Available online at
http://journals.usamvcluj.ro/index.php/promediu

ProEnvironment

ProEnvironment 10 (2017) 286 - 290

Original Article

The Influence of the Rearing Area upon Cd, Al and Pb Levels in Pork Meat

COROIAN Aurelia [1], Vioara MIREȘAN[1], Camelia RĂDUCU[1*], Adina Lia LONGODOR[1], Luisa ANDRONIE[1], Igori BALTA[1], Antonia ODAGIU[2]

[1]Faculty of Animal Husbandry, and Biotechnology, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5, Calea Mănăştur, 400372 Cluj-Napoca, Romania
[2]Faculty of Agriculture, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5, Calea Mănăştur, 400372 Cluj-Napoca, Romania

Received 17 October 2017; received and revised form 9 November 2017; accepted 28 November 2017
Available online 30 December 2017

Abstract

The presence of heavy metals in food in high quantities may pose a risk to the health of the consumer. Highly polluted areas, due to industry, cause high levels of metals in food from these areas. The present study showed that the sampling area influences the amount of heavy metals in pork meat. The Cd content of pork ranged from 0.26 mg/kg (Bistrita Nasaud) to 0.43 mg/kg (Salaj). The content of Al and Pb presented the highest average values from Sălaj and Cluj areas. Al showed a variation of 5.03 mg/kg in samples from Bistrita-Nasaud and 9.64 mg/kg from Sălaj.

Keywords: *heavy metals, pork meat, cadmium, lead, aliminium.*

1. Introduction

Heavy metals are present in products of animal origin and in products of plant origin. The presence of heavy metals occurs due to the absorption in soil, polluted atmosphere, treatment with hazardous substances and installations used for treatment as well as for transport and processing.

There are studies about the presence of heavy metals as (zinc, copper, cadmium, and lead) in applesauce, carrot and pear puree, fruit and vegetable juices, dairy products and meat [2, 13, 17, 18]. In general, cadmium strongly binds to organic matter, so it is taken up by plants and eventually gets into food.

The ways of penetration of heavy metals into the human organism are diverse: via food, chemical products we enter into contact with, environment, smoking, dental fillings and medical implants. Pathways for penetration of heavy metals into the body can include raw materials contaminated by treatments applied in agriculture, during food processing, storage, and transport, from auxiliary materials and water used in all processes of technological flow [2, 11, 12, 16].

Some metals have a potential to exert harmful action after their accumulation in the human body. They have the ability to reach the target tissues, specific to each metal.

The metals with cumulative effect are: lead, mercury, cadmium, which always act on the same tissues, degrading them gradually and even at an extremely low dose of the toxic substance affects the organ [4, 8].

Lead for example can affect almost every organ in the human organism. It mainly affects the nervous system in both children and adults.

* Corresponding author.
Tel: +40-262-59638
Fax: +40-264-593792
e-mail: craducu2001@yahoo.com

Long-term exposure to lead increase blood pressure, can lead to anemia, especially in older persons, can reduce nervous system performance, affect the ankles and damage the structure of the bone system, and is able to induce damage in peripheral damage. Pregnant women that are exposed to high levels of Pb can lead to spontaneous abortions [17]. The main way of getting aluminum into the body is through consumption of fruit and vegetables, cereals, seeds, meat, but also due to the use of aluminum compounds as food additives [18].

The purpose of the present study was the analysis of physico-chemical parameters and heavy metals in pork meat from Sălaj, Bistriţa-Năsăud, and Cluj.

2. Material and Method

Five samples of pigs (animals reared in the traditional system) were harvested in each area (Sălaj, Cluj and Bistriţa-Năsăud). The samples were subjected to physico-chemical analyzes for (fat, protein, easily hydrolyzable nitrogen) and heavy metals. Samples used for physico-chemical analysis were kept refrigerated, and samples used for heavy metals were frozen until analysis. Heavy metals from meat were determined by the ICP-MS technique.

