



Phytochemical, Pharmacological and Nutritional Profile of *Chlorophytum tuberosum* (Roxb.) Baker (Safed musli): a Review

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(Received 12 November, 2017 accepted 15 December, 2017)

(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: *Chlorophytum tuberosum* commonly known as Safed Musli belongs to the family Asparagaceae. This species possesses potential medicinal uses in traditional herbal medicine mainly in India for treating various ailments like diabetes, diarrhoea, cholera, leucorrhoea, kidney stones, sexual disorders, general debility etc. Phytochemical investigations of this plant species revealed the presence of varied contents of bioactive compounds such as saponins, tannins, glycosides, alkaloids, flavonoids, phenolics, triterpenes, triterpenoids, gallotannins. The pharmacological screening of this species have exhibited broad range of properties such as aphrodisiac, antimicrobial, antioxidant, hepatoprotective, galactagogue, antidiabetic, adaptogenic activities and as tonic. Tribal people in some Indian states like Gujarat and Madhya Pradesh also use the leaves and tubers of this species as vegetable. However, further experiments on chemical constituents and their mode of action showing various biological activities are necessary to reveal the entire phytochemical profile of this plant and confirm its suitability for future drugs. This review emphasizes on phytochemistry, ethnopharmacology, pharmacology, and nutritional aspects of *C. tuberosum*.

Key words: Asparagaceae; aphrodisiac; immunomodulatory; *Chlorophytum tuberosum*, tonic

I. INTRODUCTION

Chlorophytum tuberosum (Roxb.) Baker (Asparagaceae) is one of the prominent species used in Ayurveda, the traditional system of medicine mostly found in areas with high rainfall along the grass covered slopes, forest margins and rocky regions [1]. It is an erect plant growing up to a height of 1.5–2 ft with sheathing leaf base and tuberous roots [2]. These tubers are medicinally important. It is commonly known as *Safed musli*. It possesses aphrodisiac, galactagogue [3-5], nutritive, immunobooster, antioxidant and hepatoprotective properties [6-9]. The tubers are also used to cure fever and leucorrhoea. It is used as tonic. The roots and leaves of *C. tuberosum* are used for the treatment of diabetes. Dried bulbs and leaves are crushed to be used as flour for making bread. The plant is rich in sugars, proteins, starch, ascorbic acid, saponins, phenolics and amino acids (alanine, leucine, valine, proline and glutamic acid) [10]. Scanty literature is available on chemistry and pharmacology of *C. tuberosum*, used traditionally both as food and medicine. Hence an attempt has been made to document the phytochemical, pharmacological and nutritional profile of *C. tuberosum* to observe the research gaps for future investigations.

II. VERNACULAR NAMES

Chlorophytum tuberosum is known with different names depending upon the languages spoken in a

particular region. The names used in different languages are presented as under:

English : Edible Chlorophytum
Gujarati : Ujlimusli, Sufed or Safeta Musli, Dholi musali
Hindi : Safed Musli, Sufed or Safeta Musli, Hazarmuli, Satmuli
Kannada : Dravanti
Malayalam : Shedeveli
Marathi : Safed Musli, Sufed or Safeta Musli, Kuli
Sanskrit : Sveta Musli, Durnamaari, Maharrusha, Vrushya Kanda
Tamil : Tannirvittang, Tannirvittan-Kizhangu, Tiravanticam, Vipurutti
Telugu : Tsallogadda, Kuchhela, Sarala Pagada
Urdu : Shaaqale

III. MORPHOLOGICAL DESCRIPTION

Chlorophytum tuberosum is a herb that grows up to a height of 20–50 cm (Fig. 1) with underground small rhizome surrounded by fibres. The swollen roots having dark tubers of length up to 7 cm are present on rhizome at their tips. The leaves (10-50 cm) are linear-lanceolate, borne in a rosette. Inflorescence is a simple raceme having two flowers usually at each node. The flowers are usually large, white, showy and good scented with no differentiation between the sepals and petals (Tepals). *Chlorophytum tuberosum* is the only species within the genus *Chlorophytum* which has 10–14-veined tepals.

Stamens are shorter than tepals and style is about 10 mm in length. Flowering occurs in the month of August and early September [11]. Fruits (Capsule) are oblong-ovoid in shape containing seeds of 2 mm diameter.



Fig. 1. *Chlorophytum tuberosum* plant.

