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Research Article

PROXIMATE ANALYSIS AND ELEMENTAL COMPOSITION OF SEVENTEEN SPECIES OF *CHLOROPHYTUM* FROM THE WESTERN GHATS

Ajay Sarjerao Nalawade *, Rajaram Vithoba Gurav
Department of Botany, Shivaji University, Kolhapur, Maharashtra, India
*Corresponding Author Email: Analawade4@gmail.com

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ABSTRACT

Chlorophytum holds an important position in herbal and Ayurvedic medicines of India. The different elemental constituents at trace levels and phytochemicals specially Saponins from roots of *Chlorophytum* play an effective role in the medicines prepared. The Proximate composition and elemental content from roots of 17 species of *Chlorophytum* from the Western Ghats has been analysed. A total of 13 elements N, P, K, Ca, Mg, S, Na, Zn, Fe, Cu, Mn, Mo and B have been measured. In proximate analysis percentage of moisture, ash, crude protein, crude fats and carbohydrate were determined using standard methods. Highest Saponin content is found in *C. gothanense* (13.2±0.3%) while lowest in *C. filipendulum* subsp. *amaniense* (2.95±0.3%).

Keywords *Chlorophytum*, India, Phytochemicals, Saponin, Western Ghats

INTRODUCTION

Plants are the source of numerous valuable drugs of natural origin. Analysis of elements and phytochemicals in the wild edible plants plays decisive role in assessing their nutritional significance[1]. Scanty reports are available on the role of micronutrients[2,3]. The relation between elemental content of medicinal plants and their curative ability is not yet properly explained in terms of modern pharmacological concepts. So, the concentration of various trace elements is necessary to quantify for the determination of the impact of the medicinal plants in the treatment of various diseases to perceive their pharmacological action[4]. The overabundance or insufficiency of elements in plants, animals and soil is linked with imbalance in human health. A diet with specific trace element in excess quantity can effect activity or functioning of particular organ.[5]

A number of species from genus *Chlorophytum* (Asparagaceae) are noted for their medicinal properties are commonly known as 'Safed musli'. It has some important phytochemical constituents which make it very popular and useful for a nutritional dietary regime in body builders and sports person[6]. The roots of *C. borivilianum* are reported to contain 42% of carbohydrates, 8–9% of proteins and 2–17% of Saponins[7]. The important species of the genus such as *C. borivilianum*, *C. malayense*, *C. comosum*, and *C. arundinaceum* have steroidal saponins which has attracted much attention due to their structural diversity and therapeutic capability[8].

In India the genus *Chlorophytum* is represented by about 20 species and most of them occur in Western Ghats[9]. *C. borivilianum* is the only species, extensively studied for its medicinal properties. Hence, the present study was undertaken to determine the proximate analysis and elemental composition from the roots of *Chlorophytum.*

MATERIAL AND METHODS

Collection and preparation of samples

The root tubers of 17 species of *Chlorophytum* used as experimental material were collected from various localities (Table 1) from the Western Ghats during the rainy season. The collected plant material was placed into the zip lock polythene bags to prevent loss of moisture during transportation to the laboratory. For the correct identification of plant material efforts were made to collect these Plants in flowering and fruiting condition. Tubers were washed with distilled water, weighed, cut into small pieces and dried at 40^0C until constant weight was obtained. The dried samples were ground in the electric grinder to a fine powder[10]. The samples were packed into airtight sample bottles and stored in the refrigerator.

Proximate analysis

Estimation of moisture

10 g of fresh tuber samples were taken and cut into small pieces. The amount of moisture in the tubers was determined by drying the samples in hot air oven at about 50^0C for 72 h[11]. The dried samples were weighed again after 72 h and the moisture percentage was calculated by following formula.

