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Research Article

PROXIMATE COMPOSITION, MINERAL ELEMENTS AND ANTI-NUTRITIONAL FACTORS IN *CLEOME VISCOSA* L. AND *CLEOME BURMANNI* W. & A. (CLEOMACEAE)

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ABSTRACT

Objective: The present paper deals with the proximate composition, mineral profiling and anti-nutritional analysis of *Cleome viscosa* L. and *Cleome burmanni* W. & A. (Cleomaceae). Species of *Cleome* are reportedly used in traditional systems of medicine. Though, *C. viscosa,* the most common species, is reported to possess numerous medicinal properties, a proper scientific validation is lacking. Evaluating the nutritional worth of these species becomes essential if it is to be orally consumed as drug.

Methods: A total of 15 nutritional parameters such as total carbohydrates, reducing sugars, starch, amylose, amylopectin; total proteins; crude fat, total lipids, fatty acids; moisture content, crude fiber, chlorophyll content, ascorbic acid, tocopherol, energy value and six anti-nutrients were quantitatively determined following standard procedures. Four macro and nine micro elements were analysed by atomic absorption spectroscopy (AAS).

Results: Proximate parameters were in appreciable amounts in both species. Macroelements such as calcium, magnesium and potassium were found to be highest in both species compared to sodium. Microelements such as copper, iron, manganese and zinc were found to be present in appreciable amounts, while cadmium, lead and chromium were in trace amounts. Anti-nutritional factors such as tannins, saponins, oxalate, phytic acid, trypsin inhibitors and cyanogenic glycosides were very low.

Conclusion: Results of the present study indicate the utility of both species of *Cleome* as medicinal herbs that could possibly be recommended for oral consumption.

Keywords: *Cleome viscosa*, *Cleome burmanni*, Proximate composition, Minerals, Anti-nutrients.

INTRODUCTION

Traditional medicine practice is a significant element in the cultural heritage of India. Realizing the potential dangers associated with the continuous consumption of allopathic medicine, these days the health conscious public is shifting, though at a slow pace, to a plant based treatment method [1, 2]. Therefore, researchers are presently seeking out documented information on medicinal herbs and such documented information has formed the basis of several pharmacological and clinical investigations [3].

It is a well known fact that plants contain nutritional and antinutritional constituents in addition to the pharmacologically important secondary metabolites [4, 5]. Plants are thus classified and utilized according to their specific attributes. Medicinal plants under consideration for oral consumption preferably should contain an enhanced quantity of the nutritional constituents, essential minerals and vitamins but all the same should have only low quantities of anti-nutritional factors [6].

More than 40 elements have been considered essential to life systems for the survival of both mammals and plants. The human body needs larger amounts of major minerals than trace minerals, although trace minerals can be just as important for good health. The major minerals include calcium, chloride, phosphorus, potassium, sodium, sulphur, and magnesium, while the trace minerals include iodine, iron, zinc, selenium, fluoride, chromium, copper, molybdenum, and manganese [7, 8].

Anti-nutritional factors are substances that are generated by different mechanisms in plants as by-products of normal metabolism and are generally not lethal. However, they can diminish the nutrient bioavailability, especially if present at high levels [9, 10].

The present study is concerned with two species of *Cleome* (Cleomaceae), *C.viscosa* and *C. burmanni*. A few species of *Cleome,* such as *C.viscosa, C. chelidonii, C.gynandra* and *C. rutidosperma* are reportedly used in traditional systems of medicine but studies related with their chemical characterization is lacking [11, 12].

Cleome viscosa L., commonly known as 'Wild mustard' or 'Dog mustard' is cosmopolitan in distribution. It is an annual herb, seen along the roadsides, wastelands and forest undergrowth and is reported to possess rubefacient, vesicant, expectorant, astringent, antispasmodic, contact insecticidal, repellent, antifeedant, nematicidal and anthelmintic properties [13, 14]. The leaves and seeds are used to treat viral infections, fever, rheumatism and headache. The roots are a remedy for scurvy. The seeds have a pleasant flavour and in India they are used as a condiment substitute for mustard seed and cumin in the preparation of pickling spices, sausages, vegetables, curries and pulses. The seed oil contains linoleic acid, oleic acid, palmitic acid, stearic acid as well as some volatile compounds [15]. Several flavonoids, saponins and fatty acids have been isolated from *Cleome viscosa* [16].

Cleome burmanni W. & A. is also broadly distributed and is an erect herb commonly known as 'Kattukadku' in the regional language, Malayalam. The plant is reported to possess anthelmintic properties [13].

The present study was developed with the objective to evaluate the proximate, mineral and anti-nutritional factors in *Cleome viscosa* and *C. burmanni*, since whole plants or plant parts are being consumed in the form of extract or decoction by people in different regions.

