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Traditional, phytochemical, and biological aspects of Indian spider plant

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Abstract

Herbs are the reserve of plentiful valuable remedies of natural origin. Quite a few dynamic fundamentals are still obtained in huge quantities through them till date. One of them is Safed musli that grows in an extensive range of places in nature. It is grown in open rocky places to shady and highly humus rich soils in the forest. Thirteen well known species of Chlorophytum have been obtained from India. All these species vary in appearance. Amongst these, *C. borivilianum* (Liliaceae) produces the maximum yield and highest saponin concentration. Safed musli is a conventional Indian medicinal herb possessing therapeutic applications in Siddha, Ayurveda, Unani, Homeopathic and Allopathic systems of medicine. Roots (tubers) of this plant are frequently employed for numerous remedial applications as it is rich in phytoconstituents like steroidal and triterpenoidal saponins, saponin and fructans. Research findings have suggested that safed musli contains alkaloids, proteins, vitamins, minerals (potassium, calcium, and magnesium), phenol, resins, and mucilage. Sufficient amount of simple sugars, mainly sucrose, glucose, monomeric fructose, hexose galactose, mannose and xylose are also reported in *C. borivilianum*. Safed musli is used to increase immunity and to cure diarrhea, dysentery, leucorrhea, gonorrhoea, physical illness, natal and postnatal problems, rheumatism, joint pains and diabetes. Safed musli is widely employed as an stimulant agent, revitalizer, antimicrobial, anti-inflammatory and antitumor agent. Tropical and subtropical Africa is probably the centre of origin of the genus, where about 85% of the species are established in India.

Keywords: *Chlorophytum borivilianum*, aphrodisiac agent, saponins, antioxidant

Introduction

Traditional medicine system provided effective platform for unearthing of many novel drugs. An exceptional herb that found in India *Chlorophytum borivilianum* (Liliaceae) is a one of such renowned miraculous folk therapy with a distant past of medicinal value (Pal *et al.*, 2014 a) [23]. The herb has particularly assembled lanceolate-shaped leaves and smoggy racemosus flowers with white-coloured (Pal *et al.*, 2014b) [24]. It has standardly arrives at a height of 1.8 ft. It is most commonly called 'Safed musli,' that means "white tubers" "White gold" or "Divya aushad. This amazing herb is extensively referred in early ayurvedic scriptures of Charaka Samhita & Raj Nighantu (Khanam *et al.*, 2013) [16]. In Ayurveda, it is included in the group of "Vajikaran Rasayana" (Haque *et al.*, 2011) [10]. Thus, the universal Ayurvedic medicine marks Musli as one of the key herbs used for the Brihana Therapy that is an ayurvedic treatment that employs diverse types of herbs, that enhances strength, boosts physical performance and improves body endurance (Khan *et al.*, 2019) [15].

In Ayurveda, Unani, Homeopathy, Siddha and Allopathy, plant's root plays a key role in treatment of numerous diseases (Sethi *et al.*, 2014) [26]. Almost all Tribals in India have been using Safed Musli since ages for improving their energy. The species was first described from India in 1954. It is considered as a general health booster in India and herbal alternative to 'Viagra' even in western countries. There are around 215 species in the genus *Chlorophytum* that are distributed in the tropical and subtropical regions of the world (Cui *et al.*, 2021) [5]. Most of its species originated from Africa and distributed throughout the warmer regions of the world. In India it is available in deep forests as well as reserve sanctuaries in the Aravali Hills, Southern Rajasthan, North Gujarat and Western Madhya Pradesh (Chauhan *et al.*, 2016) [4]. The species distributed in India are *C. borivilianum* Sant. & Fernand, *C. undulatum* Wall. *syn. C. nepalense* (Lindl) Baker, *C. tuberosum* Baker, *C. breviscapum* Dalz., *C. heyneanum* Wall, *C. arundinaceum* Baker, *C. glaucum* Dalz., *C. khasianum* Hooker, *C. malabaricum* Baker, *C. orchidastrum* Lindl., *C. laxum* Br. and *C. attenuatum* Baker. Aundhe and Deokule reported

