Comparison of the Metal Concentrations in the Muscles of Slaughtered Cows, Calves, and Sheep in Sanandaj City, Iran

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ABSTRACT

Background: Heavy metals contaminated environment constitutes a serious problem for human and other organisms. Moreover, metals such as Cd, Pb, and Cr are toxic metals. Therefore, the purpose of this study was to evaluation of Cd, Pb, and Cr in the muscle of cow, calf, and sheep slaughtered in Sanandaj city from Iran.

Methods: This was a descriptive cross-sectional study in Sanandaj city in November 2014. A total number of 40 individual animals belonging to cow, calf, and sheep were analyzed for Cd, Pb, and Cr concentrations in the muscle samples. Heavy metals were assayed by using a graphite furnace atomic absorption spectrophotometer.

Results: The results of present study indicated that the mean concentrations of Pb in the muscle of cow, calf, and sheep were 15.1, 13.1, and 9.9 mg/kg. However, the Cd concentrations in the muscle of cow, calf, and sheep were 12.7, 1.8, and 2.8 mg/kg. The results of this study showed that the highest Cd and Pb concentrations were detected in the muscle samples of cow.

Conclusion: The metal concentration in the muscle samples was generally lower than the maximum acceptable concentration in European Commission.

Keywords: Animals, Cattle, Metals, Muscles.

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INTRODUCTION

Contamination of the environment by heavy metals is a worldwide issue due to their toxicity, accumulation in the food chain, and finally uptake of these metals by human and other organisms [1]. Heavy metals, such as Cd, Pb, and Cr, are considered toxic metals and have no known biological functions. They exert their toxicity by competing with essential metals for active enzyme or membrane protein sites [2]. Cd and Pb are poisonous metals that affect a number of body organs and systems, such as kidneys and lungs as well as nervous, hematological, cardiovascular, reproductive, and immune systems [3,4]. An important way of exposure to Cd is food which might be contaminated by metals from different sources, such as air, water, and soil.

Some trace metals are present mainly in muscle tissues [5]. Several studies have indicated that heavy metals, such as Cd, Pb, and Cr, have the ability to accumulate in the muscles of cows and sheep [6-8]. The findings of Massanyi *et al*. confirmed that Cd and Pb have the ability of accumulation in sheep muscles, but these concentrations are lower in comparison with kidneys and livers [6]. Though caution is exercised to ensure that a very healthy cow is processed for consumption, a cow with high levels of toxic metals may not show any obvious symptoms of illness and thereby possess hidden potential health risk to humans [8]. Thus, gaining data of metal levels' distribution in organs of animals, such as cows and sheep, is highly important for both respecting nature management and human consumption of cow and sheep.Cows and sheep meat are a very rich and convenient source of microelements. Chemical composition of meat depends on both the kind and degree of the feeding animal [9]. Due to the grazing of cattle on contaminated soil, higher concentrations of metals are found in cows and sheep [10]. Several researches have been conducted in many countries to determine the levels of metals in animal products [11-13].

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Gonzalez-Waller *et al*. reported that Cd and Pb concentrations in meat products exceeded the recommended limits [12]. Therefore, the aim of the present study was to determine the concentrations of Cd, Pb, and Cr in the meats of cows, calves, and sheep in Sanandaj city and compare these levels with those in other countries and the acceptable maximum.

MATERIALS AND METHODS

A total of 40 samples from meats of cows, calves, and sheep were collected from butcheries in Sanandaj city, Iran, in November 2014. The samples were collected in clean polyethylene bags according to their type and transported to laboratory for analysis. In the laboratory, they were immediately dissected using a stainless steel dissection instrument. Approximately 1g wet weight meat from each sample was dissected, washed with distilled water, and accurately weighed into 50-mL Erlenmeyer flasks. 10 ml nitric acid (65%) was added to each sample. The samples were left overnight in order to digest slowly. Afterward, 5ml perchloric acid (70%) was added to each sample. Digestion was performed on a hot plate (sand bath) at 85 ºC before dilution with 50ml deionized water.

