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THE MONITORING OF MERCURY CONTENT IN BABY FOODS

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ABSTRACT

Children's nutrition is very important for the healthy growth and development of the child, but it affects the health of the individual as well later in adulthood. For the production of baby food, commonly available on the market are used raw materials consistently grown under very strict supervision of specially designated for children's nutrition. It shall also apply to the more stringent standards on fertilizer, soil treatment during growth, harvesting, storage and process for the production of baby food. At work, we have focused on monitoring the content of Hg in the 12 samples of baby food, available in the sales network of the Slovak Republic and comparing it with the Highest permissible quantity (0.05 $mg.kg^{-1}$). On the basis of the findings shows that the content of Hg in the one sample exceeded the HPQ, the content of Hg was in the range 0.6 - 20.4% of the HPQ.

Keywords: mercury, baby food, baby food safety, food contamination by heavy metals

INTRODUCTION

A group of groceries referred to as infant and child food, including food products, adapted to eating infants and young children under the age of 3 years. Infant nutrition is divided into dried (powdered milk, instant milk porridge) and sterilizovanú. In industrially manufactured infant food is sometimes tasteless, on the other hand it is guaranteed hygiene safety standard in these preparations, content of nutrients and their preparation is less demanding in terms of time. Baby food is any soft, easily digestible food other than breast milk, that is made especially for babies in the age range from four to six months to two years. This dish is produced in different variants and tastes, which can be made at home buy as prepared products from a variety of manufacturers.

The contents of the nutrition, sensory and technologically significant substances in children's food depends on the content and composition of fruits and vegetables, if we do not count the added vitamins and minerals. A big influence on the content of these substances in children's food has used technology, and in especially pasteurisation. Last but not least they affect the nutritional value of the finished product, conditions of storage (climate, temperature, and light) (**Rajchl, Čížiková, Ševčík *et al,* 2009**).

Infant and baby foods are specially sterilized canning products adapted for feeding infants and toddlers. This nutrition has the main reason of supplying all essential nutrients in sufficient quantity and at the optimum proportion and in suitably modified form, which ensures a perfect use of the different components of food (**Marounek, Březina, Šimunek, 2000**).

Canned infant food is made from fruits, vegetables, meats and the appropriate additives (e.g. yogurt, rice, etc). The production is very difficult. It is used only selected materials from ecologically unburdened areas without the use of fertilizers and plant protection products, etc. Processing of raw materials is a friendly, that as much as its possible keep nutritionally important ingredients. Part of products is also enriched with vitamin C.

It is not used preservatives, artificial colorings, flavourings, stabilizers or fillers during the process of dyes. The entire production process is carried out in strict compliance with the hygiene requirements. Infant food does not contain edible salt and mostly gluten - free. Processed raw materials, production process and finished products are constantly controlled in terms of quality and health (**Kadlec, Mezloch, *et al,* 2009**).

Infants and children under three years of age are perceived as vulnerable group of consumers, therefore for infants and baby food are subject to specific requirements for the safety, quality and labelling. Legislative requirements defined for this type of products a wide range of criteria for claims on wholesomeness (limits for microbial and chemical contamination) and specify a series of nutritional requirements, additives, etc. The contents of the nutritionally, sensory and technologically significant substances in children's food depends on the actual content, composition of the fruit ingredients in the product and to heat stress during the production and storage (**Jakušová, Dostál, 2003**).

Types of baby food: fruit, vegetable, fruit - vegetable, meat - vegetable.

The raw materials used for the production of baby food: cereals, fruits (pears, bananas, apricots, strawberries, raspberries, blueberries, peaches, plums), vegetables (cauliflower, carrots, spinach, peas, potatoes), meat (chicken, turkey, rabbit, fish).

Physico - chemical analysis is determined a dry matter content and sodium chloride content in the infant and children's vegetable food, meat – vegetable food, infant baby soup and children's dishes.

