ISSN 2456-3110
Vol 6 · Issue 4
July-Aug 2021

JAiMS
INTERNATIONAL

Journal of Ayurveda and Integrated Medical Sciences

www.jaims.in

JAIMS

An International Journal for Researches in Ayurveda and Allied Sciences

Maharshi Charaka
Ayurveda

Indexed

Journal of
Ayurveda and Integrated Medical Sciences
ISSN 2456-3110
REVIEW ARTICLE July-Aug 2021

Chlorophytum borivilianum (Safed Musli) : Nature's Wonder Gift

Manish Grover

Shuddhi Ayurveda Jeena Sikho Lifecare Pvt. Ltd., Chandigarh, Punjab, India.

ABSTRACT

Chlorophytum Borivilianum is also known as *Safed Musli* that belongs to the *Liliaceae* family. In recent years, this plant has gained much popularity due to its economic value. *Safed Musli* is known for its roots and saponins components that are associated with various medicinal properties. This plant is used in Indian medicinal system since the 11th century AD. In Ayurveda, *Safed Musli* is categorized as a *'Vajikaran Rasayan'* and used to treat various diseases such as leucorrhea, gonorrhoea, impotence, infertility, diarrhoea and dysentery. It is considered a "*Divya Aushad*" or white gold and used as a health-promoting drug or tonic in the ayurvedic medicinal system. *Safed Musli* is used as an alternative to "Viagra". Some reported therapeutic and pharmacological properties of *Safed Musli* include aphrodisiac, immunomodulatory, antimutagenic, antidiabetic, antioxidant, antiulcer, adaptogenic, and antimicrobial. In folklore culture, this plant is used in the form of 'Laddoos' as a diet for mothers after delivery. Due to its high economic value, the Indian Medicinal Board has started promoting this plant's cultivation and production as the demand for this plant has been increased in the national and international markets globally. However, the plant needs to be conserved as this plant has been listed as a critically endangered species as per the Red data book of Indian plants. The factors responsible for the species deterioration are irrational cutting, overharvesting, insufficient knowledge and others. In this review article, the pharmacological properties, phytochemistry, ayurvedic and folk uses of *Safed Musli* are briefly summarized.

Key words: *Safed Musli, Phytochemistry, Folk uses, Ayurveda, Rasapanchak*

INTRODUCTION

Chlorophytum Borivilianum belongs to the family *Liliaceae*. It is the most eminent medicinal plant, which is commonly known as *Safed Musli* (as shown in figure no. 1) or *Dholi Musli*.[1] This plant is used for medicinal purposes for about 4000 years as per the Hindu epic *Srimad Bhagwat.*[2] The plant is well known for its tuberous roots because of bioactive constituents like flavonoids, alkaloids, saponins, phenols, steroids, triterpenoids, vitamins and tannins.[3] This chemical constituent have a specific mode of action in the human body as the intake of this plant improves physical stamina, physical and mental health, improve sexual desire, increases semen volume and keeps the body healthy and energetic.[4] It also helps to cure rheumatoid arthritis, post-menopausal syndrome,[5] diabetes and piles.[6] These root tubers are used in the traditional medicinal system of India since the 11th century to cure a variety of diseases.[7] In the Indian therapeutic system, this plant is considered as a 'white gold' or *'Divya Aushad'*. *Safed Musli* is medicinally used in various medicinal systems such as Ayurveda, *Unani*, allopathic, homoeopathic and *Siddha*.[8] The description of this plant is mentioned in multiple ancient works of literature such as *Rasendra Sarsangrah*, *Bhavaprakash Nighantu*, *Raja Ballabh Nighantu* as *Vajikaran* or special type of immunomodulatory.[9] It is effective against male sexual disorders such as erectile dysfunction, premature ejaculation, infertility and is used as a health tonic.[10] Roots of this plant are used widely in the ayurvedic and Unani medicinal systems for therapeutic purposes.[11,12] It is also reported that

Address for correspondence:
Dr. Manish Grover
Shuddhi Ayurveda Jeena Sikho Lifecare Pvt. Ltd., Chandigarh, Punjab, India.
E-mail: shuddhi.research@jeenasikho.co.in

Submission Date: 13/07/2021 Accepted Date: 15/08/2021

Access this article online

Quick Response Code

Website: www.jaims.in

Published by Maharshi Charaka Ayurveda Organization, Vijayapur, Karnataka (Regd) under the license CC-by-NC-SA

ISSN: 2456-3110 REVIEW ARTICLE July-Aug 2021

Safed Musli is popular in western countries as this plant is considered as an alternative to Viagra and effective in curing chronic leucorrhea, high BP, delayed menopause, arthritis, diabetes.[13] In India, it was first described by *Santapau* and Fernandes in 1954.[14] The new drug named "*Nai Chetna*" was launched by the Gujarat State Forest Development Corporation, India, a *Safed Musli*-based potency drug.[15] The tubers of this plant have a remarkable effect on the Central nervous system. It was also reported that fleshy roots contain the highest amount of saponin content. This plant is promoted and protected by the Medicinal Plant Board of India, as it is recognized as 26th among the top priority medicinal plant because of its high medicinal properties. The Indian government has started promoting its cultivation due to its high economic perspective.[16,17] This plant is also used as a culinary food in India.[18] As per the literature review, the roots of *C. brovilianum* are being used as an aphrodisiac, health-promoting, adaptogen and antiaging agent. Besides this, it is also used in pharmaceutical industries to prepare shampoos, confectionery, soaps, soft drinks, beer and other anti-hemorrhoidal ointments because of high saponin constituents. The saponin components named stigmasterol and hacogenin found in the roots of *Safed Musli* holds significant aphrodisiac property.[19] Table no. 1 &2 represents the vernacular names [20] and taxonomical classification of the *C. borivilianum* plant.

