Research Journal of Medicinal Plant

ISSN 1819-3455

Academic Journals Inc.

www.academicjournals.com

Research Journal of Medicinal Plant 7 (1): 77-81, 2013
ISSN 1819-3455 / DOI: 10.3923/rjmp.2013.77.81

Elemental Composition of Three Medicinal Plants from Uttarakhand, India

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ABSTRACT

An attempt has been made to analyse macro and micro elements in three medicinal plants (*Solidago canadensis*, *Buddleja asiatica* and *Leucas hyssopifolia*) collected from different regions of Uttarakhand, India. Macro minerals viz., sodium, potassium, calcium, lithium were estimated by Flame Photometer while micro minerals viz., iron, copper, manganese, zinc and cobalt were determined by atomic absorption spectrophotometer. Among all the elements, highest concentration of calcium was recorded in all of the three plants followed by potassium and sodium. Macrominerals such as sodium, potassium, calcium were present in greater amount in *L. hyssopifolia* while *S. canadensis* was found to be richer in microminerals.

Key words: *Solidago canadensis*, *Buddleja asiatica*, *Leucas hyssopifolia*, atomic absorption photometer, flame photometer

INTRODUCTION

Uttarakhand is known for its diverse and rich floristic wealth, magnificent snow covered peaks and a reservoir of many natural resources. This area is the store house of numerous medicinal and aromatic herbs, which are exploited for their utilization in drug, pharmaceutical and perfume industries (Chopra *et al*., 1956). These medicinal plants are used by the local people either in the form of extract or decoction (Kirtikar and Basu, 1923), therefore, their study related to their nutritional value can help to understand the worth of these plants. To do so, the present study was developed with the objective to evaluate the nutritional composition of selected medicinal plants from the different areas of Uttarakhand.

The plants under study are of great medicinal value. The roots, stems and leaves of *Buddleja asiatica* Lour. (Buddlejaceae) have been used as a traditional Chinese medicine for the treatment of fever, ache, diarrhea and articular rheumatism (Chen *et al*., 2005). The blossoms of *Solidago canadensis* Linn. (Asteraceae) are astringent, analgesic, febrifuge and roots are applied as poultice to burns (Grae, 1974; Foster and Duke, 1990; Moerman, 1998). The whole plant of *Leucas* (Lamiaceae) is useful in the treatment of bronchitis, inflammation, asthma, dyspepsia, paralysis and leucoma (Kirtikar and Basu, 2005).

The interest in chemical composition of plant materials is growing as a result of ongoing developments in agriculture, in nutrition, in biogeochemical surveying and mineral prospecting (Rodushkin *et al*., 1999). The essential (trace) elements are necessary for growth,

normal physiological functioning and maintenance of life; they must be supplied by food, since the body cannot synthesize them. The imbalances of these elements in various organs and body fluids can cause physiological disorders (Robert, 1981). Infusion of some plant materials of non-traditional species (used to make stimulant beverages) could be a valuable source of nutrient elements in the human diet (Malik *et al*., 2008).

Much study has been done on the organic constituents of these three medicinal plants but little attention has been paid towards their micro and macro elements, therefore, present study was designed to estimate the presence of these elements in the aerial parts of *B. asiatica, S. canadensis* and *L. hyssopifolia*.

MATERIALS AND METHODS

Plant material: Fresh samples of *B. asiatica, S. canadensis* and *L. hyssopifolia* were collected from different regions of Nainital in the year 2008. The identification of plants were confirmed by the Botanical Survey of India (BSI), Dehradun. The voucher specimens of each of these plants were deposited in the Herbarium Section at BSI, Dehradun, India:

- *B. asiatica*-voucher No. 112965
- *S. canadensis*-voucher No. 112284
- *L. hyssopifolia*-voucher No. 112285

Preparation of samples and instruments used: Mineral content in all of the three plants was estimated by wet digestion method (Hoenig and de Kersabiec, 1996). Aerial parts of these three plants were air-dried and ground into fine powder. One gram of each of the powdered plant material was first digested with conc. HNO_3 (5 mL each), followed by application of 15 mL of tri-acid mixture (HNO_3, $HClO_4$ and H_2SO_4, 10:4:1, v/v) heated at 200°C and reduce to 1 mL. The residue after digestion was dissolved in double distilled water, filtered and diluted to 100 mL. This solution of each of the plant was used for the estimation of minerals. Macro minerals viz., Na, K, Ca and Li were estimated by AIMIL, Flame Photometer while micro elements viz. Fe, Cu, Mn, Zn and Co were estimated by Atomic Absorption Spectrophotometer, model 4129, Electronic Corporation of India Ltd. Estimation of each element was carried out 3 times and the mean values were reported and used. For macro elements, standard blank and sample solutions were passed through flame photometer and concentrations were determined in μg mL^{-1}. Total amount of macro elements (T) in mg kg^{-1} dry weight of samples were calculated by the formula:

$$T\ (\%) = \frac{Y}{W} \times 100$$

where, Y is flame photometer reading and W is weight of sample. The concentrations of micro elements were calculated by the same formula, where, Y is reading of atomic absorption spectrophotometer and W is weight of sample.