In the infant and children's food and infant and children's fruit juices by refractometry is determined a dry mater content and acidity. In the products enriched with vitamin C is verified its contents (**Hálková, Rumíšková, Rieglová, 2001**).

Often the content of chemical elements is also a reflection of the environment, where the raw material for the production of vegetable produce, is often a reflection of the quality of the environment, as well as the appropriate technological production of raw materials of plant or animal origin.

One of the elements is the mercury risk. Mercury is a neurotoxin. Synthesizing and mainly affects the central nervous system, peripheral, and autonomic nervous system. Exposure to mercury can be represented with an inorganic and organic form. An increased incidence of toxic metals in the environment has a negative impact on the health of people and the health and productivity of farm animals.

Due to the reduction of sanitary quality of animal products with a higher content of toxic elements in meat, milk, in the internal organs, etc. Because the tissues and livestock products have an important role in the nutrition of the people, it is necessary to monitor continuously the content of mercury in meat, milk, eggs and products from them in terms of possible intoxication from the animals themselves and consequently endangering human health (**Kimáková, 1999, Kimáková, Bernasovská, 2007**).

The main source of nutrients for children is breast milk and infant food during childhood. Although the World Health Organization (WHO) recommends breastfeeding as the best method of feeding (**WHO, 2008**). Infant foood is an alternative to breast milk, which often play an important role in the baby's diet.

According to the statistics of 2007, several European women are able to breastfeed exclusively for up to 6 months of age, and only 33% of children in the USA are exclusively breastfed up to 3 months of age (Cabalero users). Increasing the number of mothers, who fed their children with industrially processed milk, or a solid foood such as fruits, vegetables and meat.

They are processed that they are easily digestible for the child in the form of creams, fruit, vegetable or meat food on the market. The demand increases on the market, so that in recent years the assortment of offered products and infant formulae has increased significantly. The composition of dishes and their consumption structure is important, due to the fact that the first year of life is a sensitive period in the human nervous, digestive, respiratory, reproductive development and the immune system.
In the presence of contaminants such as heavy metals, can pose a health risk to children and infants. In addition, children tend to be exposed to a relatively higher level of efficiency food chemicals, because they consume more food than adults in relation to their body weight. Child can absorb up to 50 % of the lead occurrence in food, while adult absorb only 10 %. There is evidence that the vegetables are able to accumulate mercury, lead, cadmium, zinc, copper and their inedible parts at different concentration levels. Mercury, and methylmercury in particular presents a risk for public health, for example, it can have an impact on the development of the baby's brain and can cause neurological changes in adults (**Marádová, 2007**).
Reference values for children, teenagers and adults, limits and safety in connection with mercury are set out by the European food safety authority (EFSA), the Scientific committee for food (SCF), the FAO / WHO committee on food additives (JECFA) and the World health organization.

MATERIAL AND METHODS

For the detection of mercury content in baby food have been used samples of commonly available in commercial network in Slovak Republik. Those 12 samples of baby food with different. composition (fruit, vegetable, vegetable with meat, vegetable with cheese) were analysed. From each kind of baby food was average weight about 2 grams of the sample taken and the guidelines described below has been established the mercury content.
Description and characteristics of the analysed samples is given in Table 1

Table 1 Description and characteristics of the analysed samples

Sample	Product	Producer	Country of origin
1	Hamánek with apples	Hamé	Czech Republik
2	OVKO apple	Novofruct	Slovak Republik
3	OVKO blueberry	Novofruct	Slovak Republik
4	Sunárek with peaches	HERO CZECH	Czech Republik
5	Hello with peaches	LINEA Nivnice	Czech Republik
6	Hamánek chicken with vegetables and potatoes	Hamé	Czech Republik
7	Hamánek turkey with vegetables and gratin rice	Hamé	Czech Republik
8	Hamánek vegetable sauce with rice and chicken	HIPP	Republic of Hungary
9	HAMI gratin broccoli with cheese	NUTRICIA Deva	Czech Republik
10	HAMI rice, tuna, zucchini	NUTRICIA Deva	Czech Republik
11	HAMI delicate spinach with potatoes	NUTRICIA Deva	Czech Republik
12	HAMI vegetable with rabbit	NUTRICIA Deva	Czech Republik

Purchase analysed samples was carried out in 2013. Determination of Hg have been carried out in the Department of Chemistry, Faculty of Biotechnology and Food Sciences, Slovak University of Agriculture in Nitra in the Laboratory of environmental and food analysis.

