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A Review on Some Important Medicinal Plants of *Chlorophytum spp.*

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ABSTRACT

A number of herbs belonging to the specie *Chlorophytum* are noted for their medicinal benefits in Ayurvedic, and Unani system of medicine. A lot of medicinally important attributes have been assigned to the plants of this specie. The important plants which have so far been explored include *C. adscendens*, *C. borivilianum*, *C. laxum*, *C. tuberosum* and *C. comosum*. Although, pandemic in usage, there is an exiguity of scientific literature proclaiming medicinal benefits of the plants belonging to *Chlorophytum spp.* It is only in the recent past that there has been an opulence of research work on the medicinal cultivation and biotechnological virtues the plants in this species. The present review is a pragmatic approach to accrue the findings on this very important *spp.*

INTRODUCTION

The genus *Chlorophytum* belonging to the family Liliaceae is widely distributed in the pantropical regions. There are almost 215 species that have been reported in the genus *Chlorophytum* [1]. They are perennial rhizomatous herbs. Rhizomes are often short and inconspicuous while roots are usually thicker or slightly fleshy. They are mainly cultivated for their ornamental flowers. Traditionally, roots of these species are reputed to possess various pharmacological utilities having saponins as one of the important phytochemical constituents [2]. Kaushik, 2005 reviewed the saponins of some of the important plants belonging to *Chlorophytum spp.* According to the author the specie is rich in both monodesmosidic saponins (oligosaccharide chain attached at C3 position) and bidesmosidic saponins (an additional sugar moiety at the C26 or C28 positions) [3-6]. Some of the plants belonging to the specie are amongst much acclaimed Ayurvedic herbs and in the recent past there has been a renewed scientific interest in exploring the specie. Although nearly 215 different species of *Chlorophytum* have been reported [7], but only a few find medicinal relevance out of which the prominent ones are:

1. *Chlorophytum arundinaceum* (distributed throughout the country) and is also designated as Safed Musli in some traditional literature.
2. *Chlorophytum attenuatum* mainly prominent in Southern India.
3. *Chlorophytum laxum* mainly found in the deccan region
4. *Chlorophytum brevispacum* mainly found in the northeastern regions.
5. *Chlorophytum malyanese* also known as spider lily plant.
6. *Chlorophytum borivilianum* being extensively cultivated throughout India.

In the present review some of the important medicinal plants belonging to the *Chlorophytum spp.* have been discussed with special emphasis on their medicinal activity and reported chemical constituents.

Chlorophytum arundinaceum Baker

Chemical Constituents:

A lot of chemical analysis has been carried out on the roots of *C. arundinaceum* the major reported constituents include 4 hydroxy- 8,11 oxidohexacosanol and pentacosanol, docosanoic acid, pentacosonyl docosanoate, n-nonacosane, tetracosanoic acid, stigmasterol and stigmasterol β -D-glucopyranoside were the major constituents reported. Arundinoside A and B have also been reported as major glycosidic portions from *C. arundinaceum*. Presence of such constituents straight chain alcohols with tetrahydrofuran moiety in saponin containing drugs are a rarity [14-16].

Antiulcer activity

Treatment with ethanolic extract of *C. arundinaceum* rendered significant protection in gastric ulceration which was evident from reduction in ulcer-index in all the models. It showed increased mucin activity in pylorus ligation model. In stress induced ulceration model, proved antioxidant activity was also observed, where it reversed the increase in lipid peroxidation and decreased the catalase levels, however, the extract did not produce any change in SOD levels, which was significantly increased in stressed condition. Further there was a significant reduction in vascular permeability and gastric emptying rate [25].

Adaptogenic activity, antiobesity and Inhibition of lipid peroxidation:

Tandon et al., reported the adaptogenic and antistress activity of methanolic extract obtained from *C. arundinaceum*. Protecting activity was observed for *Chlorophytum arundinaceum* constituents against AAPH [2,2'-Azobis (2-methylpropionamide) dihydrochloride]-induced haemolysis. AAPH generates oxygen free radicals (OH) which, in turn, disrupt RBC membrane resulting in haemolysis. Agents that inhibit AAPH-induced haemolysis possess strong oxygen radical scavenging activity. Different doses (20-600 μ g/ml) of the *Chlorophytum arundinaceum* constituents were incubated at 37^o C. for 90 minutes with 10% RBC suspension (from mice, goat and human blood) in presence of AAPH (200 mM). The extract could render effective protection against the hemolysis and disruption as well (Ghosal, 2006).

Therefore, the herb could be considered as potent antioxidant.

