Evaluation of environmentally loaded area by ewes health risks

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Abstract

Widespread contamination of some ecosystems by heavy metals has frequently been reported in Spiš regions with long histories of mining and former industry especially. The environmental concern in former mining areas is primarily related to the physical disturbance of surrounding landscape. Therefore, the monitoring of these products is important with respect to toxic elements affecting human health. Meat and meat products are important for human diet because they provide a great part of nutrients, including the necessary trace elements. Levels of selected heavy metals lead, cadmium, lead, zinc and iron were determined in seven ewes living near an environmentally loaded area. Study was performed in the eastern part of Slovakia during the springs of 2016 and 2017. We have found out significant inter-annual differences between measured values of Cd (P=0.0003), Pb (P=0.0200) and Zn (P=0.0018). Heavy metals from human activities pollution sources are continuously released into aquatic and terrestrial ecosystems and therefore, the concern about the effect of anthropogenic pollution on the ecosystems is growing.

Keywords

environment, heavy metal, health status, ewes, toxicity

Introduction

Toxic elements are chemicals that are persistent and not metabolized, although their chemical forms may change as they pass through the intestinal tract or during storage in animal tissues. They are regarded as toxic to living organisms since they have tendency to accumulate in selected human and animal target tissues with the potential of causing nephrological, carcinogenic, teratogenic and immunological disorders (Dietzová et al., 2007; Aliyu et al., 2015). Toxic elements are capable of being transported over long distances thousands of kilometres or may be deposited near their source of origin, thereby having a local impact (Babčan et al., 1999). The long-range transportation of toxic elements through the atmosphere mainly depends on the size and composition of particles with which toxic elements are associated as well as their solubility (Bodiš et al., 2000; Angelovičová et al., 2014). A toxic metal is defined as the metal, which is neither essential nor has beneficial effect on the contrary, it displays severe toxicological symptoms at low levels. With increasing

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industrialization, more and more metals are entering into the environment. These metals stay permanently in organisms and environment because they cannot be degraded in the environment. They enter into the food material and from there they ultimately make their passage into the tissue (Jarup, 2003).

Meat is a very important human food and as it may potentially accumulate toxic minerals, it represents one of the crucial sources of heavy metals for humans. Meat represents the main source of protein in the diet of Slovak consumers at 54 kg per year per person (Kročková, 2016). Meat is a very rich and convenient source of nutrient, including microelements. The chemical composition of meat depends on both the kind and degree of the feeding animal (Peng et al. 2009). Metals in general can be classified as toxic cadmium, mercury and essential cobalt, copper, zinc, iron (Lobet et al., 2003; Wiek et al., 2011).

In the area under investigation, it was assumed that there was contamination by heavy metal as a result of intensive agricultural development and former mining activities (Minár et al., 2009; Hronec et al., 2010; Krokusová, 2010). The aim of the experiment was to determine the concentration of selected heavy metals (lead, cadmium, zinc and iron) in ewe's blood and to find the correlations between the observed selected heavy metal in blood.

Material and methods

The ewes used in research came from the area Spiš in eastern Slovakia. The experimental group consisted of (n = 7) ewes with no signs of disease. Ewes were kept in the farm year-round. The animals in question drank water from the source of groundwater and surface water and also eaten grass on the meadow. Even through the above-mentioned factors, heavy metals can enter the animal's organism. The blood was taken from the jugular vein into blood collection tubes in the spring of 2016 and the spring of 2017. Blood serum was stored at -20 °C until analysed. The analysed selected heavy metals were evaluated due to the increased occurrence of these metals in the locality in question. This site is known to contain elevated concentrations of the elements (Minár et al., 2009; Hronec et al., 2010; Krokusová, 2010) we analyse. The concentrations of lead (Pb), cadmium (Cd) iron (Fe) in the experimental animals were determined using an inductively optical emission spectroscopy and zinc (Zn) was determined using a spectrophotometer type ANALYST 100 (Erman et al., 2005). The obtained results were statistically analysed by the method of the non-parametric Mann-Whitney´s U test.