A Berghoff MWS-3 + microwave digester (Eningen, Germany) was used. In the first step, the mineralization of the analyzed sample was carried out. It was used 8 ml of 65% HNO_3, 30 ml of 2% H_2O_2 and 1 g of meat sample. The next step is cooling the sample to room temperature. After the sample is diluted with ultra-pure water and filtered on a cellulose membrane. Sample measurements are performed by ICP-MS.

3. Results and Discussions

Physico-chemical composition of pork meat. The physico-chemical composition of pork meat is shown in Figure 1.

It can be noticed that our data, is consistent with the data reported in the literature and can be observed in different studies [3, 9].

The protein content is within the specific average for pork meat. Pork meat protein varied according to the sampling area as follows: the highest protein content was 19.3% for Cluj 19.3%, followed by Salaj 18.9% and the lowest content in Bistrita-Nasaud 18.6 % (Fig. 1).

From a nutritional point of view, the quality of the meat is characterized by its content in the main nutrients (proteins, lipids, vitamins and mineral salts). The compositional quality of the meat is attributed by the state of animal fattening, species, race, age and type of diet [14].

The fat content varied as follows: 22.7% for the Cluj area with the highest level of fat in pork meat and the lowest was in the Bistrita-Nasaud area 19.5%.

The chemical composition of the meat is determined primarily by the chemical composition of the muscle tissue. Meat contains water, protein and non-protein nitrogenous substances, carbohydrates, lipids, mineral salts, vitamins and enzymes [9].

The easily hydrolyzable nitrogen (EHN) for pork meat samples ranges from 16.4 mg/100 g for the Bistrita-Nasaud samples showing the lowest content, similar counts were detected in samples from Cluj area 16.65 mg/100g, and the highest content observed 17.2 mg/100 g for Sălaj (Fig. 1). These findings are in line with the current standard for pork meat.

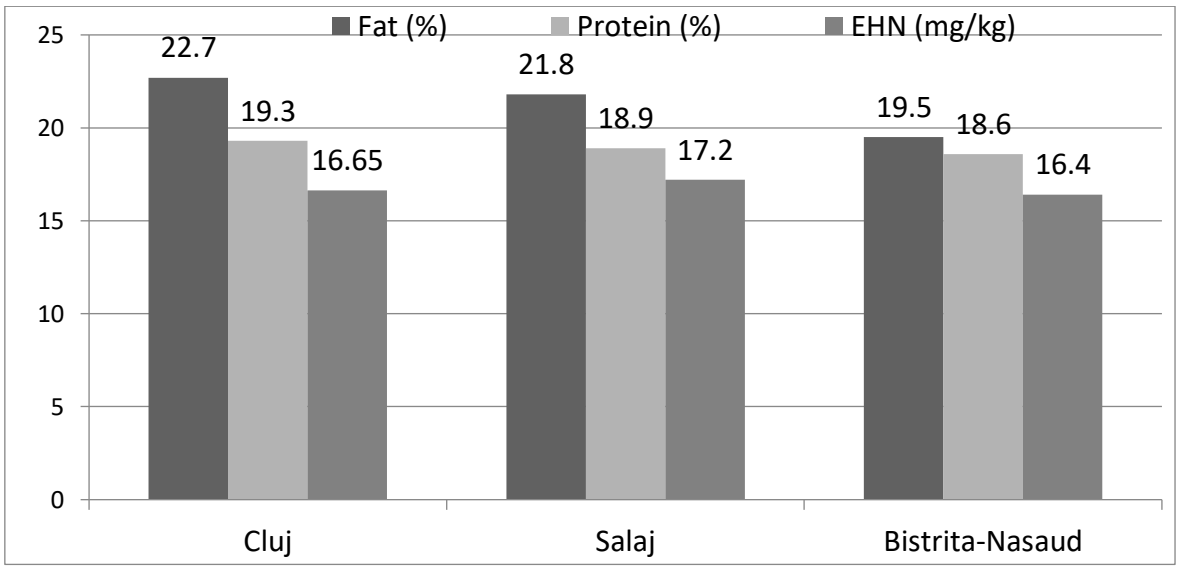

Figure 1. Fat (%), protein (%), and EHN (mg/kg) in pork meat

Cd, Al and Pb from prok meat. Fig. 2 shows the mean Cd (mg/kg) values identified in pork meat samples depending on the harvest area. The analyzed samples revealed the highest cadmium level in Sălaj zone with an average of 0.43 mg/kg, followed by Cluj, 0.39 mg/kg and Bistrița Năsăud with the lowest counts 0.26 mg/kg.

