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Research Article

Proximate and mineral composition of wild coco (*Eulophia ochreata* L.) tubers in Iran

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Abstract

The proximate composition and mineral constituents of *Eulophia ochreata* tubers were evaluated. The tubers were found to contain ash: 9.10%, crude protein: 5.44%, crude lipid: 3.25%, crude fibre: 22.90% and carbohydrates: 59.31%. The tubers also have a high energy value (288.25 kcal/100g) dry weight. Mineral ranges (mg/100g dry weight, DW) were: K (4.63), Na (1.62), Ca (7.37), Fe (5.04) and Zn (3.83). Comparing the stem mineral contents with recommended dietary allowances (RDA), the results indicated that *Eulophia ochreata* tubers could be a good supplement for some nutrients such as fibre, protein and carbohydrates.

The tubers could be promoted as a carbohydrate and protein supplement for cereal-based diets in poor rural communities.

Keywords: India**;** *Eulophia ochreata* L..; micronutrients; proximate and mineral composition; tubers

Introduction

In developing nations, numerous types of edible wild plants are exploited as sources of food to provide supplementary nutrition to the inhabitants. Recent studies on agro pastoral societies in Africa indicate that these plant resources play a significant role in nutrition, food security and income generation [1].

Furthermore, according to a Food and Agricultural Organization (FAO) report, at least one billion people are thought to use wild food in their diet [2]. In Ghana alone, the leaves of over

300 species of wild plants and fruit are consumed. In Swaziland, wild plants provide a greater share of the diet than domesticated cultivars. In India, Malaysia and Thailand, about 150 wild plants species have been identified as sources of emergency food [3]. Similarly, in South Africa about 1400 edible plant species are used, while in the Sahel region, over 200 wild food items were identified as being used by the rural communities [4]. In most of these reports, it was emphasized that nutritionally, these unconventional plants foods could be comparable to, or even sometimes superior to, the introduced cultivars [1]. It is, therefore, worthwhile to note that the incorporation of edible wild and semi-cultivated plant resources could be beneficial to nutritionally marginal populations or to certain vulnerable groups within populations, especially in developing countries where poverty and climatic changes are causing havoc to the rural populace. As one example, analyses were carried out to evaluate the nutritional content of *Momordica dioicia R*. fruit with the hope that it would be incorporated into the food basket of the country [5, 6, 7, 8].

Materials and Methods

Plant material

Eulophia ochreata tubers used as experimental material were collected from farm lands in around Behbahan, South Iran, in October 2007. The collected plant material was placed in a polyethylene bag to prevent loss of moisture during transportation to the laboratory.

Preparation of plant material for chemical analyses

Eulophia ochreata tubers were washed with distilled water and dried at room temperature to remove residual moisture, then placed in paper envelope and oven-dried at 55ºC for 24 hours [9]. The dried stems were ground into powder using a pestle and mortar and sieved through a 20-mesh sieve. The stem powder was used for nutrient analysis.

Proximate analysis

The methods recommended by the Association of Official Analytical Chemists (AOAC) were used to determine ash (#942.05), crude lipid (#920.39), crude fibre (#962.09) and nitrogen content (#984.13) [10].

Determination of crude lipid and crude fibre content

Two grams of dried tubers were weighed in a porous thimble of a Soxhlet apparatus, with its mouth plugged with cotton wool. The thimble was placed in an extraction chamber which was suspended above a pre-weighed receiving flask containing petroleum ether (b.p. 40-60ºC). The flask was heated on a heating mantle for eight hours to extract the crude lipid. After the extraction, the thimble was removed from the Soxhlet apparatus and the solvent distilled off. The flask containing the crude lipid was heated in the oven at 100ºC for 30 minutes to evaporate the solvent, then cooled in a dessicator and reweighed. The difference in weight was expressed as percentage crude lipid content. Crude fibre was estimated by acid-base digestion with 1.25% H_2SO_4 (prepared by diluting 7.2 ml of 94% conc. acid of specific gravity 1.835g ml-1 per 1000 ml distilled water) and 1.25% NaOH (12.5 g per 1000 ml distilled water) solutions. The residue after crude lipid extraction was put into a 600 ml beaker and 200 ml of boiling 1.25% H_2SO_4 added. The contents were boiled for 30 minutes, cooled, filtered through a filter paper and the residue washed three times with 50 ml aliquots of boiling water. The washed residue was returned to the original beaker and further digested by boiling in 200 mL of 1.25% NaOH for 30 minutes. The digest was filtered to obtain the residue. This was washed three times with 50 ml aliquots of boiling water and finally with 25 ml ethanol. The washed residue was dried in an oven at 130ºC to constant weight and cooled in a dessicator. The residue was scraped into a pre–weighed porcelain crucible, weighed, ashed at 550ºC for two hours, cooled in a dessicator and reweighed. Crude fibre content was expressed as percentage loss in weight on ignition [10].