and classified 10 species from Maharashtra on the basis of their root morphology namely *C. borivilianum*, *C. bharuchae*, *C. orchidastrum*, *C. arundinaceum*, *C. glaucum*, *C. attenuatum*, *C. glaucoides*, *C. breviscapum*, *C. laxum* and *C. tuberosum*. *C. borivilianum* (Vijaya and Chavan, 2009) [32]. Other important indigenous species are *C. arundinaceum*, *C. tuberosum*, *C. laxum*, and *C. breviscapum*. In the US and UK, tubers are being utilized to make chips/flakes as a alimental meal (Verma *et al.*, 2020) [31]. It is a vital element in more than hundred herbal drug compositions. Therefore, in afresh years, the demand for *Chlorophytum borivilianum* has increased in both the Indian and international medicinal markets (Ved *et al.*, 2017) [30].

Synonyms

This amazing herb has so many names including Safed Moosli, Indian Spider plant, Land-Calotrops, Asparagus adscendens, Dholi Musli, Swetha Musli, Taniravi Thang, Khiruva, and Shedheveli (Khanam *et al.*, 2013) [16].

Historical Context

Safed musli is native to the tropical and subtropical regions of Africa and Asia. Researchers named Santapau and Fernandes collected the specimens of a novel species of *Chlorophytum* in the plains and lower slopes of the Krishnagiri National Park Salsette Island, Borivali, Mumbai, on June 14th in the year 1954 (Khanam *et al.*, 2013) [16]. It was named *Chlorophytum borivilianum* Santapau and Fernandes (Khanam *et al.*, 2013) [16]. *C. borivilianum* was further reported from numerous localities like Dang forest in Gujarat, Aravali hills in Rajasthan, along plains and lower hill slopes of Akola, Amaravati, Mumbai, Kolhapur, Pune and Raigad in Maharashtra (Vijaya and Chavan, 2009) [32]. *C. borivilianum* was considered as an endangered species by Nayar and Shastri (Khanam *et al.*, 2013) [16]. *C. borivilianum* is considered as an endemic to India and its IUCN Red list status is 'vulnerable' according to Begum and Ved (Haque *et al.*, 2011) [10] due to over exploitation from the wild stands.

Geographical distribution

Chlorophytum is a genus of about 200-220 species of evergreen perennial flowering plants belongs to Agavaceae family (Pal *et al.*, 2014 a) [23]. Around 300 species are distributed right through the tropical & subtropical region of the world, particularly Africa that is estimated to be the center of origin of the genus (Vijaya and Chavan, 2009) [32]. Safed musli is extensively distributed in India chiefly in North Gujarat, Western Madhya Pradesh, Southern Rajasthan, and a small number in parts of Karnataka. *Chlorophytum comosum*, also called the Spider Plant that is native of South Africa, which is a very popular house plant (Khanam *et al.*, 2013) [16]. *Chlorophytum borivilianum* which is native of India, used as a medicinal plant. But, due to continuous exploration its frequency, quality as well as distribution is decreased because it has low rate of regeneration and also is prone to attack by several diseases, such as tuber-rot and crown-rot

Botanical description

Floral formula

$\oplus, \sigma, \varnothing, P(3+3), A(3+3), G$ (3)

It is a tiny perennial herb with an occupied crown of radical

foliage. Leaves are normally 6 to 13 in number, 13 to 23 cm x 1.75 cm in dimensions, spirally imbricate and a little tapered at the base, by and large sessile linear or ovate, having sharp apex. These leaves extend horizontally and their lower surface is rough with wavy margins and parallel venation. Roots/tubers that are straw colored (outer) and white (inner), generally fleshy, fascicled and openly arise from the stem disc. These tubers are 5-20 in quantity, 10-25 cm x 1-2 cm in measurement and cylindrical in shape. These don't possess any fibrous structure. This plant generates a single unbranched aspect that is 15-30cm in length and terete. Plant having flowers on on top of upper ¾ of its actual length. The flowers are commonly small, bracteate, white and pedicellate. They are usually arranged in alternate clusters (having 3 flowers each) that are dense on the upper part of the scape. The bracts are purplish, linear (1.0-1.5 cm long), and papery. The pedicel (6-10 mm long) is whitish, jointed and kneed at the joint. Tepals are usually white and 6 in count. They are arranged in two whorls of three each, with imbricate aestivation. Stamens are also 6 and united to the perianth (arranged in 2 whorls). Filament is ditheous and glabrous. Anthers are yellow and linear. They dehisce by longitudinal slits. Style is a little longer than the stamens and swollen at the apex. The ovary is green and sessile, 3 lobed with axile placentation. Fruit is a mainly capsule, green to yellow in color, triquetrous, almost equal in length and width. Seeds are 14 to 16 in number and are endospermic, generally black coloured, angular. (Khanam *et al.*, 2013) [16]

