDICINAL USES OF *S. HYACINTHOIDES*

The leaf sap, leaves, rhizomes, roots, and whole plant parts of *S. hyacinthoides* are used as ethnoveterinary medicine, magical purposes, to dilate birth canal and as herbal medicine for fever, respiratory problems, intestinal parasites, worms, rheumatism, swellings, skin infections, sexually transmitted infections, hemorrhoids, toothache, diarrhea, stomach problems, insect and snake bites, earache, and infections (Table 1 and Fig. 1). In Bangladesh, the fruits of *S. hyacinthoides* are mixed with *Aconitum napellus* L. and *Mucuna pruriens* (L.) DC. as an herbal medicine for urinary problems [46].

PHYTOCHEMICAL COMPOSITION OF *S. HYACINTHOIDES*

Gamboa-Angulo *et al*. [100] identified steroids 25S-ruscogenin and 1β,3β-dihydroxy-5,16-pregnadien-20-one from the leaves of *S. hyacinthoides* while Khare [8] identified alkaloids aconitic acid and *Sansevieria* from the leaves and roots of the species (Table 2). Sultana *et al*. [25] identified a flavonoid isokaemferide and steroids β-sitosterol and daucosterol from the rhizomes of *S. hyacinthoides* (Table 2). Van Wyk *et al*. [31] argued that the value of *S. hyacinthoides* in treating hemorrhoids is due to the presence of various sapogenins, particularly 25S-ruscogenin.

BIOLOGICAL ACTIVITIES OF *S. HYACINTHOIDES*

The following biological activities have been reported from the leaf and root extracts and compounds isolated from *S. hyacinthoides*: Anthelmintic [54], antibacterial [25,54,57,69,94,95,101], antifungal [25,57,94,95], and antioxidant [102-105] activities.

Table 1: Medicinal uses of *Sansevieria hyacinthoides*

Medicinal use	Parts of the plant used	Country	References
Blood disorders	Rhizomes and roots	India	[47]
Burns and wounds	Leaves and roots	South Africa	[26,48]
Colic	Leaves	Zimbabwe	[49,50]
Contusions	Leaves	Mozambique	[51]
Diabetes	Leaves	South Africa	[52]
Diarrhea and stomach problems	Leaves, rhizomes, roots, and whole plant	Mozambique, Nepal, South Africa, Uganda, and Zimbabwe	[26,31,33,48-61]
Dilate birth canal	Leaves, rhizome, and roots	South Africa, Swaziland, and Zimbabwe	[49,62-64]
Earache and infections	Leaves and rhizomes	Bangladesh, Nepal, South Africa, Swaziland, Tanzania, and Zimbabwe	[24,31,33,48,49,55,57,59,60 ,64-75]
Erectile dysfunction	Leaves	South Africa	[52]
Fever	Leaves	Guatemala and India	[47,76]
Glandular enlargements	Rhizomes and roots	India	[47]
Hemorrhoids	Leaves, rhizomes, and roots	Nepal, Mozambique, South Africa, and Swaziland	[31,33,49,51,55,57,59,60,62,67 ,69,70,77-79]
Headache	Leaves	Guatemala	[76]
Heart problems	Rhizomes and roots	India	[47]
Human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS)	Roots	South Africa	[80-82]
Infertility	Roots	Mozambique	[51]
Insect and snake bites	Leaves, roots, and whole plant	Bangladesh, Belize, Guatemala, Mexico, Mozambique, and South Africa	[24,56,72,76,83-85]
Intestinal parasites and worms	Leaves, rhizomes, and roots	Nepal, South Africa, and Zimbabwe	[31,33,49,54,55,57,59,60,62,67 ,69,71,78,86]
Magical purposes	Leaves, roots, and whole plant	Mexico, Mozambique, South Africa, and Swaziland	[24,33,51,62,64,66,67,70,85 ,87,88]
Poisoning	Leaves	Zimbabwe	[49]
Purgative	Leaves	Zimbabwe	[49]
Respiratory problems (chest pains, cough, and labored breathing)	Leaves, rhizomes, and roots	South Africa and Zimbabwe	[57,89-91]
Rheumatism and swellings	Leaves, rhizomes, and roots	India, Mozambique, South Africa, and Zimbabwe	[47-49,51]
Sexually transmitted infections (genital warts, gonorrhea, syphilis, and venereal diseases)	Leaves, rhizomes, and roots	India, Mozambique, South Africa, and Zimbabwe	[27,47,49,56,92]
Skin infections (chickenpox, leprosy, and measles)	Leaves, rhizomes, roots, and whole plant	Guatemala, India, Uganda, and Zimbabwe	[47,49,61,76]
Toothache	Leaves and rhizomes	Nepal, South Africa, Swaziland, and Tanzania	[31,33,48,49,55,57,59,60,62,67 ,69,70,78,88,93-95]
Ulcers	Leaves and rhizomes	Nepal and South Africa	[31,33,49,55,57,59,60,69,78]
Urinary problems	Fruits mixed with *Aconitum napellus* L. and *Mucuna pruriens* (L.) DC.	Bangladesh	[46]
Ethnoveterinary medicine (conjunctivitis, ectoparasites, poisoned dogs, and swollen limbs)	Fruits, leaf sap, and rhizomes	South Africa, Tanzania, and Zimbabwe	[49,71,96-99]

