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Goji berries (*Lycium barbarum*) as a source of trace elements in human nutrition

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Abstract

The goji fruits (*Licyum barbarum*) are known through their high mineral content: Ca, Mg, P, Fe, Zn, Cu, P, Se, etc., with a positive incidence of high importance on the human body. Considering these aspects, the present paper is provides information on the possibility of using such fruits as mineral supplements for human food. A series of trace essential elements: Fe, Mn, Zn, Cu, Cr and toxic substances: Pb, Cd > were determined by atomic absorption spectrometry of (AAS).The experimental results reveal contents of essential items and small values of toxigenic elements. Therefore the goji fruits (imported from China) show a variant of use, as an additional source of trace elements in human nutrition.

Keywords: goji fruits, trace elements, human nutrition

1. Introduction

Controlled *Lycium barbarum* fruit, goji berry, is the fruit of the shrub with the same name (Family Solanaceae) from north-west China. This ellipsoidal reddish fruit 1-2 cm long has been long known not only due to its nutritive features but also due to its numerous benefits for human health [1-2]. Its nutritive and pharmacological features are caused by a large number of active biological compounds that make it. Literature supplies numerous information regarding the composition and nutritive and therapeutical importance of this medicine-fruit [3-6].

Thus, goji berries contain 19 amino acids the building blocks of protein - including eight that are essential for life, 21 trace minerals - including germanium, an anticancer trace mineral rarely found in foods, more protein than whole wheat (13 percent), a complete spectrum of antioxidant carotenoids, including beta-carotene (a better source than even carrots) and zeaxanthin (protects the eyes). Goji berries are the richest source of carotenoids of all known foods. In addition, this fruit is rich in vitamin C (at higher levels than even those found in oranges), B-complex vitamins - necessary for converting food into energy, vitamin E - very rarely found in fruits, only in grains and seeds, beta sitosterol - an anti-inflammatory agent, as well as a large number of essential fatty acids - which are required for the body's production of hormones and for the smooth functioning of the brain and nervous system, cyperone - a sesquiterpene that benefits the heart and blood pressure, alleviates menstrual discomfort, and has been used in the treatment of cervical cancer, solavetivone - a powerful anti-fungal

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and anti-bacterial compound, Physalin - a natural compound that is active against all major types of leukaemia, Betaine - used by the liver to produce choline, a compound that calms nervousness, enhances memory, promotes muscle growth, and protects against fatty liver disease etc. [7-10].

The benefits on human health, the therapeutical features of the goji berries are associated to a large number of hypoglycaemia, immune-modular, anti-hypertensive, hepatic, anti-ageing, anti-fatigue, anti-oxidant, etc. treatments [11-12].

All these features recommend the introduction of the goji berries in nutrition either fresh, dried, or in preparations as healthy foods such as teas, syrups, jam, etc.

The remarkable nutritive features of the goji berries are also due to the important content in minerals, some of which are essential for the normal functioning of the human body: Ca, Mg, K, P, Fe, Zn, Cu, Cr, I, Se, etc. [13-16]. We need to mention the fact that accidentally – because of geogenous or anthropic causes (soil and climate conditions, the existence of some pollutants, some improper processing, etc.) these fruit can also contain some toxic elements (Hg, Pb, As, Cd, etc.) that have a negative impact on the human body [17-20]. This is why we believe we need to use this fruit as a nutrition supplement for essential minerals. In this paper, the authors determine the distribution of some essential microelements such as Fe, Mn, Cu, Zn, and Cr and of some toxic elements such as Pb and Cd in goji berries samples imported from China to assess the daily nutritive mineral supply.

2. Materials and Method

2.1 Materials. To carry out the experiment, we purchased dried goji berries imported from China from three different green pharmacies. To determine the elements of interest here, we sampled three homogeneous samples of 5 g each.

2.2. Reagents. Aqueous standard solutions for Ca, Mg, Fe, Mn, Zn, Cu, Cr, Pb and Cd were prepared by appropriate dilution of 1,000 gL^{-1} stock solutions (Merck Darmstadt, Germany). To disaggregate the samples, we used HNO_3 0.5 N from 65% HNO_3 (Suprapur, Merck) and bidistiled water.

2.3. Apparatus. Measurements were carried out using a Varian Atomic Absorption Spectrometer Instruments tip AA 240 FS. As working parameters, we have chosen optimum parameters according to the apparatus description. To calcinate, we used the calcination oven Nabertherm Model le 6/11.

2.3. Procedure. Determining the minerals in the analysed fruit needed two working steps: mineralisation through calcination followed by the solubilisation of the inorganic matter in nitric acid 0.5 N and by spectrophotometric determination of the absorbance of the elements of interest.