Phytoconstituents

The Medicinal Plants Board has certified Safed musli as the sixth most precious plant to be conserved as well as protected (Nautiyal *et al.*, 2020) [22]. This owes to the high content of saponins, alkaloids, flavonoids, steroids, triterpenoids, Gallo-tannins, phenolic acids, vitamins, minerals such as potassium, magnesium, calcium, zinc, copper, phosphorous, resins and a abundant quantity of carbohydrates/polysaccharides are all found in *C. borivilianum* (Khanam *et al.*, 2013) [16]. *C. borivilianum* roots are imbued with a high content of glucose (42%), protein (80–89%), fibre (3–4%), and saponin, alkaloids, saponins (2–17%), polysaccharide, and protein. Saponins are found in the tubers, which have aphrodisiac, anti-ageing, adaptogenic, health-restorative and health-promoting qualities along with providing foamy texture to the herb powder (Alam *et al.*, 2016). Saponins in Safed Musli are known to ensure the defense of the plant against microbial or fungal attack (Debnath *et al.*, 2006) [6]. Tandon and Shukla worked on *C. arundinaceum* and discovered tokorogenin, tigogenin, neogitogenin and stigmasterol. Similarly Li *et al.* in 1990 isolated four steroidal saponins termed as chloromaloside A, B, C and D from *C. malayense* rhizome. Around seven anti-tumour steroidal saponins have been isolated from *C. comosum*. *C. arundinaceum* from MP was reported to possess two new saponins, Arundinoside-A and ArundinosideB. Briefly, the two active saponin constituents present in musli are stigmasterol (that shows activities similar to the hormone testosterone) and hecogenin (helps in the synthesis of anabolic hormones, which allows men to build strong muscles) (Garg *et al.*, 2020) [8].

The nutritional value of Safed musli is given in the below table 1 (Khanam *et al.*, 2013) [16].

Table 1: Nutritional value of Safed musli

Nutritional Components	Value (%)
Alkaloids	15-25
Total sugar	66.3
Total proteins	25.4
Glycosides	1.9-3.5
Carbohydrates	35-45
Crude fibre	25-35

Cytology

The implication of cytological studies is very crucial in particular for plants such as *C. borivilianum* as they show tremendous amount of medicinal along with nutritional value (Maiti *et al.*, 2005) [19]. The chromosome number of *C. borivilianum* was initially reported as diploid ($2n=2x=16$). On the other hand, wide-ranging examinations of chromosomes in revealed that the chromosome number in the species is $2n=4x=28$, indicating the species as tetraploid with basic number $x=7$ (Doyle, 1981) [7]. A few somatic cells of some plant showed an octaploid number ($2n=8x=56$). Lavania further confirmed the chromosome number $2n=4x=28$ of *C. borivilianum* (lavania *et al.*, 2005) [17]. Cytological studies in the genus revealed the occurrence of two primary chromosome numbers, $x=7$ and $x=8$. $x=8$ chromosomes are typically diploid species found in semi-arid regions (with relatively smaller and short-lived aerial shoots). $x=7$ chromosomes could be either diploid or possess different levels of ploidy and are widely distributed at higher altitudes with fairly humid and cool atmosphere (Joshi *et al.*, 2006). These are also generally perennial. The chromosome number was $2n=6x=48$ in *C. arundinaceum*, $2n=2x=16$ in *C. tuberosum* and $2n=4x=28$ in *C. elatum* (Thakur *et al.*, 2009) [28]. Hence, safed musli is overall an exceptional plant having massive back-up for medicinal and nutraceuticals.