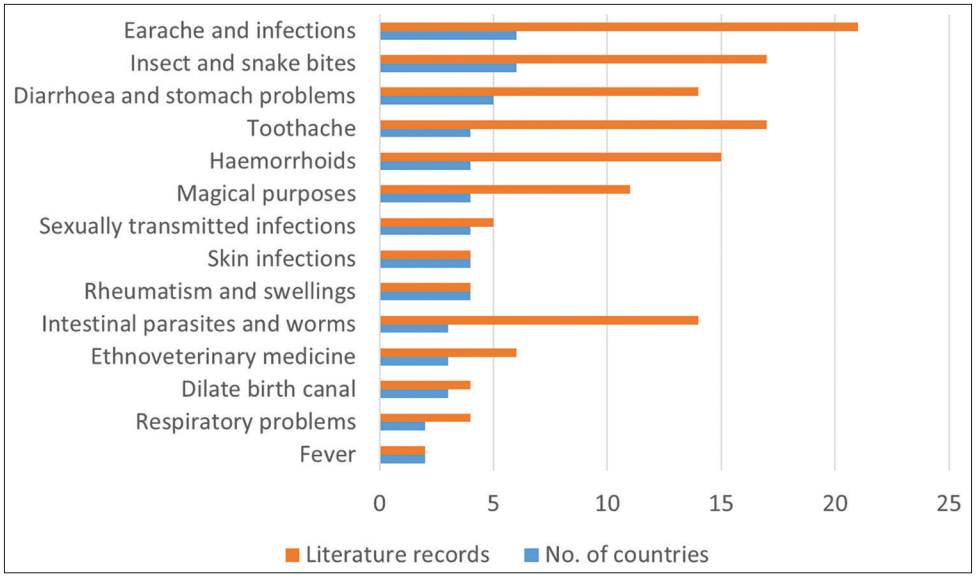

Fig. 1: Ethnomedicinal applications of *Sansevieria hyacinthoides*

Table 2: Phytochemical composition of *Sansevieria hyacinthoides*

Phytochemical composition	Plant parts	References
Alkaloid		
Aconitic acid	Leaves	[8]
Sansevieria	Roots	[8]
Flavonoid		
Isokaemferide	Rhizome	[25]
Steroids		
25S-ruscogenin	Leaves	[100]
1β,3β-dihydroxy-5,16-pregnadien-20-one	Leaves	[100]
β-sitosterol	Rhizome	[25]
Daucosterol	Rhizome	[25]

Anthelmintic activities

McGaw *et al*. [54] evaluated anthelmintic activities of hexane, ethanol, and waterleaf extracts of *S. hyacinthoides* on the mortality and reproductive ability of the free-living nematode *Caenorhabditis elegans* in two different assays. Water extract exhibited activities at a concentration of 1 mg/ml and 2 mg/ml after the 7 days incubation period [54].

Antibacterial activities

McGaw *et al*. [54] evaluated the antibacterial activities of aqueous, ethanol, and hexane leaf extracts of *S. hyacinthoides* against *Bacillus subtilis*, *Escherichia coli*, *Klebsiella pneumoniae,* and *Staphylococcus aureus* using the disc-diffusion and microdilution assays, with neomycin (5 µg) as the positive control. Water extract exhibited activities with minimum inhibitory concentration (MIC) value of 6.3 mg/mL against *B. subtilis* [54]. Case [69] evaluated antibacterial activities of 50% methanol and aqueous leaf extracts of *S. hyacinthoides* against *S. aureus*, *Pseudomonas aeruginosa,* and *Mycobacterium smegmatis* using a disc diffusion assay with ciprofloxacin as a positive control. The 50% methanol extract exhibited weak activities against *S. aureus* and *M. smegmatis* with the zone of inhibition of 1 mm against 9 mm exhibited by the control [69]. Sultana *et al*. [25] evaluated antibacterial activities of methanol and n-hexane rhizome extracts of *S. hyacinthoides* as well as compounds isokaemferide, β-sitosterol, and daucosterol isolated from the species against *Bacillus cereus*, *B. subtilis*, *E. coli*, *P. aeruginosa*, *S. aureus*, and *Salmonella typhi* using the disc diffusion method with kanamycin as a positive control. The crude extracts were active against all tested pathogens with the exception of *B. cereus* with MIC values ranging from 7.0 mg/ml to 16.0 mg/ml. The compounds were active against *B. subtilis*, *S. aureus,* and *Salmonella typhi* with MIC values ranging from 7.0 mg/ml to 9.0 mg/ml [25]. Nielsen *et al*. [57] evaluated antibacterial activities of the methanol leaf and rhizome extracts of *S. hyacinthoides* against *Citrobacter* spp., *S. aureus*, *E. coli*, *K. pneumoniae*, *P. aeruginosa*, and *M. smegmatis* using the microbroth dilution method with gentamicin and ciprofloxacin as positive controls. The extracts exhibited weak activities with MIC values ranging from 312.5 µg/ml to >2500 µg/ml which were much higher than MIC values of 0.3 µg/ml to 19.5 µg/ml exhibited by the controls [57]. York *et al*. [101] assessed the antibacterial properties of aqueous and dichloromethane-methanol (1:1) leaf extracts of *S. hyacinthoides* against *K. pneumoniae*, *Moraxella catarrhalis*, *M. smegmatis*, and *S. aureus* using microdilution assay with ciprofloxacin as the positive control. The extract showed activities with MIC values ranging from 1.7 mg/ml to >16.0 mg/ml [101]. Akhalwaya [94] and Akhalwaya *et al*. [95] evaluated antibacterial activities of aqueous and dichloromethane: methanol (1:1) leaf and rhizome extracts of *S. hyacinthoides* against *Streptococcus mutans*, *Streptococcus sanguis*, *Lactobacillus acidophilus*, *Lactobacillus casei*, *Porphyromonas gingivalis,* and *Fusobacterium nucleatum* using the microtiter plate dilution assay with ciprofloxacin (0.1 mg/mL) as a positive control. The extracts exhibited activities with MIC values ranging from 0.3 mg/mL to >8.0 mg/mL [94,95].