Moisture % = (Fresh weight – Dry weight) / Fresh weight × 100

Estimation of ash

Total ash content of tubers was determined by incineration of known weights of the samples in a muffle furnace at 550^0C until a white ash to obtain[12]

Ash % = Weight of crucible + ash (W2) – Weight of empty crucible (W1) /Weight of sample (W) × 100

Estimation of crude protein

The protein content in the tubers were determined according to AOAC[13] by the Kjeldahl method with some modification[12]. The total protein was calculated by multiplying the evaluated nitrogen by a constant value of 6.25.

Estimation of Crude fat

The crude fat content of tubers was determined by using the soxhlet extractor method[14] with some modifications[11].

Crude fat % = Weight of extract + Extraction flask (W1) – Weight of empty extraction flask/ weight of sample in g (W)

Estimation of total carbohydrate

Carbohydrates were determined by dinitrosalicylic acid method[11]. Total carbohydrate was calculated by using maltose standard curve.

Estimation of Saponin

Estimation of total Saponin content was done according to the method of Nahapetian and Bassiri[15].

Saponin % = Weight of oven dried end product (WEP) / Weight of powdered sample taken for test (WS) X 100

Elemental composition

For the estimation of elemental composition samples were digested by method of Salami and Non[16]. The elements *viz*., copper (Cu), Manganese (Mn), Iron (Fe), Zinc (Zn), Magnesium (Mg) and Molybdenum (Mb) were analysed on Atomic Absorption Spectrophotometer AA-203 (ThermoFisher Scientific, USA). Calcium (Ca) and Potassium (K) were analysed on flame photometer FP-114 (ThermoFisher Scientific, USA). Nitrogen (N) was estimated by Kjeldahl method. Phosphorous (P), Sulphur (S), Molybdenum (Mo) and Boron (B) was determined by the spectrophotometric method[17] using ammonium molybdate[12].

Statistical analysis

All the experiments were repeated for 3 times (n=3) till the data obtained statistically valid. Each value was expressed in mean ± standard error (SE). Analysis of variance was carried out for all data at $p<0.05$ using Graph Pad software (GraphPad InStat version 3.00, GraphPad Software, San Diego, CA, USA) with $n\geq3$.

RESULTS AND DISCUSSION

A proximate analysis and elemental content of all 17 species of *Chlorophytum* is shown in table 2. Information on elemental composition and medicinal value of Indian edible tubers, rhizomes, corms and roots is scanty[18,19]. Safed musli is an important plant, used in Indian system of medicine due to its aphrodisiac properties. It is an integral part of more than 100 Ayurvedic preparations[20]. Most of the species have relatively high moisture content than crude protein and lipid but it is comparatively less than ash and total carbohydrate content. Tubers of *C. gothanense* has the highest moisture content with the value of 12.5±0.3% while *C. indicum* has the lowest amount of moisture. Ash content is a measure of the total amount of elements present within a plant material ranged between 4.7±0.3% in *C. comosum* to 23±0.6% in *C. nimmonii*. Amount of crude protein has range between 1.19±0.3 to 8.05±0.2%. Maximum crude protein was found in *C. borivilianum* while minimum in *C. belgaumense*. Prevoiously 8.5% protein and 42% Carbohydrates were reported in *C. borivilianum*[7]. In present investigation it was found that proportionately higher carbohydrate content than that of protein content. Highest percentage of Carbohydrate was observed in *C. laxum* (66±0.5%) while lowest in *C. nimmonii* (3±0.5%). The crude fat content ranged from 3.35±0.8 to 11.35±0.9% of dry weight. *Chlorophytum belgaumense* (11.35±0.9%) showed highest, while *C. heynei* (3.35±0.8%) showed lowest fat content. Low fat content of the tuber make it safe to avoid obesity problem which possess a serious threat to the health of people. It can therefore frequently be consumed by individuals on weight reduction[21].

Herbs from the genus *Chlorophytum* are known for their therapeutic potential with a vast range of pharmacologically important saponins. The saponins from *C. borivilianum* have aphrodisiac property and popularly used as a safe alternative to Viagra[22]. Saponins from investigated *Chlorophytum* species was ranged from 2.95±0.3% to 13.2±0.4%. *Chlorophytum gothanense* as an excellent source of Saponin (13.2±0.4%) while, lowest quantity of Saponin is found in *C. filipendulum* subsp. *amaniense* (2.95±0.3%).

