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Contents of selected microelements in canned meat and meat pies

Zawartość wybranych mikroelementów w konserwach i pasztetach mięsnych

Summary. The paper aimed at evaluating the content of some microelements (Cu^{2+}, Zn^{2+}, Fe^{3+}, Mn^{2+}) and toxic metals (Pb^{2+}, Cd^{2+}) in selected tinned products and meat pies from different meat processing factories. Microelements were determined by means of the flame technique: Cu (λ 324.8 nm), Zn (λ 213.9 nm), Fe (λ 248.3 nm), and Mn (λ 279.5 nm) applying spectrophotometer AA-880, while lead and cadmium were assessed using the non-flame technique: lead (λ 217 nm) and cadmium (λ 228.8 nm). Other elements were analyzed by means of the flame technique. The content of the studied microelements in the canned goods and meat pies varied and depended on the product's type and its composition. Higher concentrations of the majority of the analyzed trace elements were found in meat pies. The mean content of heavy metals (lead and cadmium) in meat processed products was quite low and not threatening the consumer's health.

Key words: microelements, tinned foods, meat pies

INTRODUCTION

Food of animal origin, including meat and its products, is an essential element of human diet. These products are perfect source of protein, vitamins, and mineral components, but they may also contain considerable amount of hazardous impurities including heavy metals and excessive concentrations of iron, zinc or copper [Kołodziej 1997, Kot *et al*. 2002, Błoniarz and Zaręba 2005], due to the the fact that detoxifying organs, i.e. liver and kidneys, may be main ingredients of tinned food and meat pies. To minimize the quantity of harmful substances contained in food and ensure the sufficient quality of food, it is necessary to constantly prosecute studies to identify these substances and make laws and regulations limiting their concentration in food [Olędzka *et al.* 2000, Jędrzejak 2004, Obiedziński *et al.* 2005].

Microelements should be present in human organism within strictly defined levels of concentrations, as both their shortage and their excess are undesirable [Błoniarz *et al.*

2003]. Similarly to heavy metals these elements are able to accumulate in tissues which can result in considerable rise in their amount and, subsequently, have bad influence on functioning of human organism [Szkoda *et al*. 2003, Wojciechowska-Mazurek *et al.* 2003, Prokopiuk 2006].

As canned meat and meat pies seem to be people's popular source of nutrition, it is crucial to estimate the levels of concentration of microelements and heavy metals in these products.

MATERIAL AND METHODS

Research materials comprised samples of canned meat and meat pies manufactured by the following companies: Sokołów, Łuków, Werbliński, Meg – Graal, Dębicka (only tinned meat). The products were purchased in spring time 2007 in retail shops in the area of the town of Lublin. Heavy metals (Cd^{2+}, Pb^{2+}), as well as trace elements (Cu^{2+}, Zn^{2+}, Fe^{3+}, Mn^{2+}) in canned meat and meat pies, were marked according to ASA (Atom Spectrophotometry Absorption AA-880) technique. Zn (λ 213.9 nm), Cu (λ 324.8 nm), Fe (λ 248.3 nm), Mn (λ 279.5 nm) and Pb (λ 217.0 nm), Cd (λ 228.8 nm). First a 1 g sample of each of the products being examined was taken. The samples were then burned down in muffle furnace in 550 ± 25°C. Next the incineration ashes were dissolved in hydrochloric acid in crucibles. Received solution was filtrated into flasks and completed with water. This way stock solution was obtained. 10× and 100× diluted solutions were also prepared. The results are given in mg/kg fresh substance (f.s.)

RESULTS AND DISCUSSION

Data concerning copper and zinc contents collected during canned meat and meat pies samples testing are given in Table 1. In the Polish law there is no regulation defining maximum legal quantity of the above elements in food products. There are, however, numerous guidelines concerning daily intake of a given element. The figures were determined by WHO specialists and should be followed in order to maintain optimal levels of microelements in human organisms.

After analysis of concentrations of copper in canned meat samples, it was stated that the level of this element is the lowest in cans manufactured by Meg – Graal Company. The amount of Cu^{2+} in canned meat coming out of this company was 0.98mg/kg f.s. The highest level of copper was characteristic for cans produced by Werbliński – 1.63 mg/kg f.s.

Levels of copper were approximate in other tested canned meat samples and within limits from 1.39 mg/kg f.s. to 1.50 mg/kg f.s. Slightly higher levels of the element in question were detected in meat pies samples. They were also approximate and oscillated between 1.93 mg/kg f.s. and 2.31 mg/kg f.s.

Zinc levels in tested meat products depended on product type and fluctuated from 11.56 mg/kg f.s. to 25.39 mg/kg f.s. The amount of the above element in canned meat samples was similar to values in tested meat pies. As far as canned meat is concerned the highest average levels of Zn^{2+} were characteristic for products manufactured by Meat Company Łuków – 23.48 mg/kg f.s., and the lowest levels of zinc were characteristic for Meg – Graal products – 11.56 mg/kg f.s.

