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## SELECTED MICROELEMENTS (Cr, Zn, Cu, Mn, Fe, Ni) IN SLIMMING PREPARATIONS

### WYBRANE MIKROELEMENTY (Cr, Zn, Cu, Mn, Fe, Ni) W PREPARATACH WSPOMAGAJĄCYCH ODCHUDZANIE

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*The purpose of this study was the determination of the content of chromium, zinc, copper, manganese, iron and nickel in some slimming preparations by flame atomic absorption spectrometry. The amounts of these microelements may be treated as sufficiently supplementing food rations.*

**Key words:** obesity, trace elements, slimming preparations, atomic absorption spectrometry  
**Słowa kluczowe:** otyłość, pierwiastki śladowe, preparaty odchudzające, atomowa spektrometria absorbcyjna

## INTRODUCTION

Obesity is considered to be a civilization disease; it is a pathological syndrome of the organism, characterized by the excessively body mass. Obesity involves the excessive development of the adipose tissue, depending on the increase of the amount of fat in adipose cells (adipocytes) – (hypertrophic obesity), or in the increase of the number of adipose cells (hyperplastic obesity); it may also be a result of both phenomena simultaneously. Concerning the etiopathogenesis, one can distinguish: primary obesity – nutritional, occurring as a result of the joint action of genetic (diabetes, hyperlipidemia) and environmental factors (e.g. lifestyle, excessive consumption of fats); and secondary obesity, which is a symptom of e.g. metabolic diseases.

In abdominal obesity (as opposed to cluneal-femoral obesity), there may occur the so-called polymetabolic syndrome, characterized by e.g. disturbance of glucose tolerance, or hyperinsulinemia. In case of obesity and high-energy diet, the visceral adipose tissue releases large amounts of fatty acids (FFA), which causes the increase of their concentration in the blood serum. FFA influence, among others, the decrease of glucose uptake by the cells, and in the liver, they inhibit the degradation of insulin excess. This leads to insulin resistance, which is related to a decreased sensitivity of insulin receptors. Following this the risk of type

2 diabetes occurrence increases. Nevertheless, despite the research already accomplished, the mechanism connecting obesity and insulin resistance has not been fully explained [7,14].

It has been found out that metabolism of carbohydrates and fats in the human organism is related to some microelements, and the disturbance of their homeostasis may have an indirect relationship to obesity [2, 9]. The purpose of this study was the determination of the content of chromium, zinc, copper, manganese, iron and nickel (elements that are involved in the processes mentioned above) in chosen slimming preparations.

## MATERIAL AND METHODS

The subject of the analysis were the preparations considered to be nutraceuticals, assisting individual in slimming regime: Bio C.L.A (capsules), Bioslank (capsules), Chudeus-syt (tablets), Fat Burner (tablets), Slim Trio (capsules), which were bought in pharmacy shops in Lublin in 2005. Five samples were examined (five different batches) of each preparation, in two parallel runs.

Samples (10 – 20 capsules/ tablets) were dry-mineralized in the muffle furnace at 450°C. The incineration process was accelerated by means of the 20 % w/w aqueous solution of nitric acid (V) (HNO<sub>3</sub> - Suprapur, Merck) and ashes were dissolved in 15 % w/w aqueous solution of hydrochloric acid (HCl – Suprapur, Merck) and quantitatively transferred to scaled flasks using deionised water. In the mineralized material, the contents of chromium, zinc, copper, manganese and iron were determined directly from the aqueous phase by flame atomic absorption spectrometry, in Thermo Elemental SOLAAR M5 apparatus. Nickel ions were transferred into a complex with pyrrolidinedicarbodithionic acid ammonium salt (Fluka, purum p.a.) in the environment of the citrate buffer (with 6.5 pH) and were extracted to the organic phase, which was 4-methylpentane-2-on (Merck – for extraction analysis), saturated with deionised water. The results (the arithmetic mean, standard deviation and the range of content) are presented per one capsule / tablet and in µg/g of the preparation.

