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ELEMENTAL ANALYSIS OF *PARMOTREMA GRAYANUM* (HUE.) HALE AND *PARMOTREMA PRAESOREDIOSUM* (NYL.) HALE

M. N. VIVEK, YASHODA KAMBAR, K. A. RAMESH KUMAR[a] and T. R. PRASHITH KEKUDA[*]

P.G. Department of Studies and Research in Microbiology, Sahyadri Science College Campus, Kuvempu University, SHIVAMOGGA – 577203 (K.S.) INDIA
[a]Department of Biotechnology, U. A. S, G. K. V. K., BANGALORE – 65 (K.S.) INDIA

ABSTRACT

The present study was undertaken to determine the content of major and minor elements in two foliose macrolichensof the genus *Parmotrema* viz., *P. grayanum* (Hue.) Hale and *P. praesorediosum* (Nyl.) Hale of Western Ghats of Karnataka, India. Elemental determination was done using Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES). The content of calcium and potassium was highest in *P. grayanum* and *P. praesorediosum*, respectively among major elements while the content of sodium was least in both lichens. The content of iron and nickel was highest and least among minor elements in both the lichens. These lichens can be used as source of important elements.

Key words: Macrolichens, Western ghats, *Parmotrema*, Elements, ICP-OES.

INTRODUCTION

Good nutrition is a major problem in most developing countries of the world. As a result, the cases of under-nutrition are increasing in these countries. In order to reduce the adverse effect of hunger and or starvation, it is required that some lesser-known sources are to be investigated for their nutritive value. Lichens are one of the lesser-known nutritive sources to reduce the malnourishment problems in most of the countries[1]. Lichens are self-supporting symbiotic associations of a fungus (mycobiont) and one or several algal or cyanobacterial components (photobiont). These lichens have been used as a source of food, medicine, dye, perfumes etc. Lichens have been traditionally used as food and in preparation of food in various parts of the world. Often, the lichens were eaten only in times of scarcity (such as famine) and were treated before eating. Lichens are shown to be rich in digestible

[*]Author for correspondence; E-mail: p.kekuda@gmail.com

carbohydrates but poor in proteins and minerals. Lichens also form a portion of diet for reindeer and caribou in arctic, sub-arctic and alpine-tundra areas of northern hemisphere often constituting >50% of the forage[1-3]. The lichens of the genus *Parmotrema* (Parmeliaceae) are characterized by large foliose thalli with broad rotund lobe apices, the absence of pseudocyphellae, broaderhizinate marginal zone on the lower surface, marginal cilia, simple rhizines and thick walled ellipsoid ascospores[4]. The present study was conducted to estimate the content of major and minor mineral elements in two foliose macrolichens of genus *Parmotremaviz, P. grayanum* (Hue.) Hale and *P. praesorediosum* (Nyl.) Hale from Western Ghats of Shivamogga district, Karnataka by ICP-OES technique.

EXPERIMENTAL

Collection and identification of lichens

The foliose macrolichens *P. grayanum* and *P. praesorediosum* were collected during September 2013 at Guliguli Shankara, Hosanagara Taluk, Shivamogga district and Maragalale, Thirthahalli Taluk of Shivamogga district, respectively. The lichens were identified by morphological, anatomical and chemical tests[4].

Estimation of elements

1 g of powdered lichen material was digested in 10 mL of ultrapure metal free nitric acid in a microwave digester (CEM). After digestion, the content was diluted to 25 mL using distilled water. The digested lichen content was then aspirated into ICP-OES (Agilent Technologies 700 Series, US) to estimate five major elements *viz*., calcium, potassium, sodium, phosphorus and magnesium and five minor elements *viz*., manganese, iron, zinc, nickel and copper. The calibration standards were prepared by diluting stock multi-elemental standard solution in nitric acid. Instrument configuration and experimental conditions used are described in our previous study[3].

RESULTS AND DISCUSSION

Table 1 shows the content of major and minor elements in powdered lichen materials. The content of all major elements except calcium was found higher in *P. praesorediosum* when compared to *P. grayanum*. In case of minor elements also, *P. praesorediosum* contained minor elements in high quantity than that of *P. grayanum*. However, the content of nickel was same in both lichens. Among minor elements, the content of iron and nickel was highest and least, respectively in both lichens. The content of calcium and potassium

was high in *P. grayanum* and *P. praesorediosum*, respectively among major elements. Sodium content was found least in both lichens.

Table 1: Content of elements (ppm) in the powdered lichen materials

Element	*P. grayanum*	*P. praesorediosum*
Calcium	3546.93	2965.35
Potassium	2568.00	3805.92
Sodium	167.20	175.75
Phosphorus	751.71	1143.89
Magnesium	598.62	1182.06
Iron	4247.70	4845.03
Manganese	80.26	91.56
Copper	16.23	45.16
Zinc	36.38	138.43
Nickel	8.78	8.78

In order to live, all individuals need a number of organic and inorganic compounds in diet. Nutrients viz., carbohydrates, fats and proteins are called macronutrients as they form the major portion of the diet and are consumed in large amount. Mineral elements and vitamins form comparatively smaller part, consumed in much smaller amounts and are known as micronutrients. Mineral elements are often classified as major (macro) and minor (micro) elements on the basis of quantity required. Elements play a number of significant roles in the body. They serve as components of enzymes, regulate cellular energy transduction, gas transport, antioxidant defence, membrane receptor functions, second-messenger systems and integration of physiological functions. Some 25 elements are identified as essential for human health. Hence, the estimation of elements in food and plants is of great interest[5-7].

In case of determination of elements the samples were digested using various acids such as HF, $HClO_4$, HCl, HNO_3 and H_2SO_4 in different digestion equipments including microwave ovens. The technique ICP-OES is widely used in various industries for the determination of elements in various kinds of samples. The inductively coupled plasma generates excited atoms, which emit electromagnetic radiation at characteristic wavelengths for a particular element. These atomic emission lines are sharp and can usually be resolved

from other elements. This technique is advantageous over other techniques such as flame atomic absorption spectroscopy (with mono-elemental detection) because of its multi-element estimation capability and relatively high analytical throughput. Moreover, the accuracy, precision, limit detection and quantification are also superior over mono-element detection systems[3,7-9].

A couple of studies have been done on mineral content determination of macrolichensof Western Ghats of Karnataka[1,3]. In the present study, we estimated the content of elements in the lichens by ICP-OES technique. The phosphorus content of *P. praesorediosum* was higher when compared to *P. pseudotinctorum* while *P. grayanum* contained lesser quantity of phosphorus when compared to *P. pseudotinctorum*. The potassium content of both lichens was higher than that of potassium content of *P. pseudotinctorum* and *Usneapictoides*. The content of calcium and sodium in both the lichens was lesser than that of calcium and sodium content of *U. pictoides*. The iron content of lichens was higher than *U. pictoides* while iron content is found lesser than that of *P. pseudotinctorum*. The content of nickel is higher than that of *U. pictoides*. The copper and manganese content of both lichens was lesser than that of *P. pseudotinctorum* while the manganese content of both lichens was higher than that of *U. pictoides*. The zinc content of *P. praesorediosum* and *P. grayanum* was higher and lesser respectively when compared to zinc content of *P. pseudotinctorum* and *U. pictoides*[1,3].

CONCLUSION

The nutritional quality of any food commodity is often reflected by the content of mineral elements. The results of the present study indicate that the lichens *P. grayanum* and *P. praesorediosum* contain various elements which promote good health. These lichens can be used as a source of minerals and their incorporation in foods possibly supplement many minerals needed for the body.

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