According to Hura (2006) study, on the pork meat reported cadmium counts 0.07 mg/kg [5].

Cadmium can reach the human body from the environment, during processing and transport of food.

Once it reaches into the organism, cadmium can only be removed within 10-30 years causing various diseases.

For this reason, the dose of 0.05 mg/kg body weight was required to be the maximum admissible in meat [10, 20].

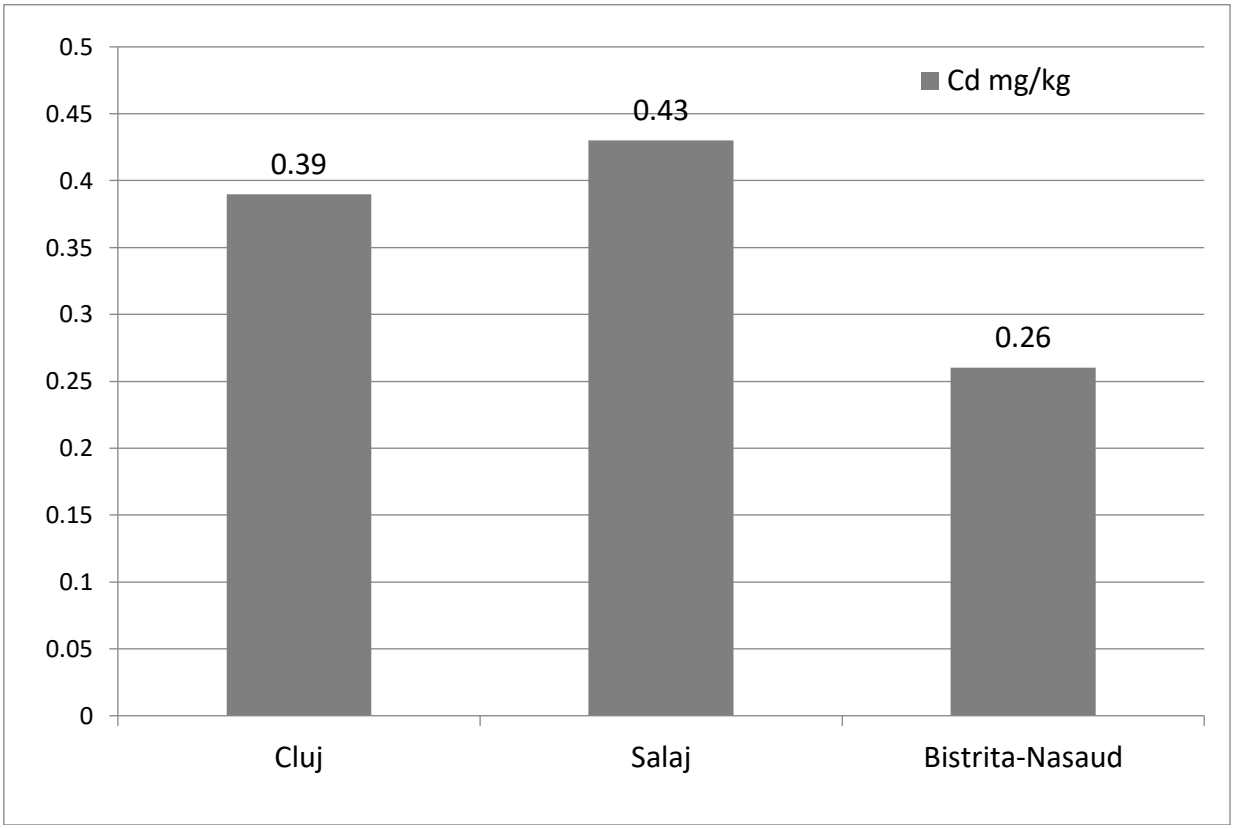

Figure 2. Cadmium (mg/kg) identified in pork meat

The highest level of Al (mg/kg) was found in meat samples from Sălaj area, showing values of 9.64 mg/kg, followed by Cluj 6.84 mg/kg and the lowest values was in Bistrița Năsăud 5.03 mg/kg (Fig. 3).

All people have a small amount of aluminum inside their organism, but they should not exceed normal average counts, as they can cause some serious illnesses. Some several studies on laboratory animals have confirmed that the absorbed aluminum crosses the placental barrier, reaching the fetus, causing damage even to the brain.

Studies conducted worldwide confirmed that aluminum salts concentrations were found even in bone marrow and spinal cord in rats [20, 21].

Al in animals and humans exhibit a toxic potential for the nervous system, skeletal system and may also induce pulmonary fibrosis [15].

Higher levels of aluminum accumulated in the human body have been observed in children with cerebral, skeletal and bone diseases.

These diseases can be caused by a high level of Al in the organism.

Various concentrations of aluminium in human milk, within the valoric interval 0.092-0.49 mg/L, soybeans, within the valoric interval 0.46-0.93 mg/L and in different infant formulas, within the valoric interval 0.058-1.5 mg/L were reported by ATSDR in 2008 [18].