Due to deficiency of elements almost assuredly a large number of people in the developing world, especially poor women, infants and children get hamper their health and productivity[22]. Present study revealed that *Chlorophytum* tubers has high levels of Nitrogen, Calcium, Magnesium and Iron. Among all the screened species *C. nimmonii* is the richest source of 3 macro and 2 micro elements (K, S, Na, Fe and Mn) with highest content.

Chlorophytum arundinaceum showed highest Phosphorus content (0.4±0.08%) while lowest content was found in *C. gothanense* (0.044±0.01%). Phosphate (PO_4^{3-}) is required in production of ATP, GTP and CTP and also in regulation of protein activity[23]. Potassium content (0.55±0.1%) of *C. indicum* was found tobe highest followed by *C. glaucoides* and *C. nimmonii* while lowest in *C. tuberosum* (0.08±0.006%). High potassium content plays an important role in the balancing of the physical fluid system and assisting nerve functions[24] The concentration of Calcium, a macro element ranged from 0.11± 0.03% in *C. comosum* to 25.02±0.5% in *C. glaucoides.* Calcium ameliorates heart patients, the most prominent role of Calcium is to keep the bones strong and reduce the risk of Osteroporosis in old age. It also plays important role in problems like colon cancer, premenstrual syndrome[24]. Magnesium enhances the responsiveness of insulin and fortify against Diabetes.[24]. Highest concentration of Mg was found in *C. borivilianum* which is 20.23±0.3%. The medicinal impact of organosulphur compounds is extraordinary. Modern medical applications of sulfur-containing compounds have grown to include antibacterials, anti-inflammatories, dermatologics, and cancer treatments[25]. Maximum content of Sulphur was found 4.16±0.2% in *C. nimmonii* and 0.25± 0.06% in *C. laxum.* Sodium involves in the production of energy, transport of amino acids and glucose into the body cells[24]. Sodium content (8±0.5%) of *C. nimmonii* was found to be highest followed by *C. laxum, C. malbaricum and C. glaucoides*.

Micronutrients plays vital role in human health. Zinc is an antioxidant element important in protecting sperm against free radical attack and Iron helps in the formation of haemoglobin[26].

Table 1: List of *Chlorophytum* species with location details

Name of the species	**Locality**	**(GPS co-ordinates)**
Chlorophytum arundinaceum Baker	Melghats, Maharashtra	N 21°21'27.05" E 77°07'47.53"
C. belgaumense Chandore, Malpure, Adsul & Yadav	Khanapur, Karnataka	N 15°40'58.27" E 74°30'20.99"
C. bharuchae Ansari, Sundaragh. & Hemadri	Appachiwadi, Maharashtra	N 16°29'53.99" E 74°21'09.22"
C. borivilianum Santapau & R.R. Fern.	Jaitapur, Maharashtra	N 16°37'34.77" E 73°22'12.98"
C. breviscapum Dalzell	Dhopeshwer Maharashtra	N 16°38'57.83" E 73°29'49.69"
C. comosum (Thunb.) Jacques	Ornamental plant	
C. filipendulum subsp. *amaniense* (Engl.) Nordal & A.D. Poulsen	Ornamental plant	
C. glaucoides Blatt.	Thoseghar, Maharashtra	N 17°36'23.52" E 73°52'12.42"
C. glaucum Dalzell	Pasarni, Maharashtra	N 17°55'58.04" E 73°40'06.49"
C. gothanense Malpure & S.R. Yadav	Gothane, Maharashtra	N 17°04'42.91" E 73°45'13.22"
C. heynei Rottl. ex Baker	Mundanthurai, Tamil Nadu	N 08°41'18.02" E 77°18'44.22"
C. indicum (Willd. ex Schult. & Schult.f.) Dress.	Siddharabetta, Karnataka	N 13°33'22.51" E 77°08'02.68"
C. kolhapurense Sardesai, S.P. Gaikwad & S.R. Yadav	Sutgatti, Karnataka	N 16°02'36.07" E 74°30'55.67"
C. laxum R.Br.	Siddharabetta, Karnataka	N 13°33'22.51" E 77°08'02.68"
C. malabaricum Baker	Baba Bhudangiri, Karnataka	N 13°25'23.95" E 75°46'13.63"
C. nimmonii Dalzell	Jambhoti, Karnataka	N 15°40'50.82" E 74°25'50.95"
C. tuberosum (Roxb.) Baker	Tungareshwar, Maharashtra	N 19°25'09.43" E 72°54'57.98"