To describe the precision of the determination of the given elements the analysis of a certificated reference material (INCT-MPH-2) prepared at the Institute of Nuclear Chemistry and Technology was performed. The determined units (ppm) were as follows: Cr  $1.65 \pm 0.09$  ( $1.69 \pm 0.13$  declared amount), Zn  $33.8 \pm 0.8$  ( $33.5 \pm 2.1$ ), Cu  $7.71 \pm 0.42$  ( $7.77 \pm 0.53$ ), Mn  $186 \pm 3$  ( $191 \pm 12$ ), Fe  $447 \pm 7$  ( $460$ ), Ni  $1.52 \pm 0.07$  ( $1.57 \pm 0.16$ ), respectively.

## RESULTS AND DISCUSSION

The content of chromium was varied as some preparations had this element as an active substance (Bioslank contained 10 µg Cr/caps. and Fat Burner 50 µg/tab.) The contents of chromium determined in this preparations (Bioslank and Fat Burner) were close to the values declared by the producers. The smallest amount of this element, on average 0.21 µg/caps. (0.15 µg/g) was found in Bio C.L.A. This preparation contained also the lowest amount of zinc, on average 0.48 µg/caps. (0.36µg/g). The maximum amount of this element was determined in Slim Trio 7.79 µg/caps. (19.1 µg/g). The content of copper was on average between 0.40 µg in a capsule (0.30 µg/g of Bio C.L.A.) and 6.13 µg/caps. (14.8 µg/g of Slim Trio). The determined amounts of manganese and iron in individual preparations were more varied. The content of manganese fitted into the range, on average, between 0.06 µg/caps. (0.06 µg/g Bio C.L.A.) and 30.5 µg/g in a capsule of Slim Trio, while the content of iron was between 2.76 µg/caps. to 1254 µg/caps. (1229 µg/g in Fat Burner). The determined content of nickel oscillated between, on average, 0.08 µg/caps. to 1.13 µg in a capsule of Slim Trio (2.74 µg/g).

Contemporary medicine connects the mechanism of obesity and related with it diabetes (in particularly type 2), among others, with a disturbance of mineral homeostasis [5] (including homeostasis of some trace elements [9]). Microelements such as: chromium, zinc, copper or nickel, found in proper amounts in the organism, are a precondition to many physiological processes. They are included in many enzymes, or catalyze some biochemical transformations on the cellular level [9, 12].

Table I. Chromium, zinc and copper content in slimming preparations ( $\bar{x} \pm SD$ , range)

Name of preparation	Chromium		Zinc		Copper	
	$\mu\text{g}/\text{capsule}$ (tablet)	$\mu\text{g}/\text{g}$ preparation	$\mu\text{g}/\text{capsule}$ (tablet)	$\mu\text{g}/\text{g}$ preparation	$\mu\text{g}/\text{capsule}$ (tablet)	$\mu\text{g}/\text{g}$ preparation
Bio C.L.A. (capsule, $m^*) = 1.347$ )	$0.21 \pm 0.03$ 0.15 – 0.23	$0.15 \pm 0.03$ 0.11 – 0.17	$0.48 \pm 0.05$ 0.40 – 0.53	$0.36 \pm 0.04$ 0.30 – 0.39	$0.40 \pm 0.06$ 0.33 – 0.48	$0.30 \pm 0.05$ 0.24 – 0.36
Bioslank (capsule, $m = 0.435$ )	$10.6 \pm 0.48$ 9.85 – 11.1	$24.41 \pm 1.10$ 22.64 – 25.40	$2.72 \pm 0.46$ 2.72 – 3.51	$6.28 \pm 1.10$ 5.21 – 8.15	$0.41 \pm 0.02$ 0.37 – 0.43	$0.95 \pm 0.06$ 0.85 – 0.99
Chudeus-syt (tablet, $m = 0.525$ )	$0.37 \pm 0.05$ 0.30 – 0.42	$0.70 \pm 0.10$ 0.57 – 0.80	$4.36 \pm 0.59$ 3.61 – 4.94	$8.31 \pm 1.06$ 6.95 – 9.33	$1.54 \pm 0.28$ 1.21 – 1.96	$2.93 \pm 0.50$ 2.33 – 3.69
Fat Burner (tablet, $m = 1.015$ )	$51.4 \pm 0.65$ 51.0 – 52.5	$50.64 \pm 0.64$ 50.20 – 51.75	$3.24 \pm 1.03$ 2.21 – 4.38	$3.24 \pm 0.97$ 2.25 – 4.29	$0.50 \pm 0.08$ 0.40 – 0.57	$0.49 \pm 0.08$ 0.39 – 0.56
Slim Trio (capsule, $m = 0.415$ )	$0.73 \pm 0.06$ 0.65 – 0.80	$1.78 \pm 0.16$ 1.57 – 1.95	$7.79 \pm 0.26$ 7.54 – 8.11	$19.1 \pm 0.81$ 18.4 – 20.4	$6.13 \pm 0.27$ 5.78 – 6.46	$14.8 \pm 0.76$ 13.8 – 15.7