MATERIALS AND METHODS

Materials and sample preparation

The plant samples of *Cleome viscosa* and *C. burmanni* were collected from Kariavattom, Thiruvananthapuram. The plants were identified and voucher specimens submitted to the Dept. of Botany, University of Kerala (KUBH 5806, KUBH 5807). The aerial parts were cleaned and freed from foreign materials. They were then minced, shade dried and powdered. The powdered samples were sealed in plastic bags and stored for further studies. All chemicals used in the study were of reagent grade, unless otherwise stated.

1. Proximate composition

The proximate composition including the moisture content [17], crude fibre [18], total carbohydrates [19], reducing sugars [20], starch [21], amylose [21], amylopectin [21], total protein [22], crude

fat [17], total lipids [23], fatty acids [24], chlorophyll content [25], vitamin C [26], vitamin E [27] and energy value [28] were evaluated in both the species of *Cleome.*

2. Mineral profiling (macro and micro elements)

The powdered sample from each species was separately digested using nitric acid-perchloric acid mixture (4:1) for 24 hours. This was then filtered using Whatman No. 42 filter paper and the filtrate was used to determine the mineral content using Atomic Absorption Spectroscopy (AAS) [29].

3. Anti-nutritional factors

The anti-nutritional factors like tannins [30], saponins [17], oxalates [17], trypsin inhibitors [31], cyanogenic glycosides [32] and phytic acid [33] were estimated in both species of *Cleome*.

RESULTS

The results of the proximate composition, mineral composition and anti-nutritional factors in the two species of *Cleome* studied are recorded (Tables 1-3)

Table 1: Proximate Composition in *Cleome viscosa* and *C. burmanni*.

S. No.	Proximate factors	*C. viscosa*	*C. burmanni*
1.	Moisture content(%)	11.94	13
2.	Crude fiber(%)	7.6	8
3.	Total carbohydrates(%)	53.18	46.77
4.	Reducing sugars(mg/g)	5.3	4.9
5.	Starch (mg/g)	3.8	3.2
6.	Amylose(mg/g)	0.63	0.55
7.	Amylopectin(mg/g)	3.17	2.65
8.	Total protein (%)	28	30
9.	Crude fat(%)	0.5	0.8
10.	Total lipids(%)	2.2	2.8
11.	Fatty acids(%)	0.4	0.64
12.	Chlorophyll content(mg/g)	0.014	0.014
13.	Vitamin C(mg/g)	2.15	1.80
14.	Vitamin E(mg/g)	0.318	0.246
15.	Energy value(Kcal/g)	3.2	3.14

Table 2: Mineral profiling in *C. viscosa* and *C. burmanni*.

S. No.	Minerals(mg/kg)	*C. viscosa*	*C. burmanni*
I	**Macro elements**		
1	Calcium	16142	7269.5
2	Magnesium	14343	7238
3	Potassium	1452.5	4315.5
4	Sodium	598.5	51.1
II	**Micro elements**		
5	Iron	301	98
6	Manganese	77	122.5
7	Zinc	19.95	117.95
8	Copper	4.71	7.62
9	Lead	3.381	4.87
10	Chromium	1.56	1.75
11	Cadmium	0.448	2.709
12	Nickel	ND	ND
13	Silver	ND	ND

*ND – "Not Detected

Table 3: Anti-nutritional factors in *C. viscosa* and *C. burmanni*.

S. No.	Anti-nutrients	*C. viscosa*	*C. burmanni*
1.	Tannins (%)	1.7	2.3
2.	Saponins (%)	12	7.4
3.	Oxalates (mg/g)	11.5	9.20
4.	Trypsin inhibitor (TIU/g)	0.88	0.75
5.	Cyanogenic glycosides (mg/g)	0.79	0.68
6.	Phytic acid (mg/g)	6.15	5.25

DISCUSSION

The nutritional worth of plants depends on their proximate composition. The nutritional and anti-nutritional parameters of *C. viscosa* and *C. burmanni* are compared with the reported values of *C. rutidosperma* and *C. gynanadra* in the present study.

Various proximate factors in *Cleome viscosa* and *C. burmanni* were invesitgated. The moisture content in both species was not too high (< 14%) indicating that the bond water in the samples is low and this probably makes them less liable to microbial spoilage. The amount of crude fiber in both the species was also appreciable (7.6-8%). Fibers in diet facilitate digestion, aid absorption of trace elements in the gut, reduce absorption of cholesterol and facilitate efficient elimination of wastes [34, 35]. The relatively high amounts of carbohydrates (53.18%, 46.77%) and proteins (28%, 30%) in *C. viscosa* and *C. burmanni* suggest the nutritive value of both species. The amount of reducing sugar and starch (amylose and amylopectin) was appreciable in *C. viscosa* and *C. burmanni*. The protein content was 28% in *C. viscosa* and 30% in *C. burmanni*. The fat content was low in both species. Low fat foods are considered as

preferable [36]. Another species of *Cleome, C. rutidosperma* is reported to contain crude fiber (5.24%), moisture (12.80%), protein (26.95%), carbohydrate (48.50%) and fats (1.16%) [37].

