Lead in minced beef from Norwegian hunted game, Elg (Alces alces)

Eurofins Food & Feed Testing Norway AS

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Norsk sammendrag (Norwegian summary)

På oppdrag fra Mattilsynet har Eurofins Food and Feed Testing Norway AS undersøkt blyinnhold(Pb) i kjøttdeig fra elg som er tilbudt i forbrukere høsten 2014. Det er innhentet kjøttdeig fra elg i sør-Norge. Det har blitt funnet varierende innhold av bly i kjøttdeigen fra elg. I enkelte prøver er det funnet større mengder bly, noe som viser at det er påvist rester av metallisk bly fra ammunisjon i kjøttdeig fra elg kjøpt ved Norske utsalgssteder.
Gjennomsnitts blyinnhold var 1,79 mg bly pr kilo kjøttdeig/ kvernet kjøtt, medianverdien var 0,37 mg bly pr kilo kjøttdeig/ kvernet kjøtt. Standardavviket var 4,14. Høyeste blykonsentrasjon var 35,23 mg Pb /Kg, og den laveste blykonsentrasjonen som ble funnet var 0.01 mg Pb/Kg. Det er i dag ikke noen grenseverdi for blyinnhold i viltkjøtt omsatt i Norge.
Det ble analysert 150 prøver. Av disse var det kun 40 prøver som hadde mindre bly enn grenseverdien for kjøtt fra storfe, som er på 0,1 mg Pb/Kg. Dersom grenseverdien på bly i kjøttdeig fra elg hadde vært på 0,5 mg Pb/Kg ville 82 av prøvene vært under grenseverdien.

Summary

During autumn 2014, 150 samples of minced Elg (European Moose, Alces alces) beef was randomly sampled from groceries in southern Norway for measuring Lead content caused by bullet Lead. There was found lead in all samples with different amount. Some samples had significant higher Lead content than others and indicated a true sign of traces of metallic lead from bullets. The mean value was 1,79 mg Pb/Kg, median value was 0,37 mg Pb/Kg and the standard deviation was 4,14. Maximum lead concentration 35,23 mg Pb/Kg and the lowest concentration was 0,01 mg Pb/Kg.

1. Project

This report is generated as a contract work on behalf of the Norwegian Food Authorities (Mattilsynet) and contains information about the content of lead in minced beef from Elg (Alces alces) which has been hunted during autumn 2014.

Expanding lead bullets produce a lot of lead fragments during impact in the body. The soft nose of the bullet will deform and fragment depending on hitting bone, muscle or soft tissue. Different bullets will also have different fragment patterns, but the most important factor is possibly the velocity of the bullet. The higher the velocity, the higher the energy transfer and the expansion will be. A good bullet should expand quickly and create a wide wound channel that destroys maximum amount of tissue on its way to vital organs to cause a human and quick death. During energy transfer to the game some of the fragments will penetrate muscles in a range around the wound channel and cause a high lead content distributed around the wound channel.

Normally minced beef is produced from the less valued parts of the body, which is not usable for producing other high quality and tender products. The major target area of a game is the carcass, which contain vital organs. Meat from Elg carcass is often used for grinding, and used as minced beef. Because of this, minced beef will be product with highest chance to find Lead fragment (Norwegian Scientific Committee for Food Safety. 2013).
The aim of the study was to analyze for lead fragments in game meat sold as minced beef in Norwegian stores. If the meat used for production of minced beef is coming from muscles near the wound channel, there could be a risk that Lead fragments from the expanded bullet could contaminate the minced beef fraction. Because of the possible toxicity of eating lead, Mattilsynet wanted to check this source for possible toxic levels of lead.
The European Commission has established a maximum level of Lead in commonly used food by regulation EC No.1881/2006. However, today there is no maximum level of Lead in wild game meat in Norway or EU.

2. Sampling

Samples of minced Elg beef were randomly bought in ordinary food groceries and butchers in different part of southern Norway, Table1 and Figure 1. The samples were bought by trained employee at Eurofins Food and Feed Testing Norway AS. Because of few retailers of minced beef from Elg during autumn 2014, it has to be bought more than one package of meat at the different stores. This was in agreement with Mattilsynet.