\*) mass of capsule or tablet, g

Table II. Manganese, iron and nickel content in slimming preparations ( $\bar{x} \pm SD$ , range)

Name of preparation	Manganese		Iron		Nickel	
	$\mu\text{g}/\text{capsule}$ (tablet)	$\mu\text{g}/\text{g}$ preparation	$\mu\text{g}/\text{capsule}$ (tablet)	$\mu\text{g}/\text{g}$ preparation	$\mu\text{g}/\text{capsule}$ (tablet)	$\mu\text{g}/\text{g}$ preparation
Bio C.L.A. (capsule, $m^*) = 1.347$ )	$0.06 \pm 0.01$ 0.05 – 0.08	$0.06 \pm 0.03$ 0.04 – 0.11	$2.76 \pm 0.67$ 2.00 – 3.55	$2.04 \pm 0.50$ 1.47 – 2.65	$0.09 \pm 0.01$ 0.08 – 0.09	$0.07 \pm 0.01$ 0.06 – 0.07
Bioslank (capsule, $m = 0.435$ )	$1.39 \pm 0.22$ 1.15 – 1.71	$3.19 \pm 0.50$ 2.64 – 3.92	$25.6 \pm 4.19$ 20.1 – 30.1	$58.9 \pm 9.80$ 46.1 – 69.2	$0.08 \pm 0.02$ 0.05 – 0.10	$0.20 \pm 0.05$ 0.13 – 0.24
Chudeus-syt (tablet, $m = 0.525$ )	$13.7 \pm 1.26$ 12.4 – 15.8	$26.5 \pm 2.18$ 24.0 – 29.8	$62.6 \pm 13.1$ 53.4 – 85.7	$119 \pm 24.2$ 101 – 162	$0.16 \pm 0.01$ 0.14 – 0.17	$0.30 \pm 0.02$ 0.27 – 0.33
Fat Burner (tablet, $m = 1.020$ )	$10.9 \pm 0.98$ 9.82 – 12.0	$10.7 \pm 0.97$ 9.63 – 11.8	$1254 \pm 82.1$ 1126 – 1326	$1229 \pm 79.6$ 1104 – 1300	$0.84 \pm 0.08$ 0.74 – 0.92	$0.83 \pm 0.08$ 0.73 – 0.91
Slim Trio (capsule, $m = 0.415$ )	$12.5 \pm 0.79$ 12.0 – 13.8	$30.5 \pm 1.78$ 29.0 – 33.4	$81.9 \pm 4.72$ 75.5 – 87.5	$201 \pm 10.8$ 183 – 213	$1.13 \pm 0.07$ 1.04 – 1.22	$2.74 \pm 0.19$ 2.50 – 3.00