III. GEOGRAPHICAL DISTRIBUTION

The plant is widely distributed from Nigeria to eastern tropical Africa. It is found in Kenya, Tanzania, Uganda, Chad, Ethiopia, Somalia, Sudan, Nigeria, Cameroon, Central African Republic, India, Nepal, Sri Lanka and Myanmar. In India it is distributed in the subtropical Himalayas from Kumaon eastwards, the Khasia hills, Bengal, Assam, West peninsula and Madras extending to Kanyakumari [11]. It normally grows up to altitude of 1,700 m (asl). In India, Safed musli is also found in mixed forests.

IV. PHYTOCHEMISTRY

Qualitative phytochemical analysis shows that *Chlorophytum tuberosum* contains a wide range of bioactive compounds. The most important class of phytochemicals of this plant are saponins (sitosterol, stigmasterol etc.) which have been reported in its tubers [12] (Fig. 2a, 2b).

Studies indicated that it contains steroids, proteins,

phenolics, sugars, triterpenoids, gallotannins. Hexane extract gave positive results for the presence of sterols while as, chloroform extract gave confirmation for the presence of triterpenes, triterpenoids and saponins. Sugars, saponins, fructans and phenolics have been found present in aqueous alcohol extract. Various amino acids namely aniline, valine, proline, leucine, arginine and glutamic acid were found present. The percentage of individual amino acids revealed that arginine was found to be in maximum concentration [10]. Phytochemical analysis of tubers for phenolic estimation showed 4.69 ± 0.1 (mg/g) total phenolic content [13]. Preliminary analysis of its root revealed the presence of proteins, reducing and non-reducing sugars, fats, saponins, tannins, alkaloids and glycosides [14-16]. The proteins were found to be present in higher quantity than carbohydrates and saponins. High Performance-Thin Layer Chromatography (HPTLC) studies carried out on root samples revealed that the saponins gave yellow bands in visible light and blue bands after derivatization (in fluorescence light) while as stigmasteroids gave white bands in visible light [15]. The tubers have been reported to contain 35-42% carbohydrates, 8-8.5% proteins and 4-7% saponins [12]. Comprehensive investigation of total phenol, flavonoid and saponin content of *Chlorophytum tuberosum* tubers showed 93.5 total phenolic content (mg GAE/g extract), 104.3 total flavonoid content (mg Quercetin/g extract) and 4.76% total saponin content [17]. A new Bis-isoflavonoid glycoside characterized as Bis (8-methyl-4'-methoxy-7-O- β -L-rhamnopyranoside) I-5, II-5 Bis isoflavone have been isolated from the roots of this plant (Fig. 2c). The structure of this newly isolated compound has been determined by using spectroscopic techniques like IR, UV, ^1H NMR, 2D NMR, ^{13}C NMR and FABMS [18].

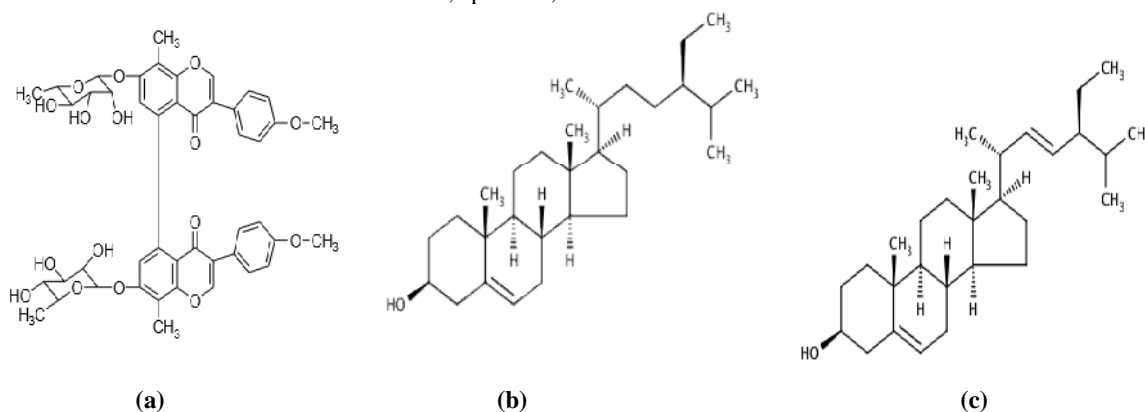


Fig. 2. Chemical compounds of *C. tuberosum*: (a) 4'-Methoxy 8 Methyl 7-O- β -L Rhamnopyranoside bis Isoflavone, (b) Sitosterol (c) Stigmasterol.