Table 1: Vernacular names

Hindi	*Safed Musli, Hazarmuli, Satmuli*
Sanskrit	*Swetha Musli*
Gujrati	*Dholi Musali, Ujlimusli*
Malyalam	*Shedeveli, Shedheveli*
Marathi	*Safed Musli, Sufed Musli, Kuli*
Tamil	*Tannirvittang, Tannirvittan-Kizhangu, Taniravi Thang, Vipurutti*
Telugu	*Tsallogadda, Swetha Musli*
Garhwali	*Jhirna*
Bhojpuri	*Khairuwa*
English	Indian spider plant, Spider plant, White musale
French	Chlorophytum medicinal
Arabic	Shaqaqule-hindi, Shaqaqule

Table 2: Taxonomical Classification

Taxonomical Rank	Taxon
Kingdom	Plantae
Clade	Angiosperms
Clade	Monocots
Order	Asparagales
Family	Asparagaceae
Sub-family	Agavoideae
Genus	*Chlorophytum*
Species	*C. borivilianum*

Figure 1: *Chlorophytum borivilianum*

Botanical Description

C. borivilianum is a small perennial, branched herb that belongs to the family *Liliaceae* (*Asparagaceae*).[21] It is an annual herb that takes 18 months to mature. It has 6-16 radicals in crown form with length 13-23 cm

ISSN: 2456-3110 REVIEW ARTICLE July-Aug 2021

and width 1-2.5 cm, spirally imbricate at the base, sessile, linear ovate leaves.[22] Roots are cylindrical, greenish-yellow, 8-25 cm long, 5-20 in numbers with 10-25 cm × 1-2 cm in dimensions. Fruits are loculicidal capsulated, triquetrous, containing 3-12 seeds in each fruit that are black, angular in shape and endospermic.[23] Leaves are 13 to 23 cm × 1.75 cm in size, 6 to 13 in numbers, sessile linear or ovate with acute apex. The leaves are spreading, parallel venation, and rough from the lower surface with wavy margins. Flowers are zygomorphic, white, bracteate, pedicellate, small, arranged in alternate clusters, each cluster containing three flowers that are brown to black-skinned, tasteless with a characteristic odour. Floral bracts are linear, purplish, papery with length 1.0-1.5 cm.[24,25]

Geographical Distribution

Safed Musli is a native species of subtropical and tropical Africa and was proposed in India from South Africa in 1954. *Chlorophytum borivilianum* is found across diverse habitats and landscape elements and is mainly cultivated in forest areas worldwide. It is located at a high altitude of up to 1500 meters and distributed in tropical Africa, Australia and America. It is mainly distributed in Western Madhya Pradesh, North Gujarat (Dang forests), Southern Rajasthan, and the subtropical Himalayas from Kumaon, Bengal, Khasia hills, Kokan, Assam, Kanara, West peninsula and Chennai to Kanyakumari.[26] It is also found in the valleys of Himalaya, Satpuda, Aravalli, Vindhya, Haryana, Kolhapur, Pune [27] and Raigad in Maharashtra.[28,29] Sandy loamy soil is best suited for its growth and is usually cultivated from April to May.[30]

Phytochemical constituents

C. borivilianum constitutes various chemical constituents such as alkaloids, saponins, phenolic acids and flavonoids.[31] It also contains triterpenoids, Gallo-tannins, potassium, vitamins, potassium, calcium, magnesium, steroids, a high amount of glucose, fructose, sucrose, xylose and mannose and a small amount of Zn, Cu, P and resins.[32] These chemical constituents are found in different parts of the plant. For example, the roots of this plant contain 2-17% saponin, 20-30% fibers, 8-9% protein and 42% carbohydrates.[33] It was also reported that roots of this plant contain 40-45% polysaccharides, 30% alkaloids and 10-20% saponins.[34] Saponins include furostanol saponin chlorophytoside-I, saponinchloromaloside-A, stigmasterol, hacogenin[35] and spirostanolpentaglycosides embracing beta-dapiofuranose.[36] Other chemical constituents reported in *C. borivilianum* are 11-oxidoheneicosanol, 3-heptadecanone-4-hydroxy-8, pentacosy decasonate, tri-acontanoic acid, tatracosaanicic acid, neogitogenin, trigogenin, benzylglucoside, tokorogenin, methyl pentacosanoate, 8-hexadecanoic acid, stearic and palmitic acid.[37] A new chemical constituent named 1-acetoxychavicol acetate (ACA)was also reported in the roots of *C. borivilianum*.[38,39] The structures of some significant phytochemical constituents of *C. borivilianum* are shown in figure no. 2.

