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LEAD CONCENTRATIONS IN DIFFERENT ANIMAL TISSUES, MUSCLES AND ORGANS AT SPECIFIC LOCALITIES IN PROBIŠTIP AND ITS SURROUNDINGS

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SYNOPSIS

This study is aimed at casting the light at the concentrations of lead in the muscles, liver, kidneys, spleen and hearts of different animals (swine, sheep, and goat) from three different localities around Probištip. A total of 450 samples were collected for this purpose and lead concentrations were analyzed using atomic absorption spectrophotometer. Results indicate that lead concentrations are dependent on the sampling locality, the organ and animal species. The concentrations of lead in the liver and kidney tissue taken from the industrial area were higher as compared to other localities from which samples of tissue were taken for analysis.

INTRODUCTION

Lead is one of toxic metals; it is dangerous to most human body organs if the exposure exceeds tolerable levels (BAHT & MOY, 1997). Lead can affect individuals of any age, but it has a disproportionate effect on children because their behavioral patterns place them at higher risk of exposure to lead, their bodies absorb a larger percentage of the lead that they ingest and they exhibit lead toxicity at lower levels for exposure than adults (CORREIA et al., 2000). Accumulation of lead produces damaging effects in the hematopoietical, hematic, renal and gastrointestinal systems (CORREIA & OLIVEIRA, 2000). Lead has been associated with various forms of cancer, nephrotoxicity, effects on central nervous system and cardiovascular diseases in humans (PITOT & DRAGAN, 1996; RYAN et al., 2000). Toxicity of lead is closely related to age, sex, route of exposure, level of intake, solubility, metal oxidation state, retention percentage, and duration of exposure, frequency of intake, absorption rate and mechanisms and efficiency of excretion (MERTZ, 1986). The

inhalation of lead can permanently lower intelligence quotient (IQ), damage emotional stability, cause hyperactivity, poor school performance and hearing loss (GOYER, 1996).

The presence of lead in the environment is partially due to natural processes and anthropogenic sources (FERNANDES et al., 2000; BEAVINGTON et al., 2004), but is mostly the result of industrial wastes (KHILLARE et al., 2004). Although atmospheric lead originates from a number of industrial sources, leaded gasoline appears to be a principal source of general environmental lead pollution. So, the heavy traffic flow of vehicles that burn gasoline with high lead content is the main cause of the high levels of lead in street dusts and in airborne particles (DURANDS & ARAGON, 1982).

Foods may be contaminated by lead from different sources such as air, water and soil. Accurate determination of lead in food is important since intake of even low concentrations of lead can cause serious toxic effects.

The aim of the present study was to evaluate the concentrations of lead in animals (buffalo, cattle, sheep, goats and elk) meat and consumable organs (liver, kidney, spleen and heart), which are liable to contamination by lead. Also, the investigation provided information about the concentrations of lead in three main areas. Different localities around Probištip, i.e., Industrial zone in the town of Probištip, village Strmoš and control point are represented.

MATERIALS AND METHODS

Lead concentration was extracted from the samples (muscle, liver, kidney, spleen and heart) according NIEMI et al. (1991) method. Samples were homogenized separately and 5-10 g of the fresh homogenate were weighed into quartz dishes and evaporated to dryness in an oven at 100°C (~16 h). Dried samples were incinerated in a muffle furnace at 450-500°C for 8-12 h. Incinerated samples were cooled to room temperature and 1.0 ml of concentrated nitric acid was added and the volume was adjusted to 25 ml with deionized water. The metal was measured by atomic absorption spectrophotometer (Perkin Elmer 5000). Lead was measured at wavelength 217.0 nm with Hollow Cathode Lamp of lead. The limit of detection was 0.06 mg/kg for lead. The recovery of lead was studied by adding known amounts of standard solution to different samples under investigation. The added amounts of lead were selected so that they would be close to the amounts normally found in the different samples. Recoveries in muscle, liver, kidney, spleen and heart ranged from 94-98%. All the results obtained were corrected according to the percentage of recovery.