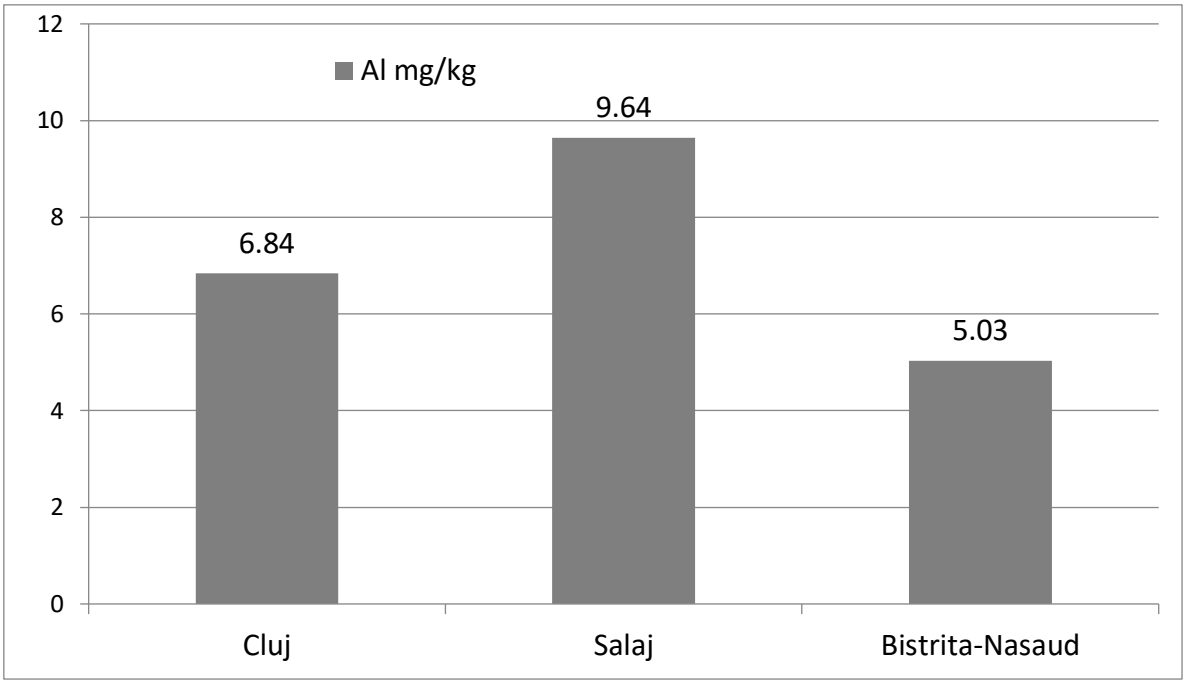

Figure 3. Aluminium (mg/kg) identified in pork meat

The highest concentrations of Pb were detected in pork meat samples from Cluj and Sălaj areas, respectively 0.32 and 0.29 mg/kg. In the Bistrita Nasaud area, the analyzed meat samples showed the lowest level of 0.16 mg/kg (Fig. 4). These aspects can be explained due to the more polluted environment from Sălaj and Cluj, areas with more intense industrial activity compared to Bistrita-Nasaud. Lead (Pb) can be found in many sources as fruits, vegetables, meat, cereals, seafood and various beverages. Pb causes significant harm in the body, from diminishing of concentration and learning ability in children, and leads to a severe destruction of the central nervous system. For this reason, a maximum limit of 0.020 mg/kg body weight is allowed in