Originally the aim of this project was to measure lead in minced beef from different wild game, but there is no commercial hunt for Roe Deer (rådyr, *Capreolus capreolus*), Red Deer (Hjort, *Cervus elaphus*) and Reindeer (Reinsdyr, Rangifer tarandus) and was not found available in stores. The minced beef from Red Deer and Reindeer in Norway is mostly from farmed breeding. Because of this, the report contain only data on Lead in Elg hunted autumn 2014.

Table 1 shows the places were the samples of minced beef from Elg were bought.

Grocer/Butcher	Geographical Place
Alf Strøm Larsen AS	Oslo
Annis Pølsemakeri	Ringebu
Aurskog kjøtt	Aurskog
Brandbu Pølsemakeri	Brandbu
Brødrene Ringstad	Rakkestad
Den blinde Ku	Ås
Hadeland Viltslakteri AS	Jevnaker
Heidal Landbruk Produkter	Heidal
Helt Vilt, Moen Gård	Klæbu
Helt Vilt Bjørkelangen	Bjørkelangen
Hognamat AS	Rennebu
Kirkebygda Produkter	Rødberg
Kistefoss Viltkjøtt AS	Kistefoss
Kokk Henriksen	Jessheim
M. Aakervik Laks og Vilt	Namsos
Meny Lillesand	Lillesand
Rivelsrud & Co	Bergen
Siljanhjort	Siljan
Spar Ekholt (Ekholt Matsenter)	Moss
Spikkeland Viltslakteri	Finsland
Stensaas Viltslakteri	Røros
Tamt og Vilt	Hemsedal
Telemark Viltslakteri/Løvenskiold	Skien
Ultra	Sandvika
Veikåker Gård	Noresund
Vilteksperten AS	Steinkjer
Øyvind Karlsen, Manstad Kjøtt AS	Manstad

Figure 1 indicates the distribution of the samples bought in southern part of Norway

It was not possible to get any commercial samples from the northern part of Norway, but the sampling in southern Norway was well distributed. Totally 150 samples of minced Elg beef was collected for analysis. During sampling, there was a trend that it was easier to find minced beef from Elg in stores in areas were Elg hunting is common.

3. Storing of samples prior analysis

All samples were stored dark at -20 °C in original packaging before sample preparation and analysis.

4. Analysis of samples

The sample preparation and analysis procedure was based on the report “Bly i älgfärs- et forstudie”, Jorheim,L., Kollander,B., 2012-06-21, Livsmedelverket, Sverige, with modifications.

4.1. Sample preparation

Samples of minced beef in original package, approx. 400 gram were thawed during night. The samples were then weighted exactly in a 3000 ml plastic beaker with lid and added 1000 ml 15% HNO_3. The samples were homogenized for 60 seconds before closing the lid.

The samples were hydrolyzed for 24 hours at ambient temperature before analysis. 50 ml of the supernatant was diluted 20 x before analysis on the ICP-MS.
The beakers were tested negative for Lead content by simulating hydrolysis with adding 1000 ml 15% HNO_3 to a beaker store for 24 and 36 hours before analysis.
During the hydrolysis of the samples, all fragments of metallic Pb was been dissolved.

4.2. Analysis of Pb on ICP-MS

The analytical method used for analysis of Pb is not accredited for analysis of heavy metals in meat but in Biota (Intern method AM384.07, based on NS-EN ISO 17294-2) and Sediments (Intern method AM384.01, based on NS-EN ISO 17294-2: 2004). The method used for analysing Lead in meat in this project is based on the AM384.07 and AM384.01 method (http://www.akkreditert.no/no/akkrediterteorganisasjoner/akkrediteringsomfang/?AkkId=634).
The only difference between the method used in this project and the accredited methods is the sample preparation. The analysis was performed on an Agilent 7700 series ICP-MS and the data analysis was performed on Agilent G7200B ICP-Masshunter version B.01.01 software. The LOD and LOQ were measured from the blank reference to be respectively 0, 09 and 0, 3 µg Pb/kg. There was used certified reference standards which were tested every 20th sample analyzed.

Table 2 shows stability of instrument on reference standards performed during each 20th samples analyzed. The table shows average on 3 analysis of standard (60 analysis of sample).

	Average µg/Kg	STDEV
STD 0	0,00	0,00
STD 1	0,43	0,00
STD 2	2,01	0,01
STD 3	7,97	0,11
STD 4	40,01	0,02

The results from the analysis of reference standards indicates that the instrument was very stable during the analysis, and the standard deviation was 0,1 µg/Kg.