The material for analysis (fresh tissue from muscle, liver, kidney, spleen and heart of three domestic animals – swine, sheep and goat) were taken from three localities in the vicinity of the town Probištip.

- The first measuring point is the industrial zone in the town of Probištip – flotation of the lead-zinc ore.

- The second measuring point is the village Strmoš in whose immediate vicinity the old and new waste landfills of waste water from the lead and zinc mines "Zletovo" are located. Strmoš village is located only 6 km from the town of Probištip.

- The third measuring point is the control measuring point, located at 10 km from the town of Probištip where there are no sources of pollution with heavy metals.

Statistical differences between the different areas (heavy traffic, urban and industrial) were determined by one-way analysis of variance (ANOVA). A general linear model of was performed for the analysis of variance.

RESULTS AND DISCUSSION

Results presented in Tables 1-3 show the mean concentrations of lead in analyzed samples collected from the different investigated animal species. If we compare the results obtained for lead content in different organs of domestic animals in the three measuring points around Probištip, it will be noticed that different values are obtained in terms of the tested sites, as well as of animal organs. These results show the relation between concentration of lead on the spot where the tested animals are kept and in tissue samples contaminated from water and soil. The highest concentrations of lead were detected in kidney followed by liver samples. The levels of lead varied according to the species of animal and the locality (Fig. 1, 2 and 3).

Table 1: Lead concentrations [mg/kg wet average weight ± Standard Deviation (SD)] in swine organs collected from three areas represent different ecosystems in Probistip.

Organs	Industrial Zone in the town of Probištip	Village Strmoš	Control point
Muscle	0.077±0.15	0.106±0.05	0.048±0.02
Liver	0.275 ±0.02	0.594±0.14	0.074±0.02
Kidney	0.422±0.02	0.810±0.02	0.135±0.05
Spleen	0.010±0.01	0.075±0.02	0.009±0.02
Heart	0.124±0.02	0.245±0.07	0.012±0.01

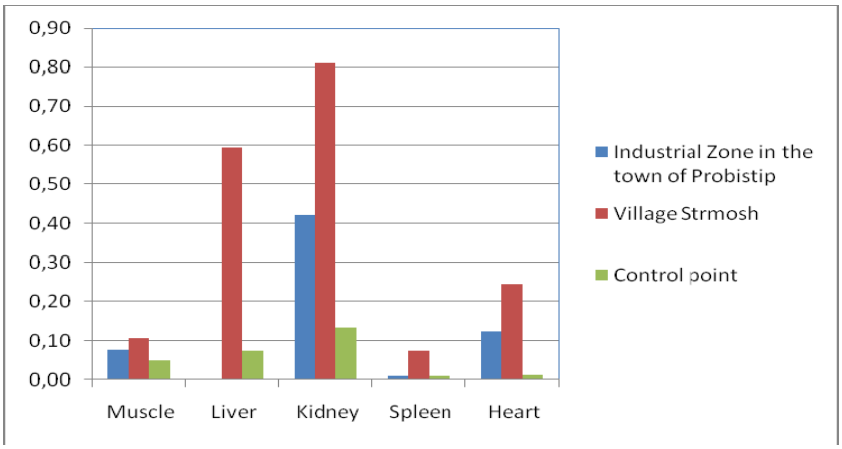

Figure 1: Lead concentrations (mg/kg wet average weight) in swine organs collected from three areas represent different ecosystems in Probištip.

Table 1 shows the contents of lead in muscle, liver, kidney, spleen and heart of domestic pigs. In terms of the tested organs, the highest values are measured in kidney (0.135±0.810 mg/kg fresh weight), and the lowest in heart tissue (0.012±0.245 mg/kg fresh weight). According to localities the lowest values were obtained at the control measurement point in whose vicinity there are no sources of contamination of heavy metals, and the values were highest near the village Strmoš The concentrations of lead in liver and kidney in the industrial zone were highest in relation to other sites, so that consumption and using of organs from these sites for food should be avoided. The results obtained from our research are in close correlation with the content of lead in the areas where these animals are kept and with lead content in the examined organs.