Micro-propagation

Safed Musli is being haphazardly collected, before it could reach its vegetative regeneration competence and phenological ripeness, owing to the high medicinal value (Huang *et al.*, 2019) [11]. This has resulted in the depletion of its natural source. The constrained distribution and arbitrary over exploitation of it together with stumpy seed set and poor seed germination pace has made it an endangered species. Plant micropropagation is a resourceful method of breeding and propagating disease free, genetically consistent and enormous plants *in vitro* (Jain, 2005) [12]. Therefore, novel propagation techniques can play an imperative role in the hasty multiplication of selected clones and germplasm conservation of *C. borivilianum* (Purohit *et al.*, 1994) [25]. Rapid micropropagation procedure for this endemic remedial plant from a variety of explants in solid media and in liquid media has already been reported in the literature. Crown plate explant leaf base segments, stem disc with shoot meristematic, root tuber in sliced, younger shoot buds, floral buds in immature form & inflorescence axis were used as explants (Nakasha *et al.*, 2016) [21].

Benefits of Safed Musli

Aphrodisiac: Safed musli increases androgen levels from adrenal gland, which improves blood flow to the genitals, boosts spermatogenesis, allows for strong and longer erections and prevent premature ejaculation. Therefore, it is very good aphrodisiac and revitalizer (Nakasha *et al.*, 2016)

[21].

Weight gain: Safed musli acts as a useful dietary supplement that aids in muscular growth by increasing the amount of GH (growth hormone) level among in exercise-trained adults (Alleman *et al.*, 2011) [2].

Hypoglycemic agent

It helps in managing blood sugar levels of the body. It protects the pancreas from damage due to rich amount of antioxidants. Hence it upgrades the insulin levels (Giribabu *et al.*, 2014) [9].

Anti-arthritis

Saponins present in Safed musli have anti-inflammatory/anti-histaminic and anti-arthritis properties that suppress inflammatory mediators such as histamine neurotransmitter and prostaglandins (Nazir *et al.*, 2022).

Galactagogue

Root in powdered form and the safed musli pak are extensively used in breastfeeding mothers to elevated milk lactation quantity (Grover *et al.*, 2021).

Natural tonic for pregnancy and post-partum: It aids in maintaining pregnancy and also acts as a nutritive tonic for mother as well as fetus. In post-partum condition it refill fluids in the body, lost during delivery. (Grover *et al.*, 2021)

Immunomodulator

Safed musli has a noteworthy impact on the body's overall endurance and vigor levels. It helps in scavenging harmful oxygen radicals therefore boosts immunity. It helps in alleviating weakness and weariness. It also improves the working of the emergency adrenal glands thus reducing stress levels (Thakur *et al.*, 2007) [29].

Antacid

It greatly helps in normalising the amplified acid levels in the abdomen thus ensuring relief from indigestion and ulcers. It not only curbs flatulence, bloating and sudden hunger pangs but also prevents constipation (Kaur *et al.*, 2021) [14].

Anti-diarrhoeal

Safed musli possesses excellent antibacterial and anti-diarrhoeal activity. The powder of the root significantly reduces the frequency of passing stools while eliminating toxins from the body (Huang *et al.*, 2019) [11].

Anti-Stress

Because of its adaptogenic properties, safed musli aids in stress management. It also possesses antioxidant properties, which help to reduce free radicals in the body and lessen the risk of oxidative stress-related illnesses. It offers calmness and serenity and helps in relieving anxiety and depression, when taken on regular basis (Sharma *et al.*, 2012) [27].

Anti-Cancer

Certain phytoconstituents in safed musli, for example steroidal glycoside, have anti-cancer actions. It may assist in cellular apoptosis and reduce tumour size and weight, if administered during premature stages of cancer development (Bhat *et al.*, 2018) [3].