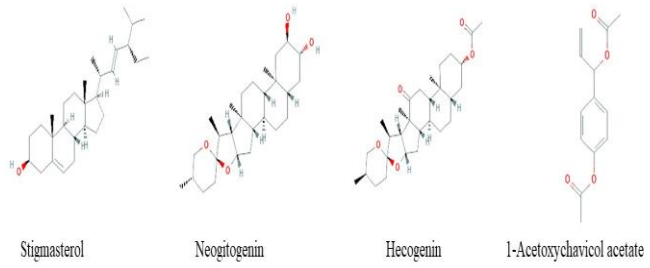

Figure 2: Phytochemical constituents of *Chlorophytum borivilianum*

Traditional and Modern View

Ayurvedic View

C. borivilianum holds an important place in the ayurvedic medicinal system and is a major ingredient in about one hundred ayurvedic formulations prescribed for joint pain, diabetes, diarrhea.[40,41,42] It is considered nature's wonder drug, which is mainly known for its aphrodisiac property. It is used in various immunity strengthening drugs in Ayurveda.[43] The roots of *Safed Musli* are used as a *Vajikaran Rasayana* and the main constituent in *Chyawanprash*.[44] *Rasayana* is a combination of two

ISSN: 2456-3110 REVIEW ARTICLE July-Aug 2021

words where *Rasa* meaning elixir and *'Ayana'* meaning house, which signifies its adaptogenic property.[45] These are mainly used in the Indian traditional culture of Ayurveda to cure male impotence, erectile dysfunction, oligozoospermia and is described as *'Ayurvedic Viagra'* for its aphrodisiac properties.[46,47] *C. borivilianum* is described as *'Divya Aushad'* in *Ayurvedic* literature because of its unique medicinal properties [48]. The roots of this plant are diuretic, aphrodisiac, astringent and are used as a galactagogue, antidiabetic and appetizer.[49,50] This plant is associated with immunomodulatory significance and prevents premature ejaculation.[51] The dried root powder of this plant with warm milk is effective in male sexual disorders. It is also used as a health promoter and blood purifier.[52] The rasapanchak (properties) are shown in table no. 3.

Table 3: *Rasapanchak* (properties) of *Chlorophytum borivilianum*

Sanskrit / Hindi	Sanskrit / Hindi
Veerya / Potency	*Madhura* / Sweet
Vipaka / Metabolic property	*Sheeta* / Cold
Guna / Physical property	Moist, Unctuous
Rasa / Taste	*Katu* / Bitter, *Madhur* / sweet

Actions and Properties

Doshkarma: It alleviates the *Kapha Dosha*, balances the *Vata* and *Pitta Doshas*.

Sansthanik Karma: It increases the sperm count, cures sexual related disorders and acts as an aphrodisiac agent.

Mutravahsansthan: It is used to cure dysuria or urine obstruction and act as a diuretic agent.

Satmikaran: It is a health tonic, used in case of weakness, malnutrition and provides strength.

Folk Uses

The tubers of this plant are utilized as a nutritious meal in the form of chips/ flakes in the USA and England.[53] The tribal people of Western Ghats consume the leaves of *Safed Musli* because of its expectorant property. It is consumed with milk twice a day for the healthcare regime in Gujarat.[54] The root powder is effective in curing rheumatism, joint pain, and throat and mouth ulcers. Traditionally, it is given in Ladoos as a diet to mothers after delivery.[9] The leaves of this plant are utilized in the states of Madhya Pradesh, Chhattisgarh and Gujarat of India as a leafy green vegetable.[13] Roots of *Safed Musli* have been used to cure erectile dysfunction in the Mewar region of India.[55] The dried root powder of the plant is used to cure gonorrhea, leucorrhea, gynecological disorders. It also helps in increasing lactation in both nursing mothers and lactating cows.[55] In Madhya Pradesh, India, traditional practitioners use the leaves of *Safed Musli* in combination with other herbs to delay menopause and make the human body resistant to sex-related disorders.[26] The roots of this plant are used as a substitute for European salad.[56]

Modern View

Due to its unique medicinal properties, *Safed Musli* has a high market value in the national and international markets around the world. The annual foreign demand of this plant has been estimated as 300-700 tones which is a growing issue as this demand cannot be fulfilled by the Indian forests.[57] The high global market leads to adulteration and substitution in the plant species, which ultimately alters the quality of these herbal drugs. It is the most significant drawback considered in the promotion of herbal medicines in India. Other factors responsible for the deterioration of quality and mycotoxin contamination are unscientific and indiscriminate collection, immature extraction of tubers, fruits, rhizomes and uprooting of the whole plant without leaving the seeds for future regeneration.[58] Due to this, several herbal plant species are facing the threat of becoming endangered and extinct. Overexploitation, overharvesting, deforestation and conversion of traditional plant habitat to crop-based agriculture are also the factors that lead to the extinction of species.[59] Poor seed germination and dormancy affects the uniform supply of the *Musli* in the market.[60] Also, due to the confusion in

ISSN: 2456-3110 REVIEW ARTICLE July-Aug 2021

vernacular names, various species of the same genera with different taxa has been sold in the market. As per Red Data Book 2020, *Safed Musli* has fallen into critically endangered species.[61] So, there is an immediate need to formulate some conservative strategies and enhance its abundance as this plant holds high economic and commercial value.[62]

Reported Therapeutic and Pharmacological Properties

Aphrodisiac: As *Safed Musli* is used in Ayurveda medicinal system for its aphrodisiac property as a *Vajikaran Rasayana*, this improves the impotency and cures sexual disorders. This herb is scientifically studied *in vitro* to evaluate its aphrodisiac property in a rat model. The root powder of this plant was orally administered at 125 mg/kg and 250 mg/kg of dosage in Wistar albino rats and observe for the next 3 hours for sexual behavior using receptive females and further for the next 60 days for sperm count.[63] The dosage of 125 mg/kg showed significant aphrodisiac properties on days 1, 7, 14 and 21. A substantial rise in the sperm count was also observed after six months.[64] In another study, the aqueous root extract of the plant exhibits significant aphrodisiac activity against male albino rats by weight gain in the body and reproductive organs.[65] Another study was conducted against streptozotocin-induced diabetic male rats using aqueous root extract at 250 and 500 mg/kg/day of dosage and glibenclamide at 600µg/kg/day for 28 days. A significant increase in the sperm count and caspase-3 level and reduction in abnormal sperm count, viability, percentage of forwarding motility was observed in the diabetic male rats. The clinical study was also conducted on 30 male volunteer's age between 20 to 40 years. The drug was administered in the capsulated form at 500 mg daily for 12 weeks, where a placebo was used as a standard drug. Results showed significant improvement in the serum testosterone level in the majority of volunteers as compared to placebo.[66]