Table 2: Proximate analysis from root tubers of *Chlorophytum* species

Parameter / **Plant species**	**Moisture (%)**	**Ash (%)**	**Protein (%)**	**Crude Fats (%)**	**Carbohydrate (%)**	**Saponin (%)**
C. arundinaceum	3±0.1	13.5±0.4	4.9±0.2	10.6±0.8	5±0.8	5.69±0.8
C. belgaumense	8±0.6	20±0.8	**1.19**±0.3	**11.35**±0.9	33±1.2	3.99±0.2
C. bharuchae	5±0.6	21.5±0.9	3.5±0.4	8.09±0.7	12±0.8	8.16±0.1
C. borivilianum	6.5±0.3	12.5±0.4	**8.05**±0.2	8.33±0.5	6±0.8	11.28±0.6
C. breviscapum	7±0.2	9.5±0.5	4.2±0.4	4.37±0.6	24±0.8	3.34±0.5
C. comosum	2.6±0.1	**4.7±0.3**	4.55±0.3	4.46±0.7	7±0.5	5.8±0.6
C. filipendulum	8.8±0.3	9.6±0.3	2.45±0.3	5.32±0.4	44±1.2	**2.95±0.3**
C. glaucoides	11±0.3	6.5±0.3	3.5±0.2	3.49±0.9	23±0.8	3.82±0.2
C. glaucum	4±0.3	7±0.6	4.55±0.3	3.74±0.7	8±0.8	3.53±0.7
C. gothanense	**12.5±0.3**	20.23±0.7	3.5±0.4	3.92±0.7	9±0.8	**13.2±0.4**
C. heynei	3.3±0.5	5.2±0.3	3.85±0.3	**3.35±0.8**	21±1.4	3.55±0.3
C. indicum	**1.5±0.2**	9±0.4	2.8±0.2	6.3±0.4	37±1.4	3.95±0.7
C. kolhapurense	7±0.3	14.64±0.4	3.5±0.6	6.1±1.2	53±0.8	3.2±0.3
C. laxum	10±0.4	22.5±0.7	4.9±0.5	7.71±0.9	**66±0.5**	3.36±0.2
C. malbaricum	4±0.3	5±0.6	5.95±0.4	6.04±1	28±0.3	3.74±0.2
C. nimmonii	8±0.3	**23±0.6**	3.5±0.9	5.26±0.6	**3±0.5**	3.53±0.6
C. tuberosum	9±0.1	11.5±0.1	4.55±0.8	8.79±0.8	58±1	9.04±0.8

Values are expressed as the mean of three replicates ± SD and the mean differ significantly at ($p<0.05$) level.

