Game Meat Hygiene and Human Toxicology

Conventional and Innovative Hunting Rifle Bullets

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Threatment of the Issue in Three Parts

1. Comparative lead content of agriculturally produced meat and game meat

2. Game meat hygiene

3. Human Toxicology
Comparative lead content in the meat of domestic animals and game animals

0.02 mg/kg

No difference in the median value

0.02 mg/kg
## Comparative lead content in the meat of domestic animals and game animals

<table>
<thead>
<tr>
<th>Kind of meat</th>
<th>Lead content in mg/kg</th>
<th>Share of total consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median (50% Percentile)</td>
<td>95% Percentile</td>
</tr>
<tr>
<td>Pork (n=5244)</td>
<td>0.02</td>
<td>0.06</td>
</tr>
<tr>
<td>Beef / Sheep / Goat (n=7229)</td>
<td>0.02</td>
<td>0.078</td>
</tr>
<tr>
<td>Poultry (n=3343)</td>
<td>0.02</td>
<td>0.060</td>
</tr>
<tr>
<td>Game meat (n=2521)</td>
<td>0.02</td>
<td>1.525</td>
</tr>
</tbody>
</table>

Table 1: Lead contents in different kinds of meat (without processed products and offal) as well as their share of average consumption of meat and meat products; values in green are below, values in red are above threshold value for meat of 0.100 /kg; source: EFSA (2010)
Figure 3a: Lead Content of Selected Foods Median Value in mg/kg
source: EFSA (2010)
Comparative Lead Ingestion from Foods on the Basis of Average Consumption

Figure 3b: Percentage of selected foods of the total lead ingestion on the basis of average consumption; source: EFSA (2010)
Figure 4: Boxplot displaying the lead content of wild boars from regions with different lead background levels shot with conventional (lead-containing) and alternative bullets; area below threshold value of 0.100 mg/kg in green, above in red colour; from Mueller-Graf u. Sommerfeld (2013), modified.
### Exceedances of threshold value for lead in roe deer and wild boar

Table 2: Lead contents in different partial samples from roe deer and wild boar, shot with conventional and innovative ammunition; values in green are below threshold, values in red above threshold value of 0.100 mg/kg; source: Mueller-Graf u. Sommerfeld.

<table>
<thead>
<tr>
<th>Partial sample</th>
<th>Ammunition</th>
<th>Roe deer Lead content mg/kg</th>
<th>Wild boar Lead content in mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Median</td>
<td>Maximum</td>
</tr>
<tr>
<td>Haunch</td>
<td>Lead-containing</td>
<td>0.005</td>
<td>73.000</td>
</tr>
<tr>
<td></td>
<td>Alternative</td>
<td>0.005</td>
<td>0.228</td>
</tr>
<tr>
<td></td>
<td>Lead-containing</td>
<td>0.007</td>
<td>189.293</td>
</tr>
<tr>
<td></td>
<td>Alternative</td>
<td>0.004</td>
<td>0.090</td>
</tr>
<tr>
<td>Shot Channel</td>
<td>Lead-containing</td>
<td>0.015</td>
<td>4727.979</td>
</tr>
<tr>
<td></td>
<td>Alternative</td>
<td>0.007</td>
<td>1.260</td>
</tr>
</tbody>
</table>

- 0.005 to 0.023% of the meat consumption could contain excessive lead values.
Treatment of the Issue in Three Parts

1. Comparative lead content of agriculturally produced meat and game meat

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Game Meat Hygiene

Figure 5: Radiologic pictures of a shot roe deer; uneviscerated – untreated in the sense of game meat hygiene; in the hide; bright points represent metal splinters (source: Krone Trinogga 2011)
Game Meat Hygiene

Figure 6: radiologic pictures of a shot roe deer; eviscerated – after treatment according to game meat hygienic standards; removed from the hide (source: Krone Trinogga 2011)
Treatment of the Issue in Three Parts

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Human Toxicology

The toxicological effect of ingested metal particles depends in principle on:

- the used metal of the projectile
- the ingested size of the particle
- the biologic solubility of the metal
- the ingested quantity of metal
- the way of ingestion (oral oder inhalative)
- relevant for hunting bullets is only the oral ingestion
Toxicological attention needs to be placed above all on the metals mainly used in hunting bullets:

- **Copper**: essential trace element
- **Zinc**: essential trace element
- **Lead**: non-essential metal
### Human Toxicology

The oral absorption rate additionally depends on the food composition and is for:

<table>
<thead>
<tr>
<th>Element</th>
<th>Absorption Rate</th>
<th>Toxic Window</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>30 to 40 %</td>
<td>A: 1.5 – 5 mg/day, C: 1 – 4 mg/day</td>
</tr>
<tr>
<td>Zinc</td>
<td>30 to 40 %</td>
<td>A: 10 – 25 mg/day, C: 1 – 7 (22) mg/day</td>
</tr>
<tr>
<td>Lead</td>
<td>5 to 10 %; for children up to 40 %</td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

- The lead content in meat of agricultural production and game meat does not show any differences in the median value.
- The preparation of the meat according to the hygienic standards applicable for game meat reduces the potential oral ingestion of metal splinters to the minimum.
- In the median value, lead-containing or lead-free bullet constructions do not show any difference in their impact on the lead content in game meat outside the shot channel.
- A ban on lead-containing hunting ammunition does not factually result in a noticeable reduction of the lead contamination of the total population.
- The quantitatively relevant lead contaminations of the total population are caused by the common foodstuffs and only for a small share by game meat (0.04%).
- The discussion on conventional or innovative hunting bullets is obviously about a marginal problem.
Game Meat Hygiene, Human Toxicology

Classification of conventional lead bullets
relative classification of copper-containing alternative bullets