4.3. Uncertainty of measurement

According to the Accreditation of the ICP-MS method the measurement of Pb has a measurement uncertainty of <25%.

5. Results

There was found significant levels of Lead in most of the samples analyzed. The mean value was 1,79 mg Pb/Kg, median value was 0,37 mg Pb/Kg and the standard deviation was 4,14. The results are almost similar to the results from Lindboe 2012. Maximum lead concentration was measured to be 35,23 mg Pb/Kg and the lowest concentration was measured to be 0,01mg Pb/Kg.

Table 3 shows amount of Pb found in different minced beef commercially bought at groceries/butchers.

Grocer/Butcher	Sample name	mg/kg Pb
Alf Strøm Larsen As, Oslo	Elgkjøtt hakket	3,47
Alf Strøm Larsen As, Oslo	Elgkjøtt hakket	1,14
Alf Strøm Larsen As, Oslo	Elgkjøtt hakket	5,32
Alf Strøm Larsen As, Oslo	Elgkjøtt hakket	2,15
Alf Strøm Larsen As, Oslo	Elgkjøtt hakket	12,96
Annis Pølsemakeri, Ringebu	Elghakk	0,01
Annis Pølsemakeri, Ringebu	Elghakk	0,02
Annis Pølsemakeri, Ringebu	Elghakk	0,01
Annis Pølsemakeri, Ringebu	Elghakk	0,02
Annis Pølsemakeri, Ringebu	Elghakk	3,06

Grocer/Butcher	Sample name	mg/kg Pb
Annis Pølsemakeri, Ringebu	Elghakk	0,01
Annis Pølsemakeri, Ringebu	Elghakk	0,01
Annis Pølsemakeri, Ringebu	Elghakk	1,13
Annis Pølsemakeri, Ringebu	Elghakk	3,09
Annis Pølsemakeri, Ringebu	Elghakk	0,50
Annis Pølsemakeri, Ringebu	Elghakk	0,16
Annis Pølsemakeri, Ringebu	Elghakk	0,43
Aurskog kjøtt, Aurskog	Karbonadedeig elg. kvernet	0,21
Aurskog kjøtt, Aurskog	Karbonadedeig elg. kvernet	0,48
Aurskog kjøtt, Aurskog	Karbonadedeig elg. kvernet	0,06
Aurskog kjøtt, Aurskog	Karbonadedeig elg. kvernet	0,10
Aurskog kjøtt, Aurskog	Karbonadedeig elg. kvernet	0,03
Brandbu Pølsemakeri, Brandbu	Elg Karbonadedeig	0,03
Brandbu Pølsemakeri, Brandbu	Elg Karbonadedeig	0,07
Brandbu Pølsemakeri, Brandbu	Elg Karbonadedeig	0,10
Brandbu Pølsemakeri, Brandbu	Elg Karbonadedeig	0,52
Brandbu Pølsemakeri, Brandbu	Elg Karbonadedeig	0,04
Brandbu Pølsemakeri, Brandbu	Elg ytrefilet	1,90
Brandbu Pølsemakeri, Brandbu	Elg ytrefilet	0,99
Brødrene Ringstad, Rakkestad	Kjøttdeig av elg	1,22
Brødrene Ringstad, Rakkestad	Kjøttdeig av elg	15,37
Brødrene Ringstad, Rakkestad	Kjøttdeig av elg	10,40
Den blinde Ku, Ås	Elghakk	35,23
Den blinde Ku, Ås	Elghakk	0,36
Den blinde Ku, Ås	Elghakk	4,51
Den blinde Ku, Ås	Elghakk	0,50
Hadeland Viltslakteri AS, Jevnaker	Elgkjøttdeig	5,13
Hadeland Viltslakteri AS, Jevnaker	Elgkjøttdeig	0,45
Hadeland Viltslakteri AS, Jevnaker	Elgkjøttdeig	0,36
Hadeland Viltslakteri AS, Jevnaker	Elgkjøttdeig	0,62
Hadeland Viltslakteri AS, Jevnaker	Elgkjøttdeig	0,80
Hadeland Viltslakteri AS, Jevnaker	Elgkjøttdeig	5,43
Hadeland Viltslakteri AS, Jevnaker	Elgkjøttdeig	5,42
Hadeland Viltslakteri AS, Jevnaker	Elgkjøttdeig	1,23
Hadeland Viltslakteri AS, Jevnaker	Elgkjøttdeig	0,57