The composition of the analyzed products

- **Hamánek (with apples)**

Ingredients: apple pulp (85%), fructose, lemon concentrate, rice flour, water, antioxidant: ascorbic acid.

- **Hamánek (chicken with vegetables and potatoes)**

Ingredients: water, potatoes (28% by weight), carrots, chicken (10%), peas, vegetable oil, potato starch, tomato paste. Does not contain: cow's milk protein, lactose, gluten, preservatives, artificial colours or flavourings, added sugar or salt.

- **Hamánek (turkey with vegetables and gratin rice)**

Ingredients: water, carrot, turkey meat (15%), rice and rice flour (9%), tomato paste, vegetable oil. Does not contain cows ' milk protein, lactose, gluten, preservatives, artificial colours or flavourings, added sugar or salt.

- **Hamánek (vegetable sauce with rice and chicken)**

Ingredients: water, carrot, chicken (10 %), rice (9 %), peas, tomato paste, vegetable oil. Does not contain: cow's milk protein, lactose, gluten, preservatives, artificial colours or flavourings, added sugar or salt.

- **OVKO (apple)**

Ingredients: apple puree (94 %), sugar, acidity regulator - citric acid, ascorbic acid (vitamin C at least 10 mg.100 g^{-1}). Does not contain: gluten, artificial preservatives

- **OVKO (blueberry)**

Ingredients: apple puree (69 %), blueberry puree (22 %), sugar, drinking water, acidity regulator - citric acid, ascorbic acid (vitamin C at least 10 mg 100 g^{-1}). Does not contain: gluten, artificial preservatives.

- **Hami (gratin broccoli with cheese)**

Ingredients: potatoes, skimmed milk, carrot, rice, water, cheese cheddar, broccoli, onion, tapioca starch, black pepper.

- **Hami (rice, tuna, zucchini)**

Ingredients: zucchini (25 g), rice (22 g), water, meat of tuna, (10.5 g), carrot (5 g), red pepper, green pepper, corn starch, sugar corn, onion, corn oil, extract of yeast.

- **Hami (vegetable with rabbit)**

Ingredients: carrots (39 g), water, potatoes (16 g), rabbit meat (9 g), corn starch, celery (2.5 g), soybean oil.

- **Hami (fine spinach with potatoes)**

Ingredients: potatoes (40 g), spinach (22.5 g), water, apple juice, rice flour, corn oil.

- **Hello (with peaches)**

Ingredients: apple and peach pulp, water, sugar, E 1422, E 300 (L - Ascorbic acid)

- **Sunárek (with peaches)**

Ingredients: apples (80 %), peaches (20 %), citric acid, ascorbic acid, vitamin C. Does not contain: artificial preservatives, sugar, starch, gluten.
The measured values were compared with the applicable legislative provisions for mercury maximum permissible levels of contaminants in baby foods by the food codex of the Slovak Republic and EU Commission Regulation No. 420/2011 and No. 1881/2006 setting maximum levels of contaminants in foodstuffs.

Instrumental determination of mercury content in the samples of baby food by using the methods of the AMA 254

Automatic mercury analyzer AMA 254 is an atomic absorption spectrophotometer for the determination of mercury. It is intended for the direct determination of mercury in solid and liquid samples without the chemical pretreatment of the sample (mineralization, etc.). Using the technique of generating a pair of metallic mercury with the consequent capture and enrichment to the golden amalgamator is high sensitivity setting and the independence of the outcome of the determination of the sample matrix.