dairy products and baby concentrates [6, 7, 18, 19]. By washing meat with an acidic detergent considerably reduce, the zinc, cadmium and lead concentrations compared with the meat washed by neutral or alkaline solutions [1]. In the study of. According to Hura (2006), content Pb of 0.08 mg/kg is reported in pork meat [5].

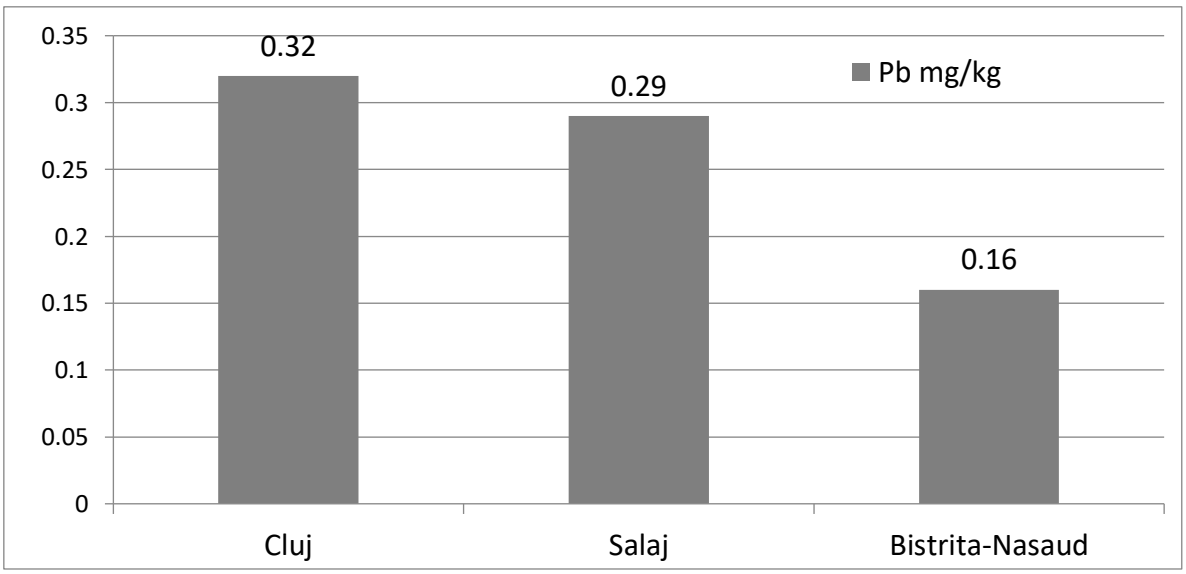

Figure 5. Lead (mg/kg) identified in pork meat

4. Conclusions

The analyzed pork meat samples presented the average values for physico-chemical composition according to the standard values.Samples with the highest fat content showed an increased level of Cd, Pb and Al. It can be noticed that area also had a significant influence on the assimilation of metals in meat composition. Meat samples from Sălaj and Cluj presented the highest concentrations counts of Cd, Pb an Al.