Results and discussion

In the past, the area under analysis has been burdened by intensive mining activities as well as agricultural activity, with the associated increase in the occurrence of heavy metals in the surrounding environment. Therefore, the objective of this study was to analyse selected elements of the environment in terms of the occurrence of heavy metals. Concentrations of selected heavy metals in the blood in relation to the significance of differences between the experimental group of ewes, were evaluated lead, cadmium, iron and zinc. On basis of the statistical analysis, it was

observed a significant difference in comparison between 2016 and 2017 in the parameters Cd (p= 0.0155), Zn (P<0.0001) a Fe (p= 0.0021). The average evaluated values Cd in 2016 (0.331 ±0.106 μmol/l) were lower than the measured value in 2017(0.696 ±0.425 μmol/l). In 2016 were evaluated lower values of Zn (9.808 ±0.813 μmol/l) as in 2017 (12,533 ±1,392 μmol/l). Also, we have found out lower values of FE in the year 2016 (11,741 ±2,972 μmol/l) compared with the average in 2017 (15,285 ±2,393 μmol/l). No significant differences were found by statistical analysis between years 2016 and 2017 in parameters Pb (p= 0.0823), though the measured values of Pb in 2016 (0.498 ±0.188 μmol/l) were lower compared to 2017 (0.591 ±0.189 μmol/l). Authors Aliyu et al. (2015) and Póti et al. (2012) from different continents of the world, from the West African sub-Saharan region and the northeast part of Hungary in Central Europe, analysed the concentration of heavy metals in ewes' milk. Nkansah & Ansah (2014) reported the concentration of some heavy metals in the meat of sheep from Republic of Ghana. The above-mentioned authors analysed similarly to ours in our work the occurrence of heavy metals in selected components of the environment. This type of monitoring is important in terms of mapping hazardous areas with increased concentrations of heavy metals in the surrounding environment.

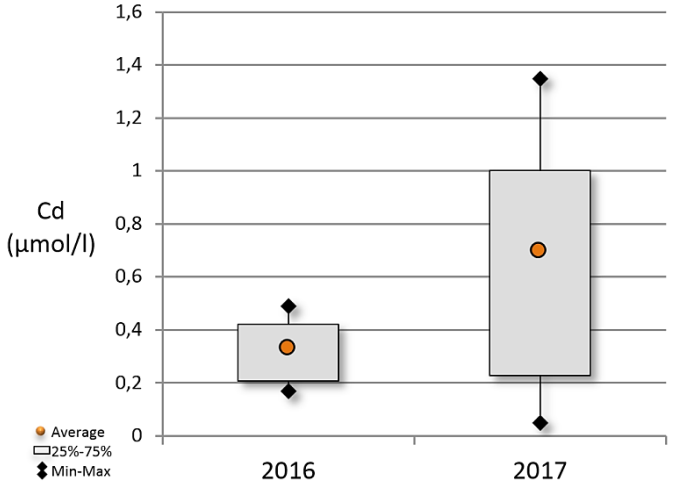

Figure 1. Concentrations of Cd in 2016 and 2017.

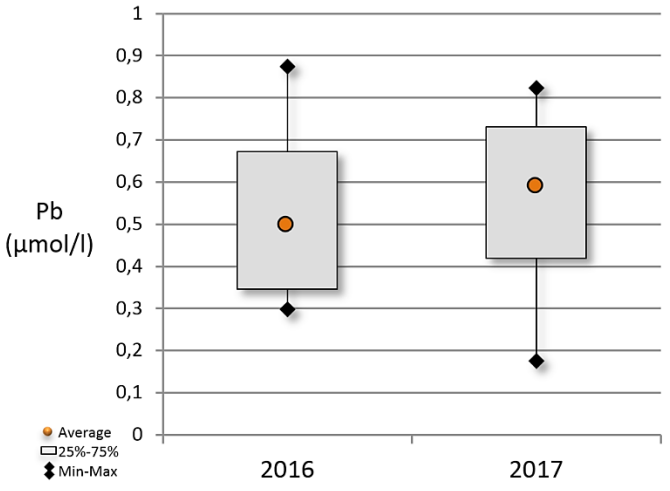

Figure 2. Concentrations of Pb in 2016 and 2017.

