

Lead in Game Meat- Swedish National Food Agency Report 18- 2014

English summaries of the chapters

Game meat, ammunition and chemical analyses

Game carcasses and game meat from moose, wild boar, fallow deer, roe deer, brown hare and hooded crow were investigated for lead fragments from ammunition. The results show that lead fragments from bullets and shot were abundant in game carcasses and occurred in game meat intended for consumption.

In all, lead levels were analysed for 200 samples and lead levels ranged from below the level of detection (0.004 mg/kg) to hundreds and even thousands of mg/kg. The highest levels were found in the meat from the wound channels, but very high levels were also found in meat intended for consumption from the area around the wound channel.

The median lead level in minced moose meat was 0.03 mg/kg and the mean level was 0.9 mg/kg. One third of minced moose meat samples were above the legal limit (0.1 mg/kg) for beef, pork, mutton and poultry.

More than 40 percent of the cuts from roe deer, fallow deer and wild boar contained levels above the legal limit for beef, pork, mutton and poultry. There was a significant decrease in lead level with increasing distance from the wound channel. The median lead level in cuts intended for consumption was 0.05 mg/kg and the mean level was 9.9 mg/kg (n= 104).

The results from roe deer and fallow deer shot with bullets on the shoulder showed that the cleaned meat from the shoulder still contained high levels of lead (median 0.08 mg/kg, mean 30 mg/kg). The median levels in the loin, tenderloin and steak from the haunch were 0.004 mg/kg (i.e. below level of detection). The mean lead level in those samples was 0.25 mg/kg, which is approximately 1000 times lower than the level for the wound channel (defined as any meat that was visibly affected by the bullet or fragments, including all traces of bloodshot meat).

Lead levels were high for game taken with lead shot before cleaning (mean 111 mg/kg), but could be reduced by up to 100 times by removing any meat visibly affected by the shot or fragments. Alternatively, lead free ammunition can be used.

Experiments of solubility showed that lead fragments from bullets dissolve in chloric acid of the same concentration as in the stomach of humans. The solubility of the lead fragments varied, depending on time in the acid (0-4 h), between 2-8 %.

Lead levels in blood from Swedish hunter families

Previously, the Swedish National Food Agency (NFA) has investigated the lead content in minced meat from moose shot with ammunition containing lead. The results showed that the meat close to the wound channel (meat typically used for minced meat) might contain lead fragments and elevated lead levels.

As a result, the NFA issued advice in 2012 that children 0-7 yrs. and women that are pregnant or plan to get pregnant should avoid eating game meat from the region around the wound channel. Recent investigations in Sweden and Norway show that consumers that eat game meat more often than once per month suffer from higher lead levels in the blood than consumers who do not eat game meat. In addition, the studies showed that there was a positive relationship between blood lead levels and the number of shots fired, and in the Norwegian study also from reloading of ammunition.

This study related lead levels in blood to shooting and eating habits in hunters and their families. The participating families consisted of men and women (18-65 yrs.) and children living in the same household (3-17 yrs.). Other criteria for inclusion in the study was that at least one parent was a hunter and that at least one person in the household consumed game meat more often than twice per month.

Participants were recruited from five different areas in Sweden (Nyköping, Stockholm, Umeå, Uppsala and Östersund). The study was conducted in collaboration with FoodFiles® and The Swedish Association for Hunting and Wildlife Management.

The study showed that adults who consume game meat had significantly higher lead levels in the blood than adults who do not eat game meat (16.3 µg/L compared to 11,0 µg/L in adult men). Women who do not shoot but eat game meat also had significantly higher blood lead levels than women who did not eat game meat (30 % higher). There was no significant effect of the amount of consumed game meat on lead levels within the group of hunter families, however.

Shooting influenced lead levels in the blood, just as in the Norwegian study. There were no differences between lead levels in the blood from children from hunters' families and children in other Swedish surveys.

In conclusion, the study suggests that consumption of game meat and shooting independently may result in elevated blood lead levels of hunters' families.

Risk assessment

This report assesses the risk of lead from ammunition in game meat causing health effects. The assessment of the risk for consumers mainly rests on the data from the report *Lead levels in blood from Swedish hunter families*. The results showed that adult game consumers from the hunter families had significantly higher lead levels in the blood than adults that reported that they had not eaten game meat in the latest survey by the Swedish National Food Agency.

Within the study of hunter families, there was a clear relationship between number of shots fired over the previous six months and blood lead levels for adults. However, there was no relationship between lead level in the blood and amount of game meat consumed within the group of hunter families.

In all, the results show that blood lead levels should be reduced, as 70 % of the males, 30 % of the women and 40-50 % of the children that consumed game meat had blood lead levels above the reference points established by the European Food Standards Authority (EFSA).

Advice on handling practices for game meat was also developed, based on the data and results from the report *Game meat, ammunition and chemical analyses*. A health-based adjusted critical level for lead was developed using data from *Lead levels in blood from Swedish hunter families* showed that the lead content had reached tolerable levels 10 cm from the wound channel, defined as any meat that is visibly affected or bloodshot by the bullet. The adjusted critical level is based on the health based reference points (Efsa 2010), the solubility of lead in the stomach (set to 10 %) and allocation of 10 % of the exposure of lead from food to game meat. In the model, a median consumption of game meat was set to 27 g / day.

Risk management

This risk management report pertains to:

Risks from lead in game taken with ammunition containing lead

Handling practices for game shot with lead ammunition - hunters

1. For game shot with bullets, remove the wound channel defined as any meat that is visibly affected by the bullet (or bloodshot) and an additional 10 cm of meat visibly unaffected by the bullet. All of this meat should be discarded.
2. For game taken with shot, remove any meat that is visibly affected or bloodshot. This meat should be discarded. Remove any visible shot from the meat. Use cartridges intended for hunting purposes only.

Handling practices for game shot with lead ammunition- consumers

1. Avoid consumption of meat from the area close to the wound channel, unless the carcass has been cleaned in accordance with the advice above.

Handling practices for commercial game processing plants

1. Game processing plants and their retailers should develop procedures that ensure that game meat released on the market does not contain elevated levels of lead.

Additional information to be communicated

-Consumers that eat game meat once or twice per year are unlikely to receive a portion with elevated lead levels, regardless of the choice of cut. The associated lead exposure would not entail increased risks of negative health effects.

-Game meat that already has been harvested (e.g. in freezers in households) and which can be expected to contain elevated lead levels need not be discarded, but consumption should be limited to once per month. Pregnant women and children 0-7 yrs. should avoid eating such meat.

-Using lead-free ammunition eliminates the problem of elevated lead levels in game meat and products made from game meat.