Antimicrobial

The methanolic callus extract of *Safed Musli* was used as a substrate to synthesize silver nanoparticles (AgNPs) to evaluate the antimicrobial activity using different strained bacteria's and pathogenic microbes and cytotoxicity against human colon cancer cells. AgNPs showed significant inhibitory effects against other pathogenic microbes such as *Pseudomonas aeruginosa, Methicillin* - resistant *E. coli, Staphylococcus aureus, Bacillus subtilis* and *Candida albicans.* The cytotoxic effect of AgNPs was also observed against the human colon adenocarcinoma cell line (HT-29) in a dose-dependent manner using MTT assay. In addition, 7% cell viability was monitored by AgNPs at a higher concentration of 500 µg/mL after 24 hours with an IC50 value of 254 µg/mL.[67] In another study, the antimicrobial activity of the callus extract of *Safed Musli* was evaluated using the disc diffusion method against different pathogenic microbes. The extract showed an inhibitory effect against *Bacillus Subtilis B29*, *Candida Albicans*, *Escherichia coli E266, Pseudomonas aeruginosa* and *methicillin*-resistant *Staphylococcus Aureus.*[68]

Furthermore, the crude ethanolic extract of the roots of safed musli was evaluated for the leishmanicidal activity against promastigote form and cytotoxicity against Hela cells at the dosage of 500 and 1000 mg/kg. Results showed that the extract inhibits the growth of promastigotes with an IC50 of 28.25 µg/mL with negligible toxicity. Also, a significant reduction in the parasite load was observed along with active immunomodulation through enhanced Type 1 T helper cells (Th 1) of immune responses and suppressed Th2 type of immune responses.[69]

Immunomodulatory

The in vivo study was carried out on Wistar strain albino rats for humoral response to sheep red blood cells (RBCs) and immunoglobulin-level to determine the role of CBP (polysaccharide fraction) in modulating immune function by using enzyme-linked immunosorbent assay (ELISA). Results showed that the aqueous extract of the plant exhibited notable immunomodulatory activity. In another study, the polysaccharide fraction (CBP) derived from hot water extraction of *C. borivilianum* was examined *in vitro* for its effect on natural killer (NK) cell activity. The

ISSN: 2456-3110 REVIEW ARTICLE July-Aug 2021

extraction of human peripheral blood mononuclear cells (PBMCs) from whole blood on a Ficoll-hypaque density gradient were evaluated in the presence or absence of different concentrations of each *C. borivilianum* fraction for modulation of NK cell cytotoxic activity toward K562 cells. Results showed a remarkable stimulation of NK cell activity due to the CBP of *C. borivilianum*.[70] Another study was conducted on *Labeo rohita* fingerlings to evaluate the effects of *C. borivilianum* polysaccharide (CBP) as a dietary supplement administered at different dosages with basal diet. After feeding, the immune-related gene expressions and immune parameters were measured on the 3rd, 4th and 5th week. A significant upregulation of serum lysozyme and phagocytic activity was observed after the dietary administration of CBP at 0.2% and 0.4% for four weeks. Also, the immune-related genes and iNOS were found to be down regulated ($P<0.05$) in groups with 0.2% and 0.4% CBP supplemented diets at the 4th week.[71]

Adaptogenic

A clinical study was conducted to evaluate the *Chlorophytum borivilianum* (CB) effect on physical performance in random 60 volunteers and placed in two groups. Placebo was taken as the standard drug. The volunteers were administered with *C. borivilium* drug and placebo of two groups at a 3g / day dosage for two months. At 0, 30 and 60 days, they were evaluated for physical stressors (6-min walk test [6MWT]-distance, heart rate, blood pressure, 6 min exercise test [6ETC]-distance, and static workload test [FWT]-systolic BP, diastolic BP and handgrip strength test using Jammar's dynamometer test. Results showed that in the 6MWT CB group, there was a significant increase in the distance, i.e. from day 30 (456± 42.1) today 60 (468.3±0.4) compared with the placebo-treated group. Distance in 6ETC in CB group was more on day 60, i.e., 2.92±0.6 as compared to that of placebo group i.e 2.4±0.6. A fixed workload test (FWT) and DBP in CB treated group was comparatively low, i.e., 75.8±4.4, then the placebo-treated group i.e. 82.4±7.4. It showed that CB increases physical performance, thus validating its adaptogenic activity.[72] Another study was conducted in crossbred cows where CB was administered at a low dosage of 40 mg/kg and a high dose of 80 mg/kg. The study suggested that the dietary supplementation of CB of dosage 80 mg/kg showed more effective results in lowering the stress level.[73]