References

[1] Abou-Arab A.A.K., 2001, Heavy methal content in Egyptian meat and the role of detergent washing on their levels, Food and Chemical Toxicology, 39, 593-599.

[2] Coroian A., 2013, Toxicologia alimentelor, Editura Bioflux.

[3] Coroian A., V. Miresan, D. Cocan, C. Raducu, A.L. Longodor, A. Pop, G. Feher, L. Andronie, Z. Marchis, 2017, Physical-chemical parameters and the level of heavy metals in cow milk in the Baia Mare area, Banat′s Journal of Biotechnology, VIII(16), 69-74.

[4] Helfrich W., 2001, Food Toxicology, Winter CK, CRC Press LLC.

[5] Hura B.A., 2006, Assesment of the heavy metals in the food from Romania, Toxicology Letters, 164S, S1-S324.

[6] Marsh K., B. Bugusu, 2007, Food Packaging-Roles, Materials, and Environmental Issues. Journal of food science, 72, 3, 39-55.

[7] Papanikolaou M., 2010, Evaluation of conventional and adaptive pushover analysis I: Methodology, 205.

[8] Popa G., Dumitrache S, Apostol C, Segal B, Segal R, Teodoru N, 1986, Toxicologia produselor alimentare, Editura Academiei.

[9] Raducu C., V. Miresan, O. Negrea, M. Cadar, D. Cocan, *A. Coroian*, R. Constantinescu, L. Andronie, 2014, Researches regarding the quality of some*meat* products obtained at SC "Marele Alb", SRL Turda, Cluj County, Bulletin UASVM Animal Science and Biotechnologies, 71(2), 311-312.

[10] Reeves P.G., R.L. Chaney, 2008, Bioavailability as an issue in risk assessment and management of food cadmium: A review. Science of the Total Environment, 398 (1–3), 13 – 19.

[11] Salama A.K., M.A. Radwan, 2005, Heavy metals (Cd, Pb) and trace elements (Cu, Zn) contents in some foodstuffs from the Egyptian market, Emir J Agric Sci 17 (1), 34-42.

[12] Suharoschi R., 2013, Toxicologia alimentelor, Editura AcademicPres, Cluj-Napoca.

[13] Tofană M., 2011, Contaminanţi alimentari-performanţe analitice și limite legislative, Editura MEGA, Cluj-Napoca.

[14] Vintilă C., 2008, Tehnologia prelucrării cărnii de calitate, Editura Waldpress.

[15] Yokel R.A., P.J. McNamara, 2001, Aluminium toxicokinetics: an updated minireview. Pharmacol Toxicol. 88(4),159-67.

[16] Zhang C. P. Liang, D.D. Shao, S.C. Wu, X.P. Nie, K.C. Chen, K.B. Li, M.H. Wong, 2011, Mercury Biomagnification in the Aquaculture Pond Ecosystem in the Pearl River Delta, Archives of Environmental Contamination and Toxicology, 61,491-499.

[17] ***, 2007, Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological profile for Lead. US Department of Health and Human Services. Public Health Service, Atlanta, GA.

[18] ***, 2008, ATSDR, Agency for Toxic Substances and Disease Registry Toxicological profile for Cadmium. US Department of Health and Human Services. Public Health Service, Atlanta, GA.

[19] ***, 2012, Agency for Toxic Substances and Disease Registry (ATSDR), Public Health Statement for Cadmium. Atlanta, GA: U.S. Department of Health and Human Services. Public Health Service.

[20] ***, 2004, EFSA Opinion of the Scientific Panel on Contaminants in the Food Chain on a request from the Commission related to mercury and methylmercury in food. EFSA Journa , 34, 1-14.

[21] ***, 2010, EFSA, Scientific Opinion on Lead in Food. EFSA Panel on Contaminants in the Food Chain (CONTAM) 8(4), 1570.