Table 3: Elemental composition from root tubers of *Chlorophytum* species

Parameter / Plant species	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	S (%)	Na (%)	Zn (PPM)	Fe (PPM)	Cu (PPM)	Mn (PPM)	Mo (PPM)	B (PPM)
C. arundinaceum	18.2±0.7	**0.4±0.08**	0.5±0.1	3.45±0.3	14.35±0.2	0.26±0.02	1.5±0.2	9.1±0.4	480.2±1.5	6.16±0.1	**3.86±0.02**	10.5±0.4	2.79±0.2
C. belgaumense	14.28±1.1	0.058±0.01	0.085±0.2	4.17±0.1	5.77±0.4	2.7±0.4	0.3±0.1	93.36±0.3	956.2±0.2	2.54±0.1	5.5±0.3	21.68±0.5	3.26±0.3
C. bharuchae	8.4±0.4	0.046±0.005	0.085±0.01	3.62±0.1	15.42±0.4	2.84±0.3	1.95±0.1	**253.73**±0.9	884.4±0.2	189.7±2.6	51.02±0.6	12.56±0.4	**0.59±0.1**
C. borivilianum	18.76±0.3	0.116±0.01	0.065±0.01	3.45±0.4	**20.23±0.3**	2.59±0.2	0.4±0.08	48.72±0.5	251.8±0.3	**212.9±1.3**	10.2±0.6	10.69±0.5	1.22±0.2
C. breviscapum	21±0.6	0.069±0.03	0.135±0.02	3.2±0.3	16.15±0.5	2.52±0.2	0.65±0.1	81.39±0.5	961.04±0.5	0.38±0.04	8.2±0.3	15.12±0.6	3.18±0.3
C. comosum	0.72±0.2	0.4±0.2	0.1±0.01	**0.11±0.03**	**0.29±0.05**	0.78±0.1	**0.1±0.03**	4.75±0.2	**5.1±0.6**	2.15±0.2	7.15±0.5	**3.2±0.1**	13.78±0.3
C. filipendulum	**0.39±0.09**	0.12±0.01	0.18±0.01	0.27±0.02	0.7±0.09	0.34±0.06	0.24±0.04	11.4±0.3	12.24±0.6	5.16±0.3	17.146±0.2	4.13±0.3	10.64±0.1
C. glaucoides	8.65±0.5	0.35±0.08	**0.55±0.07**	**25.05±0.5**	5.6±0.6	0.38±0.03	4±0.3	**2.02±0.1**	542.8±0.6	1.68±0.1	17±1.2	12.4±0.5	2.03±0.5
C. glaucum	7.55±0.5	0.37±0.2	0.45±0.1	3.8±0.2	15±0.2	0.32±0.1	1.75±0.4	6.1±0.3	598.01±0.6	5.04±0.3	177.22±1.2	10.7±1.1	2.03±0.6
C. gothanense	7±1.2	**0.044**±0.01	0.18±0.02	5.6±0.1	4.27±0.3	2.36±0.1	0.35±0.1	91.03±0.6	1162.6±1	189.32±0.9	44.59±0.4	29.69±1.1	1.69±0.1
C. heynei	0.61±0.07	0.1±0.004	0.12±0.02	0.15±0.02	0.41±0.04	0.69±0.08	0.14±0.02	6.65±0.3	7.14±2	3.01±0.1	10.01±0.3	4.13±0.2	**15.69±0.5**
C. indicum	8.95±0.5	0.38±0.04	**0.55±0.1**	5.4±0.1	7.25±0.8	0.29±0.03	1.5±0.5	24±0.08	86±0.5	64±0.8	31±1.5	10.6±0.5	1.61±0.3
C. kolhapurense	9.24±0.4	0.081±0.009	0.21±0.06	3.7±0.1	10.15±0.7	2.41±0.1	**0.1±0.03**	91.42±0.9	657.6±0.1	210.02±1.7	74.61±0.4	22.24±0.9	1.39±0.3
C. laxum	5.9±0.3	0.38±0.1	0.25±0.02	4.3±0.06	8.2±0.5	**0.25**±0.06	4.5±0.2	9.91±0.4	619.7±0.4	**0.28±0.01**	9±0.5	14.12±0.6	1.78±0.2
C. malbaricum	7.85±0.5	0.39±0.1	0.15±0.02	2.4±0.2	15.65±0.6	0.26±0.02	4.5±0.6	6.5±0.7	15.2±2.2	10.65±0.6	179.26±2.9	22.8±0.4	1.48±0.1
C. nimmonii	23.24±0.6	0.065±0.01	**0.55±0.03**	4.87±0.02	2.5±0.8	**4.16**±0.2	**8±0.5**	99.73±0.3	**1248.2±05**	193.45±1.1	**727.61**±0.6	12.92±0.2	1.22±0.2
C. tuberosum	**24.36±1.1**	0.072±0.01	**0.08±0.006**	5.37±0.1	9.68±0.7	2.78±0.3	0.5±0.1	77.21±1.4	1185.2±1.5	2.53±0.1	579.97±0.8	**30.1±0.8**	3.47±0.1

