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**TRACE ELEMENT CONTENTS OF FOOD AND THEIR LEVELS IN
HUMAN HAIR**

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ABSTRACT: The correlations between Ca, Mg, Fe, Zn, Cu, Mn, Cr, Ni, Pb, As, Se and Cd daily intake, calculated by 72 hour trials and hair elemental content measured by ICP-AES and ICP-MS methods in relatively healthy 152 women and 123 men, living in Moscow, were investigated. Women consumed significantly more lot of diary products, cheeses, fruits and fats, but less meat products, bread and sour cream, as compared to men. In general, women's diet is more deficient in Mg ($p < 0.1$), Fe, Zn, Cu ($p < 0.05$). Both groups are consuming suboptimal amounts of Ca and it reflects in significant correlation among dietary and hair Ca in men ($r = 0.35$, $p < 0.005$) and dietary and hair Pb in women ($r = 0.21$, $p < 0.03$).

Introduction

Determination of hair elemental content is one of methods using in estimation of nutritional provision in essential macro- and trace elements and pollution of food by toxic elements (Anke, Risch, 1979; Haaranalyze..., 1987; Martinchik et al., 2002; Skalnaya, 2005; Zimmermann, 2003). Nevertheless, there are limited scientific data, suggesting the connection between daily intake of elements in usual (not toxic or very restricted amounts) conditions. Also, in last 15 years the assortment and content of foods in Russia revolutionary changed, especially in megalopolises, but data for nutritional tables, using in calculations of average nutrients' intake remained 20-40 years old (Scurikhin, Tutelian, 2002). The aim of recent investigation was to analyzed elemental content of to-days foods and diets in inhabitants of Moscow city and than compare average daily intake of macro- and trace elements with their hair levels.

Materials and methods

During 2004-2005 years the multielement analysis of 683 samples of the foodstuff most consumed by the population was carried out. On the base of obtained data, Ca, Mg, Fe, Zn, Cu, Mn, Cr, Ni, Pb, As, Se and Cd daily intake, calculated by 72 hours trials was investigated and compared to hair elemental content relatively healthy

152 women and 123 men, living in Moscow.

Analytical determination of hair elemental content has been carried out by atomic emission spectrometry with inductively coupled argon plasma (ICP-AES) method using ICAP-9000 (Thermo Jarrell Ash, USA) and Optima 2000 DV (Perkin Elmer, USA) spectrometers. Hair analyses were carried out in accordance with IAEA recommendations and methodical guidelines of Ministry of Health of Russian Federation. For the check-up our laboratory data the certified reference material of human hair GBW09101, obtained from Shanghai Institute of Nuclear Research, was used (Skalnaya et al., 2004). Statistical calculations were made using Microsoft Excel XP application package.

Results and discussion

It was established, that average daily food intake volume was significantly higher in women (107% as compared to men, $p < 0.05$). Women are consumed more the next foods: 142% of milk, 200% of yogurts and quark, 153% of hard and processed cheeses, 360% of fruits, 150% of fats. Men prefer meat and meat products (141%), sour cream and cream (193%), bread and baker's products (128%) as compared to women.

The average daily As intake (including drinking water) minimally but exceeded the upper allowable level (UAL), especially in men. Pb and Cd are in lower amounts, than UAL. The main sources of As are meat and fish, rice and those of Cd are vegetables.

Among the essential elements only Ca daily intake was significantly lower than adequate daily intake (ADI) (63% in women and 55% in men), but the Se and Cr intakes exceeded UAL. Possibly, currently accepted national recommendations are not adequate, and they differs, for example, in case of Ca, from other countries ones significantly.

According to obtained numerical data, discussed above, the significant prevalence of As daily intake exceedings of UAL (especially in men) and Ca daily intake insufficiencies in individuals were found (table 1).

Also there were a lot of cases of nutritional Mg, Fe, Zn deficiencies, especially in women. The gender difference

Table 1. Frequency of deficiencies and excess of chemical elements in actual diets of Moscow inhabitants

Element	Deficiency or excess frequency (%)	
	female	male
Pb	0	0
Cd	0	0
As	32.9	41.5
Ca	90.1	95.1
Mg	46.6	39.8
Fe	49.3	27.6
Zn	42.3	24.3
Cu	7.2	0.8
Mn	2.3	0
Se	5.3	1.6
Cr	0	0

in Fe, Zn and Cu deficiencies was statistically significant. Totally, despite the bigger amount of consumed foods, women have higher prevalence of nutritional elements lacks, presumably because of lower meat and bread and baker's products consumption.

Finally, significant correlations were only revealed between the dietary and hair Ca in men ($r = 0.35$, $p < 0.005$), dietary and hair Pb in women ($r = 0.21$, $p < 0.03$). Possibly, this result is due to relatively low number of investigated persons for comparison of indirect dietary intake estimation method and direct and precise determination of macro- and trace elements in hair.

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