J. Elem. s. 587–596 DOI: 10.5601/jelem.2014.19.2.648

CONTENT OF Na, K, Ca AND Mg IN COMPLEMENTARY INFANT FOOD

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Abstract

The aim of the study was to determine the content of selected mineral elements (sodium, potassium, calcium, magnesium) in fruit and vegetable desserts and dinner meals available on the Polish market designed for the nutrition of infants.

The research material consisted of commercial desserts and dinner meals for infants, purchased in Lublin and Warsaw (Poland) before their use-by date. Fifteen different types of desserts (in glass jars) and seventeen types of dinner meals (in glass jarshe t) from ten different manufacturers were tested. The tested baby foodstuffs were made in Poland, Germany, Slovakia, the Czech Republic and Switzerland. The content of Na, K, Ca and Mg was determined by means of the AAS flame technique on a Unicam 939 (AA Spectrometer Unicam) apparatus. The concentrations of Na, Ca and Mg in the analyzed baby foods did not exceed the norms. Assuming that a baby aged 9-12 months consumes one jar of dessert and one jar of dinner meal daily, he/she takes in 94 mg of Na (21% of the AI), more than 342 mg of K (45% of the AI), about 35 mg of Ca (7% of the AI) and above 41 mg of Mg (33% of the AI) which are included in the product.

Keywords: infant nutrition, fruit and vegetable food, desserts, dinner meals, macroelements.

ZAWARTOŚĆ Na, K, Ca I Mg W UZUPEŁNIAJĄCYCH PRODUKTACH SPOŻYWCZYCH PRZEZNACZONYCH DLA NIEMOWLĄT I MAŁYCH DZIECI

Abstrakt

Celem pracy było określenie zawartości wybranych składników mineralnych (sodu, potasu, wapnia, magnezu) w dostępnych na polskim rynku deserach owocowo-warzywnych oraz daniach obiadowych przeznaczonych do żywienia niemowląt.

Materiał do badań stanowiły gotowe desery oraz dania obiadowe przeznaczone dla niemowląt i małych dzieci, zakupione w sklepach spożywczych na terenie Lublina oraz Warszawy, w okresie ich przydatności do spożycia. Badano 15 różnych typów deserów (w słoikach) oraz 17 typów dań obiadowych (w słoikach). Badane produkty wyprodukowano w Polsce, Niemczech, Słowacji, Czechach oraz Szwajcarii. Zawartość Na, K, Ca i Mg

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oznaczono za pomocą płomieniowej techniki AAS w aparacie Unicam 939 (AA Spektrometr Unicam). Koncentracja Mg, Ca i Na w badanych deserach nie przekraczała dopuszczalnych norm. Zakładając, że niemowlę w wieku 9-12 miesięcy spożywa dziennie 1 słoik deseru oraz 1 słoik obiadku, przyjmuje wraz z tymi posiłkami 94 mg Na (21% AI), ponad 342 mg K (45% AI), ok. 35 mg Ca (7% AI) oraz prawie 41 mg Mg (33% AI).

Słowa kluczowe: żywienie niemowląt, owocowo-warzywne produkty dla niemowląt, desery, obiady, makroelementy.

INTRODUCTION

During the first 4–5 months of life, the baby's only food is mother's milk or a suitable milk substitute formula. Afterwards, it is recommended to enrich the diet with other food to ensure an adequate intake of minerals. Minerals are involved in many functions in the body, e.g. bone mineralization and enzymatic reactions. Infant nutrition often includes commercial products, industrially manufactured and targeted at this particular group of children. Such products, designed for infants and children up to 3 years of age, are regarded as foods for special nutritional purposes. Desserts are the first fruit meal in the child's diet.

Fruit and vegetables are an important source of sodium, potassium, calcium and magnesium in the baby's diet. Sodium is found in carrot, celery, parsley and table salt (KUNACHOWICZ et al. 2005). Sodium helps regulate the functioning of nerves and muscular contraction; it also interacts with potassium for maintain extracellular fluid balance (SOETAN et al. 2010). Carrot is an important source of potassium (KUNACHOWICZ et al. 2005). Potassium activates a number of enzymatic reactions and participates in the transmission of neural impulses in the nervous and muscular systems; it also takes part in energy and carbohydrate transformations, systemic protein synthesis and amino acid transport in the cell (SHIMONI 2005). Green vegetables, like broccoli or spinach, are among the best sources of calcium (MANSON 2002). As well as being the major component of bones and teeth, calcium is a co-factor of numerous enzymes; calcium deficiency in children is manifested by rickets as well as a retarded growth (MANSON 2002). Magnesium is a co-factor in a number of enzymatic reactions. Deficiency of Mg leads to anaemia, irritability, protein synthesis disorders and brittleness of the bones (POLESZAK, NOWAK 2006, GRIFFIN et al. 2008). Green vegetables and legumes are an important source of magnesium (KUNACHOWICZ et al. 2005).