Ascorbic acid or vitamin C was detected to be present in both species at relatively high amount. It is a major water soluble antioxidant in the cell cytoplasm and has an important role in the maintainence of redox homeostasis. It reacts enzymatically and non-enzymatically with reactive oxygen species, which in mammals play an important role in aging and cancer. *Cleome viscosa* contained more amounts of Vitamin C and Vitamin E when compared to *C. burmanni* (Table. 1).

Mineral analysis (Table 2) showed that *C. viscosa* was rich in macro-elements such as calcium, magnesium and sodium. Calcium is required for normal growth, activities of muscles and skeletal development and electrical impulses in brain and preventing osteoporosis [38]. Magnesium aids in the chemical reactions in the body, intestinal absorption, also prevents heart diseases and high blood pressure [39]. Sodium helps in fluid balance and nerve transmission. *Cleome burmanni* contained high amounts of potassium. Potassium helps prevent excess fluid retention in the body [38].

Micro-elements such as iron, manganese, zinc were relatively high in both species. Iron was high in *C. viscosa.* Iron is an important part of haemoglobin and helpful for maintaining a healthy immune system [39]. *Cleome burmanni* contained high amounts of manganese and zinc. Manganese plays a role in energy production and supporting immune system [40]. Zinc is useful for protein synthesis, normal growth, reproduction and recovery from illness and the upper toxic limit of zinc in most plants is 500mg/kg [41].

Minerals such as cadmium, lead, copper and chromium in trace amounts are necessary for the proper functioning of the human body but are toxic at high levels. In both species of Cleome, these elements were detected in low amounts. Chronic exposure to Chromium causes lung cancer and is proved to be toxic at 10mg/kg [38]. Excessive amounts of lead in the body results in blindness, deafness, hypertension and neurological disorder. Foods contaminated with cadmium causes vomiting and acute gastrointestinal effects, while chronic exposure causes kidney damage and spontaneous abortions. However, low concentration of cadmium and lead in these plants makes them suitable for medicinal use. Nickel and silver were absent in both species.

Reports on the mineral analysis in *C. gynandra* revealed Ca (3100mg/100g), Mg (1311.4 mg/100g), Fe 38 (1mg/100g), Zn (43.7mg/100g) and Se (0.5 mg/100g) [42].

The nutritional importance of a given sample also depends on the amount of anti-nutrients present. *Cleome viscosa* and *C. burmanni* contained low amounts of anti-nutrients (Table 3). The presence of even a low amount of tannin is not desirable from nutritional point of view. Tannins are polyhydric phenols that form insoluble complexes with proteins, carbohydrates and lipids leading to reduction in digestibility of nutrients. They are not easily completely destroyed by heat due to their high molecular weight [43]. Saponins possess hypocholesterolemic effect and have haemolytic activity against RBC [44]. Oxalates when taken inside the body, combines with calcium to form calcium oxalate crystals which are deposited as urinary stones that are associated with the blockage of renal tubules [45]. Trypsin inhibitor activities affect protein digestibility negatively. They cause pancreatic enlargement and growth depression [46]. Cyanogenic glycosides are precursors of hydrogen cyanide, a well known natural toxicant in foods. It is toxic when ingested by monogastric animals in large quantity. Only plants that produce more than 20mg HCN/100g fresh weight are deleterious [47]. Phytate is an organically bound form of phosphorus in plants. It has 12 replaceable hydrogen atoms and therefore could form insoluble salts with Ca, Fe, Zn, Mg and P, thereby preventing the proper utilization of these minerals [48, 49]. *Cleome rutidosperma* is also reported to contain tannins (0.28 mg/100g), saponins (0.20mg/100g), oxalates (0.37mg/100g), trypsin inhibitor (1.03mg/100g), cyanogenic glycosides (18.50mg/100g) and phytic acid (0.38mg/100g) [37].

CONCLUSION

The present evaluation of various proximate parameters in *Cleome viscosa* and and *C. burmanni* will be helpful while standardizing the drug for its various pharmacological potentials. These plants are rich sources of mineral elements and could be utilized to treat a number of diseases that are mainly caused due to the deficiency of these minerals. Low amount of anti-nutritional factors suggests their utility for consumption. The data obtained in the present work will be useful in the synthesis of new drugs of pharmaceutical importance.

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