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Heavy metal content in meat from Astana city, Kazakhstan.

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ABSTRACT

This study presents the results of determination of heavy metals, such as Pu, As, Cu and Zn in meat samples collected from different places of Astana city, Republic of Kazakhstan. The average concentrations were 0.035 mg/kg, 0.076 mg/kg, 2.52 mg/kg and 6.28 mg/kg for Pb, As, Cu and Zn, respectively. Mean values are not exceeded the permissible levels for these metals according to the National regulations of Kazakhstan.
Keywords: meat, heavy metals, toxicity, lead, contamination

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INTRODUCTION

The problem of environment pollution by heavy and toxic metals remains as relevant as ever, due to the industry growth. Accumulation of heavy metals in animal's body harm to health not only for animal, but human through eating animal products [1, 2].

Heavy metals are chemical elements with atomic mass more than 50 atomic mass unit. These include lead (Pb), cadmium (Cd), zinc (Zn), molybdenum (Mo), manganese (Mn), nickel (Ni), titanium (Ti), cobalt (Co), copper (Cu), vanadium (V) et.c. The major source of animal exposure is ingestion of contaminated feed. Once accumulated in intestinal tract, heavy metals are distributed by blood to all organs and affect to the metabolic processes [3].

The potential sources of heavy metals are mining enterprises, iron and steel industries, machine-building plants and other heavy industries. Mining operation, ore processing, metal smelting has collateral damage to flora and fauna of adjacent area. Water discharge and emission of gases to the atmosphere lead to the contamination of water sources and air [4].

However, not only the industrial sector contaminates the environment, but also the automobile transport, working on petroleum and gas fuel. Incorrect recycling of car and consumer batteries lead to the spreading of Mn, Pb, Cd, Li and other toxic metals to the environment [5].

The safety of food is the main factor of human health preservation. Technogenic pollution of environment calls for regularly study the concentration of heavy metals in food [6]. Therefore, ensuring food safety is a priority task of the government aimed to protect and improve of human health, control the production of high quality and safe food products. The purpose of this paper is to study the concentration of Pb, Cu, As,Zn in meat samples of Astana city, Kazakhstan.

MATERIALS AND METHODS

Meat was sampled from five different meat markets which located in different places of Astana city. Totally number of samples was 125 (25 samples from each market). Meat samples were put into polythene bags and transported to laboratory and stored at -18 – 20 °C before analysis.

Heavy metal determination

Heavy metals (Pb, As, Zn and Cu) were quantified by Atomic Absorption Spectrophotometer (Perkin Elmer 2380) according to the method of (AOAC, 2012) [7].

Statistical Analyses

Statistical analysis was performed using Statistica 12.0 (STATISTICA, 2014; StatSoft Inc., Tulsa, OK, USA). The differences between samples were evaluated using ANOVA method. The differences were considered to be statistically significant at $p \leq 0.05$.

RESULTS AND DISCUSSION

The content of heavy metals in food products is regulated by national of world food agencies. The concentration of heavy metals did not exceed the permissible levels of National Regulations of the Republic of Kazakhstan. The mean concentration of Pb was 0.035 mg/kg and varied from 0.029 mg/kg to 0.045 mg/kg depending on sample locations.

Our finding is lower than [8] for Pb content (0.19 mg/kg) in meat from Novosibirsk region (Russia), and a study done by Martynov where the maximum concentration of Pb was 1.58 mg/kg. Kosilov [9] reported that Pb content in beef from Orenburg region (Russia) is 0.20-0.27 mg/kg which higher than this study, while Oorzhak [10] found 0.38-0.44 mg/kg of Pb in meat from Tuva Republic. In Libya [11] the concentration of Pb in meat varied between 0.152 to 0.156 mg/kg, whereas in meat from Egyptian markets Pb content were 0.45-2.81 mg/kg [12].

Lead and other heavy metals being accumulated on the cells deactivated ferments. Lead is slowing down the brain function of children, increases the blood pressure and causes heart disease [13]. Moreover, lead can replace the calcium in bone tissues and therefore intoxicating whole human body [14]. Lead exposure causes several health problems such as brain and kidney damage, high blood pressure, behavioral problems in young children, neurologic disorders, heart disease, abdominal pain [13]. Lead has a negative effect to heart and blood system (damaging red blood cells,), kidney, nervous system,

Table 1: Heavy metals concentration in meat samples, mg/kg

Heavy metal	Sampling place					Mean	PL'
	1	2	3	4	5		
Pb	0,040±0,003	0,045±0,002*	0,031±0,001**	0,029±0,002**	0,030±0,002**	0,035	0,5
Cu	2.522±0.129	3.108±0.110*	2.496±0.146	1.973±0.047*	2.521±0.107	2.524	5,0
As	0,076±0,004	0,086±0,005*	0,072±0,004	0,068±0,003*	0,078±0,005	0,076	0,1
Zn	4,92±0.37	6,33±0.62**	6,57±0.81**	6,37±0.76**	7,21±0.61**	6,28	70,0

*P<0.05; **P<0.001

' PL – Permissible level

Average As concentration was measured as 0.076 mg/kg with maximum value as 0.086 mg/kg and minimum value as 0.068 mg/kg. The arsenic content was lower than 0.1 mg/kg in all sample locations. Arsenic enters the human body by food consumption and accumulates mainly in liver, spleen, kidneys, blood, hair and nails. The toxic effects of arsenic related to oxidative process disruption, nervous system [15].

The mean concentration of Cu was 3.89 mg/kg with the lowest and highest values of 3.04 mg/kg and 4.80 mg/kg, respectively. These values higher than in study [16], where Cu content varied from 0.80 mg/kg to 1.60 mg/kg and in meat samples from Novosibirsk region (0.36 mg/kg) [8]. Similar results were determined by Kosilov [9] in meat from Orenburg region (3.12-3.76 mg/kg) and by Oorzhak (3.88-4.28 mg/kg) [10].

Copper in high concentration (more than 5.0 mg/kg) has a toxic effect and poisoning symptoms include metallic taste in the mouth, vomiting, and abdominal pain [17].

Zn content in meat samples varied from 4.92 mg/kg to 7.21 mg/kg and was below the permissible level of Zn in meat (70.0 mg/kg). Similar results were reported by Chernysheva (5.10 mg/kg) [8]. Martynov [16] studied the heavy metal content in meat from Sakha Republic (Yakutia) and determined, that the concentration of Zn varied from 10.49 mg/kg to 14.13 mg/kg which higher than our findings two times. However, in meat samples from Orenburg region [9] and Tuva Republic [10] Zn content were far more than this study results (34.9-45.1 mg/kg and 37.19-41.16 mg/kg).

Zinc is poorly absorbed in body and accumulated in gastrointestinal tract. Gastric disturbance and vomiting are the early symptoms of toxicity [18].

CONCLUSION

The levels of heavy metals found in this study were below the standard regulations of the Republic of Kazakhstan and in safer range. However, the constant monitoring of the food toxicity is required for controlling the safety of food products and health of people.

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