Study on the Heavy Metal Pollution Level of Bovine Meat and Organs in Maramures County

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Abstract
In the Baia Mare area there was an excessive residual pollution with heavy metals which had disastrous consequences on the environmental factors. The samples collected for determining the contamination degree came from animals located at 5-25 km distance from the main pollution sources. The concentration of heavy metals was determined by atomic absorption spectrophotometry. The degree of heavy metal contamination in bovine muscle tissue was higher than the maximum level allowed by the European legislation.

Keywords: heavy metal, bovine meat, pollution

1. Introduction
The environment pollution causes imbalances of the life that was previously held in a natural way, species of animals and plants disappear, the whole existence of the living world being the expression of destruction risks. In these strongly polluted areas, such as the Baia Mare depression, the vital elements - water, air, soil – are invaded with large pollutant masses which exceed the environment natural capacity of transforming and integrating them into the environment [4, 6, 7]. Due to the development of the mining industry in the Baia Mare area, an excessive and residual pollution with heavy metals occurred, especially lead, which had disastrous consequences on the environment components, materialized in the extinction or reduction of certain species of plants or animals in the area.

Following research works conducted in the Baia Mare industrial area, Avram and collaborators [1, 2] and Medrea and collaborators [5] reported the serious implications of the heavy metal industrial pollution on the animals health and production.

The presence and concentration of heavy metals along the food chains lead to a large number of species used by humans in food to constitute bio-indicators of heavy metal pollution, but at the same time to become public health risk factors.

It is to be noted that in the highly industrialized countries, with a high environment protection level, the lead level in food products is lower than in the countries that are in the industrializing process, with a low or ineffective environment protection. [3]
2. Materials and methods

In order to determine the degree of contamination with heavy metals – Lead and Cadmium – of the animal origin products in Maramures county, samples have been collected from two slaughter facilities. The samples collected came from animals located 5-25 km far from the main pollution sources, such as Romplumb S.A., RBG Phoenix S.A, which process non-ferrous metals and release in the air and discharge in the running waters significant amounts of Pb, Cu, Zn, Mn, Cd, Ni, Fe ions. Identification of the animal origin was based on ear tags and on the accompanying documents within the slaughter facility.

The samples were collected from bovine species for the following reasons:
- long lifetime
- almost exclusively vegetal feeding
- due to the meat and milk production – strategic food in human nutrition

A total number of 120 samples were collected: 40 samples of muscle tissue, 40 liver samples and 40 kidney samples, each sample weighing 250-300 g. The samples were collected during a three month period, in fresh condition and they were kept refrigerated until tested.

The work method used for determining the heavy metal residues is the atomic absorption spectrophotometry.

The principle of atomic absorption spectrophotometry is to determine the concentration of one element from the test sample by measuring the absorption of a particular wavelength electromagnetic radiation while it passes through that environment. The absorption level is proportional with the atom concentration in the distribution environment. For the heavy metals – Cadmium and Lead – the environment in which their atoms are released is represented by the high temperature flame (approximately 2500°C) of an air-acetylene mixture.

3. Results and discussion

The value of Lead concentration in the muscle tissue samples was between 0.05 and 0.25 mg/kg, while the average was 0.16 mg/kg, being 6 times higher than the Maximum Allowable Limit (M.A.L.) (0.10 mg/kg).

Out of the total number of muscle tissue samples tested (20), 7 samples showed higher values than the maximum allowable limit.

The value of Lead concentration in the liver samples was between 0.06 and 0.41 mg/kg, while the average was 0.225 mg/kg, being below the maximum allowable limit (0.50 mg/kg). All the samples tested showed values below the maximum allowable limit.

The value of Lead concentration in the kidney samples was between 0.11 and 0.59 mg/kg, while the average was 0.29 mg/kg, being below the maximum allowable limit (0.50 mg/kg). Out of the total number of kidney samples tested (20), 3 samples showed higher values than the maximum allowable limit.

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Number of samples</th>
<th>Lead mg/kg</th>
<th>Maximum Allowable Limit [8] mg/kg</th>
<th>Values obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>muscles</td>
<td>20</td>
<td>0.16</td>
<td>0.10</td>
<td>0.05-0.25</td>
</tr>
<tr>
<td>liver</td>
<td>20</td>
<td>0.225</td>
<td>0.50</td>
<td>0.06-0.41</td>
</tr>
<tr>
<td>kidney</td>
<td>20</td>
<td>0.29</td>
<td>0.50</td>
<td>0.11-0.59</td>
</tr>
</tbody>
</table>

Figure 1. Lead concentration in bovine muscles, liver and kidney

The value of Cadmium concentration in the muscle tissue samples was between 0.03 and 0.12 mg/kg, while the average was 0.073333 mg/kg, being 0.6 times higher than the Maximum Allowable Limit (M.A.L.) (0.050mg/kg). Out of the total number of muscle tissue samples tested [20], 14 samples showed higher values than the maximum allowable limit.

The value of Cadmium concentration in the liver samples was between 0.03 and 0.29 mg/kg, while the average was 0.145 mg/kg, being below the maximum allowable limit (0.50 mg/kg). All the samples tested showed values below the maximum allowable limit.
The value of Cadmium concentration in the kidney samples was between 0.11 and 0.15 mg/kg, while the average was 0.493333 mg/kg, being below the maximum allowable limit (1.0 mg/kg). Out of the total number of kidney samples tested (20), 1 sample showed higher values than the maximum allowable limit.

3. Conclusions

Therefore, in general the degree of heavy metal pollution can be considered low, not alarming; a higher level of Lead and Cadmium pollution is showed in the muscle tissue samples, compared to the kidney and liver samples tested which were within the maximum allowable limits.

Table 2. Average values and maximum allowable limits for Cadmium in the muscle tissue, liver and kidney of bovines

<table>
<thead>
<tr>
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<td>0.493333</td>
<td>1.0</td>
<td>0.11-1.15</td>
</tr>
</tbody>
</table>

References