Cd, Pb, and Cr concentrations were measured using graphite furnace atomic absorption spectrophotometer. For each heavy metal, the detection limits were obtained as 0.01 (Cd), 0.2 (Pb), and 0.07 (Cr). Moreover, the mean recovery values for Cd, Pb, and Cr were 98.7%, 98%, and 97.4% respectively. Statistical analysis was performed using SPSS statistical package (version 16; SPSS, Chicago, IL). The one-way analysis of variance (ANOVA) was performed to establish the statistically significant differences in the concentration of metals among the samples of each species. Pearson correlation (r) was used to determine the correlation between the levels of accumulated metals in meats of cows, calves, and sheep.

RESULTS

The highest concentrations of Cd and Pb were detected in the samples of cow, while the highest concentration of Cr was detected in the samples of sheep (Table 1). Moreover, the analysis of Pearson correlation coefficients of metal concentrations in the meats of three species showed significant correlations between Cd and Cr in cows, Cd and Pb in calves, and Pb and Cr in sheep ($P<0.05$) (Table 2).

Table1. Metals concentrations (Mean ±SD; mg/kg) in the muscles of cows, calves, and sheep.

Species/Sex	No.	Metals		
		Cd	Pb	Cr
Cows				
Male		12.2±3.1	14.1±2.7	225±13
Female		13.1±2.4	16.2±3.2	213±15
Overall Mean		12.7±2.4	15.1±2.8	219±13
Calves				
Male		2.1±2.9	10.5±3.7	237±17
Female		1.4±1.5	17.4±6.4	228±32
Overall Mean		1.8±2.4	13.1±4.8	234±22
Sheep				
Male		1.1±0.7	9.2±2.4	242±14
Female		4.5±4.9	10.5±5.9	236±16
Overall Mean		2.8±3.7	9.9±4.2	239±14
p value*		0.001	NS	NS

* *p* significance level, NS= not significant

Table2. Correlation coefficient (r) of the metals concentrations in muscles of cows, calves, and sheep from Sanandaj city.

	Cd	Pb	Cr	Cd	Pb	Cr	Cd	Pb	Cr
Cow				**Calves**			**Sheep**		
Cd	1			1			1		
Pb	-0.37	1		-0.64*	1		-0.50	1	
Cr	-0.65*	-0.45	1	-0.41	-0.04	1	-0.21	0.67*	1

*$p<0.05$

DISCUSSION

According to the results of the present study, Cd and Pb levels in the meats of female cows and calves were only slightly higher than those recorded in their male counterparts. The difference was not significant, however. It is possible that the higher Cd levels in female cattle in some countries may, in fact, be due to the higher age of female animals [14].

The muscle organ is the main edible animal part that can directly affect human health if carries metals beyond standards. For this reason, most rules have established allowable concentration limits for toxic elements in this organ [1]. The maximum Cd and Pb concentration for cattle and sheep has been proposed as 50 and 100 mg/kg for muscle, respectively [14]. It is clear from the results of the present study that Cd and Pb concentration in the muscle of slaughtered cattle and sheep in Sanandaj city were generally lower than the maximum acceptable concentration by the European Commission.Cr is not usually an analytical target within routine surveillance of pollutants in animals, and there is an absence of contemporary information available for comparison purposes [1]. Levels of Cd in sheep muscles in the present study are slightly higher than those reported by Kazemeini *et al.* from Falavarjan abattoir, Iran [15]. Moreover, Cd concentrations in the present study were lower than those in sheep and cattle of Palestinian Authority [16], in sheep of Egypt [11], and in cows and sheep of Borno State, Nigeria [9]. Cd and Pb are highly toxic elements in the environment. Exposure to these metals for a long period can result in kidney, liver, circulatory system, and nerve tissue damages.

CONCLUSION

In conclusion, the results of this study indicated that Cd, Pb, and Cr concentrations in the muscles of three species from Sanandaj city are below levels of concern for human consumption. In other words, their levels in the muscle indicate that the risk of these metals for consumer's health is low. Moreover, the accumulation of metals in the muscle depends on the type of species and the kind of metals.

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