V. PHARMACOLOGY

Roots and tubers of *Chlorophytum tuberosum* are highly useful owing to its medicinal and pharmaceutical properties. The plant has been reported to have aphrodisiac, antioxidant, anticancer, adaptogenic, antidiabetic, antimicrobial, hepatoprotective and immunomodulatory properties. Numerous phytoconstituents are present in this plant species which are responsible for its use for the treatment of various ailments.

A. Antioxidant activity

Oxidative reactions are very critical for the normal body functioning but can also be destructive for fundamental cells as well in absence of antioxidants. Vitamin A, vitamin C and vitamin E and various enzymes such as glutathione, catalase, superoxide dismutase, peroxidase etc., are the examples of natural antioxidants which help us to fight against oxidative damage. Higher consumption of antioxidant-rich foods has been shown to be allied with reduction in risk of diseases and decreases morbidity and mortality [19]. In the reducing capacity assay as well as DPPH radical scavenging activity ethanolic extract of the dried roots showed much promising effects than all other test samples [20]. Inulin type fructans (Polysaccharide) were found to possess immunomodulatory activity with IC₅₀ values being 225.31, 888.44, 809.22 and 422.97 µg/ml for scavenging of DPPH, nitric oxide, lipid

peroxidation and ferric bi-pyridyl complex, respectively, along with a integral antioxidant activity of 2.986 nmol ascorbic acid/g equivalents in photochemiluminescence assay [21]. Antioxidant potential of this plant has been screened for its potential to scavenge DPPH, nitric oxide radical along with their capacity to reduce lipid peroxidation in rat liver homogenate. The studies showed that the plant extract scavenged the DPPH radical in a dose dependent mode (IC₅₀ value= 225.31 g/ml) with moderate lipid peroxidation scavenging property (IC₅₀= 809.22 g/ml) in rat liver homogenate. The total antioxidant potential of the extract was observed to be 187.91 nmol ascorbic acid giving the confirmation of the antioxidant potential of the extract [10]. Bajpai *et al* calculated the total phenolic content (TPC) and antioxidant activity (AOA) of tubers of this plant species and found that the antioxidant activity as 52.0 % [13].

B. Antimicrobial activity

Ethyl acetate and alcoholic extracts of *Asparagus racemosus*, *Chlorophytum tuberosum*, *Hemidesmus indicus*, *Withania somnifera* had shown significant antimicrobial activity as compared to the standard antibiotics. The new isolated bisoflavanoid [Bis (8-methyl-4'-methoxy-7-O- -L-rhamnopyranoside) I-5, II-5 Bis isoflavone] of *Chlorophytum tuberosum* was found to possess considerable antimicrobial activity (Table 1 and 2) [18].

Table 1: Antibacterial Activity [18].

S. No.	Test Bacteria	Diameter of inhibition (mm)	Control*
1	<i>E. coli</i> at 250 µg/disc	12	18
2	<i>B. subtilis</i> at 250 µg/disc	14	24

*Streptomycin against Gram⁺ and Gram⁻ bacteria

Table 2: Antifungal Activity [18].

S. No.	Test Fungi	Diameter of inhibition (mm)	Control*
1	<i>Rhizopus stolonifer</i>	8	17
2	<i>Aspergillus niger</i>	7	15
3	<i>Penicillium expansum</i>	5	11

* naphthol (20.0 ppm)

Aqueous extract of leaves of eight *Chlorophytum* species screened for antimicrobial activity using agar diffusion method against bacteria *E. coli*, *S. aureus*, *P. vulgaris*, *B. subtilis* and fungi *A. niger*, *C. albicans* showed outstanding antimicrobial activity of *C. tuberosum* leaf extracts against bacteria and fungi tested [14].

C. Anticancer activity

Saponins are a group of naturally derived compounds, which have showed considerable cytotoxic activity. So, various researchers made their efforts to evaluate possible anticancer effect of saponins of different plant

species. One such effort was made on evaluating the possible effect of various *Chlorophytum* species on leukemia cell lines [16]. *In vitro* anticancer action of methanolic extract and saponins of *C. borivilianum*, *C. comosum*, *C. tuberosum*, *C. laxum* and unidentified *Chlorophytum* species was studied (SRB assay method) on HL60 leukemia cell line. Result showed that methanolic extract of *C. comosum* inhibited the growth of HL 60 cells to certain extent. Other species extracts and fractions do not possess anticancer potential against leukemia, but may act as anticancer agents against other cancer types.