The aim of the study was to determine the content of selected mineral elements (sodium, potassium, calcium, magnesium) in desserts and dinner means available on the Polish market and designed for the nutrition of infants.

MATERIAL AND METHODS

Food samples

The research material consisted of commercial fruit and vegetable desserts and dinner meals for infants, purchased in Lublin and Warsaw before their use-by date. Fifteen different types of desserts (in glass jars) and seventeen types of dinner mealls (in glass jar) from ten different manufacturers were tested. All were labelled as a "food for special purposes" (Tables 1, 2), some were additionally given the BIO symbol, which means that their components originated from certified organic farms, while two of the products

Table 1

Specification of baby desserts

Trade mark	Ingredients[c]	Annotation	Portion (g)	Country	Energy (kcal)	
					in 100 g*	in jar**
A-1	apple, pear, apple juice, wheat starch (gluten free), corn starch, vit. C	*a*	125	Poland	70	88
A-2	white grape juice, pear, plum, apricot, tapioca starch, rose hip, vit. C	*a*	125	Poland	69	86
B	apple, peach, grape juice, water, sugar, corn starch, vit. C	*a*	130	Poland	64	83
C-1	apple, apricot, vit. C	*a*	130	Poland	46	60
C-2	banana, pineapple juice, orange juice, apple, corn starch, lemon juice, vit. C	*a*	130	Poland	84	109
D-1	ecological yoghurt, water, apple, bilberry, sugar, carrot juice, vit. C	*a*, *b*	125	European Union	76	121
E-1	apple, apricot, yoghurt	*a*	190	Slovakia	59	77
E-2	apple, apricot	*a*	190	Slovakia	47	61
F-1	apple juice, apple, cherry	*a*, *b*	190	Germany	50	95
F-2	pear, apple	*a*, *b*	190	Germany	51	97
G-1	apple, banana, vit. C	*a*	125	Czech Republic	63	79
G-2	white grape juice, pear, plum, apricot, tapioca starch, rose hip, vit. C	*a*	125	Czech Republic	69	86
G-3	apple, rose hip, grape juice, wheat starch (gluten free), corn starch, vit. C	*a*	125	Czech Republic	64	80
H-1	banana, water, peach, rise flour, lemon juice, apple juice	*a*, *b*	190	Switzerland	63	120
H-2	water, apple, banana, pear juice concentrate, rice starch, apricot, lemon juice	*a*, *b*	190	Switzerland	65	124

a – food for special purposes, *b* – organic food, [c] – ISO 9001:2000, 14001:1996
* values as declared by the manufacturer, ** values calculated

Table 2

Specification of baby dinners

Trade mark	Ingredients[c]	Annotation	Portion, (g)	Country	Energy (kcal)	
					in 100 g *	in jar **
A-3	water, carrot, potato, rice, chicken meat, celery, soybean oil	*a*	125	Poland	48	60
C-3	spinach, potato, milk, water, cream	*a*, *b*	190	Poland	55	104
C-4	potato, carrot, water, chicken meat, corn oil, salt	*a*, *b*	190	Poland	56	106
C-5	carrot, water, potato, chicken meat, pea, corn starch, rape oil	*a*	190	Poland	61	116
C-6	carrot, tomato, pea, water, turkey, rice flour, onion, corn oil,	*a*, *b*	190	Poland	62	118
C-7	carrot, tomato, water, chicken meat, corn oil	*a*, *b*	190	Poland	53	101
D-2	water, potato, tomato, rice, chicken meat, onion, corn oil, salt, white pepper, caraway seed	*a*, *b*	220	European Union	69	152
D-3	tomato, carrot, pea, water, wheat pasta, chicken meat, wheat flour, corn oil, onion, salt	*a*, *b*	220	European Union	73	161
D-4	water, rice, carrot, turkey meat, corn oil, salt	*a*, *b*	220	European Union	72	158
H-3	broccoli, water, whole-meal rice flour, rice starch	*a*, *b*	190	Switzerland	34	65
H-4	carrot, potato, tomato, spinach, water, rice	*a*, *b*	220	Switzerland	34	75
H-5	water, potato, corn, beef meat, rice flour, vegetable oil	*a*, *b*	190	Switzerland	52	99
I-1	carrot, potato, spinach, parsnip, leek, water	*a*, *b*	190	Germany	24	46
I-2	carrot, pea, tomato, water, ham, whole-meal wheat pasta, sunflower oil, herbs	*a*, *b*	220	Germany	52	114
I-3	pumpkin, water, chicken meat, whole-meal rice flour, sunflower oil	*a*, *b*	190	Germany	74	141
I-4	carrot, potato, water, chicken meat, sunflower oil, herbs	*a*, *b*	190	Germany	55	104
J-1	carrot, water, rice, oil	*a*, *b*	125	Poland	45	56