Determination of nitrogen content and estimation of crude protein

Macro–Kjeldahl method was used to determine the nitrogen content of the stem. 2g of dried tubers were digested in a 100 ml Kjeldahl digestion flask by boiling with 10 ml of concentrated tetraoxosulphate (VI) acid and a Kjeldahl digestion tablet (a catalyst) until the mixture was clear. The digest was filtered into a 100 ml volumetric flask and the solution made up to 100 ml with distilled water. Ammonia in the digest was steam distilled from 10 ml of the digest to which had been added 20 ml of 45% sodium hydroxide solution. The ammonia liberated was collected in 50 ml of 20% boric acid solution containing a mixed indicator. Ammonia was estimated by titrating with standard 0.01 mol L-1 HCl solution. Blank determination was carried out in a similar manner. Crude protein was estimated by multiplying the value obtained for percentage nitrogen content by a factor of 6.25 [10].

Estimation of carbohydrates and energy values

Available carbohydrate was estimated by difference, by subtracting the total sum of percent crude protein, crude lipid, crude fibre and ash from 100% DW of the tubers The plant calorific value (in kJ) was estimated by multiplying the percentages of crude protein, crude lipid and carbohydrate by the factors 16.7, 37.7 and 16.7 respectively [10].

Mineral analysis

The mineral elements Na, K, Ca, Fe and Zn were determined on 0.3g tuber powder by the methods of Funtua [6, 7] using Energy Dispersive X-ray Fluorescence (EDXRF) transmission emission spectrometer carrying an annular 25 mCi 109Cd isotopic excitation source that emits Ag-K X-ray (22.1 keV) and a Mo X-ray tube (50KV, 5mA) with thick foil of pure Mo used as target material for absorption correction. The system had a Canberra Si (Li) detector with a resolution of 170eV at 5.9keV line and was coupled to a computer controlled ADCCard (Trump 8K). Measurements were carried out in duplicate. Na was analyzed after wet digestion of one gram of the fruit powder with nitric/perchloric/sulphuric acid (9:2:1 v/v/v) mixture. Sodium was analyzed with a Corning 400 flame photometer [10].

Results and Discussion

Proximate analysis

The results of proximate composition of *Eulophia ochreata* tubers are shown in Table 1. The ash content, which is an index of mineral contents, for *Eulophia ochreata* tubers value of 9.10% DW was less than the values .reported for other edible leaves such as *Momordica balsamina* leaves (18.00 ± 1.27% DW) [11, 12, 13]. It is apparent that *Eulophia ochreata* tubers were not a good source of potassium and iron. The crude protein content (5.44%) was less than what is reported for some lesser known wild leafy vegetables such as *Momordica balsamina* (11.29 ± 0.07%), *Moringa oleifera* (20.72%), *Lesianthera africana* leaves (13.10 – 14.90%) and *Leptadenia hastate* (19.10%) [14]. Plessi *et al.* [15], found that plant food that provides more than 12% of their calorific value from protein are a good source of protein. In that context, *Eulophia ochreata* tubers (5.44%) are a good source of protein. The crude lipid content (3.25%) of the fruit was less than the range (8.3 – 27.0% DW) reported for some vegetables consumed in Nigeria and Republic of Niger [16].

The estimated carbohydrate content (59.31%) in *Eulophia ochreata* tubers was found to be higher than that for *Senna obtusfolia* leaves (20%) and *Amaranthus incurvatus* leaves (23.7%). The crude fibre content in *Eulophia ochreata* tubers (22.90%) was higher than the reported values (8.50 – 20.90%) for some Nigerian vegetables [16]. One discussed drawback to the use of vegetables in human nutrition is their high fibre content, which may cause intestinal irritation and a decrease of nutrient bioavailability. The fibre RDA values for children, adults, pregnant and breast-feeding mothers are 19 –25%, 21 – 38%, 28% and 29% respectively. Thus, *Eulophia ochreata* tubers could be a valuable source of dietary fibre in human nutrition. The calorific value of *Eulophia ochreata* tubers was estimated to be 288.25kcal/100g (DW), which is an indication that it could be an important source of dietary calories. High calorific content of the fruit could be attributed to high total carbohydrates content.