D. Immunomodulatory activity

During early times, a large number of plants were used to cure human ailments due to the presence of immunomodulatory potential. The use of traditional plants has been reported in Ayurveda and other traditional medicine systems for immunostimulatory activities [16-27]. Inulin type fructans rich extract of *Chlorophytum tuberosum* was found to possess strong immunomodulatory activity with IC₅₀ values being 225.31, 888.44, 809.22 and 422.97 g/ml for scavenging of DPPH, nitric oxide, lipid peroxidation and ferric thiocyanate complex, respectively [21].

VI. *Chlorophytum Tuberosum* AS A TABLET BINDER

Plants act as source of binder for tablet formulation in Pharmaceutical Industries worldwide. A preliminary study has been carried out for establishing powdered tubers of *Chlorophytum tuberosum* as a tablet binder. Tablets prepared by wet granulation method using Paracetamol as a drug, Bentonite as a diluent and 3.5% talc as a glidant and concentration of 0.25% (w/w), 0.5% (w/w), 0.75% (w/w) and 1% (w/w) of the tablet binder introduced in different formulations revealed good results. The physicochemical parameters such as thickness, friability, hardness weight etc. of the tablets prepared with different concentrations of tuberous material showed better results as compared with the already prepared tablets using 5% starch (paste) as standard binder. The presence of carbohydrates in tubers helps this plant to act as a binding agent with best results at 0.5% concentration or above. This indicated that the tubers of this plant can be used as a tablet binder in minute concentration for tablet formulation in pharmaceutical industries [28].

VII. NUTRITIONAL PROFILE

Since the time immemorial edible wild plants have played a very important role in supplementing the diet of the people. The dependence on these food plants has now gradually declined. But many people in rural and tribal areas still rely on these plants for supplementing their food. Besides their traditional use of food, potentially they have many more importance. They are having good nutritional value providing proteins, carbohydrates etc. and many other minerals like sodium, magnesium, potassium, calcium, iron, phosphorus etc. Tubers of *Chlorophytum tuberosum* are washed, sliced and cooked as vegetable curry with onion and tomato by tribals in Orissa [29]. In Andhra Pradesh, its tender leaves are eaten as vegetable. Tubers are also edible and after drying are used as tonic [30, 31]. Flowers, young buds and tubers of this plant are used in ethnic food in India [32]. Roots are eaten raw and also cooked as vegetable in Maharashtra [33].

VIII. TRADITIONAL USES

Medicinal herbs continue to play a vital role in revolutionizing the treatment of sexual disorders. *Chlorophytum tuberosum* is believed to have effective aphrodisiac effect and considered as the most powerful revitalizing herb in Indian traditional medicine. The traditional medicinal uses of various parts of this plant species for the treatment of various ailments are shown in table 3. Whole plant has been traditionally used for its aphrodisiac properties. Ayurveda prescribes this plant species for the patients suffering from erectile dysfunction and pre mature ejaculation [34, 35]. Paste made from Tubers was reported to be used for curing centipede bites and poisonous bites by Hooralis tribe in Sathyamangalam forest division, Western Ghats of Tamil Nadu [36]. Tuber extract (250 ml) of *Chlorophytum tuberosum* is given orally thrice a day during loose motion and muscle cramps by Tharu tribe. This plant species is used for the treatment of cholera by the inhabitants of Dudhwa National Park, India [37]. The root powder is used as tonic [38]. Juice of Roots/tubers of Safed musli plants is reported to be used by the Taungya community in the Terai Arc Landscape (U.P) as tonic [39]. The powder of tuber or raw tuber is considered to be highly energetic [30, 40]. The root of *Chlorophytum tuberosum* is powdered with that of *Bombax ceiba*, *Capparis sepiaria* and fruits of *Pedaliium murex* and taken with water as a tonic [41]. The drug obtained from tubers of this plant species is considered to be an important nervine and general tonic for strength and vigour [30]. The root of Safed Musli after crushing with twigs of *Pedaliium murex* and seeds of *Sida spp.* has been reported to be used for the treatment of leucorrhoea [41]. The tuberous roots are used as tonic during fatigue, general weakness and tubers are used to cure leucorrhoea [10]. Tribals use the extract of the roots crushed in rice water to cure dysmenorrhoea [42]. Root powder is given to women after delivery for strengthening [43]. Its root in combination with small twigs of *Pedaliium murex* and *Sida* seeds are used to cure nocturnal emission [41]. Seminal debility can be cured by taking 1 teaspoon dry powder of cladodes of this plant with 1 glass of milk every day [41]. Root is used to cure impotency and low sperm count [45]. Root paste after mixed in water and taken against sexual debility in man and woman [41]. Decoction of leaves and root of *C. tuberosum* is used to cure diabetes and some immune disorders in Vindhya region of Eastern U.P., India [46]. It is believed that roots and tubers of *Chlorophytum tuberosum* plant possess activity to dissolve kidney stones [47].

