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METAL IONS

SPIRULINA PLATENSIS IS AN ADVANCED FOOD SOURCE OF THE ESSENTIAL TRACE ELEMENTS ORGANIC FORMS

V.K. Mazo[1], I.V. Gmoshinski[1], Ju.P. Aleshko-Ozhevski[1], N.A. Pronina[2], G.N. Mazo[3], S.N. Savvin[3]

[1]State Institute of Nutrition R.A.M.S., 2/14 Ustjinski proezd, Moscow 109240 Russia.

[2]Institute of Plant Physiology R.A.S. 35 Botanicheskaya ul. Moscow 127276 Russia

[3]Moscow State University, Leninskie gory, Moscow, 119899 Russia.

Introduction

Epidemiological research testifies about a wide prevalence of trace elements (TE) inadequate security in population of Russian Federation and adjacent countries.

An effective and accessible means to increase the TE security of the population is a wide use in people nutrition of biologically active food supplements containing organic derivatives of these TE. An advanced source of selenium, zinc, copper, chromium and other TE organic forms is a food micro alga *Spirulina platensis*.

There is a process of TE biological transformation from inorganic into organic forms that takes place during the course of their assimilation. High bioavailability and small toxic action of TE organic forms lowering the probability of accidental overdose define their wide use in biologically active food supplements and specialized foodstuffs of prophylactic destination. Correspondingly the identification and quantitative determination of TE organic forms have direct relation to quality valuation of their food sources. Aims of this study is the characteristics of new food TE source received by photo biological incorporation of TE in food micro alga *Spirulina platensis* during its cultivation.

Materials and Methods

Spirulina platensis biomass samples enriched with zinc and chromium in the course of cultivation were granted by Victoria LTD, Sochi, Krasnodar Province, Russia. During cultivation proceedings there were zinc (II) sulphate, copper (II) sulphate, chromium (III)-potassium sulphate and sodium selenite added to cultivation media.

For the purpose of quantitative estimation of metal protein and lypophylic (lipides, pigments) fractions were separated from biomass. In this case dry biomass (200 mg) was treated by methanol in a homogenizer with glass balls for 15 minutes. The ratio balls: methanol was 1:1. After that precipitate containing denatured protein was isolated from fraction enriched with lipides, chlorophyll, etc. The quality of lypophylic fraction extraction

TABLE 1. MEASUREMENTS CONDITIONS.

Zn (213.9 nm)	Cr (S 357.9–359.4–360.5 nm)	Cu (S 234.8–327.4 nm)
RF power 600 watts	RF power 550 watts	RF power 550 watts
Viewing height 130 mm	Viewing height 110 mm	Viewing height 130 mm
Lamp current 11 mA	Lamp current 20 mA	Lamp current 10 mA
Sample uptake rate 4 ml/min	Sample uptake rate 4 ml/min	Sample uptake rate 4 ml/min
Argon gas pressure 300–370 kPa	Argon gas pressure 300–370 kPa	Argon gas pressure 300–370 kPa
Detection limit 0.3–1 mg/l	Detection limit 3–10 mg/l	Detection limit 2–6 mg/l
Gas flow:	Gas flow:	Gas flow:
➢coolant 10 l/min	➢coolant 10 l/min	➢coolant 10 l/min
➢carrier 1.8 l/min	➢carrier 1.8 l/min	➢carrier 1.8 l/min
Interelement (matrix) interferences with Zn are generally absent at the above RF power.		
Reproducibility of replicate measurements 1% "%RSD" readout 3%		

TABLE 2. ANALYSIS OF SAMPLES*.

Fractions	Concentration of Zn		Concentration of Cu		Concentration of Cr	
	ppm	%	ppm	%	ppm	%
Fraction I	1288±11	100	2409±18	100	199±9	100
Fraction II (proteins)	1110±8	87	1491±21	62	163±9	82
FractionIII (lipids)	89±3	7	141±5	6		
Cell		94		66		
Fraction IV	18±2	2	473±13	20	6±2	3
Total		96		88		85

* High-purity ultrafiltered water was used for dilution of the standards and samples.

was controlled by the color of protein fraction. It did not contain chlorophyll and had a blue color. In case of partial extraction a protein precipitate was boiled with methanol in a water bath for 15 minutes at 30°C. All methanol extracts were combined and methanol was removed in a rotary evaporator.

Protein and lypophylic fractions were decomposed by mineralization procedure. Samples obtained were used for further speciation analyses.

The quantitative estimation of copper, zinc and chromium associated with different fractions extracted from Spirulina Platensis algae was conducted using Inductively Coupled Plasma Atomic Fluorescence spectrometry (see table 1). All analyses were done in 4 to 5 replicates. The detection limits for Zn, Cr, and Cu were 0.8 mg/l, 5 mg/l, and 4 mg/l, respectively.

Quantitative determination of selenium contents was established by means of spectrofluorimetry methods (Golubkina, 1995).

Results and Discussion

The total biomass enrichment with Zn, Cr, and Cu was determined, as well as the concentration of elements adsorbed outside the cell, and the microelement content associated with biologically active compounds within the cell. It was demonstrated that the cells contain microelements in proteins (80–90%) and in lypophylic compounds (2–5%). The microelement content adsorbed outside the cells was below 8% (see table 2).

Selenium enriched biomass *Spirulina platensis* contents about 600 ppm selenium organic derivatives.

Modern nutrition concepts focus on micronutrients, and therefore biologically active food supplements. The biological availability of essential microelements increases if they are bound to organic compounds rather than added as inorganic salts, and at the same time their overdose toxicity is reduced. Micro algae are the new prospective food sources of essential microelements in organic form. *Spirulina platensis*, a blue-green micro alga grown in the media enriched with inorganic salts of zinc, chromium and copper has been used for this purpose as a natural biological “matrix”.

Acute toxicity studies revealed twofold administration of zinc- and selenium enriched *Spirulina* had no any signs of toxic action in laboratory animals (white rats).

Conclusion

The materials presented confirm good advances of *Spirulina* with high levels of biologically incorporated TE as stuff for new generation of bioactive food supplements.

Reference

Golubkina N.A. 1995. Fluorimetric method of selenium determination // Zhurnal Analiticheskoj Khimii. Vol.50. P.492–497.