RESULTS AND DISCUSSION

The mineral profiles of *B. asiatica, S. canadensis* and *L. hyssopifolia* aerial parts are shown in Table 1. The results show that both Na and K are higher in aerial parts of *S. canadensis* (Na; 27.43 and K; 553.5 mg/100 g) followed by *L. hyssopifolia* (Na; 24.43 and K; 410.6 mg/100 g)

Table 1: Elemental composition of three medicinal plants

Minerals (dry wt. mg/100 g)	*S. canadensis*	*B. asiatica*	*L. hyssopifolia*
Sodium	27.43±0.24	21.94±0.68	24.43±0.45
Potassium	553.50±0.09	324.90±0.92	410.60±0.56
Calcium	637.10±2.55	720.20±1.98	1191.10±2.78
Zinc	5.60±0.28	11.40±0.89	12.50±0.12
Iron	126.70±0.85	29.10±1.84	99.40±0.24
Manganese	11.90±0.86	3.60±0.56	6.90±0.56
Lithium	7.00±1.71	5.00±1.34	12.00±1.98
Copper	2.90±0.45	4.60±0.24	3.30±1.40
Cobalt	3.30±0.12	0.00+0.00	3.00±0.15

Values are Mean±SEM of three findings

and then *B. asiatica* (Na; 21.94 and K; 324.9 mg/100 g). The regulation of potassium is intimately involved with that of sodium in the human body and the two are largely interdependent. A K/Na ratio in diet is an important factor in prevention of hypertension and atherosclerosis since K depresses and Na enhances blood pressure (Yoshimura *et al*., 1991).

The Ca content was found to be highest in *L. hyssopifolia* (1191.10 mg/100 g) and lowest in *S. canadensis* (637.10 mg/100 g). Calcium is required for the synthesis of neurotransmitter acetylcholine, for the activation of enzymes such as pancreatic lipase and absorption of the dietary vitamin B. It is essential for healthy bones, teeth and blood. The health of the muscles and nerves depends on calcium and its deficiency causes rickets, osteomalacia and scurvy (Charles, 1992; Hughes, 1972). The presence of higher Ca content in aerial parts of *L. hyssopifolia* suggests its use in the deficiency of Ca, since it can be absorbed through amino acid secreted by the small intestine (Zhang *et al*., 2001).

The elements like Zn, Fe and Mn are essential trace elements (micronutrients) for living organisms. Zinc is necessary for the growth and multiplication of cells (Thunus and Lejeune, 1994). Its deficiency is characterized by recurrent infections, lack of immunity and poor growth (Prasad, 1982). The average amount of Zn content in *L. hyssopifolia* (12.5 mg/100 g) and *B. asiatica* (11.4 mg/100 g) suggests its use in treatment of bleeding, boils, wounds, insect bites and skin diseases (Thunus and Lejeune, 1994).

The role of iron in the body is clearly associated with hemoglobin and the transfer of oxygen from lungs to the tissue cells (Sigel, 1978). In the plants under study, *S. canadensis* (126.7 mg/100 g) and *L. hyssopifolia* (99.4 mg/100 g) were found to contain good amount of iron while *B. asiatica* (29.1 mg/100 g) aerial parts have very small amount of iron content. Hence, the use of *S. canadensis* aerial parts in general tonic preparation may be advised to compensate iron deficiency.

Mn is an essential element required for various biochemical processes (Weber and Konieczynski, 2003). It is essential for normal bone structure, reproduction and the normal functioning of the central nervous system (Hamilton *et al*., 1994; O'Dell and Sunde, 1997). The higher Mn content was observed in aerial parts of *S. canadensis* (11.9 mg/100 g) followed by *L. hyssopifolia* (6.9 mg/100 g) and finally *B. asiatica* (3.6 mg/100 g).

The aerial parts of *L. hyssopifolia* (12.00 mg/100 g) contain greater amount of Li as compared to other two plants under study. Observational studies in Japan, suggested that naturally occurring lithium in drinking water may increase human lifespan (Zarse *et al*., 2011).

Cu was found to be highest in the aerial parts of *B. asiatica* (4.6 mg/100 g) while Co was totally absent in this plant. Both Cu and Co were present in very small amounts in the aerial parts of both *S. canadensis* (Cu; 2.9 and Co; 3.3 mg/100 g) and *L. hyssopifolia* (Cul; 3.3 and Co; 3.0 mg/100 g).

CONCLUSION

The present study provides data on various elements found in the three plants (*S. canadensis, B. asiatica* and *L. hyssopifolia*), commonly used in the treatment of various ailments. Ca was present in highest concentration in *L. hyssopifolia* and K was found to be in greater amount in *S. canadensis* while the rest of the elements were present in average amount in all of the three plants. Thus, the presence of essential trace elements in these three medicinal plants may readily account for the most of the therapeutic efficiencies. The data may also be used in deciding the dosage of herbal drugs prepared from these plants in the treatment of various diseases.

ACKNOWLEDGMENT

The authors are highly thankful to Dr. H.K. Pandey, Scientist-D, DIBER (DRDO), Pithoragarh, Uttarakhand for biochemical analysis.

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