Table 3: Use of different plant parts of *Chlorophytum tuberosum* in folk and traditional medicine.

Plant Part	Common Use	Mode of Consumption	Reference
Whole plant	Gynaecological disorders	Decoction used as general tonic, in post-natal care to increase the fertility and in diseases pertaining to females.	[48]
	Sexual disorders	Decoction	[49]
Tuber	Centipede bites and poisonous bites.	Paste made from Tubers is applied on the affected area.	[36]
	Loose motion & muscle cramps	Extract (250 ml) of tuber thrice a day is given orally	[37]
	Tonic	The powder of tuber or raw tuber is considered to be highly energetic as good as tonic.	[40]
		Dried Tubers	[30][50][51]
	Cholera	Dried form	[37]
	Nervine and general tonic	Drug obtained from tubers	[30]
	Leucorrhoea	Dried tubers	[10]
	Kidney stones	Dried roots and tubers	[47]
	Asthma	250 g tubers of <i>C. tuberosum</i> are mixed with 5 g of each of <i>Crocus sativus</i> and <i>Syzygium aromaticum</i> in an earthen pot, mouth of which to be made air tight with clay. This pot is then kept in heap of cow dung for 5 days. 6 g of this paste obtained, is given with cow milk twice daily for 6 months	[52]
	Waist pain	Rhizome of <i>Dicranopteris linearis</i> and about 5 g of rhizome <i>C. tuberosum</i> and root of <i>Bombax ceiba</i> are made into paste which is given for one month for waist pain as tonic.	[53]
Seminal debility.	Tuber powder with milk given in seminal debility	[54]	
Root	Tonic	The root powder is used as tonic	[38][47]
		2 teaspoon of juice obtained from fruits given twice daily	[39]
		The root powdered with that of <i>Bombaxceiba</i> , <i>Capparis sepiaria</i> and fruits of <i>Pedaliium murex</i> and taken with water	[41]
	Leucorrhoea	Roots of Safed Musli after crushing with twigs of <i>Pedaliium murex</i> and seeds of <i>Sida</i> spp. is used for the treatment of leucorrhoea.	[41]
	Fatigue, general weakness	Decoction made from tuberous roots	[10]
	Mental retardation	Root tuber are boiled and given for mentally ill person. The tuber is boiled with milk in case of impotency and weakness.	[55]
	Dysmenorrhoea	Extract of the roots crushed in rice water.	[42]
	Post delivery Tonic	Root powder is given to women after delivery for strengthening	[43]
	Nocturnal emission	The root of <i>C. tuberosum</i> in combination with small twigs of <i>Pedaliium murex</i> and <i>Sida</i> seeds.	[41]
	Impotency and low sperm count	Root powder	[45]
	Increase masculinity	Powder of roots is given to drink every day	[56]
	Weakness Sexual vitality	Root	[57]
	Sexual debility in man and woman	Root powder made into paste by mixing in water.	[41]
	Tonic	Dried root powder mixed with milk or water is taken orally once a day in early morning in the empty stomach for a month.	[58]
Diarrhoea and dysentery	Roots are used to treat diarrhoea and dysentery and also used as demulcent and galactogogue	[59]	
Cladodes	Seminal debility	1 teaspoon of dry powder of cladodes of this plant with 1 glass milk every day	[44]
Leaf	Immune disorders	Decoction of Leaf and Root	[46]
	Diabetes	Decoction made from fresh leaves is orally given to Diabetic persons.	[46]
	Cutaneous	Paste of leaf applied on the affected area	[60]

X. CONCLUSION

Based on preliminary information, we summarized the dynamic therapeutical potentials of *Chlorophytum tuberosum* which would encourage researchers to explore the underlying molecular mechanisms and mode of action of various bioactive compounds against various ailments. Despite the widespread use of *C. tuberosum*, controlled clinical trials have not been conducted for the evaluation of the toxicity of this plant. Hence in this review article, effort has been taken to collect and compile the details on *Chlorophytum tuberosum* which will be useful to the society to project into a field of alternative systems of medicine. This plant is quite promising as a multipurpose medicinal agent so, more and more clinical trials should be carried out to prove its efficacy.

CONFLICTS OF INTEREST

Authors do not have any conflict of interest.

ACKNOWLEDGEMENTS

The authors are thankful to Honorary Director, Institute of Ethnobiology, and Head, School of Studies in Botany, Jiwaji University, Gwalior, for providing the needed facilities.

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