\*) mass of capsule or tablet, g

The significance of chromium (+3) in many medical cases is essential, but has not been fully explained yet. This element has been considered indispensable in the proper metabolism of carbohydrates, fats and proteins. A diet deficient in chromium may lead to hypercholesterolemia and insulin resistance [1, 5]. The administration of 1000  $\mu\text{g}$  of chromium picolinate daily results in the decrease in the level of cholesterol [3]. A diet with additional amounts of Cr, Zn and Se, used in animals, results in the reduction of their body mass and adipose tissue

as compared to animals supplied with non-supplemented food [2]. The chromium preparation administered to patients suffering from type 2 diabetes positively influenced the glycemia control, causing the increase in sensitivity of insulin receptors [4].

Moreover, it has been found out that there exists a complex relationship between the content of zinc in the cells of the human organism and the occurrence of obesity and insulin resistance, leading to type 2 diabetes [10]. This element influences the metabolism of fatty acids. The addition of zinc to the high-fat diet resulted in the decrease in obesity in animals as compared to a control group [11]. The level of zinc in the serum of children and obese adults has been observed to be lower than in the control group, and there has been a negative correlation between the content of this element in the serum, and the thickness of skin folds [9].

As for copper [9], no relevant difference in the content of this element in the blood serum of obese and non-obese people have been reported. However, the authors noticed the directly proportional dependence between its content and the thickness of skin folds.

The transformation of carbohydrates, fats and cholesterol in the organism is also effected by manganese. This element participates in diabetes prevention [12].

Each of the examined preparations had a different qualitative composition, thus, they were different in relation to microelements contained in them. As a confirmation, numerous examples could be quoted here [8, 6, 13]. Two of the studied preparations contained the addition of chromium (Bioslank 10 µg/caps. and Fat Burner 50 µg/tab. ), the content of other elements, though, depend on only the specific organic components of capsule or tablet.

## CONCLUSIONS

1. The studied slimming preparations may supplement food rations in mineral compounds essential for humans.
2. The determined levels of chromium in preparations with its addition (Bioslank and Fat Burner) were comparable with the amount declared by the producers, while the contents of the other elements studied depended on the share of other organic compounds.

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#### Summary

Concerning the etiopathogenesis, one can speak about the following types of obesity: primary – nutritional, occurring as a result of the joint action of genetic and environmental factors, and secondary obesity – which is a symptom of e.g. metabolic diseases. It has been found out that metabolism of carbohydrates and fats in human organism is connected with some microelements, and the occurrence of obesity may indirectly be connected with the disturbances of homeostasis.

The purpose of this study was determination of the content of chromium, zinc, copper, manganese, iron and nickel (elements that are involved in the processes mentioned above) in slimming preparations: Bio C.L.A., Bioslank, Chudeus-syt, Fat Burner, Slim Trio. The samples were mineralized at 450°C, and the determination of elements was performed using the absorption atomic spectrometry. The determined amounts of the examined elements may be regarded as the complementary daily demand of the organism for those elements.

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Streszczenie

Metabolizm węglowodanów i tłuszczów w organizmie człowieka związany jest z udziałem niektórych mikroelementów, a wystąpienie otyłości może pośrednio wiązać się z zaburzeniem ich homeostazy. Celem pracy było określenie zawartości chromu, cynku, miedzi, manganu, żelaza i niklu (pierwiastków, które mają największy związek z wymienionymi procesami), w preparatach wspomagających odchudzanie: Bio C.L.A., Bioslank, Chudeus-syt, Fat Burner, Slim Trio. Próbkę mineralizowano w temp. 450°C, a oznaczenia pierwiastków wykonano stosując płomieniową absorpcyjną spektrometrię atomową w aparacie SOLAAR M5, firmy Thermo Elemental. Ilości wymienionych mikroelementów w badanych preparatach można traktować jako uzupełniające dzienne racje pokarmowe.

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