Immunomodulatory activity:

Ghosal, 2006 in his patent reported another aspect for the effectiveness of *C. arundinaceum*, the immuno-modulatory effect(s) of the constituents of *C. arundinaceum* was assessed, among other determinations, by their capacity to attenuate the cold-immobilization stress-induced elevated level of plasma corticosterone. The aqueous ethanolic extract of *C. arundinaceum* could render tremendous protective effect against stress induced elevated plasma corticosterone levels as compared to stressed control group animals.

***Chlorophytum borivilianum* Sant. F.**

Chlorophytum borivilianum Santapau & Fernandez also known as Safed Musli is a traditional herbal plant with assorted Ayurvedic relevance [1]. Safed Musli is a member of special class of herbs known as 'Rasayana' and it falls into a special class of Rasayana known as 'Vajikarana' i.e. Aphrodisiacs [2]. 'Ayurvedic Rasayanas' have been designated as a special class of herbs having multifaceted action inside the human body. Their activities range from improvement in mental acuity, keenness to enhancement of anabolism, maintenance of homeostasis, prevention of degenerative diseases, antioxidant activity and improvement in failing sexual functions [3]. 'Chywanprash' is an excellent example of Rasayana which is a convergence of numerous therapeutic benefits and was formulated by 'Rishi Chyawan' after years of research put together, to keep the ailments at bay and look young and rejuvenated [4]. Safed Musli is a part of this age old, time tested formulation.

Herbal aphrodisiacs or sexual stimulant plants viz. *Asparagus racemosus*, *Asparagus adscendens*, *Chlorophytum borivilianum*, *Chlorophytum laxum* and *Chlorophytum arundinaceum* are regarded as source of Safed Musli, leading to confusion about its identity and usage, whereas *Asparagus* species is largely employed for the treatment of female debility, galactogogue action and enhancement of female libido [5]. In the same context *Chlorophytum borivilianum* is regarded as male sex tonic [6]. Keeping in view, the large-scale cultivation and export. *Chlorophytum borivilianum* is considered as main source for Safed Musli in the present article.

Safed Musli (*Chlorophytum borivilianum*) belongs to the family *Liliaceae* and is probably christened so because of the white milky texture of its tubers after peeling. Tribals in India, have used Safed Musli since ages for enhancing their virility. The herb is very popular as far as modern herbal scenario in the states of Madhya Pradesh and Chattisgarh is concerned.

Chemical Constituents reported from *C. borivilianum*.

Although, there is a paucity of scientific work on specific characterization and standardization of Safed Musli, still there are few reports on its chemical constituents:

Inulin type 2→1 linked fructans have been reported by Thakur and Dixit, 2004 [9] by a comparative RP-HPAE Chromatography in a Dionex system. The structure of the fructans have also been characterized by MalDI-MS and NMR

studies as identified as O-β-D-fructofuranosyl-(2→1)-β-D-fructofuranosyl)n-(2→1)-D-glucopyranoside (n = 5-30) [10] and is shown in Fig. 1.

The total fructan content of the herb was found to be nearly 14% [9]. Presence of mannans of pure type have also been determined by us in a separate set of experiments (unpublished data).

Saponins and saponinins of *Chlorophytum borivilianum* (Sant. & F.) were standardized using HPTLC [11] and HPLC [12-13].

In HPTLC analysis the saponinins isolated from powder hydrolyzed Safed Musli by ethanolic extraction were standardized against β-sitosterol in Chloroform : Diethylether (1:1 v/v) mobile phase Fig.2. A HPLC method in order to detect adulteration/substitution and for identification of different species, was developed using UV spectrum of four synonyms of Safed Musli viz. *Asparagus adscendens*, *Chlorophytum borivilianum*, *Chlorophytum laxum* and *Chlorophytum tuberosum* were used as diagnostic markers. This method can be used to differentiate different species based on the absorbance and the spectral pattern, which was found to be different in all the species [13].

Apart from biologically effective steroidal and triterpenoidal saponins, saponinins and fructans having prebiotic importance [17], the other phytoconstituents reported from the plant are, high quantities of simple sugars mainly sucrose, glucose, fructose, galactose, mannose and xylose [11]. Proteins, phenolics, Triterpenoids, gallo-tannins and mucilage are also reported from *Chlorophytum borivilianum* [18].

Medicinal importance of *C. borivilianum*

Safed Musli has been traditionally acclaimed and advocated for its aphrodisiac activity [8]. In a recent study, ethanolic extract of roots as well as saponinins isolated from the roots were studied for effect on sexual behavior and spermatogenesis in albino rats. Treatment had pronounced anabolic and spermatogenic effect in treated animals, evidenced by weight gains of body and reproductive organs. Administration of extracts markedly affected sexual behavior of animals reflected in reduction of mount ejaculation, post ejaculatory and intromission latency. An increase in mount frequency and attractability towards female was observed [19-20].