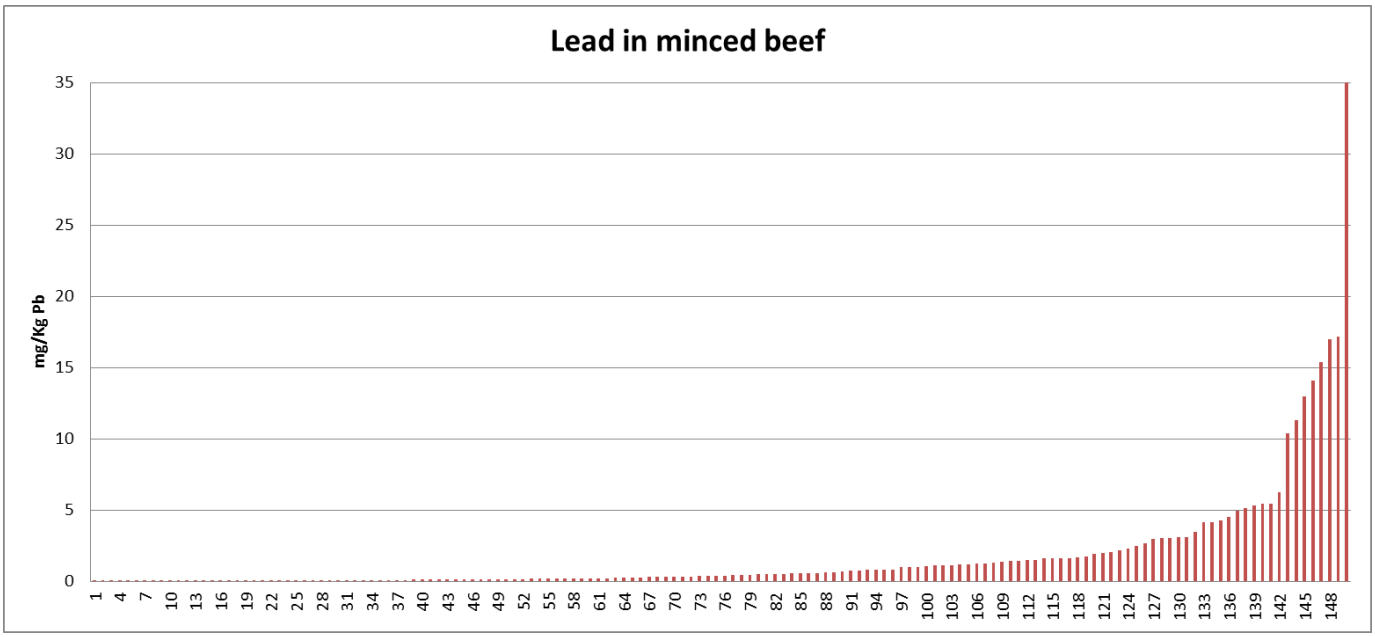
Grocer/Butcher	Sample name	mg/kg Pb
Hadeland Viltslakteri AS, Jevnaker	Elgkjøttdeig	3,02
Heidal Landbruksprodukter, Heidal	Elghakk	1,61
Heidal Landbruksprodukter, Heidal	Elghakk	2,03
Heidal Landbruksprodukter, Heidal	Elghakk	4,12
Heidal Landbruksprodukter, Heidal	Elghakk	4,12
Heidal Landbruksprodukter, Heidal	Elghakk	2,27
Helt Vilt, Moen Gård, Klæbu	Grovmalt elgkjøtt	0,04
Helt Vilt, Moen Gård, Klæbu	Grovmalt elgkjøtt	0,11
Helt Vilt, Moen Gård, Klæbu	Grovmalt elgkjøtt	0,01
Helt Vilt, Moen Gård, Klæbu	Grovmalt elgkjøtt	0,01
Helt Vilt, Moen Gård, Klæbu	Grovmalt elgkjøtt	0,01
Hognamat AS, Rennebu	Elgkjøtt kvernet	0,11
Hognamat AS, Rennebu	Elgkjøtt kvernet	0,01
Hognamat AS, Rennebu	Elgkjøtt kvernet	0,01
Hognamat AS, Rennebu	Elgkjøtt kvernet	0,31
Hognamat AS, Rennebu	Elgkjøtt kvernet	1,60
Kirkebygda Produkter, Rødberg	Elgkjøtt kvernet	0,14
Kirkebygda Produkter, Rødberg	Elgkjøtt kvernet	0,05
Kirkebygda Produkter, Rødberg	Elgkjøtt kvernet	0,16
Kirkebygda Produkter, Rødberg	Elgkjøtt kvernet	0,17
Kirkebygda Produkter, Rødberg	Elgkjøtt kvernet	0,06
Kistefos Viltkjøtt AS, Kistefos	Elgkjøttkarbonadedeig	0,99
Kistefos Viltkjøtt AS, Kistefos	Elgkjøttkarbonadedeig	11,28
Kistefos Viltkjøtt AS, Kistefos	Elgkjøttkarbonadedeig	17,18
Kistefos Viltkjøtt AS, Kistefos	Elgkjøttkarbonadedeig	1,50
Kistefos Viltkjøtt AS, Kistefos	Elgkjøttkarbonadedeig	0,32
Kokk Henriksen, Jessheim	Elg kjøttdeig	0,43
Kokk Henriksen, Jessheim	Elg kjøttdeig	1,62
Kokk Henriksen, Jessheim	Elg kjøttdeig	0,18
Kokk Henriksen, Jessheim	Elg kjøttdeig	0,33
Kokk Henriksen, Jessheim	Elg kjøttdeig	0,11
M. Aakervik Laks og Vilt, Namsos	Elghakk innh. kvernet elgkjøtt	2,63
M. Aakervik Laks og Vilt, Namsos	Elghakk innh. kvernet elgkjøtt	0,29
M. Aakervik Laks og Vilt, Namsos	Elghakk innh. kvernet elgkjøtt	1,35
M. Aakervik Laks og Vilt, Namsos	Elghakk innh. kvernet elgkjøtt	0,38