Values are expressed as the mean of three replicates ± SD and the mean differ significantly at ($p<0.05$) level.

Copper play important role in chest wounds and prevent inflammation in arthritis. Manganese assist the body in metabolizing protein and in treating diabetes. Molybdenum is responsible for amino acids and purine metabolism[27]. While, Boron assists brain function, memory, alertness and activation of vitamin D[28].

The concentration of phytoconstituents and elements from plant to plant and region to region get changes due to various factors such as season of sample collection, condition of sample and soil and atmosphere which affect the plant growth.

In this study 6 constituents and 13 elements were determined from tubers of different species of *Chlorophytum.* The phytoconstituents and elements detected in the different species of genus *Chloriophytum* are used in various diseases. The data acquired from the present investigation will be beneficial in modern drugs development to synthesise various amalgations of ethnomedicinal plants to counteract many diseases.

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REFERENCES

1. Pandey M, Abidi AB, Singh S and Singh RP. Nutritional Evaluation of Leafy Vegetable Paratha, Journal of Human Ecology. 2006; 19(2): 155-156.
2. Bonnefont-Rousselot D. The role of antioxidant micronutrients in the prevention of diabetic complications. Treatments in Endocrinology. 2004; 3(1): 41.
3. Rajurkar NS and Pardeshi BM. Analysis of some herbal plants from India used in the control of Diabetes by NAA and ASS techniques. Appled Radiation Isotopes. 1997; 48: 1059.
4. Rajua GJN, Sarita P, Murty GAVR, Kumar MR, Reddy BS, Charles MJ, Lakshminarayanaa S, Reddy TS, Reddy SB and Vijayan V. Estimation of trace elements in some anti-diabetic medicinal plants using PIXE technique. Applied Radiation Isotopes. 2006; 64: 893-900.
5. Obiajunwa EI, Adebajo AC and Omobuwajo OR. Essential and trace element contents of some Nigerian medicinal plants. Journal of Radio Analytical Nuclear Chemistry. 2002; 252(3): 473-476.
6. Thakur GS, Baga, M, Sanodiya BS, Debnathb M, Zachariac A, Bhadauriya P, Prasad GBKS and Bisena PS. *Chlorophytum borivilianum*: A White Gold for Biopharmaceuticals and Neutraceuticals Current Pharmaceutical Biotechnology. 2009; 10: 650-666.
7. Bordia PC, Joshi A and Simlot MM. Safed musli, Advances in Horticulture: Medicinal and Aromatic Plants (Chadha K L and Gupta R. eds), Malhotra Publishing House: New Delhi; 1995. p. 440-449.
8. Sharma R, Thakur GS, Sanodiya BS, Pandey M and Bisen PS. Saponin: A Wonder Drug from *Chlorophytum* Species. Global Journal of Research on Medicinal Plants and Indigenous Medicine. 2012; 1(10): 503-515.
9. Adsul AA. Taxonomic Revision of Genus *Chlorophytum* Ker Gawl. for India, Ph. D. thesis submitted to Shivaji University, Kolhapur; 2014.
10. Holloway WD, Argall ME, Jealous WT, Lee JA and Bradbury JH. Organic acids and calcium oxalate in tropical root crops. Journal of Agriculture and Food Chemistry. 1989; 37: 337-341.
11. Basu S, Das M, Sen A, Choudhury UR and Datta G. Analysis of complete nutritional profile and identification of bioactive components present in Alocasia indica tuber cultivated in Howrah District of West Bengal, India. Asian Pacific Journal of Tropical Biomedicine. 2014b; 4(2): 879-885.