Antimutagenic and Antioxidant

The methanol extract of *C. borivilianum* seeds was evaluated for antioxidant and antimutagenic activity using various standard *in vitro* assays such as DPPH free radical scavenging assay, deoxyribose degradation, lipid peroxidation, chelating power assay, plate incorporation assay and reducing power assay. The significant antimutagenic activity was shown by methanolic seed extract in both co-incubation and pre-incubation modes in the presence and absence of S9 using plate incorporation assay. Furthermore, high free radical scavenging activity was shown by the methanolic seed extract of the plant in 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay, while moderate inhibitory activity was demonstrated by other antioxidant assays.[74] Another in vitro study stated that the aqueous extract of *C. borivilianum* at a dosage of 125 mg/kg inhibited the level of DPPH free radicals and thiobarbituric acid reactive substances, thus exhibited strong antioxidant potential because of the presence of phenolic compounds.[75]

Antidiabetic

To evaluate the antidiabetic activity of the tubers of *C. borivilianum*, a clinical study was conducted where four groups of individuals were taken, each containing ten individuals (group 1: Nondiabetic control group. Group 2 Nondiabetic control + *C. borivilianum*, group 3: diabetics + *C. borivilianum*, group 4: diabetic + glibenclamide). The root extract of *C. borivilianum* was administered for one month to groups 2, 3 and 4. Results showed that extract-treated groups showed a notable reduction in the blood glucose, cholesterol, LDL, triglyceride level and improvement in HDL cholesterol level.[76] As per another study, the oral administration of aqueous root extract of *C. borivilianum* at a dosage of 250 mg/kg and 500 mg/kg showed antidiabetic activity in streptozotocin-induced hyperglycaemic rats by reducing the blood glucose

ISSN: 2456-3110 REVIEW ARTICLE July-Aug 2021

level from 285.56 to 206.82 mg/dl.[77] In another study, intake of aqueous root extract inhibited the increase in lipid peroxidation and a significant reduction in the levels of catalase (CAT), superoxide dismutase (SOD) and glutathione peroxidase (GPx) in diabetic rats.[78,79]

Antiulcer

The alcoholic root extract of *C. borivilianum* was evaluated for antiulcer activity. The significant antiulcer activity was exhibited by 50% alcoholic extract against ethanol-induced Pylorus ligation-induced gastric ulcers in Sprague-Dawley rats at the dosage of 100 mg/kg where omeprazole was used as a standard drug.[80]

Conclusion

Medicinal plants are the source of various bioactive components. *Chlorophytum Borivilianum* is a multi-therapeutic and multi-nutritional plant which is well known for its roots. The saponin components present in the plant parts are associated with various medicinal properties such as anti-ageing, adaptogenic, aphrodisiac, antimutagenic etc. This plant is considered a precious gift of nature in the ayurvedic therapeutic system and is used in numerous ayurvedic formulations. *Safed Musli* is used primarily for its aphrodisiac and immunomodulatory property. In Ayurveda, this plant is considered a 'White Gold' or *'Divya Aushad'* and used to cure diseases like impotence, diarrhoea, dysentery, leucorrhea, infertility, erectile dysfunctioning, libido and other disorders.

Moreover, the plant needs to be explored more in research to identify its more pharmacological activities. Besides this, *Safed Musli* holds a significant economic value and is used as a health-promoting drug. However, overexploitation, deforestation, low productivity, insufficient knowledge of its production are factors responsible for the species counted in the Red data book as critically endangered species. Therefore, conservative strategies and some innovative plans should be aligned to protect the species from becoming endangered.

Acknowledgement

The author would like to express special thanks to Dr. Bhawna for their guidance and support in completing this review paper.

References

1. Puri HS. Rasayana: Ayurvedic Herbs for Longevity and Rejuvenation: Volume 2 of Traditional Herbal Medicines for Modern Times.2004;9(2):331-332.
2. Kumari I, Chaudhary G, Kaurav H. Folkloric Significance of Anti-urolithic Plant CrataevanurvalaBuch Ham (Varuna). 2021;3(11)
3. Nakasha JJ, Sinniah UR, Puteh AB, Kumara Swamy M. Influence of tuber weight and cutting on growth and yield of safed musli (Chlorophytum borivilianum). Archives of Agronomy and Soil Science. 2017 Apr 16;63(5):619-25.
4. Thakur M, Loeppert R, Praznik W, Dixit VK. Effect of some ayurvedic vajikaran rasayana herbs on heat induced testicular damage in male albino rats. Journal of Complementary and Integrative Medicine. 2008 May 5;5(1).
5. Deore SL, Khadabadi SS. Larvicidal activity of the saponin fractions of Chlorophytum borivilianum santapau and Fernandes. Journal of Entomology and Nematology. 2009 Nov 30;1(5):064-6.
6. Nikam V, Chavan P. Influence of water deficit and waterlogging on the mineral status of a medicinal plant Chlorophytum borivilianum. Acta Botanica Hungarica. 2009 Mar 1;51(1-2):105-13.
7. Kirtikar KR. Liliaceae: Chlorophytum. Indian medicinal plants, LM. Basu Publishers, Allahabad, 1975:2508-2509.
8. Sharma SK, Chunekar KC, Paudal K. Plants of Sharangdhar Samhita. National Academy of Ayurveda. 1999;1:289.
9. Thakur GS, Bag M, Sanodiya BS, Debnath M, Zacharia A, Bhadauriya P, Prasad GB, Bisen PS. Chlorophytum borivilianum: a white gold for biopharmaceuticals and neutraceuticals. Current Pharmaceutical Biotechnology. 2009 Nov 1;10(7):650-66.
10. Choudhary s, kaurav h, chaudhary g. Gokhru (tribulus terrestris and pedalium murex): medicinal importance of chota gokhru and bada gokhru in ayurveda and modern science. Asian Journal of Pharmaceutical and Clinical Research. 2021 Apr 13:6-13.
11. Oudhia, P. and Tripathi, R.S. Proceedings National Conference on Health care and Development of Herbal Medicines. Indira Gandhi Agricultural University: Raipur, India, 1999: 71-78.
12. Khanam Z, Singh O, Singh R, Bhat IU. Safed musli (Chlorophytum borivilianum): A review of its botany,

ethnopharmacology and phytochemistry. Journal of Ethnopharmacology. 2013 Nov 25;150(2):421-41.