In the first step, the samples of 5±0.0002 g were calcinated at 550^0C in two sessions of 4 h each. After cooling, the ashes from the calcination was recovered with 25 mL solution of HNO_3 0.5 N, and then evaporated until almost dry; the second operation was repeated two times. After the complete solubilisation the samples solution was filtered and made up to 50 ml with bidistiled water and was submitted for analysis.

The determination of elements in the dry fruit in was performed by atomic absorption spectrometry in air-acetylene flame (FAAS).

3. Results and discussion

The distribution of microelement in goji berries (*Lycium barbarum*) in the samples analysed is shown in Table 1.

Table 1. Microelement content in goji berries (*Lycium barbarum*) samples imported from CHINA

Sample	Metal content - average values (mg/kg)						
	Fe	Mn	Zn	Cu	Cr	Pb	Cd
Sample 1	46	4,70	130	6	0,51	< 0,1	< 0,01
Sample 2	87	5,97	110	9	0,45	< 0,1	< 0,01
Sample 3	68	7,15	90	10	0,24	< 0,1	< 0,01
Average	**67**	**5,94**	**110**	**8,3**	**0,4**	**< 0,1**	**< 0,01**

Table 1 shows that the distribution of the elements in the analysed samples is uneven. This is confirmed by literature, which mentions that the distribution of minerals in different vegetal products (fruits or vegetables) is determined by the nature of the products and elements analysed as well as by the cultivation conditions. Among the elements we analysed, Zn is the best represented with values between 90 and 130 mg/kg, followed by Fe in smaller concentrations of 46-87 mg/kg. Mn and Zn are in almost equal concentrations (between 4.70 and 7.15, and 6.0 and 10.0 mg/kg, respectively), but lower than Fe and much lower than Zn. We need to mention that Zn and Cu above certain concentrations established by regulations have negative effects on the human body [21]. In our case, the samples we analysed do not contain excessive amounts of Zn and Cu.

Cr was identified in very small concentrations of 0.24-0.51 mg/kg.

We did not identify any detectable amounts of toxic elements such as Pb and Cd. Experimental data show that goji berries can be considered one of the richest fruits in essential elements such as Fe, Zn, Mn, Cu, and Cr.

The increased content of essential elements and the negligible concentrations (SLD) of toxic elements could make possible the use of these fruit fresh or dry as food supplements supplying minerals. If we take into account the average daily dietary intake (ADDIs) [22] for the studied elements presented in Table 2, we can calculate the contribution in minerals to the daily nutrition of a certain amount of fruits.

Table 2. Dietary Reference Intakes (DRI): Recommended intakes for individuals elements

Mineral	Dietary reference intake	
	Men	Women
Iron (mg/day)	8	18
Manganese (mg/day)	2,3	1,8
Zinc (mg/day)	11	8
Cooper (μg/day)	900	900
Chromium (μg/day)	35	25

Thus, for a daily intake of 10 g of dry goji fruit (a teaspoonful) – the equivalent of a medium-size fresh apple – the supply of essential minerals is shown in Table 3.

Table 3. Supply of essential elements in Dietary reference intakes for 20 g dry goji berries

Mineral	Supply from ADDI (%)	
	Men	Women
Iron	16,75	7,44
Manganese	5,16	6,23
Zinc	25,00	27,5
Cooper	18,44	18,44
Chromium	22,86	32,00

Data presented in Table 3 point out the substantial contribution of this fruit to the daily mineral intake. The percentage in essential elements in average daily dietary intake (ADDI) follows the trend Cr > Zn > Cu > Fe > Mn.

To mention that when using systematically this fruit as a mineral supplement we need to take into account not to go above certain daily doses. Improper excessive consumption can overload the body with certain minerals or nutrients that could have unwanted side effects [23-25]. This is why it is imperative to have a good control of the concentration of minerals not only to know the quantum of essential or toxic elements but also to avoid excess or cumulative effects caused by other constituents of such fruit.

4. Conclusions

Experimental results from the determination of some mineral microelements in goji berries point out important amounts of essential elements (Zn > Fe > Cu > Mn > Cr) and very small, negligible amounts of toxic elements (Pb and Cd). As such, goji berries analysed are of interest as supplementary supply of some essential elements with a substantial contribution to the daily mineral intake; percentage supply in essential elements in average daily dietary intake (ADDI) follows the trend Cr > Zn > Cu > Fe > Mn. However, we recommend caution when systematically using this fruit as a mineral supplement because improper, excessive consumption can overload the body with certain minerals or nutrients that could have unwanted sid.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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