Antioxidant activity

Antioxidant activity of the ethanolic extract was evaluated by DPPH radical and hydroxyl radical scavenging activity. The capacity to reduce lipid peroxidation in rat liver tissue along with chelating potency towards ferrous ion was also evaluated. Chemiluminescence activity was also performed. Ethanolic extract exhibited potent antioxidant activity as evidenced by scavenging of 85.51% of DPPH radical, 48.95% of hydroxyl radical, ferryl bipyridyl complex (84.53%). The % inhibition of lipid peroxidation was found to be 67.17% at 100µg/ml concentration. Significant inhibition of superoxide radical was also exhibited in photochemiluminescence activity [8]. The studies affirm for the potent antioxidant potential of this traditional Rasayana drug.. Srividya et al., 2006 have also reported a potent free radical scavenging activity in *C. tuberosum* which is also designated as Safed Musli and is some times referred to as Safed Musli as well.

Immunomodulatory activity

The drug is an immuno stimulating herb akin to many Ayurvedic rasayanas [21-22]. Ethanolic extract of the roots and its sapogenin were evaluated for their immunomodulatory activity. The assessment of immunomodulatory activity was carried out by determining the effect of azathioprine induced myelosuppression and administration of extracts on hematological and serological parameters. Administration of extract greatly improved survival against *Candida albicans* infection. An increase in delayed type hypersensitivity response, % neutrophil adhesion and *in-vivo* phagocytosis by carbon clearance method was observed after treatment with extracts [23].

Results suggested a potent activity of ethanolic extract when compared to sapogenin fraction of *C. borivilianum*.

Aphrodisiac activity

Thakur and Dixit, 2006 evaluated the roots of *Chlorophytum borivilianum* for their folkloric claims as aphrodisiac and sexual stimulant. Ethanolic extract of roots as well as sapogenins isolated from the roots were studied for effect on sexual behavior and spermatogenesis in albino rats. Administration of 100 mg/Kg and 200 mg/Kg b.w. of the sapogenin and ethanolic extract respectively had pronounced anabolic and spermatogenic effect in treated animals as evidenced by weight gains in the body and reproductive organs and histological studies. The treatment also markedly affected sexual behavior of animals as reflected in reduction of mount latency, ejaculation latency, post ejaculatory latency, intromission latency and an increase of mount frequency and attraction towards female. The study therefore, validated the overall claim for utilization of this herb as potent sexual stimulant.

Antidiabetic activity

Chlorophytum has also been acclaimed for its antidiabetic activity traditionally. In a recent study the herb was studied for its antidiabetic activity against streptozotocin induced diabetes [10]. The study thus provides evidence for the effectiveness of drug in managing diabetic stress. Also, fructans have been reported for their ability to alleviate diabetes by normalizing the blood glucose level. Fructans themselves serve as source of energy [24]. Therefore, the presence of fructans in the herb may have a major role to play in reducing glucose level in diabetic individuals. In a study conducted by the authors the aqueous extract of *C. borivilianum* rich in polysaccharides could ameliorate the sexual dysfunction induced by streptozotocin and alloxan induced oxidative stress. Thus, the study did not only validate the concept of Vajikaran but also substantiated the role of the plant as a Rasayana herb (Thakur and Dixit, 2007).

Effectiveness against lipid metabolism:

Visavadiya and Narsimhacharya, 2007 reported the efficacy of *Chlorophytum borivilianum* root (powder) in modulating the hyperlipaemic/hypercholesteraemic conditions in male albino rats. The whole root powder of *C. borivilianum* was administered in two doses i.e. 0.75 and 1.5 g root powder/rat per day for 4 weeks to hypercholesteraemic rats. The administration significantly increased high-density lipoprotein-cholesterol levels and decreased plasma and

hepatic lipid profiles. An increase in faecal cholesterol, neutral sterol and bile acid excretion with elevated hepatic 3-hydroxy-3-methylglutaryl coenzyme was also reported by the authors. Furthermore, the hypercholesteraemic rats treated with both doses of *C. borivilianum* also exhibited increases in superoxide dismutase and ascorbic acid levels. There was no evident variation in lipid or anti-oxidant profiles in control normocholesteremic animals. Therefore the herb was significantly effective in ameliorating the lipid metabolism in hypercholesteremic animals which remained normal and unaltered in untreated animals. The present activity corroborate with the previous findings reporting antioxidant activity of *C. borivilianum* extracts as well. Also the presence of fructans as reported by Thakur and Dixit 2006 could also be considered as the major contributing factor in better management of hypercholesteremia (Van loo et al., 2005).