RESULTS AND DISCUSSION

The meaning of the current methodology for the determination of mercury in children's food we evaluated each product in terms of the mercury content. After evaluating the samples for mercury content, we will focus on the assessment of the various types of products in terms of their composition, producer, country of origin and mutual comparison.

Table 2 Content of mercury in children's food

Sample	Product	Producer	Country of origin	Mercury content [mg.kg^{-1}]
1	Hamánek with apples	Hamé	Czech Republik	0.002
2	OVKO apple	Novofruct	Slovak Republik	0.0004
3	OVKO blueberry	Novofruct	Slovak Republik	0.0003
4	Sunárek with peaches	Hero CZECH	Czech Republik	0.0003
5	Hello with peaches	Linea Nivnice	Czech Republik	0.0004
6	Hamánek chicken with vegetables and potatoes	Hamé	Czech Republik	0.0005
7	Hamánek turkey with vegetables and gratin rice	Hamé	Czech Republik	0.0018
8	Hamánek vegetable sauce with rice and chicken	HIPP	Republic of Hungary	0.0016
9	HAMI gratin broccoli with cheese	Nutricia Deva	Czech Republik	0.0003
10	HAMI rice, tuna, zucchini	Nutricia Deva	Czech Republik	0.0102
11	HAMI delicate spinach with potatoes	Nutricia Deva	Czech Republik	0.0006
12	HAMI vegetable with rabbit	Nutricia Deva	Czech Republik	0.0034
Food codex limit of SR				**0.05**
Average				**0.00182**

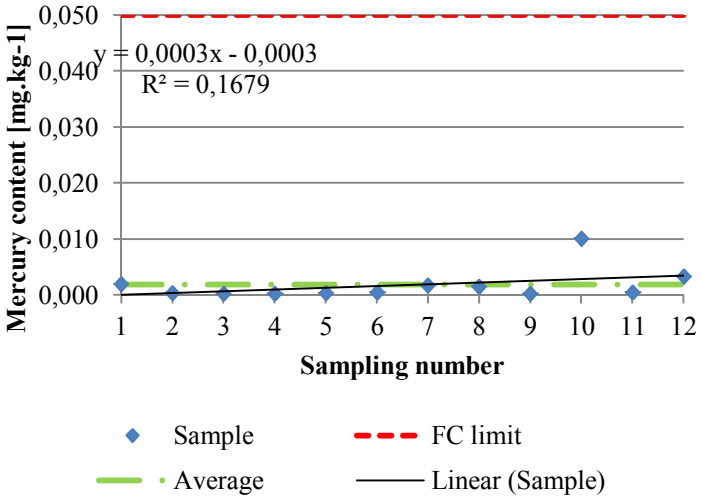

Figure 1 Mercury content in the children's food

The concentration of mercury in most of food moves in ten-thousandths up to plus/minus hundredths mg.kg^{-1}. Values of mercury in most field crops are low enough for it to have any harmful effect on human health. Fish and seafood are the predominant source of mercury in food **(Bourn, Prescott, 2002, Klien, Snodgrass, 2003)**, which is demonstrated in the children's food. Hami rice, tuna and zucchini have among the highest values of the samples to be evaluated to 0.0102 mg kg^{-1}. The second product with the highest mercury content of is Hami vegetables with rabbit with value 0,0034 mg.kg^{-1}. During analysis, we found that none of the samples has exceeded the amount of mercury in the food codex of the Slovak Republic and EU commission regulation No. 420/2011 and No. 1881/2006 setting maximum levels of contaminants in foodstuffs. The following table shows the percentage of the mercury content in analyzed samples.

