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## Cadmium levels of edible offal from Saanen goat male kids

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### Abstract

Concentration of cadmium was investigated in the heart, tongue, lungs, spleen, liver, kidney, testis, brain and thymus of 15 Saanen goat male kids. This element was determined by inductively coupled plasma optical emission spectrometry (ICP-OES), after microwave digestion. The cadmium concentration was significantly influenced by the type of edible offal. Mean cadmium concentrations ranged from 0.018 mg/kg (heart) to 0.114 mg/kg (kidney). The maximum cadmium concentrations found in the kidney (0.133 mg/kg) and liver (0.075 mg/kg) were below maximum levels (1.0 and 0.5 mg/kg, respectively) set by legislation for these tissues.

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## 1. Introduction

Cadmium is a heavy metal, known as a contaminant.<sup>1,2</sup> The International Agency for Research on Cancer has classified cadmium as a human carcinogen (Group 1) on the basis of occupational studies.<sup>3</sup> The World Health Organization has recommended that the provisional tolerable weekly intake (PTWI) of cadmium should not exceed 0.4–0.5 mg per person or 0.007 mg/kg.<sup>4</sup>

The general population is exposed to cadmium by the consumption of contaminated food and water as well as by the inhalation of fumes or smoke<sup>1,5</sup>. Edible offal (liver, kidney, etc.), which is also a form of meat, may also contain cadmium. Cadmium accumulates in mammalian tissues, especially in the kidney and liver<sup>6-8</sup>, with a very long biological half-life, ranging from 10 to 30 years<sup>1,5</sup>.

Except for meat, liver and kidney, cadmium levels have not been set for other edible animal tissues (tongue, heart, lungs, spleen, brain, lard, etc.). The EU, as well as Serbia, set maximum levels of cadmium in edible offal of bovine animals, sheep, pig, poultry and horse at 0.5 mg/kg (wet weight) for liver and 1.0 mg/kg (wet weight) for kidney<sup>9-12</sup>. However, maximum levels of cadmium in meat and edible offal of goat are not set by law.

According to Serbian legislation<sup>13</sup>, the edible organs and glands (edible offal) of a slaughtered goat that are removed in dressing include: brain, tongue, heart, lungs, thymus, liver, spleen, kidney and testis.

The aims of this study were: (i) to establish cadmium levels in nine edible offal items of Saanen goat male kids from Vojvodina; (ii) to compare the obtained values with the maximum levels set by legislation.

## 2. Materials and methods

This study included 15 Saanen male kids. All kids were raised under identical husbandry, management and feeding conditions. Body weight at slaughter ranged from 18.7 to 24.3 kg.

After evisceration, heart, tongue, lungs, spleen, liver, kidney, testis, brain and thymus were collected. After chilling, each edible offal was homogenized, vacuum packaged in polyethylene bag and stored at -40°C until determination of cadmium.

The content of cadmium (Cd) was determined using inductively coupled plasma optical emission spectrometry, after microwave digestion.

All data are presented as mean, standard deviation (SD) and range. Analysis of variance (one-way ANOVA) was used to test hypothesis about differences between multiple mean values.

## 3. Results and discussion

The mean content, the standard deviation and range for the cadmium in the investigated samples of the heart, tongue, lungs, spleen, liver, kidney, testis, brain and thymus of Saanen goat male kids from Vojvodina, are presented in Table 1.

The kidney had significantly ( $p < 0.001$ ) the highest mean Cd concentration (0.114 mg/kg), followed by liver (0.064 mg/kg), with significant ( $p < 0.001$ ) difference between them. Furthermore, brain (0.043 mg/kg), spleen (0.038 mg/kg), testis (0.035 mg/kg) and thymus (0.035 mg/kg) had significantly ( $p < 0.001$ ) lower Cd concentrations, compared to kidney and liver, with significant difference between brain and testis ( $p < 0.01$ ), brain and thymus ( $p < 0.01$ ), and brain and spleen ( $p < 0.05$ ). Tongue (0.026 mg/kg) and lungs (0.024 mg/kg) had significantly ( $p < 0.001$ ) lower Cd concentrations, compared to kidney, liver, brain, spleen, testis and thymus, without significant ( $p > 0.05$ ) difference between them. Finally, heart (0.018 mg/kg) had significantly the lowest Cd concentration, compared to kidney, liver, brain, spleen, testis, thymus ( $p < 0.001$ ), tongue ( $p < 0.01$ ) and lungs ( $p < 0.05$ ).

Table 1. Cadmium levels in edible offal tissues of Saanen goat male kids.

Edible offal	Parameter	Concentration (mg/kg wet weight)
Heart	Mean ± SD	0.018 ± 0.004 <sup>f,n,z</sup>
	Range	0.014–0.024
Tongue	Mean ± SD	0.026 ± 0.002 <sup>e,m,z</sup>
	Range	0.023–0.029
Lungs	Mean ± SD	0.024 ± 0.003 <sup>e,mn,z</sup>
	Range	0.021–0.030
Spleen	Mean ± SD	0.038 ± 0.003 <sup>d,kl,y</sup>
	Range	0.032–0.042
Liver	Mean ± SD	0.064 ± 0.005 <sup>b,j,x</sup>
	Range	0.058–0.075
Kidney	Mean ± SD	0.114 ± 0.013 <sup>a,i,w</sup>
	Range	0.096–0.133
Testis	Mean ± SD	0.035 ± 0.007 <sup>d,l,y</sup>
	Range	0.018–0.044
Brain	Mean ± SD	0.043 ± 0.003 <sup>e,k,y</sup>
	Range	0.039–0.049
Thymus	Mean ± SD	0.035 ± 0.002 <sup>d,l,y</sup>
	Range	0.031–0.039

abcdef P < 0.05; ijklmn P < 0.01; wxyz P < 0.001.

Maximum individual cadmium concentrations determined in liver and kidney of Saanen goat male kids were several times lower than maximum levels set for these tissues of other ruminants (bovine and sheep).<sup>9-11</sup>

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