

Cadmium levels in poultry meat

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ABSTRACT

A survey of cadmium (Cd) levels in poultry meat from polluted area of Eastern Slovakia is presented. Samples of poultry tissue (72 samples of breast muscle, leg muscle, liver and heart) were analysed for the presence of Cd on atomic absorption spectrophotometer (Unicam Solar 939). Mean values of cadmium in breast and leg muscle, liver and heart were 0.019; 0.021; 0.061; 0.099 mg/kg, respectively. On the basis of presented results of cadmium analyses it follows that its levels in poultry meat are below the highest permissible hygienic limits for Cd (muscle 0.1mg/kg; internal organs 0.5 mg/kg - Codex Alimentarium of the Slovak Republic No. 981/1996). The presented results are higher than those in unpolluted areas. The regular monitoring and control of poultry meat guarantee that a consumer is protected against unfavourable higher values of cadmium.

Key words: cadmium, poultry, muscle, heart, liver

Introduction

Eastern European nations face singular challenges related to food quality and safety. More information is needed on the quality of food consumed

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and its health effects on the population of our region. We have focussed on the role of natural antioxidants, micronutrients and chemical contaminants in food and nutrition. Increase in the concentration of heavy metals in the environment has become a serious problem. Cadmium ranks with the toxic environmental pollutants. Tissue Cd concentrations in animals are closely related to Cd levels in feedstuffs, the dose of Cd and the duration of Cd load (BOKORI et al., 1995). Other tissues that could be injured include liver, reproductive tract (disorders), the immune and nervous systems, and blood (ANKE et al., 1993; KOTTFEROVÁ, 1996; HURNÁ and HURNÁ, 1998; MARAČEK et al., 1998). The main risk posed by cadmium as an environmental pollutant is its easy access to the food chain (ONDRAŠOVIČ et al., 1997). Cadmium content of human foods varies widely depending on place of their origin (BOKORI and FEKETE, 1995).

The objective of our study was to assess the effect of environmental exposure on cadmium concentrations in various tissues and organs of poultry kept in areas differing in burdens of industrial emissions.

Materials and methods

Seventy-two samples of breast muscle, leg muscle, liver and heart of poultry were collected from commercial poultry slaughterhouses found in the vicinity of Košice (Slovak Republic - Fig. 1). The samples were immediately frozen and stored at -20 °C until analysed. The analysis



Fig. 1. Map of Slovak Republic

consisted of digestion (5 ml HNO₃ and 1 ml HCl per 1g of sample) in the microwave oven Milestone, and determination of cadmium by the method of KOCOUREK (1992). Analysed reference material (MBH Anal Ltd., England) tested the reproducibility of the method of cadmium determination. Samples were analysed for the presence of cadmium using an atomic absorption spectrophotometer (AAS) with a graphite furnace with background correction (Unicam Solar 939, UK). The operating parameters used were those recommended by the instrument manufacturer for cadmium (wavelength 228.8 nm, band pass 0.5 nm). Quantification limit was 0.03 µg/l and detection limit 0.01 mg/l. The standards were prepared from the individual 1000 mg/kg standard (Merck, Germany); 100 ml of five combined standards were prepared in 0.1 N HNO₃. The lamp current used was 75%. The signal type was transient for cadmium. Measurement time was 3s. Recovery methods were 96-98% and reproducibility was better than 1.0%. All metal concentrations are expressed on a wet mass basis. The statistical evaluation of the results has been done using the Microsoft Excel 7.0 program. Data are presented as mean, maximum, minimum, median and standard deviation (sd).

Results and discussion

The results obtained were compared with the maximum permissible hygiene limits for Cd in meat (0.1 mg/kg) and liver (0.5 mg/kg) according to the Codex Alimentarius of the Slovak Republic No. 98/1996, and with results presented in literature of some European countries. The Cd content of breast and leg muscle, heart and liver poultry originating from the polluted area of the metallurgical plant is shown in Table 1.

The mean concentrations of Cd measured in poultry breast and leg muscle were relatively low (0.0187; 0.021 mg/kg, respectively). The mean concentrations of Cd were slightly lower in breast than in leg muscle. BRAECKMAN et al. (1997) reported that no major differences have been demonstrated in Cd content of different muscles (breast muscle, leg muscle). Cd mean contents in poultry meat were found to be 0.009 mg/kg in the central database from a non-contaminated area of the Slovak Republic (SOKOL et al., 1998). The mean concentrations of Cd measured in muscle

from polluted area in our results were higher than results presented in this database. According to KÖFER and FUCHS (1993), relatively little Cd can be found in muscles, brain, myocardium, hair follicles and bone of poultry.

