EVALUATION OF OLIGOELEMENTS IN THE FRUITS OF *AESCULUS HIPPOCASTANUM L.* BY AASF

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Abstract

Aim and objectives. *The lack of oligoelements (essential trace elements) in organisms may constitute the cause of diseases whose symptoms become reversible by means of a nutrition based on these oligoelements. Vegetal products may constitute an important source of essential oligoelemets.*

Material and methods. *The following study was performed on the fruit of Aesculus hippocastanum L. tree (the pig chestnut tree), originally coming from two regions of Bihor county. The fruits were extracted in periods of vegetation corresponding to their complete growth and treated for the purpose of analyzing the oligoelements (Cu, Zn, Mn, Ni, Cr and Cd) through the atomic absorption spectroscopy with flam (AASF).*

Results and conclusions. *Taking into account that the type and humidity of the soil, the atmospheric pollution, the age of the plant and the morphologic properties influence the content of oligoelements, with this work we performed a comparative analytical study.*

Big concentrations of Cu, Zn and Mn have been determined from the samples collected in the Oradea city (2007)). As regards the presence of non-essential oligoelements or noxious to the human organism (Ni, Cd, Pb) in all the samples, we notice concentrations exceeding the admitted limits.

Keywords: *Aesculus hippocastanum L.*, atomic absorption spectrometry, oligoelements.

EVALUAREA OLIGOELEMENTELOR DIN FRUCTUL DE *AESCULUS HIPPOCASTANUM L.* PRIN SAAF

Rezumat

Obiective. *Carenţa organismelor în oligoelemente poate constitui o cauză a îmbolnăvirilor, a căror simptome devin reversibile printr-un aport nutriţional îmbogăţit în aceste oligoelemente. Produsele vegetale pot constitui o sursă importantă în oligoelemente esenţiale.*

Material şi metodă. *S-a luat în studiu fructul arborelui Aesculus hippocastanum L. (castan sălbatic) originar din două zone ale judeţului Bihor. Fructele au fost prelevate în perioade de vegetaţie corespunzătoare maturării complete, tratate în vederea analizei oligoelementelor (Cu, Zn, Mn, Ni, Cr şi Cd) prin spectroscopie atomică de absorbţie în flacără (SAAF).*

Rezultate şi concluzii. *Ţinând seama că natura şi umiditatea solului, poluarea atmosferică, vârsta plantei şi caracteristicile morfologice influenţează conţinutul în oligoelemente, în lucrare s-a întreprins un studiu analitic comparativ.*

Concentraţii mari de Cu, Zn şi Mn s-au determinat din probele prelevate în Oradea (2007). În ceea ce priveşte prezenţa oligoelementelor neesenţiale sau nocive organismului uman (Ni, Cd, Pb) în toate probele se semnalează concentraţii peste limitele admise.

Cuvinte cheie: *Aesculus hippocastanum L.,* spectroscopie atomică de absorbţie, oligoelemente.

INTRODUCTION

The term „oligoelements" is attributed to the elements that are present in infinitesimal quantities, having a biocatalytical function and being apt to interfere in a biochemical way in the improvement of the vital function [1]. Since the oligoelements play a crucial vital role: the catalyser role or coenzyme in numerous metabolic ways, the severe deficits in humans can diminish vitality, resistance to aggressions (immune response) and lead to various diseases.

The quantification of oligoelements in some plants represents a current subject for researchers on a worldwide level; they appeal to analytical methods of great performance, thus managing to surpass the difficulties connected to isolating the elements in the organism mould and protecting them by avoiding the losses through oxidation or the overdosing through pollution.

The most important microelements are: Copper, Zinc, Manganese, Chromium, Iron, Boron, Strontium, Barium, Lithium, Molybdenum, Arsenic, Vanadium, Rubidium, present in quatities between 0.00001 and 0.001% of the dry substance of the plant.