Table 1. The levels of trace elements Cu^{2+}, Zn^{2+} (in mg/kg f. s.) in tested tinned meat and meat pastes originating from different meat factories
Tabela 1. Poziom pierwiastków śladowych Cu^{2+} i Zn^{2+} (mg/kg ś.m.) w badanych konserwach i pasztetach mięsnych pochodzących z różnych zakładów

Product Produkt	Factory Zakład	Copper Miedź	Zinc Cynk
Canned pork and beef Konserwy wieprzowo-wołowe	Sokołów	1.40 ± 0.20	19.90 ± 3.15
	Łuków	1.39 ± 0.60	23.47 ± 4.16
	Werbliński	1.63 ± 0.40	18.33 ± 5.6
	Meg – Graal	0.98 ± 0.03	11.56 ± 2.14
	Dębicka	1.50 ± 0.42	17.40 ± 2.18
Meat pies Pasztety	Sokołów	2.16 ± 0.58	17.02 ± 4.12
	Łuków	2.31 ± 0.62	25.39 ± 5.03
	Werbliński	2.21 ± 0.71	16.67 ± 3.21
	Meg – Graal	1. 93 ± 0.63	17.11 ± 5.12
	Dębicka	-	-

Among tested meat pies the highest levels of zinc were found in Łuków Company products – 25.39 mg/kg f.s. The lowest levels of the element were found in meat pies manufactured by Werbliński Company – 16.67 mg/kg f.s. If the levels of zinc in meat pies and cans are compared, meat pies were richer in Zn^{2+}. They contained 4.78% more of the tested element. Contents of iron and manganese are given in Table 2.

The highest levels of iron were found in canned meat samples originating from Dębica Meat Company – 29.44 mg/kg f.s. The lowest levels were in Meg – Graal tins – 18.37 mg/kg. The amount of iron in other tested samples oscillated between 21.61 mg/kg f. s. and 26.57 mg/kg f. s. The analysis of contents of iron in meat pies showed the highest amount of this element in meat pies of Sokołów – 38.66 mg/kg f.s. The level of iron was definitely lower in products of Werbliński – 24.93 mg/kg f.s. Generally, tested meat pies were 27.03% richer in iron than canned meat products.

The amount of manganese in tested tinned goods was from 1.18 mg/kg f.s. to 3.39 mg/kg f.s., the highest concentration – 4.4 1mg/kg f.s. occured in Werbliński products and the lowest – 0.46 mg/kg f.s. in products made by Sokołów.

The levels of manganese were not so diversified in meat pies. Here, the highest concentration of this element was found in products of Meg – Graal – 3.65 mg/kg f.s. and the lowest – 2.12 mg/kg f.s., in meat pies of Sokołów. Generally, similarly to other tested elements, manganese concentrations were higher in meat pies.

Contents of heavy metals (Pb^{2+}, Cd^{2+}) in tested products are given in Table 3. According to Minister of Health Decree dated 13 January 2003 concerning maximum concentrations of chemical and biological impurities which may be present in food; food ingredients; permitted supplementary substances and substances helpful in food processing – the contents of heavy metals such as lead and cadmium in food products cannot be larger than, respectively, 0.30 mg/kg for Pb^{2+} and 0.05 mg/kg for Cd^{2+}. In meat products containing liver and kidneys permissible level of cadmium is slightly higher – Cd^{2+} 0.1 mg/kg [Wojciechowska-Mazurek 2003, Schwind 2004, Juszczak 2008]. Also, the latest Decree of European Commission 2006 defines maximum legal levels of impurities in meat and offal, but there is no mention about acceptable levels of Pb^{2+}, and Cd^{2+} in meat products (i.e. canned meat and meat pies).

Table 2. Levels of trace elements – iron and manganese in tested canned meat and meat pastes originating from different meat factories (mg/kg f.s.)
Tabela 2. Poziom pierwiastków śladowych Fe^{3+} i Mn^{2+} (mg/kg ś.m.) w badanych konserwach i pasztetach mięsnych pochodzących z różnych zakładów

Product Produkt	Factory Zakład	Iron Żelazo	Manganese Mangan
Canned pork and beef Konserwy wieprzowo-wołowe	Sokołów	25.60 ± 6.12	0.46 ± 0.001
	Łuków	26.57 ± 4.03	3.39 ± 0.92
	Werbliński	21.68 ± 3.25	4.51 ± 1.01
	Meg – Graal	18.37 ± 5.16	1.18 ± 0.26
	Dębicka	29.44 ± 4.81	2.52 ± 0.93
Meat pies Pasztety wieprzowe	Sokołów	38.66 ± 6.13	2.16 ± 0.65
	Łuków	34.47 ± 5.06	2.22 ± 0.92
	Werbliński	24.93 ± 5.02	3.85 ± 0.91
	Meg – Graal	35.30 ± 4.05	2.71 ± 0.73
	Dębicka	-	-