Grocer/Butcher	Sample name	mg/kg Pb
M. Aakervik Laks og Vilt, Namsos	Elghakk innh. kvernet elgkjøtt	1,30
Meny Lillesand, Lillesand	Kjøttdeig av elg ca 15 % fett	0,18
Meny Lillesand, Lillesand	Kjøttdeig av elg ca 15 % fett	0,06
Meny Lillesand, Lillesand	Kjøttdeig av elg ca 15 % fett	0,20
Meny Lillesand, Lillesand	Kjøttdeig av elg ca 15 % fett	0,09
Meny Lillesand, Lillesand	Kjøttdeig av elg ca 15 % fett	0,20
Rivelsrud & Co, Bergen	Elg deig	0,04
Rivelsrud & Co, Bergen	Elg deig	0,83
Rivelsrud & Co, Bergen	Elg deig	1,08
Siljanhjort, Siljan	Kvernet elgkjøtt	0,79
Siljanhjort, Siljan	Kvernet elgkjøtt	0,97
Siljanhjort, Siljan	Kvernet elgkjøtt	3,05
Siljanhjort, Siljan	Kvernet elgkjøtt	1,20
Siljanhjort, Siljan	Kvernet elgkjøtt	0,33
Spar Ekholt (Ekholt Matsenter), Moss	Elg Karbonade	0,24
Spar Ekholt (Ekholt Matsenter), Moss	Elg Karbonade	0,01
Spar Ekholt (Ekholt Matsenter), Moss	Elg Karbonade	0,01
Spar Ekholt (Ekholt Matsenter), Moss	Elg Karbonade	0,27
Spar Ekholt (Ekholt Matsenter), Moss	Elg Karbonade	0,02
Spikkeland Viltslakteri, Finsland	Kjøttdeig Elg	0,32
Spikkeland Viltslakteri, Finsland	Kjøttdeig Elg	0,06
Spikkeland Viltslakteri, Finsland	Kjøttdeig Elg	0,06
Spikkeland Viltslakteri, Finsland	Kjøttdeig Elg	0,72
Stensaas Reinsdyrslakteri AS, Røros	Elg kvernet kjøtt	0,07
Stensaas Reinsdyrslakteri AS, Røros	Elg kvernet kjøtt	0,05
Stensaas Reinsdyrslakteri AS, Røros	Elg kvernet kjøtt	0,06
Stensaas Reinsdyrslakteri AS, Røros	Elg kvernet kjøtt	2,48
Stensaas Reinsdyrslakteri AS, Røros	Elg kvernet kjøtt	0,12
Stensaas Reinsdyrslakteri AS, Røros	Elg kvernet kjøtt	16,97
Stensaas Reinsdyrslakteri AS, Røros	Elg kvernet kjøtt	0,03
Stensaas Reinsdyrslakteri AS, Røros	Elg kvernet kjøtt	0,03
Stensaas Reinsdyrslakteri AS, Røros	Elg kvernet kjøtt	0,18
Stensaas Reinsdyrslakteri AS, Røros	Elg kvernet kjøtt	0,14
Tamt og Vilt, Hemsedal	Kjøttdeig av Elg	0,56
Tamt og Vilt, Hemsedal	Kjøttdeig av Elg	0,83