13. Maiti S, Geetha KA. Characterization, genetic improvement and cultivation of Chlorophytum borivilianum—an important medicinal plant of India. Plant Genetic Resources. 2005 Aug;3(2):264-72.
14. The Indian Express, 1st December, 1999.
15. Kalra S, Puniya BL, Kulshreshtha D, Kumar S, Kaur J, Ramachandran S, Singh K. De novo transcriptome sequencing reveals important molecular networks and metabolic pathways of the plant, Chlorophytum borivilianum. PLoS One. 2013 Dec 23;8(12):e83336.
16. Kalra S, Kumar S, Singh K. Molecular analysis of squalene epoxidase gene from Chlorophytum borivilianum (Sant. and Fernand.). Journal of Plant Biochemistry and Biotechnology. 2015 Oct;24(4):417-24.
17. Thakur S, Kaurav H, Chaudhary G, A review on Woodfordia fruticose Kurz (Dhatki): Ayurvedic, Folk and Modern Uses, Journal of Drug Delivery and Therapeutics.2021;11(3):126-131.
18. Kumari I, Kaurav H, Chaudhary G. Ethnobotanical significance of picrorhiza kurroa (kutki), a threatened species. International Journal of Research and Review. 2021;8(3):363-75.
19. Tapre V, Deshmukh S, Muradi B, Deshmukh A, Pawar A, Rathod D. Performance of safed musli (Chlorophytum borivilianum L) under different intercropping systems. Journal of Pharmacognosy and Phytochemistry. 2021;10(1):787-9.
20. Singh D, Pokhriyal B, Joshi Y, Kadam V. Phytopharmacological aspects of Chlorophytum borivilianum (Safed Musli): a review. International journal of research in pharmacy and chemistry. 2012;2(3):853-9.
21. Kaur g. a review on cultivation and phytopharmacological aspects of chlorophytum borivilianum, Ann Trop Med & Public Health. 2020;23(17):SP232021.
22. Mandal GD, Nandi AK. Morphological and anatomical circumscription for the identification of two source plants of aphrodisiac medicine Chlorophytum borivilianum Santapau & Fernandes and Chlorophytum tuberosum (Roxb.) Baker. International Journal of Medicinal and Aromatic Plants. 2012;2(3):406-10.
23. Paturde JT, Wanklade SG, Dipali D, Khode PP. Safed musli an important medicinal plant. Indian Farming. 2000;49:8-9.
24. Singh A, Khanuja SP, Srivastava NK, Bahl JR, Darokar MP, Shashney AK, Singh M, Pandey R, Singh UB. Development of cultivation practices of safed musli (Chlorophytum borivilianum) for sub tropical north India. Journal of Tropical Medicinal Plants. 2004:44-9.
25. Kumari I, Kaurav H, Choudhary G. Bauhinia variegate (Kanchnara), An ornamental Plant with significant value in Ayurvedic and Folk Medicinal system. Himalayan Journal of Health Sciences. 2021 Jun 6:1-6.
26. Manjunatha G, Tyagi SK, Srinivasan K. Safed musli: a white gold. Agrobios (India); 2004:12-14.
27. Verma R, Misra V, Bisen PS. Nutritional and Medicinal Values of Chlorophytum borivilianum: Minireview of Current Status and Future Possibilities. Current Nutrition & Food Science. 2020 Dec 1;16(9):1338-45.
28. Acharya D, Mitaine-Offer AC, Kaushik N, Miyamoto T, Paululat T, Lacaille-Dubois MA. Steroidal saponins from the roots of Chlorophytum borivilianum. Planta Medica. 2008 Jul;74(09):PB23.
29. Gore YD, Wankhade SG, Wanjari SS, Patke NK, Konde NM. Effect of safed musli+ pigeonpea intercropping system on root quality of safed musli. Int. J. Curr. Microbiol. App. Sci. 2018;7(04):1862-5.
30. Vijaya K, Chavan P. Chlorophytum borivilianum (Safed musli): a review. Pharmacognosy Reviews. 2009;3(5):154.
31. Visavadiya NP, Soni B, Dalwadi N, Madamwar D. Chlorophytum borivilianum as potential terminator of free radicals in various in vitro oxidation systems. Drug and Chemical Toxicology. 2010 Apr 1;33(2):173-82.
32. Thakur M, Dixit VK. Fructan; The polymer with unexplored potential. Ind. Pharm. 2005;4(40):7-12.
33. Bordia PC, Joshi A, Simlot MM. Safed Musli In: Advances in Horticulture. Vol 11: medicinal and aromatic plants (Chadha KL and Gupta R eds). 1995:429-51.
34. Giri SS, Sen SS, Chi C, Kim HJ, Yun S, Park SC, Sukumaran V. Chlorophytum borivilianum polysaccharide fraction provokes the immune function and disease resistance of Labeo rohita against Aeromonas hydrophila. Journal of immunology research. 2015 Nov 15;2015.
35. Tandon M, Shukla YN, Thakur RS. 4-hydroxy-8, 11-oxidoheneicosanol and other constituents from Chlorophytum arundinaceum roots. Phytochemistry. 1992 Jul 1;31(7):2525-6.
36. Idris SN, Ahmed AB, Taha RM. Sucrose enhanced stigmasterol production in callus cultures of Wedelia biflora (L.) DC. Philippine Agricultural Scientist. 2018 Sep 1;101(3):251-60.
37. Mimaki Y, Kammoto T and Sashida Y. Steroidal saponins from the underground parts of Chlorophytum and their inhibitory activity on tumor promoter-induced phospholipids metabolism of Hela cells. Phytochemistry. 1996;41:1405-10.
38. Sharma VK, Mazumdar B. Versatility of Safed musali (Indian Viagra) in Human Ailments. Proteins. 2012;8:8-5.