The key under Table 1

were manufactured under the supervision of experts in baby nutrition and had the quality certificate ISO 9001:2000, 14001:1996. The tested baby foods were made in Poland, Germany, Slovakia, the Czech Republic and Switzerland. One manufacturer labelled the products as “Made in the European Union”.

Methods

The baby food samples were shaken manually before analysis. The content of Na, K, Ca and Mg was determined by means of the AAS flame technique on a Unicam 939 (AA Spectrometer Unicam) apparatus. Portions of approximately 10 g of the analyzed material were weighed out. The samples were dried at a temperature of 105°C for 48 hours and then mineralized in a zinc furnace at a temperature of 550°C for 16 hours. 10 ml of 6 N HCl was added to the burnt samples and the solution was filtered to measuring flasks and replenished with distilled water to the volume of 50 ml. The stock solution was used in the analyses, except for Mg and K, where the solution was diluted ten-fold.

All the chemical analyses were performed in two replications.

Calculations and statistical analysis

The content of Na, K, Ca and Mg in each of the analyzed products (n = 32) was converted into 1 g and peer container (a jar or a glass bottle). The size of a container was 125-190 g in the case of a dessert or 125-220 g for a dinner meal (Tables 1, 2). The calculation of % of the AI (adequate intake) of Na, K, Ca and Mg was based on the Polish recommendations (Jarosz, Bułhak-Jachymczyk 2008).

The results were subjected to statistical analysis. The Statistica 6.0 software was used to calculate the maximum, minimum and mean values, standard deviation (SD), standard error of the mean (SEM), and the median.

RESULTS

Table 3 presents the mean content of Na, K, Ca and Mg in the desserts and dinner meals, calculated per 1 g of the product and in one jar. One jar of a baby dessert contained an average of 15.11 mg of Na, 160.4 mg of K, 5.97 mg of Ca and 17.7 mg of Mg. A jar with a dinner meal contained on average 79.14 mg of Na, 181.7 mg of K, 28.62 mg of Ca and 23.3 mg of Mg. Assuming that a baby aged 9-12 months consumes one jar of dessert and one jar of dinner daily, he/she takes in 94 mg of Na (21% of the AI), more than 342 mg of K (45% of the AI), about 35 mg of Ca (7% of the AI) and above 41 mg of Mg (33% of the AI) which are included in the product (Table 3).

The highest content of sodium was found in the baby dinner meals (Table 3). All the baby dinners and only 13 desserts had labels informing that the product contained Na, and the amount of this element was given per 100 g of the product. Figures 1 and 2 present the declared and measured content of sodium in the examined desserts and dinners. The author's own studies revealed that only 3 desserts (A-1, G-1 and G-3) contained more sodium than declared by the manufacturer, although the differences were not significant.

Table 3

Results of baby food analyses and AI

Descriptive statistics	In 1 g of natural mass				In jar			
	Na (mg)	K (mg)	Ca (mg)	Mg (mg)	Na (mg)	K (mg)	Ca (mg)	Mg (mg)
Baby desserts								
Maximum	0.22	2.59	0.22	0.31	41.8	486.4	27.5	58.9
Minimum	0.03	0.13	0.01	0.06	3.9	24.7	1.3	7.8
Mean	0.10	1.06	0.04	0.11	15.11	160.4	5.97	17.7
Median	0.09	1.02	0.02	0.09	11.5	127.5	3.8	11.4
SD	0.06	0.58	0.05	0.07	11.51	107.4	6.6	14.83
SEM	0.016	0.15	0.014	0.02	2.97	27.7	1.71	3.83
Baby dinners								
Maximum	1.11	1.93	0.34	0.18	224.2	366.7	64.60	39.6
Minimum	0.09	0.20	0.08	0.07	17.11	25.00	12.50	12.5
Mean	0.41	0.94	0.15	0.12	79.14	181.7	28.62	23.3
Median	0.21	0.95	0.12	0.11	44.00	180.5	24.70	22.8
SD	0.38	0.42	0.07	0.03	78.23	86.45	14.09	7.17
SEM	0.16	0.15	0.10	0.01	3.02	16.8	9.43	2.11
AI (6-12 months old children) acc. JAROSZ, BUŁHAK-JACHYMCZYK (2008)					370	400	400	70
% of AI *					21.39	45.44	7.15	33.29