Mineral content

Table 2 shows the results of the mineral concentrations of *Eulophia ochreata* tubers. Nutritionally significant elements are compared with the standard recommended dietary allowance. When compared with standard values as shown in Table 2, *Eulophia ochreata* tubers show a less than adequate level of K, Fe, Zn, Ca and Na. In Figure 1 it is shown that the plant tubers are satisfactory sources of calcium for all categories of people, while sodium is adequate enough for adult females and children, assuming total assimilation of these minerals.

Table 1. Proximate composition of *Eulophia ochreata* tubers.

Parameters	Concentration (% DW) *
Ash	9.10± 0.80
Crude protein	5.44± 0.27
Crude lipid	3.25± 0.50
Crude fibre	22.90± 0.35
Carbohydrates	59.31±0.68
Calorific value(kcal/100g)	288.25±5.31

* The data are mean values± deviation(SD) of three replicates.

* Values expressed as % wet weight

Table 2. Mineral composition of *Eulophia ochreata* tubers.

Mineral	Available Quantity in mg/ 100gDW*	Recommended Dietary Allowances (mg/day)**			
		Children 7-10 Years	Adult male	Adult female	Pregnant & Lactating mothers
Potassium	4.63±0.15	800	800	800	1200
Calcium	7.37±0.02	1600	2000	2000	2000
Sodium	1.62±0.08	400	500	400	500
Iran	5.04±0.01	10	10	15	13
Zinc	3.83 ±0.07	10	15	12	19

* The data are mean values± deviation(SD) of three replicates. ** Sources: Thangadari *et al*.(2001)

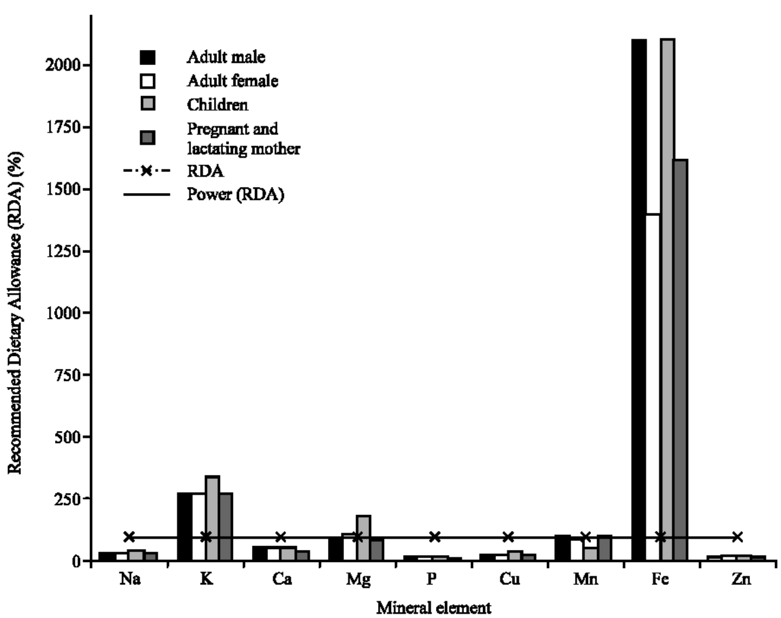

Figure 1. Comparison of mineral content of *Eulophia ochreata* tubers with recommended dietary allowances.

Conclusion

The results of the nutritional analysis show that *Eulophia ochreata* tubers are a good source of plant fibre, protein and carbohydrates. The results suggest that, if consumed in sufficient amounts, the plant tubers could contribute greatly towards meeting human nutritional requirements for normal growth and adequate protection against diseases arising from malnutrition. From the results, *Eulophia ochreata* tubers are recommend for continued use for nutritional purposes, considering the amount and diversity of nutrients they contain. Chemical analysis alone however, should not be the exclusive criteria for judging the nutritional significance of plant parts. Thus, it becomes necessary to consider order aspects such as the presence of anti-nutritional/toxicological factors and biological evaluation of nutrient contents [17].

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