Antifungal activities

Sultana *et al*. [25] evaluated antifungal activities of methanol and n-hexane rhizome extracts of *S. hyacinthoides* as well as compounds isokaemferide, β-sitosterol, and daucosterol isolated from the species against *Candida albicans* using the disc diffusion method with kanamycin as a positive control. The methanol and n-hexane extracts were active with MIC values of 11.0 mg/ml and 12.0 mg/ml, respectively, and compound isokaemferide was active with MIC value of 9.0 mg/ml [25]. Nielsen *et al*. [57] evaluated antifungal activities of methanol leaf and rhizome extracts of *S. hyacinthoides* against *C. albicans* and *Microsporum audouinii* using the microbroth dilution method with nystatin as a positive control. The rhizome and leaf extracts exhibited MIC values of 156.3 µg/ml and 312.5 µg/ml, respectively, against both fungi species in comparison to MIC value of 19.5 µg/ml exhibited by the control [57]. Akhalwaya [94] and Akhalwaya *et al*. [95] evaluated antifungal activities of aqueous and dichloromethane:methanol (1:1) leaf and rhizome extracts of *S. hyacinthoides* against *C. albicans*, *Candida glabrata*, and *Candida krusei* using the microtiter plate dilution assay with amphotericin B (0.01 mg/mL) as a positive control. The extracts exhibited activities with MIC values ranging from 0.5 mg/mL to >8.0 mg/mL [94,95].

Antioxidant activities

Aliero *et al*. [102] evaluated the antioxidant activities of acetone and methanol leaf and root extracts of *S. hyacinthoides* using the 1,1-diphenyl-2-picrylhydrazyl free radical (DPPH) free radical scavenging assay. The leaf extracts showed activities at 1 mg/ml exhibiting over 80% DPPH activity, while acetone and methanol extracts from the roots at 0.75 mg/ml exhibited 91.4% and 92.8% DPPH scavenging activities, respectively [102]. Tkachenko *et al*. [103] evaluated the antioxidant activities of leaf extracts of *S. hyacinthoides* by assessing their *in vitro* effects against protein damage in equine erythrocytes using the carbonyl derivatives content of protein oxidative modification (OMP) assay. The extract efficiently inhibited the formation of ketonic derivatives of OMP showing potential in protecting the protein groups and reducing the protein carbonyl content [103]. Tkachenko *et al*. [104] evaluated the antioxidant activities of leaf extracts of *S. hyacinthoides* by assessing their *in vitro* effects against protein damage in equine erythrocytes using the OMP assay. The extracts reduced the concentration of ketonic derivatives of OMP when compared to untreated erythrocytes by 13.4% [104]. Similarly, Tkachenko *et al*. [105] evaluated the antioxidant activities of leaf extracts of *S. hyacinthoides* by assessing the level of 2-thiobarbituric acid reactive substances (TBARS) as biomarkers of lipid peroxidation in equine erythrocyte suspension induced by treatment of the leaf extracts. The leaf extracts resulted in a significant increase of 29.7% of TBARS concentration in erythrocytes. These results suggest that *S. hyacinthoides* has a promising antioxidant and prooxidant potential.

CONCLUSION

The present review summarizes the botany, medicinal uses, phytochemistry, and pharmacological properties *S. hyacinthoides*. From a chemical, pharmacological, and toxicological point of view, *S. hyacinthoides* has not received any major emphasis. At present, there is not yet enough data on ethnopharmacological evaluations on the species that can be correlated with its medicinal applications. Therefore, detailed phytochemical, pharmacological, and toxicological studies of *S. hyacinthoides* are recommended.

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AUTHOR'S CONTRIBUTIONS

The author declares that this work was done by the author named in this article.

CONFLICTS OF INTEREST

The author declares that there are no conflicts of interest regarding the publication of this paper.

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