MATERIAL AND METHODS

In our research fruits of *Aesculus hippocastanum L* (wild chestnut tree) have been drawn, from two areas (Oradea – in the center and Adoni – Bihor country) in the same periods of time in 2005, 2006, 2007 [2,3].

Fig.1. *Aesculus hippocastanum L.*

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Chestnuts were collected in September and October, daily, selecting the ones that are entire, wholesome, clean. Stretched out on layers of 25-30 cm in thickness, in dry places, they gradually become dry during three weeks, being kept at room temperature. In drying rooms with warm temperature they are being kept at 40°C, for an hour, then the temperature is raised up to 60°C [4].

For the quantitative analyses of the oligoelements, in the obtained extracts, the method of *atomic absorption spectrometry AAS* was used, the method that corresponds to the level of sensitivity and specificity that the analyses of these elements requires *in marks*, in the vegetal samples that we studied.

The factors that influence in a decisive way the results of the determinations:

- the method of separation and extraction of the active element;
- in the vegetal samples the method of analysis.

In order to obtain the determination, the vegetal samples were drawn, dried and shredded in appropriate conditions and submitted to mineralization operations (acid moist oxidation), extracted with solvents and prepared in order to be introduced in the spectrometer device [5,6,7,8].

Working method:

We weighed 0.5000 ± 0.0001 g of dry vegetal material, finely cut and then, quantitatively, removed in a dry Erlenmeyer flask (100 ml). Over the sample we added 10 mL of oxidising mixture (1:1) concentrated nitric acid: concentrated perchloric acid and we left it until the next day at room temperature. Further on, the sample was heated on a thermo-electric heater at 150°C under basket funnel. We continued the heating at the same temperature until the nitrate vapours vanished and the solution lost colour. The discolouring of the solution was also enhanced by the addition of 1 ml H_2O_2 30%. The samples rendered soluble and filtered were brought to the line with double distilled water in containers of 10 ml [7,8,9].

The apparatus standardization: from the reserved standard solution (1 g/l), we prepared, through dilution, a working solution (100 mg/l). Afterwards, from this solution, we prepared the calibration standards with the following concentrations: 0.5 mg/l; 1.0 mg/l; 3.0 mg/l; 5.0 mg/l. We set the apparatus according to the instructions [8,10]. We established the wavelength corresponding to the element to be determined, according to the table I.

Table I. The wavelength of some oligoelements [5].

Nr. crt.	THE ELEMENT	λ-Wavelength (nm)
1.	Cu	324.8
2.	Zn	213.9
3.	Mn	279.5
4.	Ni	232.0
5.	Cr	357.9
6.	Cd	228.8
7.	Pb	217.00

The device used: **GBC AVANTA atomic absorption flame spectrometer.** The parameters of the device: flame air/acetylene, substance correction with deuterium lamp, the length of the burner being 10 cm, optical system with double fascicle. The command of the device and the data processing was done using the *AVANTA* software.

The calculus of the concentrations was as follows:

Oligoelement (µg /g) = (A-M) x V/m

where:

A and M – values read on the device screen for exhibit A and for the witness (M=0)

V – the volume of the quoted balloon in which the exact measured exhibit was weighed (50)

m – the powder quantity of measured vegetal material (0,5 g)

RESULTS AND DISCUSSION

In the atomic absorption spectrometry with flame (AASF), the atoms of an element put in flame can receive energy both from the heat of the flame, and from a radiation having a proper wavelength, that is passing through the flame. In both cases, the atoms can be stimulated from an initial power state to a different superior state, accepted by the spectroscopic laws.

The absorbability of the atoms in the flame is directly proportional to the vaporized atoms, existing in a fundamental state, being independent of the flame temperature. The absorbed intensity is independent of the excitation energy of the atoms, but it is directly proportional to the thickness of the absorbent layer [10]. The obtained results are calculated for each element and the average of individual determinations (n = 3) are specified in table II.