Table 1. Concentration of cadmium in biological samples of poultry from Slovakia (mg/kg, origin matter)

	Leg muscle	Breast muscle	Heart	Liver
Max	0.0250	0.0250	0.0800	0.1210
Min	0.0100	0.0170	0.0420	0.0750
Median	0.0205	0.0205	0.0600	0.1054
Mean	0.0187	0.0210	0.0613*	0.0985*
sd	0.0052	0.0034	0.0155	0.0172
n	72	72	72	72

n = number of samples; min = minimal levels; max = maximal levels; sd = standard deviation

* statistical significance at $P \leq 0.05$

Cadmium mean values determined in our work are comparable with those published by TAHVONEN and KUMPULAINEN (1995). Cd mean content found in their study was low (muscle < 0.001 mg/kg). The decrease is due both to presently low Cd emissions in Finland and abroad, and improved analytical methods. Several authors have shown that Cd primarily accumulates in liver and kidneys (SALISBURY et al., 1991; SAGER et al., 1998; YSART et al., 2000).

Furthermore, feed composition can influence the retention of trace elements (GER VOS et al., 1986). Absorption and accumulation of Cd in tissue seems to be determined by a wide range of factors: nutritional and vitamin status, age and sex (TORRA et al., 1995). According to FALANDYSZ et al. (1994) the mean concentrations of Cd in the muscle of poultry in Poland were 0.038 mg/kg. Lower mean Cd contents, 0.005 mg/kg, were observed in Hungary than in Poland (BOKORI et al., 1996). Cadmium has been shown to accumulate preferentially in the inner organs.

Mean Cd contents in organs reported in this paper were low, ranging from 0.075 mg/kg to 0.121 in liver and from 0.042 to 0.080 mg/kg in heart.

Mean concentrations of Cd were slightly higher in liver (0.099 mg/kg) than in heart (0.061 mg/kg). A significant increase ($P \leq 0.05$) of mean Cd concentration was found between heart and other muscles (leg and breast muscle). A similar significant increase ($P \leq 0.05$) of mean Cd concentration was also observed between liver and other muscles (leg and breast muscle). The presented results of Cd contents of liver in the vicinity of Košice, polluted by metallurgical plant, in comparison with the literature data are higher. The mean concentrations of Cd in the liver of poultry from a polluted area in Poland were 0.038 mg/kg (FALANDYSZ et al., 1994), Finland 0.021 mg/kg (TAHVONEN, 1996) and Hungary 0.053 mg/kg (BOKORI and FEKETE, 1995).

Despite this fact, over limited findings have not been found in all poultry samples. We hope that a way for the production of agricultural products with only slight Cd contents will continue to be favourable in the future. Cd contents of cultivated soils will be lowered by applying restrictions on the use of fertilizers and sludge containing Cd. Efforts towards decreasing predominant sources exposure to Cd through lubricating oils, diesel oil, fertilizers and rubber car tires (although emission of the volatile Hg, Pb, Zn, and Cd are also associated with high temperature stack sources - e.g. incinerates, smelters, coal fired plants) is the route to the provision of food quality and safety of foodstuffs.

The present results show that cadmium content in poultry meat was slightly higher in the area of Eastern Slovakia in comparison to maximum permissible hygiene limits for Cd in poultry meat (0.1 mg/kg) and inner organs (0.5 mg/kg) according the Codex Alimentorum of the Slovak Republic No. 98/1996. Cadmium concentration was comparable with the highest permissible hygienic limits for meat and liver. These results guarantee that the consumer is protected against unfavourable effect of cadmium on the human body.

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SAŽETAK

Prikazani su rezultati određivanja kadmija u mesu peradi uzgajane u zagađenim područjima istočne Slovačke. Razine kadmija određene su u 72 uzorka mesa peradi (grudnog mišićja, mišićja noge, srčanog mišića i jetre) atomsko-apsorpcijskom spektrofotometrijom (Unicam Solar 939). Srednja vrijednost kadmija u grudnom mišićju iznosila je 0,019 mg/kg, u mišićju noge 0,021 mg/kg, jetri 0,061 mg/kg, te u srčanom mišićju 0,099 mg/kg. Na temelju dobivenih rezultata autori zaključuju da su količine dokazanog kadmija niže od najviših dozvoljenih vrijednosti prema pravilniku o ispravnosti mesa (za mišićno tkivo 0,1 mg/kg, za unutarnje organe 0,5 mg/kg - Codex alimentarium Republike Slovačke broj 981/1996). Količine kadmija bile su više u odnosu na nezagadeno područja. Redovito praćenje kvalitete mesa peradi jamči potrošaču sigurnu zaštitu od visoke količine kadmija sadržanog u tkivu.

Ključne riječi: kadmij, perad, mišić, srce, jetra