SD – standard deviation, SEM – standard error of the means, AI – adequate intake
* assuming that a 12-month-old child consumes on average one jar of baby dessert and one jar of dinner daily

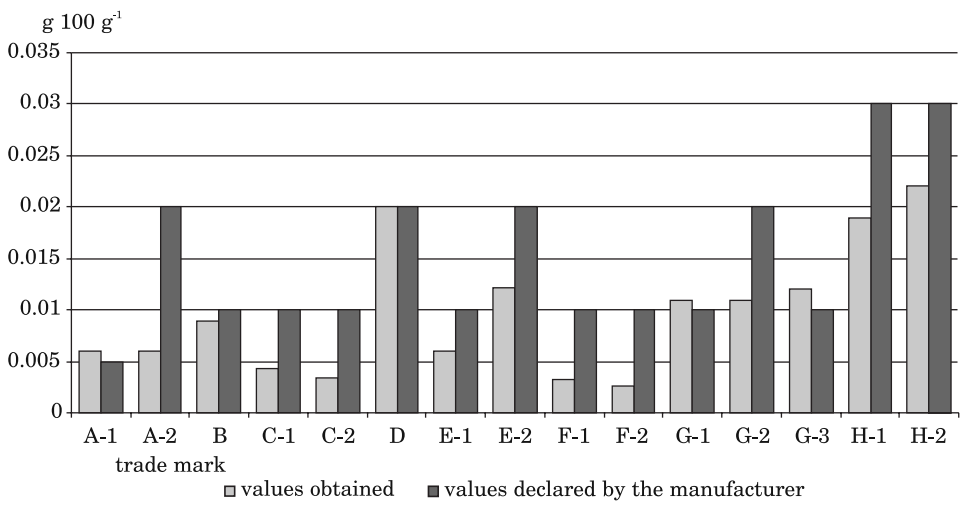

Fig. 1. Declared and measured content of sodium in examined baby desserts (g 100 g^{-1})

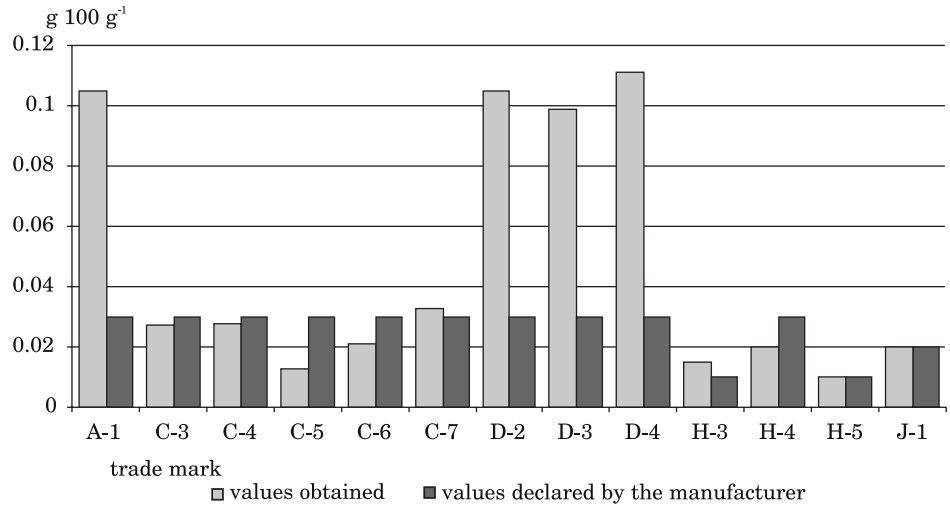

Fig. 2. Declared and measured content of sodium in examined baby dinner meals (g 100 g^{-1})

DISCUSSION

Processed nutritional products for infants are not very popular in Poland. Research has shown that only 22% of parents feed their children with such products on a regular basis (Winiarska-Mieczan, Gil 2007). The studies performed by these authors revealed that the most popular products are fruit and vegetable desserts, while dinner meals are fed far less often. Among desserts and fruit-vegetable purees, the most popular are those prepared from home-grown fruit, especially apples, as well as the products containing bananas (Górecka et al. 2007). Desserts are the first fruit meal in the child's diet. They contain pressed fruit and have delicate taste and smooth consistency, which makes them easy to swallow. Additionally, fruit desserts facilitate introduction of fruit into babies' diet and provide a valuable source of vitamins (Čižkova et al. 2009), as well as an important source of mineral elements.