Table 2: Lead concentration (mg/kg wet weight ± SD) in sheep organs collected from three areas represents different ecosystems in Probištip.

Organs	Industrial Zone in the town of Probištip	Village Strmoš	Control point
Muscle	0.062±0.02	0.125±0.03	0.045 ±0.02
Liver	0.398±0.02	0.742±0.12	0.100±0.01
Kidney	0.510±0.02	0.824±0.04	0.182±0.05
Spleen	0.031±0.02	0.054±0.03	0.014±0.04
Heart	0.132±0.05	0.254±0.02	0.019±0.03

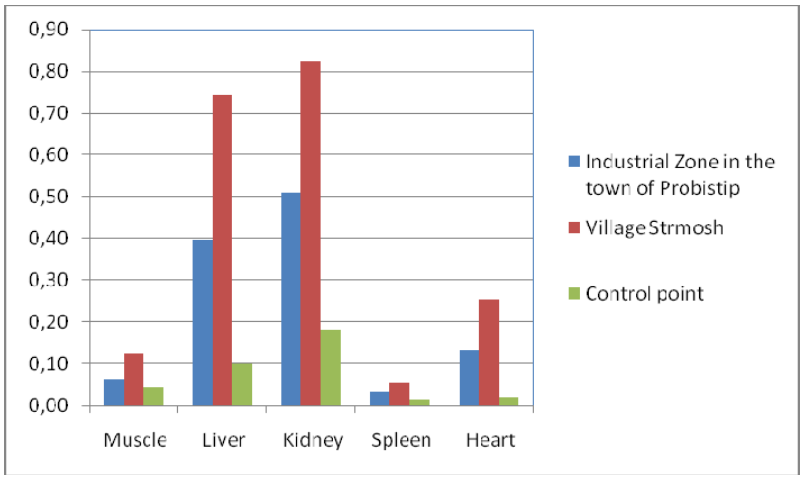

Figure 2. Lead concentration (mg/kg wet weight) in sheep organs collected from three areas represent different ecosystems in Probištip.

Table 2 shows the results for lead content in the examined tissues in sheep. Here the highest values were measured in kidneys and they vary from 0.182 at the control measurement point to 0.824 at the locality Strmoš.

Table 3 gives the results for lead content in the examined tissues in goat. In respect of the measuring sites, all tissues - muscle, liver, kidney, spleen and heart were analyzed and concentrations vary from 0.062 in heart to 0.740 in kidney, and the lowest values were obtained at the control measuring point. They vary from 0.005 in muscle to 0.165 mg/kg fresh weight in kidney. Kidneys accumulate the highest amounts of lead, which are not less in the analyzed spleen too.

Table 3: Lead concentration (mg/kg wet weight±SD) in goat organs collected from three areas represent different ecosystems in Probištip.

Organs	Industrial Zone in the town of Probištip	Village Strmoš	Control point
Muscle	0.058±0.02	0.094±0.02	0.005±0.01
Liver	0.305±0.10	0.625±0.09	0.078±0.02
Kidney	0.412±0.09	0.740±0.20	0.165±0.05
Spleen	0.115±0.05	0.095±0.02	0.052±0.01
Heart	0.017±0.01	0.062±0.01	0.112±0.03