39. Chua B, Abdullah Z, Pin KY, Abdullah LC, Choong TS, Yusof UK. Isolation, structure elucidation, identification and quantitative analysis of 1'-acetoxychavicol (ACA) from the roots of chlorophytum boriviliuanum (SAFED MUSLI). Journal of Engineering Science and Technology. 2017 Jan 1;12(1):198-213.

40. Paques M, Boxus P. A model to learn" vitrification", the rootstock apple M. 26 present results. InSymposium on In Vitro Problems Related to Mass Propagation of Horticultural Plants 212 1985:193-210.

41. Kaurav H, Choudhary S, Chaudhary G. Bryonia Laciniosa An Ayurvedic Herbal Plant 'Bryonia laciniosa'with its Ethnomedicinal Significance. Journal of Drug Delivery and Therapeutics. 2021 Jun 14;11(3-S):137-41.

42. Oudhia P. My experiences with wonder crop Safed Musli. Insovenier. International seminar on medicinal plants& quality standardization VHERDS, Chennai, India 2001 Jun (pp. 9-10).

43. Govindarajan R, Vijayakumar M, Pushpangadan P. Antioxidant approach to disease management and the role of 'Rasayana'herbs of Ayurveda. Journal of ethnopharmacology. 2005 Jun 3;99(2):165-78.

44. Triveni A. Rasendrasarasangrah: Vajikaranadhikar. Rajkot, India. Nutan Press. 1977:617-43.

45. Thakur S, Kaurav H, Chaudhary G. Terminalia arjuna: A Potential Ayurvedic Cardio Tonic. International Journal for Research in Applied Sciences and Biotechnology. 2021 Apr 16;8(2):227-36.

46. Govindarajan R, Sreevidya N, Vijayakumar M, Thakur M, Dixit VK, Mehrotra S, Pushpangadan P. In vitro antioxidant activity of ethanolic extract of Chlorophytum borivilianum. Natural product sciences. 2005;11(3):165-9.

47. Chauhan NS, Sharma V, Dixit VK, Thakur M. A review on plants used for improvement of sexual performance and virility. BioMed research international. 2014 Aug 18;2014.

48. Dutta S, Sengupta P. Medicinal herbs in the management of male infertility. Journal of Pregnancy and Reproduction. 2018;2(1):1-6.

49. Sharma P, Chandrul KK. Chlorophytum borivilianum (Safed musli): a vital herbal drug. Int J Pharm Med Res. 2017 Feb 15;5(1):401-11.

50. Chetty KM, Rao KN. Ethnobotany of Sarakallu and adjacent areas of Chittoor district, Andhra Pradesh. Vegetos 2: 51. 1989;58.

51. Bhandary MJ, Chandrashekar KR, Kaveriappa KM. Medical ethnobotany of the siddis of Uttara Kannada district, Karnataka, India. Journal of ethnopharmacology. 1995 Jul 28;47(3):149-58.

52. Choudhary s, kaurav h, chaudhary g. Wheatgrass (triticum aestivum linn.): a potential substitute of human blood in traditional system of medicine. Asian Journal of Pharmaceutical and Clinical Research. 2021 Apr 26:43-7.

53. Hunshal CS. *Response of safed musli (Chlorophytum borivilianum) to NPK, FYM and mulching in north-east transitional zone of Karnataka* (Doctoral dissertation, UAS, Dharwad).2008

54. Sebastian MK, Bhandari MM. Medicinal plant lore of Udaipur district, Rajasthan. Bull Med Ethnobot Res. 1984;5:122-34.

55. Deshwal RK, Trivedi P. Effect of kinetin on enhancement of tuberous root production of Chlorophytum borivilianum. International Journal of Innovations in Biological and Chemical Sciences. 2011;1:28-31.

56. Goyal RK, Singh PK, Goyal SK. Satavar and safed musli-ingredients for herbal food: an appraisal. J Nutr Health Food Eng. 2018;8(3):253-8.

57. Bordia PC, Joshi A, Simlot MM. Safed musli In: KL Chadha and R. Gupta ed. Advances in Horticulture Vol. 11-Medicinal and Aromatic Plants.1995:429-449.

58. Singh P, Singh S. Cultivation of safed musli: A medicinal cash crop. Intensive Agriculture. 2007;45(1):31-3.

59. Dubey NK, Kumar A, Singh P, Shukla R. Microbial contamination of raw materials: A major reason for the decline of India's share in the global herbal market. Current Science (00113891). 2008;95(6):717-18.

60. Mishra M. Harvesting practices and management of two critically endangered medicinal plants in the natural forests of central India. Harvesting of Non wood Forest Products. Publ. FAO-ECE-ILO, Menemen-Izmir, Turkey. 2000 Oct 2:335-41.