Hypolipidemic

The herb was considerably effective in ameliorating the lipid metabolism in hypercholesteremic animals as compared to controls. It is well known that increased HDL-cholesterol levels have a protective role in cardiovascular diseases

(Thakur *et al.*, 2009)^[28].

Analgesic: This activity could be attributed to the steroidal components in the plant. Panda *et al.* have reported the effectiveness of methanolic extract of *C. borivilianum* in treating pain (Mayank *et al.*, 2008)^[20].

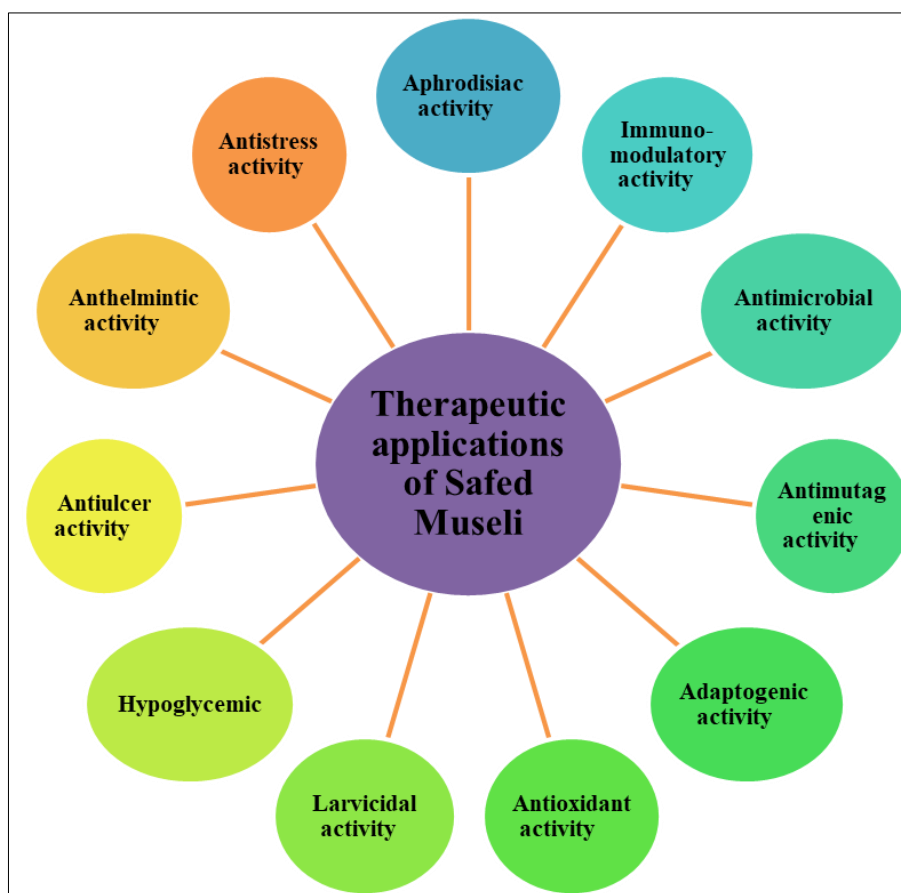


Fig 1: Therapeutical applications of Safed Museli

Conclusion

Hunting for the drugs effective against aging, cancer, diabetes, hyper-lipidemia, hypercholesterolemia, stress etc. and devoid of various adverse effects is the focal point of the research all the way through the world. A number of experiments have been performed so far on the medicinal as well as nutritional importance of *C. borivilianum*. In India Safed Musli is highly considered as a valuable medicinal herb, whereas in other regions of the world it is being used as ornamental plant. The tubers are rich in minerals, alkaloids, proteins, vitamins, carbohydrates, polysaccharides, saponins and steroids of diverse therapeutic importance such as total rejuvenator, Immuno modulator and antioxidant. Hence, it is a best option in the current context which can be taken up as a medicinal and nutritional diet in diverse forms The effort on production of secondary metabolites and their pharmacological studies should be on impetus by the pharmaceuticals and nutraceuticals sectors so that *C. borivilianum* that has established itself as a 'Wonder drugs could play an imperative part in an individual wellbeing.

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