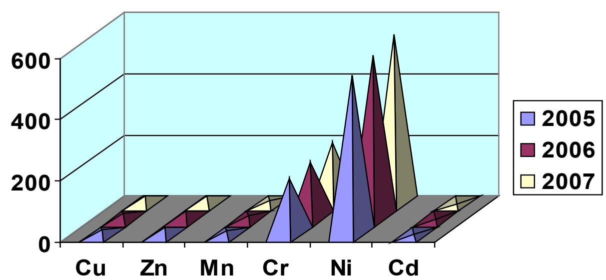

Fig. 2. The variation of the oligoelements concentration in the *fruits* of *Aesculus hippocastanum L.* harvested in Oradea.

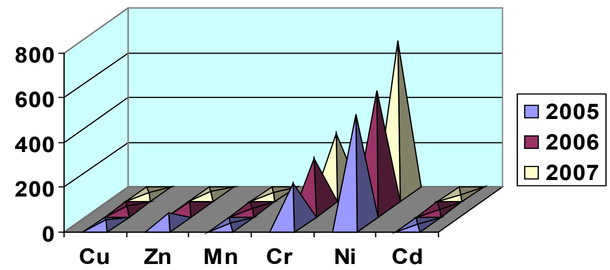

Fig. 3. The variation of the oligoelements concentration in the *fruits* of *Aesculus hippocastanum L.* harvested in Adoni.

CONCLUSIONS

As we can see, there is an increase of about 150% in Oradea and a 50% decrease in Adoni, respectively in the *Cu concentration*. The highest Cu concentration was found in the pig chestnut tree fruits coming from Oradea (27.08 µg/g), and the lowest one was found in Adoni fruits (9.33 µg/g), the both samples harvested in 2007 (Fig. 2-3).

An increase of 135% occurred in the Zn concentration for the Oradea samples (maximum concentration of Zn 28.03%) and a decrease of 26% for the Adoni samples (minimum concentration of Zn 13.68%).

There has been an increase in the Mn concentration in all samples of about 110% (Oradea) and 133% (Adoni). The concentration limits vary between 12.13 µg/g (Oradea, 2007) and 6.32 µg/g (Adoni, 2005).

Cr concentration, ranging from 181.70 µg/g and 271.40 µg/g, increased every year and in every area with about 110% in Oradea and about 142% in Adoni, peaking in Adoni in 2007.

Concerning the Ni, we cannot speak about a loss of concentration by the year (2005-2006-2007) and the collection area, but an increase of approx. 106-140%.

A special situation happened in the case of chestnut fruits harvested in Adoni where the Cd concentration in the decreased from 1.403 µg/g la 0.194 µg/g in the period analyzed by us (2005-2007).

Pb was present in fruits during the three years studied by us, having an adverse effect on all living organisms of the biosphere.

Table II. The content of oligoelements in the *fruit* of *Aesculus hippocastanum L.* evaluated through AASF (µg/g).

Vegetal material	Region / Year	Cu (µg/g plant) *	Zn (µg/g plant) *	Mn (µg/g plant) *	Cr (µg/g plant) *	Ni (µg/g plant) *	Cd (µg/g plant) *	Pb (µg/g plant) *
FRUIT	Oradea / 2005	16.68	21.73	11.28	181.70	520.30	0.202	< 1.00
	Oradea / 2006	20.03	25.33	12.01	187.25	535.15	0.112	< 1.00
	Oradea / 2007	27.08	28.03	12.13	199.13	554.08	0.025	< 1.00
	Adoni / 2005	18.65	53.90	6.32	183.68	489.97	1.403	< 1.00
	Adoni / 2006	14.14	37.77	7.25	227.13	529.27	0.781	< 1.00
	Adoni / 2007	9.33	13.68	8.32	271.40	686.53	0.194	< 1.00

*- the arithmetic mean of a number of 3 determinations (n = 3).

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