61. Chavan PD. Chlorophytum borivilianum (Safed musli): A Review. Pharmacognosy Reviews. 2009;3(5):154-169.

62. Choudhary S, Chaudhary G. Sandalwood (Santalum Album): Ancient tree with significant medicinal benefits. International Journal of Ayurveda and Pharma Research. 2021 Jun 1:90-9.

63. Ray S, Chatterjee K, De D, Ghosh D. Bioefficacy of hydromethanolic extract of tuber of C hlorophytum borivilianum (Safed Musli) for the management of male infertility in cyproterone acetate-treated albino rats. Andrologia. 2014 Aug;46(6):659-71.

64. Kumar A, Gadhwal N. Traditional Herbal Medicines and their Fertility Potential: A Review. Journal of Complementary and Alternative Medical Research. 2020 Nov 9:24-32.

65. Das S, Singhal S, Kumar N, Rao CM, Sumalatha S, Dave J, Dave R, Nandakumar K. Standardised extract of safed musli (Chlorophytum borivilianum) increases aphrodisiac potential

ISSN: 2456-3110 **REVIEW ARTICLE** July-Aug 2021

besides being safe in male Wistar rats. Andrologia. 2016 Dec;48(10):1236-43.

66. Giribabu N, Kumar KE, Rekha SS, Muniandy S, Salleh N. Chlorophytum borivilianum (Safed Musli) root extract prevents impairment in characteristics and elevation of oxidative stress in sperm of streptozotocin-induced adult male diabetic Wistar rats. BMC complementary and alternative medicine. 2014 Dec;14(1):1-6.
67. Rath SK, Panja AK. Clinical evaluation of root tubers of Shweta Musali (Chlorophytum borivilianum L.) and its effect on semen and testosterone. Ayu. 2013 Jul;34(3):273.
68. Huang F, Long Y, Liang Q, Purushotham B, Swamy MK, Duan Y. Safed Musli (Chlorophytum borivilianum L.) callus-mediated biosynthesis of silver nanoparticles and evaluation of their antimicrobial activity and cytotoxicity against human colon cancer cells. Journal of Nanomaterials. 2019 Feb 13;2019.
69. Charl RK. Antimicrobial activity of safed musli (chlorophytum borivilianum l.) Callus extract and gc-ms based chemical profiling ravinder kaur charl, mallappa kumara swamy and uma rani sinniah. 2017;46(1):305-310.
70. Kaur R, Kaur S. Protective efficacy of Chlorophytum borivilianum root extract against murine visceral leishmaniasis by immunomodulating the host responses. Journal of Ayurveda and integrative medicine. 2020 Jan 1;11(1):53-61.
71. Thakur M, Connellan P, Deseo MA, Morris C, Dixit VK. Immunomodulatory polysaccharide from Chlorophytum borivilianum roots. Evidence-based complementary and alternative medicine. 2011 Jan 1;2011.
72. Giri SS, Sen SS, Chi C, Kim HJ, Yun S, Park SC, Sukumaran V. Chlorophytum borivilianum polysaccharide fraction provokes the immune function and disease resistance of Labeo rohita against Aeromonas hydrophila. Journal of immunology research. 2015 Nov 15;2015.
73. Tripathi RK, Dethe PD, Bhojne SK, Raut AA, Rege NN. A prospective, randomized, placebo-controlled, double-blind comparative pilot study to evaluate the efficacy of Chlorophytum borivilianum on physical performance. Indian journal of pharmacology. 2019 May;51(3):150.
74. Devi P, Singh M, Somagond YM, Aggarwal A. Alleviation of heat stress by Chlorophytum borivilianum: impact on stress markers, antioxidant, and immune status in crossbred cows. Tropical Animal Health and Production. 2021 Jul;53(3):1-0.
75. Gill RK, Arora S, Thukral AK. Evaluation of protective effects (antioxidant and antimutagenic) of methanol extract of seeds of Chlorophytum borivilianum Sant. et Fernand. Journal of Pharmacognosy and Phytochemistry. 2015;3(5):167-72.
76. Kenjale RD, Shah RK, Sathaye SS. Anti-stress and anti-oxidant effects of roots of Chlorophytum borivilianum (Santa Pau & Fernandes).2007;45:974-79.
77. Gayathri P, Saroja S. PA03. 14. Antidiabetic and antioxidant potential of Chlorophytum borivillianum (Safed musli) in type 2 diabetics. Ancient Science of Life. 2013 Jan;32(Suppl 2):S83.
78. Mujeeb M, Khan SA, Ali M, Mall A, Ahmad A. Antidiabetic activity of the aqueous extract of Chlorophytum borivilianum L. in streptozotocin induced-hyperglycemic rats: a preliminary study. J Pharm Res. 2009 Jan;2(1):5-3.
79. Giribabu N, Kumar KE, Rekha SS, Muniandy S, Salleh N. Chlorophytum borivilianum (Safed Musli) root extract prevents impairment in characteristics and elevation of oxidative stress in sperm of streptozotocin-induced adult male diabetic Wistar rats. BMC complementary and alternative medicine. 2014 Dec;14(1):1-6.
80. Rachchh MA, Shah MB, Santani DD, Goswami SS. Study of Chlorophytum arundinaceum. Against Experimental Gastric Ulcer. Pharmaceutical biology. 2005 Jan 1;42(8):592-8.

How to cite this article: Manish Grover. Chlorophytum borivilianum (Safed Musli) : Nature's Wonder Gift. J Ayurveda Integr Med Sci 2021;4:93-102.

Source of Support: Nil, **Conflict of Interest:** None declared.

****