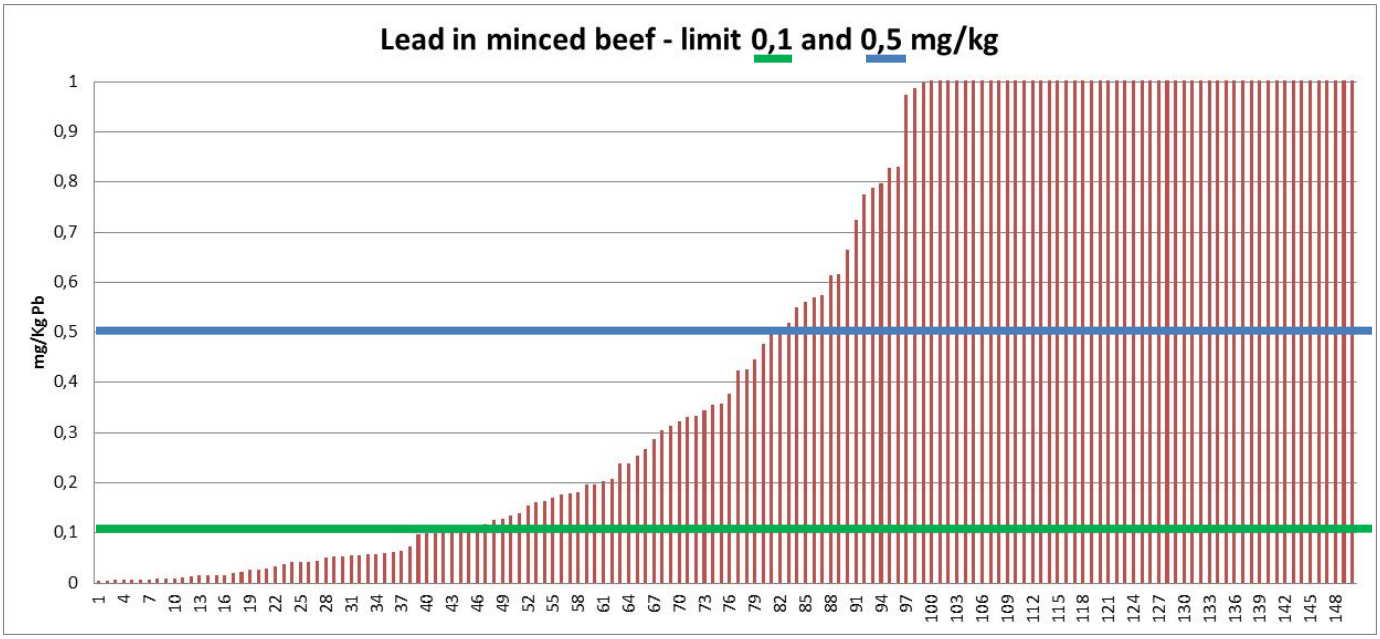
Grocer/Butcher	Sample name	mg/kg Pb
Tamt og Vilt, Hemsedal	Kjøttdeig av Elg	0,66
Tamt og Vilt, Hemsedal	Kjøttdeig av Elg	1,62
Tamt og Vilt, Hemsedal	Kjøttdeig av Elg	1,67
Tamt og Vilt, Hemsedal	Kjøttdeig av Elg	0,20
Tamt og Vilt, Hemsedal	Kjøttdeig av Elg	1,42
Telemark Viltslakteri/Løvenskiold, Skien	Elgkjøttdeig	0,04
Telemark Viltslakteri/Løvenskiold, Skien	Elgkjøttdeig	0,24
Telemark Viltslakteri/Løvenskiold, Skien	Elgkjøttdeig	0,13
Telemark Viltslakteri/Løvenskiold, Skien	Elgkjøttdeig	0,11
Telemark Viltslakteri/Løvenskiold, Skien	Elgkjøttdeig	4,98
Ultra, Sandvika	Elgkjøtt ca. 8% fett	0,78
Ultra, Sandvika	Elgkjøtt ca. 8% fett	0,05
Ultra, Sandvika	Elgkjøtt ca. 8% fett	0,25
Ultra, Sandvika	Elgkjøtt ca. 8% fett	0,61
Ultra, Sandvika	Elgkjøtt ca. 8% fett	1,47
Veikåker Gård, Noresund	Kjøttdeig av Elg	0,13
Veikåker Gård, Noresund	Kjøttdeig av Elg	0,10
Veikåker Gård, Noresund	Kjøttdeig av Elg	0,35
Veikåker Gård, Noresund	Kjøttdeig av Elg	1,43
Veikåker Gård, Noresund	Kjøttdeig av Elg	0,06
Vilteksperten AS, Steinkjer	Elg Hakk	0,57
Vilteksperten AS, Steinkjer	Elg Hakk	1,97
Vilteksperten AS, Steinkjer	Elg Hakk	1,19
Vilteksperten AS, Steinkjer	Elg Hakk	1,72
Vilteksperten AS, Steinkjer	Elg Hakk	0,55
Øyvind Karlsen - Manstad Kjøtt AS, Manstad	Elg Karbonadedeig	1,09
Øyvind Karlsen - Manstad Kjøtt AS, Manstad	Elg Karbonadedeig	0,02
Øyvind Karlsen - Manstad Kjøtt AS, Manstad	Elg Karbonadedeig	0,01
Øyvind Karlsen - Manstad Kjøtt AS, Manstad	Elg Karbonadedeig	0,02
Øyvind Karlsen - Manstad Kjøtt AS, Manstad	Elg Karbonadedeig	0,02
HeltVilt Bjørkelangen, Bjørkelangen	Elg-kvernet kjøtt	0,16
HeltVilt Bjørkelangen, Bjørkelangen	Elg-kvernet kjøtt	2,94
HeltVilt Bjørkelangen, Bjørkelangen	Elg-kvernet kjøtt	14,10