Table 3. Levels of toxic metals (Pb^{2+}, Cd^{2+}) in tested canned meat and meat pastes originating from different meat factories
Tabela 3. Poziom pierwiastków toksycznych (Pb^{2+}, Cd^{2+}) w badanych konserwach i pasztetach pochodzących z różnych zakładów

Product Produkt	Factory Zakład	Lead Ołów	Cadmium Kadm
Canned pork and beef Konserwy wieprzowo-mięsne	Sokołów	0.022 ± 0.010	0.038 ± 0.010
	Łuków	0.019 ± 0.009	0.062 ± 0.012
	Werbliński	0.017 ± 0.008	0.040 ± 0.011
	Meg – Graal	0.019 ± 0.007	0.025 ± 0.010
	Dębicka	0.079 ± 0.012	0.038 ± 0.011
Meat pies Pasztety	Sokołów	0.021 ± 0.008	0.026 ± 0.009
	Łuków	0.068 ± 0.010	0.035 ± 0.009
	Werbliński	0.039 ± 0.011	0.073 ± 0.001
	Meg – Graal	0.058 ± 0.012	0.106 ± 0.018
	Dębicka	-	-

Of all tested canned meat samples the highest content of Pb^{2+} was found in canned meat for tourists manufactured in Dębica – 0.079 mg/kg f.s. In other samples the levels of iron were similar, within limits from 0.017 to 0.022 mg/kg f.s. The amount of lead in meat pies was slightly higher with the highest level in Łuków pies – 0.068 mg/kg f.s.

The contents of lead in other samples were between 0.021 – 0.058 mg/kg f.s. Because of the fact that all lead levels in tested samples were below permissible maximum limit (0.10 mg/kg) as defined in Minister of Health Decree dated 13 January 2003, the levels of lead both in canned meat and meat pies should be treated as fairly low and not hazardous for consumers' health.

In result of analyses of canned meat samples it was found that the concentration of cadmium is the highest in products made by Łuków – 0.062 mg/kg f.s., and the lowest in products made by Meg – Graal – 0.025 mg/kg f.s.

In tested meat pies samples the contents of Cd^{2+} were approximate, within limits from 0.038 to 0.040 mg/kg f.s., with the highest level of cadmium detected in Meg – Graal products – 0.106 mg/kg f.s. This concentration is slightly over the permissible limit of cadmium in meat products. According to Minister of Health Decree dated 13 January 2003, maximum acceptable concentration of cadmium in meat products containing liver and kidneys is 0.1 mg/kg. Thus, the limit of this element in Meg – Graal meat pie was exceeded 0.006 mg/kg. The levels of cadmium in other samples did not exceed the permissible limit. Similarly to lead analyses results, it was determined that meat pies were generally richer in cadmium than canned meat. They contained 33.3% more cadmium than canned meat.

The contents of cadmium in meat products, lead alike, are fairly low in most products, so they do not make a threat to consumers' health. As meat pies contain livers and kidneys – the detoxifying organs of the organism – the contents of heavy metals in these products can understandably be higher than in canned meat containing neither of these components.

CONCLUSIONS

1. The average contents of heavy metals: cadmium and lead in meat products were fairly low, not hazardous for consumers.

2. Higher levels of heavy metals (Pb^{2+}, Cd^{2+}) were characteristic for meat pies – due to the fact that these products contain livers and kidneys, the organs of biggest toxic metals accumulation.

3. Of all analysed meat products samples (canned meat and meat pies) the highest concentration of lead was found in Łuków products while Meg – Graal products contained the highest level of cadmium.

4. Contents of microelements in tested samples were diversified and depended on the product type and its content but considerably higher levels of concentration of most of microelements were present in meat pies.

5. Both meat pies and canned meat can become valuable source of trace elements in modern men diet. These products proved to be rich in all analysed elements.

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Streszczenie. Celem pracy była ocena zawartości niektórych składników mineralnych należących do grupy mikroelementów (Cu^{2+}, Zn^{2+}, Fe^{3+}, Mn^{2+}) oraz metali toksycznych (Pb^{2+}, Cd^{2+}) w wybranych konserwach i pasztetach mięsnych pochodzących z różnych zakładów mięsnych. Mikroelementy oznaczono metodą płomieniową (Cu – λ 324,8 nm, Zn – λ 213,9 nm, Fe – λ 248,3 nm i Mn – λ 279,5 nm), przy użyciu spektrofotometru AA-880, natomiast ołów i kadm bezpłomieniową (ołów – λ 217 nm i kadm – λ 228,8 nm). Pozostałe pierwiastki oznaczono metodą płomieniową. Zawartość mikroelementów w przebadanych konserwach i pasztetach mięsnych była zróżnicowana i zależała od rodzaju przetworu i jego składu. Wyższe stężenie większości analizowanych pierwiastków śladowych stwierdzono w pasztetach. Średnia zawartość metali ciężkich – ołowiu i kadmu – w przetworach mięsnych była dość mała, niezagrażająca zdrowiu konsumentów.

Słowa kluczowe: mikroelementy, konserwy, pasztety mięsne