Table 3 Percentage by comparison with the FC of SR

Sample	Product	Mercury content	Percentage
1	Hamánek with apples	0.002	4 %
2	OVKO apple	0.0004	0.8 %
3	OVKO blueberry	0.0003	0.6 %
4	Sunárek with peaches	0.0003	0.6 %
5	Hello with peaches	0.0004	0.8%
6	Hamánek chicken with vegetables and potatoes	0.0005	1 %
7	Hamánek turkey with vegetables and gratin rice	0.0018	3.6 %
8	Hamánek vegetable sauce with rice and chicken	0.0016	3.2 %
9	HAMI gratin broccoli with cheese	0.0003	0.6 %
10	HAMI rice, tuna, zucchini	0.0102	20.4 %
11	HAMI delicate spinach with potatoes	0.0006	1.2 %
12	HAMI vegetable with rabbit	0.0034	6.8 %
Food codex limit of SR		**0.05**	**100 %**

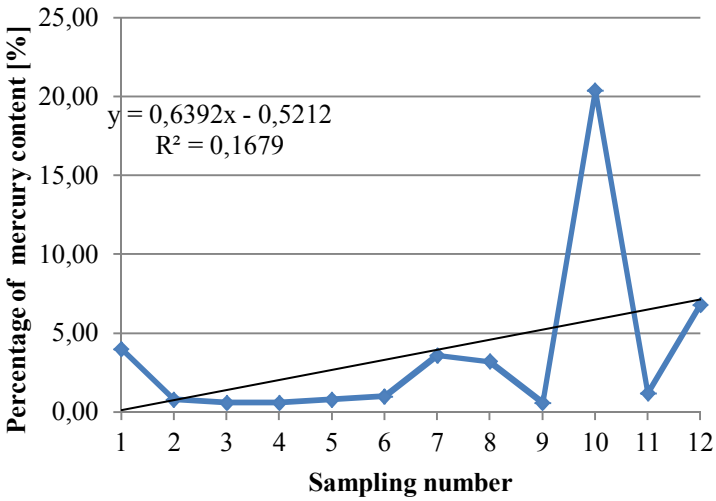

Figure 2 Mercury content in the samples by comparison with the HPQ referred to in the FC of SR (0.05 mg.kg^{-1} = 100%)

CONCLUSION

The research was carried out by analyzing samples of infant food available to buy in commercial networks in Slovakia. Sampling was random and was tasked with the most different representation of products. The products came from Slovakia, Czech Republic and Republic of Hungary, the baby food from a variety of companies.

During analysis of samples made from fruit, meat - vegetable and vegetable children's food it have been used an automatic mercury analyzer AMA 254, which is an atomic absorption spectrophotometer dedicated to the determination of mercury. Using this apparatus, we were able to determine the mercury content in the samples.

Our findings can be summarized in the following points:

1. In view of the evaluation of the mercury content in baby foods, even one case is not exceeded the permitted maximum value of its content, provided that the legislation is set out in the Food codex of the Slovak Republic.
2. The average content of mercury in the entire file of baby food on the market was 0.00182 mg.kg^{-1} with a maximum capacity of 0.0102 mg.kg^{-1} and a minimum level of 0.003 mg.kg^{-1} table of contents.
3. The mercury content in fruit child food was an average 0.0068 mg.kg^{-1}.
4. In the meat – vegetable child food was an average content of Hg 0.015 mg.kg^{-1}.
5. The average content of Hg in the meat - vegetable child food was compared with the average content of Hg in fruit child food, and it is 2.3 times higher in a causal link with the child nutrition HAMI in the composition of the rice-tuna-zucchini, where was detected the highest mercury content of the whole set of children's food.
6. The content of Hg in the baby's food wasthe highest in the sample with the addition of the tuna with value of 0.0102 mg.kg^{-1}, which is 7 times higher than the average of the whole analyzed samples. This is probably due to the fact that mercury in an enlarged scale may be located in the muscle tissue of marine fish, where its an accumulation. It should be noted, however that even the maximum content is 5 times less than the maximum quantity for the content of mercury in baby foods.
7. All analyzed children's food comply with the hygiene levels for maximum mercury content and they are suitable as supplementary nutrition for children.

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