12. Habtamu, F.G. Nutritional composition, antinutritional factors and effect of boiling on nutritional composition of Anchote (*Coccinia abyssinica*) tubers. Journal of Scientific and Innovative Research. 2014; 3(2): 177-188.
13. Association of Official Analytical Chemists (AOAC). Official methods of Analysis Vol. 2nd 17th Ed. of AOAC International. Washington, DC, USA; 2010.
14. Itoch L and Kaneko H. Yeast lipids in species variation. Simple method for stimulating cellular lipids. Yakagaku Zasshi. 1974; 23: 350-354.
15. Nahapetian A and Bassiri A. Changes in concentration and interrelationship of phytate, P, mg, Cu, Zn, in wheat during maturation. Journal of Agricultural and Food Chemistry 1974; 32: 1179-1182.
16. Salami S and Non D. Delaimination of Trace Elements in water Lily and Lettuce. Journal of Chemical Society of Nigeria. 2002; 27(1): 92-94.
17. AOAC. Official Methods of Analysis. Association of Official Analytical Chemists. 4th Ed. Washington, DC; 1984.
18. Shanthakumari S, Mohan VR and John de B. Nutritional evaluation and elimination of toxic principles in wild yam (*Dioscorea* spp.). Tropical and Subtropical Agroecosystem. 2008; 8: 313-319.
19. Udensi EA, Oselebe HO and Iweala OO. The investigation of chemical composition and functional properties of water yam (*Dioscorea alata*): Effect of varietal differences. Pakistan Journal of Nutrition. 2008; 7: 342-344.
20. Kirtikar KR and Basu BD. Liliaceae: *Chlorophytum.* In: Kirtikar K.R., Basu B.D. (Eds) Indian Medicinal Plants: LM Basu, Allahabad; 1975. p. 2508-2509.
21. Basu S, Das M, Sen A, Choudhury UR and Datta G. Analysis of complete nutritional profile of *Amorphophallus campanulatus* tuber cultivated in Howrah district of West Bengal, India. Asian Journal of Pharmaceutical Clinical Research. 2014a; 7(3): 25-29.
22. Martinez-Ballesta MC, Dominuez-Perles R, Moreno DA, Muries B, Alcaraz-L´opez C, Bast´ias E, et al. Minerals in plant food: effect of agricultural practices and role in human health, A review. Agronomy of Sustainable Development. 2010; 30: 295-309.
23. Sobotka L, Allison S and Stanga Z. Basics in clinical nutrition: Water and electrolytes in health and disease. European e-Journal of Clinical Nutrition and Metabolism. 2008; 3: 259-266.
24. Khan KY, Khan MA, Niamat R, Munir M, Fazal H, Mazari P, et al. Element content analysis of plants of genus *Ficus* using atomic absorption spectrometer. African Journal of Pharmacy and Pharmacology. 2011; 5(3): 317-321.
25. Acton AQ. Sulfur Compounds: Advances in Research and Application; Scholarly Editions: Atlanta, GA; 2012.
26. B. Jaykumar, S.K. Sagar, and G. Sinnathurai. Neutraceutical compositions and methods of use of Safed Musli extracts. Patent No. WO/2008/020451 A2. February 21, 2008.
27. Shenkin A. Basics in clinical nutrition: Physiological function and deficiency states of trace elements. European e-Journal of Clinical Nutrition and Metabolism. 2008; 3: 255-258.

28. Hass E and Levin B. Staying healthy with nutrition, rev: The Complete Guide to Diet and Nutritional Medicine. Celestial Arts Publisher: Berkeley, California; 2006.

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