Fruit and vegetable products typically contain insufficient amounts of Na and Ca; therefore infants must obtain these minerals from other sources. The author noticed that the average content of Na in baby desserts was 0.1 mg g^{-1}, while in dinners it was 0.41 mg g^{-1} of the product. The data available in the bibliography regarding the content of sodium in Polish fruit and/or vegetable products intended for infants revealed that the content of this mineral in juices reached 0.013-0.168 mg g^{-1} of the product (Winiarska-Mieczan, Nowak 2008). The study performed by Marzec et al. (2008) showed that the average content of sodium in fruit desserts was 0.069 mg g^{-1} of natural mass, whereas in fruit and vegetable juices it amounted to 0.072 mg g^{-1} of the product. The sodium content in Norwegian

fruit puree products was similar to the Polish results, i.e. 0.029 mg g^{-1} on average (Melø et al. 2008). According to Saudi Arabian studies, the content of sodium in fruit and vegetable pastes was 0.45 mg per 1 g of the product. A much better source of sodium for infants originates from cereals-based food (Al Khalifa, Ahmad 2010, Melø et al. 2008) and dinner meals (Melø et al. 2008). The adequate daily sodium intake for babies up to 12 months of age in Poland is 370 mg (Jarosz, Bułhak-Jachymczyk 2008). According to the regulation by the Polish Minister of Health regarding nutritional products of special use, sodium salt must not be added to dessert and pudding products prepared from fruit, except when such supplementation could be technologically justified (Journal of Laws 2007).

The author's own studies showed that the average content of Ca in the analysed baby food was 0.04 mg g^{-1} in desserts and 0.94 mg g^{-1} in dinners. According to Marzec et al. (2009), the average content of calcium in baby fruit and fruit and vegetable desserts available in Poland is 0.071 mg g^{-1} of the product, while the mean content of this mineral in fruit and fruit and vegetable juices is nearly 0.087 mg in 1 g (Marzec et al. 2009). Norwegian studies revealed that the mean content of calcium in fruit products was 0.1 mg in 1 g of the product (Melø et al. 2008). The studies carried out in Saudi Arabia showed that the content of Ca in fruit and vegetable pastes intended for infants was 0.2 mg in 1 g (Al Khalifa, Ahmad 2010). The richest sources of calcium for a baby are mother's breast milk, milk formula and cereal gruel. According to the European Union law (Commission Directive 2006), milk formulas intended for infants should contain 50-140 mg of Ca/100 kcal. In Polish, the adequate intake of calcium for babies up to 12 months of age is 400 mg (Jarosz, Bułhak-Jachymczyk 2008).

The author found that the average content of K in baby desserts and dinners was about 1 mg g^{-1}, while the content of Mg was about 0.1 mg g^{-1} of these products. Other studies carried out in Poland showed that the level of potassium and magnesium in commercial baby food is high. According to Marzec et al. (2008), the average content of potassium in baby soups is 1.32 mg g^{-1} of the product, in baby dinners – 1.61 mg g^{-1}. The study performed by Winiarska-Mieczan and Gil (2002) revealed that vegetable and meat dinner meals contained approx. 0.4-0.6 mg of K per 1 g of the product. The concentration of Mg in baby dinners reached 0.076 mg – 0.105 mg g^{-1} of the product (Marzec et al. 2007). The potassium and magnesium content in Norwegian commercial dinners was 1-2 mg and 0.07-0.11 mg g^{-1}, respectively (Melø et al. 2008). The analyses carried out in Saudi Arabia showed that fruit and vegetable products contained as much as 0.69 mg of potassium and about 0.13 mg of magnesium per 1 g of the product (Al Khalifa, Ahmad 2010). Cereal porridges and infant formulas are a much better source of K and Na for infants (Melø et al. 2008).

CONCLUSION

The concentration of Na, Ca and Mg in the analyzed baby products did not exceed the acceptable norms (JAROSZ, BUŁHAK-JACHYMCZYK 2008). An excessive level of potassium was observed in nearly half of the studied desserts and dinners. Assuming that a baby aged 9-12 months consumes one jar of dessert and one jar of dinner daily, he/she takes in 94 mg of Na (21% of the AI), more than 342 mg of K (45% of the AI), about 35 mg of Ca (7% of the AI) and above 41 mg of Mg (33% of the AI) which are included in the product. Desserts and dinners are an important source of mineral elements in the baby's diet.

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