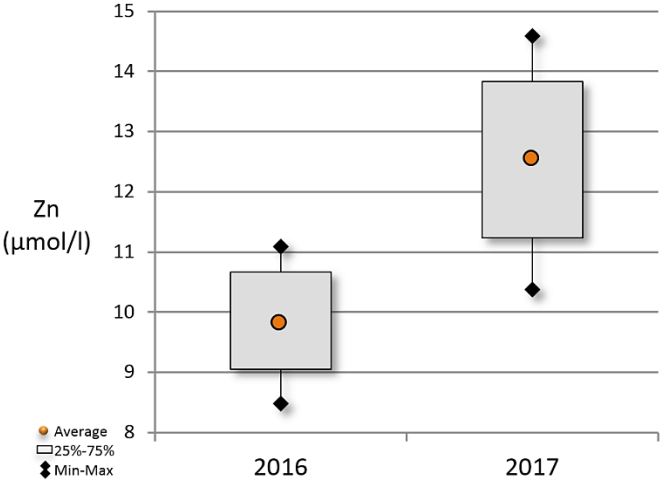

Figure 3. Concentrations of Zn in 2016 and 2017.

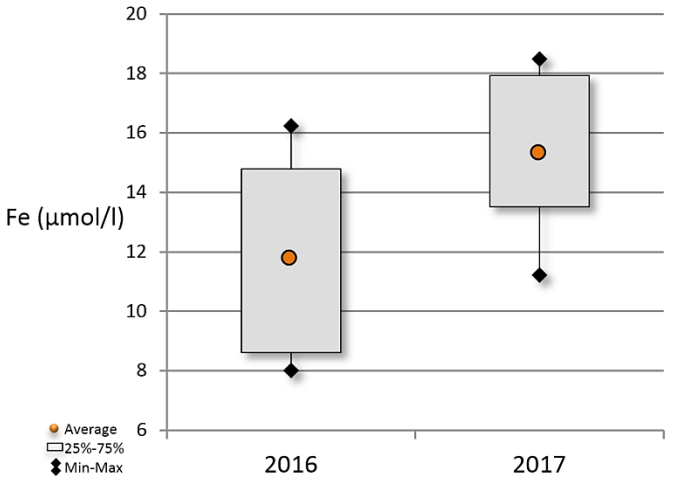

Figure 4. Concentrations of Fe in 2016 and 2017.

Conclusions

Based on the above results, it can be concluded that metals bioaccumulation in the meat species studied did not exceeds the permissible limits set for heavy metals by FAO and WHO except lead and cadmium (WHO 2016). The high heavy metal content found in ewe blood in the eastern part of Slovakia meat products may be caused by pollution and the environment itself, more probably by secondary contamination caused by agricultural practices and livestock feed (Perveen & Zeb, 2007; Vlčkova et al., 2008). Contamination is transferred to animals through direct sewage water. Another factor in the introduction of heavy metals into the animal's body is the water that the animals drink and the grass they eat on the meadows. Contamination of meat can also be caused by emission located in this part of Slovakia (Škultéty, 2015). This work is the use for the preventive diagnosis of production diseases and the evaluated data can serve as a control indicator to detect toxic hazards related to the heavy metal (Rao 2014). Based on the statistical analysis was found a statistically significant difference in comparison of years 2016 and 2017 in values Cd ($p=0.0155$), Zn ($P<0.0001$) and Fe ($p= 0.0021$). By statistical analysis was not found significant differences in compared years 2016 and 2017 in Pb parameters ($p = 0.0823$). If there are no differences in food source/pasture/water between years, it is obvious there

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