Grocer/Butcher	Sample name	mg/kg Pb
HeltVilt Bjørkelangen, Bjørkelangen	Elg-kvernet kjøtt	4,25
HeltVilt Bjørkelangen, Bjørkelangen	Elg-kvernet kjøtt	6,27

Figure 2 illustrates the distribution of lead among the samples of minced Elg beef



There is no limit for content of Lead in Norwegian wild game. Figure 2 b illustrates distribution of minced Elg beef with limit 0,1 and 0,5 mg/kg



If the limit of Lead content in wild game had been set to 0,1 mg/kg, only 40 of the 150 samples had been within the limit. If the limit of Lead content in wild game had been set to 0,5 mg/kg, 82 of the 150 samples had been within the limit.

6. Discussion

There is no typical trend regarding lead content and grocer/butcher. The samples with high content of lead are geographically more or less evenly distributed. The analyses of lead were performed during a period of a month and there was no problem with the equipment used. There was used one person for sample preparation and another person for the instrumental analysis. We have found no fails during the analysis.

7. Reference

M. Lindboe, E.N. Henrichsen, H.R. Høgåsen, A. Bernhoft, 2012, Lead concentrations in meat from lead-killed moose and predicted hunman exposure using Monte Carlo simulation, Food additives and Contaminants, vol 29, Issue 7, 1052-1057.

Risk assessment of lead exposure from cervid meat in Norwegian consumers and in hunting dogs. Opinion of the Panel on Contaminants of the Norwegian Scientific Committee for Food Safety. 2013;11-505.