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Few heavy metal levels in certain tissues of cattle in Burdur of Turkey

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ABSTRACT

In the present study, the occurrence of some heavy metals was determined in muscle, liver and kidney tissues of cattle in Burdur, Turkey. The samples were analyzed for cadmium, lead, arsenics and mercury using Inductively Coupled Plasma-Optical Emission Spectrometry in 50 samples. Concentrations of Cd exceed the permissible limits in 2 samples of muscle tissues (0.05 mg/kg), while the concentrations of Cd in the liver and kidney tissues were below the allowed limits (0.5 mg/kg for liver; 1.0 mg/kg for kidney). One sample in muscle tissue contained Pb above the allowed limit (0.1 mg/kg). Arsenic was detected in one sample of muscle, liver and kidney tissues. Hg was not detected in any of the samples. A high proportion of samples did not contain detectable level of the heavy metals. Except for Cd and Pb in muscle tissue, concentrations of other metals were below the permissible limits.

Key words: Cattle, Heavy metals, Kidney, Liver, Muscle.

INTRODUCTION

Environmental pollutants are capable of disrupting human and animal health. Among the environmental pollutants, heavy metals are of particular importance since they are very resistant to environmental conditions and are able to accumulate in increasing concentrations. Cadmium (Cd), lead (Pb), arsenic (As) and mercury (Hg) are non-essential heavy metals which can be toxic to human depending on the amount of exposure. Heavy metals can readily enter the food chain and show toxic effects on biological systems (Ihedioha and Okoye, 2013; Kramer *et al.*, 1983). One of the important entry ports of these heavy metals is through the dietary intake of edible parts of animal tissues. Cd compounds are classified as human carcinogens by The International Agency for Research on Cancer (IARC) and US National Toxicology Program. Cd exposure has been also correlated with chronic renal failure, skeletal damage and cardiovascular diseases in human. Cd has been found to have reproductive toxicity and teratogenic effects in animals. Lead has been classified as probable human carcinogen by IARC. In addition, chronic exposure to lead affects many systems such as CNS, blood, kidneys and vitamin D metabolism. Arsenic and mercury are reported to result in carcinogenesis and genotoxicity. Both are also capable of inducing mitochondrial oxidative stress leading to various toxic effects (Jarup, 2003; Tchounwuo *et al.*, 2012). Due to potentially serious toxic effects, screening and monitoring of these heavy metals is of particularly important for public health. In the present study, the occurrence of heavy metals was determined in muscle, liver and kidney tissues of cattle slaughtered in Burdur vicinity of Turkey.

MATERIALS AND METHODS

Samples of muscle, liver and kidneys were collected from 50 cattle, slaughtered in Burdur, Turkey during the period of April 2014 and June 2014. All samples were randomly obtained from the healthy animals. Approximately a 100 g of sample was taken from the same part of the organs (muscle, liver and kidney). All samples were packed in plastic bags and then transported to the laboratory under cold chain and stored -18 ^{0}C until the analyses is performed.

Microwave extraction has been performed in a microwave laboratory oven (Milestone, SRL). Before analysis, the tissues were thawed and 0.5 g sample was taken from each tissue (muscle, liver and kidney). Modified microwave method was applied for the digestion procedure of samples. Three thawed 0.5 g homogenates from each tissue were placed in a Teflon digestion vessel with 8 ml of concentrated nitric acid (HNO_3 65%) and 2 ml of hydrogen peroxide (H_2O_2, 30%). The samples in the vessels were then digested, and they were cooled at room temperature. The residues were then dissolved and diluted to 25 ml. The diluted digests were directly measured by a Perkin- Elmer Optima 7000 V inductively coupled plasma-optical emission spectrometry (ICP-OES). In the ICP-OES analysis using the standard wavelength lines (Pb 220.3 nm, Cd 228.8 nm, As 193.6, Hg 253.6 nm).

RESULTS AND DISCUSSION

Heavy metals are released to the ecosystem as a result of mostly human activities including use of fertilizers and pesticides in agriculture, exhaust gases, industrial and mining activities (Celechovska *et al.*, 2008). Burdur and

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Table 1: The number of samples and levels of cadmium (Cd), lead (Pb) and arsenic (As) in muscle, liver and kidney tissues of cattle slaughtered in Burdur, Turkey.

Heavy Metal	Tissue	Number of tissue detected	Concentration (mg/kg)	Mean Concentraion (mg/kg)	Maximum Allowed limit by TFC (mg/kg)
Cd	Muscle	2	0.156, 0.119	0,138	0.05
	Liver	2	0.067, 0.257	0.162	0.5
	Kidney	6	0.028, 0.032, 0.049,0.139, 0.045, 0.068	0.060	1.0
Pb	Muscle	3	0.075, 0.01, 0.27	0.118	0.1
	Liver	2	0.035, 0.062	0.485	0.5
	Kidney	2	0.071, 0.046	0.085	0.5
As	Muscle	1	0.044	-	1
	Liver	1	0.003	-	1
	Kidney	1	0.08	-	1

n= 50, (TFC: Turkish Food Codex)

Isparta region of Turkey is in a downstream position of the most important centers in the Mediterranean region. One of the important deposits of marble ore in Turkey is found in this region and has been continuously removed for many years. Hence, animals grazing in this region could potentially be at risk of taking environmental pollutants. Furthermore, most of the cattle bred in these provinces are sent to other provinces as fattening or breeding material. Therefore, humans as the uppermost member of food chain could be potentially at risk due to exposure to heavy metals. A total of 50 samples from each tissue (muscle, liver and kidneys) were analyzed for the presence of Cd, As, Pb and Hg. The results were compared with the maximum allowed limits according to the Turkish Food Codex (TFC) and European Union limits. The number and the concentrations of elements detected in samples are presented in Table 1. Cadmium was detected in 10 samples including muscle, liver and kidneys. Of the detected samples, the number of Cd which was detected with respect to the tissue type was: 2 in muscle and liver, 6 in kidney tissues. The level of Cd found in muscle tissue samples (0.156, 0.119 mg/kg) exceeded the maximum allowed limit (MAL) as fixed by TFC (0.05 mg/kg). The level of Cd in 2 samples from the liver tissue contained Cd below the MAL (0.5 mg/kg). The level of Cd detected in 6 kidney samples was below the MAL (1 mg/kg) set by TFC. Lead was detected in 7 samples. Of the detected samples, Pb was found in 3 muscle, 2 liver and 2 kidney samples. Lead level in 1 muscle sample out of 2 exceeded the MAL (0.1 mg/kg) set by TFC. The detected levels of Pb in the liver and kidney were below the MAL (0.5 mg/kg for kidney and liver). The levels of Cd and Pb in muscle and/or offal screened in this study were lower compared to other countries found in European Union such as in Ireland (Canty *et al*., 2014), in Poland (Zasadowski *et al*., 1999), in Spain (Lopez *et al*., 2000) and in Belgium (Roggeman *et al*., 2014). Arsenic was detected in all 3 samples as 1 in each tissue. Mercury was not detected in any of the samples. There was no specified maximum limits set by TFC and European Union for As and Hg in bovine tissues. Hence, distribution of a particular heavy metal was compared among the tissues using Pearson Chi Square test. Results also indicated that no difference in the accumulation of heavy metals was present between the tissue types analyzed.

In conclusion, a high proportion of samples of all tissue types did not contain detectable level of the heavy metals analyzed. Although the number of samples containing these heavy metals is low, Cd in muscle tissue exceeded the allowed limit in all samples detected. Except for Cd and Pb in muscle tissue, concentrations of other metals within the detected samples were below the permissible limits.

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