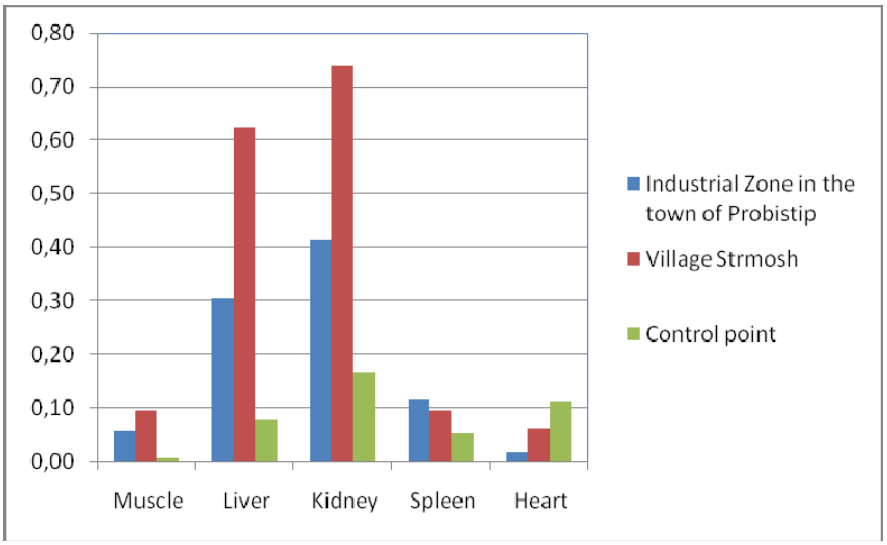

Figure 3: Lead concentration (mg/kg wet weight) in goat organs collected from three areas represent different ecosystems in Probištip.

The concentration of lead at the locality Strmoš is significantly higher than those obtained at the control point as a consequence of the position of the waste landfill in the vicinity of the village Strmoš where waste waters from the flotation of lead-zinc ore from the mine "Zletovo" are accumulated. Another source of atmospheric pollution is the re-suspension of lead dust from the old waste landfill which is also located in the vicinity of this site and which is dispersed by the wind. The results obtained at the Strmoš site show that the content of lead is much higher compared to the lead content in tissue samples collected at other measurement points.

The difference is probably a result of different diets of animals; whereas the animals exposed to the influence of air pollution for longer periods accumulate lead. Lead in the industrial area is emitted from different sources (smelters, batteries recycling, combustion of fuel for different industries). These results show the relation between lead concentration in soil and in meat samples contaminated from water and soil.

Where should we look for the reason for keeping domestic animals at such sites that are heavily contaminated with heavy metals?

- In the fact that the population is uninformed about the consequences of eating meat with high content of lead which is inserted into the human organism and indirectly causes serious diseases.

- In the low standard of the population seeking ways to survive during the state of crisis.

Heavy metals represent a serious problem of global pollution of the planet Earth, with the serious consequences arising from that pollution. Because of this they are the subject of much research in many countries worldwide: The Netherlands

(VOS et al., 1987), Brazil (ARANHA et al., 1994), and Finland (VANALAINEN et al., 1996). Also, the mean concentrations of lead in sheep liver and kidneys in the present study were lower than those detected in Greece (FALANDYSZ, 1991). With respect to the results of urban area and by comparing them with the values of (ERVIO et al., 1990), the levels of lead were below this proposed limit (0.5 mg/kg). Moreover the concentrations of lead in kidneys of buffalo (0.456), cattle (0.490) and goat (0.462 mg/kg) were near the maximum value of proposed limit (0.5 mg/kg).

CONCLUSION

The results of research of lead content in muscle, liver, kidney, spleen and heart of swine, sheep, and goat show a variation of the values in a relatively wide range between the respective measurement sites. In terms of research the highest values were obtained in kidney and liver, and the lowest values were measured in heart tissue.

These significantly high concentrations of lead in liver and kidney in the industrial zone of Probištip and the vicinity of the village Strmoš suggest an appeal to the population to avoid consumption of these organs.

In the control measurement site the lead content in all examined tissues from the organs of swine, sheep, and goat is considerably lower compared to the industrial zone of Probistip and the vicinity of the village Strmoš.

All the mentioned facts require greater commitment to remediation of the harmful effects of heavy metals on the environment and man.

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