Analgesic activity

Panda et al., 2007 have reported the effectiveness of methanolic extract of *C. borivilianum* in treating pain. Their study was based on the traditional claim of utilization of this herb against rheumatoid arthritis. This activity could in part be attributed to the steroidal components in the plant.

Biotechnological and Agricultural Perspective

According to a recent report the total demand of Safed Musli world over is 35000 tons compared to a meager 100 tons supply [27]. Since India is a leader in production and supply of the herb so there is a recent upsurge in biotechnological and agricultural exploration for improvement in variety and quality of the drug.

Germ plasm of Safed Musli have been procured and biochemical traits have been determined [28-29] the technique is being explored for conservation and spawning of the herbal drug. There is an increased awareness of herbal community for husbandry of the nutraceutically and medicinally important herb. Nearly 25-30% germination percentage has been found in *Chlorophytum borivilianum* with a nearly 8 month dormancy period [30-31]. Clonal propagation techniques have also been used for determining optimum growth requirements in the plant [28].

In the studies conducted this far, there has been a desperate effort in reducing the cultivation and plantation cost and increasing the benefits for farmers. The plant grows well in loamy soil with good drainage and aeration. Although the plant has good regeneration capacity still, biotechnological agronomy and use of modern techniques need to be pushed for considerable reduction in the cost factor involved in cultivation and processing of Safed Musli [8]. The task for the agronomists in the near future is to further the good work in the field of reducing the cultivation cost and blend it with greater yield and production using proper manure and fertilizing techniques. Maintaining the desired level of macro and micronutrients required for an optimal growth of the plant.

FUTURE PROSPECTS

Inulin type fructans have latterly received a special denomination in scientific community [32-33]. The polymer has been conferred with number of prebiotic and medicinal benevolence [34]. A few reported medicinal benefits of inulin

containing herbs are antitussive activity [35], prevention of post gastrectomy anemia and osteopenia [36] antidiabetic activity [24], immunomodulatory activity [37]. They have also been found useful for targeting drugs to colon [38] and prevention of colon cancer [39]. Since Safed Musli contains appreciable quantity of fructans so there is an ample possibility for exploration of mentioned medical attributes in the herb. These polymers may have a role in the purported Rasayana action of the herb. This virgin aspect needs to be thoroughly investigated to enhance the commercial value of the herb.

Therapeutic and medicinal values of a plant are major concerns for imparting a prominence and propelling the sale of any medicinal herb in the global market. Although, Indian share has not gained the desired global prominence and has been overrun by superpowers in the field like Germany, China and Japan still it is not a dooms day situation [40]. In modern context, a thorough identification of biologically active marker compound, a complete and systematic chemical identification and determination of medicinally useful components from the herb is very important for developing a standardization profile of the herb. Proper standardization of any medicinal herb is very important as per the WHO guidelines before any herb can truly find its potential market in the global arena [41]. An important aspect that has to be dealt with utmost care is of creating awareness amongst the state farmers growing Safed Musli. The farmers must be well versed with pros and cons of growing Safed Musli, they must be cognizant of a possible fiasco that may occur if an equal heed is not paid to the processing and formulation development from the herb [42].

From, the current trends available it can rightly be said that if assenting and quick steps are not taken for the preparation of commercially viable products from Safed Musli then no sooner the roots of gold may just loose their shine and glitter. It is not just by promoting the agricultural aspect that a true value of herbal drug may be recognized. It is a blend of cultivation, adequate processing, formulation, marketing and subsequent globalization that makes any herbal drug judiciously successful in the market. To keep the white tubers glowing and golden a firm step in increasing research input on the plant is the need of the hour.

Other Chlorophytum Species of Importance

Chlorophytum malyanese is another important plant group which has been evaluated extensively for various botanical perspectives as well as medicinal properties. Chromalioside A isolated from this plant is reported as a major cytotoxic agent and is being explored for a potential anticancer agent. *C. tuberosum* another important plant has been reported to possess potent antioxidant activity by Srividya et al., 2006. *C. arundinaceum* is also an important plant commonly designated as Safed Musli which has been reported to possess adaptogenic activity (Tandon and Shukla, 1995).

Other plants or species designated as Safed Musli

Asparagus adscendens Linn. Family Liliaceae and *Chlorophytum arundinaceum* Baker Family Liliaceae are two other important plants which have been designated as Safed Musli by some of the workers. The plants are reported to

possess immunomodulatory and adaptogenic properties as well.

Saponins of *Chlorophytum* spp. have been reviewed extensively by Kaushik, 2005. The important property that has been ascribed to saponins of this particular species is there bidesmosidic nature which in part may also be responsible for better bioavailability of steroidal saponins *in-vivo*. Although, since most of the plants of this specie remain potentially unexplored, it would be apt to state that further research on some traditionally acclaimed plants of this specie may provide some important insights.

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