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Meat, fat, and bone ratios of Icelandic lamb - Chemical composition of lamb meat and side-products

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Title	Meat, fat, and bone ratios of Icelandic lamb. Chemical composition of lamb meat and side products.		
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Summary in English:	Meat, fat, and bone ratios of Icelandic lamb meat, were studied. Carcasses from the EUROP classes: O-2, R-2, R-3, U-2, U-3, U-3+, and E-3 were selected, nine carcasses from each class, a total of 63 carcasses. Carcasses from these classes represent 92% of the lamb meat production in Iceland as reported for 2021. Carcasses were selected during three slaughtering days, in two slaughterhouses in north and south Iceland. The EUROP classifications of carcasses were confirmed by a specialist from the Icelandic Food and Veterinary Authority. The carcasses were divided into halves the day after slaughtering. One half was divided into traditional cuts: leg, forequarter, saddle, and flank. The other half was used for study of various cuts, where each product was made from one of three selected carcass weight ranges: light carcasses below 14.5 kg, medium carcasses 14.5-16.8 kg and heavy carcasses 16.9-19.0 kg. Deboning was carried out on all products and yields were reported (meat, fat, bones, tendons). Wastage due to cutting, and deboning was reported. Tissue ratios for whole lamb carcasses were on average 59% meat, 16% fat, 18% bones, and 6% tendons. Wastage during cutting and deboning was 1,1%. The meat yields were highest for class U-2, except for forequarter which had a bit higher meat yield for class E-3. For conformation classes U and R, it was clear that fat yields were related to the definitions of fat thickness for fat classes 2, 3 and 3+. Yields were reported for meat, fat, bones, and tendons in 30 meat products. Highest meat yields were for leg products (74% and 69%). Selected nutrients were analysed in legs, forequarters, saddles, flanks, and several products. The results will be used for labelling and dissemination. Lamb meat was rich in vitamin B_{12}, folate, potassium, and zinc. These nutrients can be used for nutrition declarations of the meat. The heavy metals mercury, cadmium, lead, and arsenic were below the quantification limits in lamb meat. The quantification limits were very low. Sampling of lamb organ foods and side-products was carried out in three slaughterhouses. The following side-products were sampled: Liver, kidneys, heart, lungs, testicles, gullet, sweetbread, spleen, and blood. Selected nutrients and heavy metals were analysed. These products were generally rich in selenium and iron which can be used for nutrition declarations in most cases. The heavy metal cadmium was reported for liver, and kidneys, cadmium was however below the quantification limit in other products. Mercury was only reported in kidneys. Lead and arsenic were below the quantification limits in the products.
English keywords:	*Lamb meat cuts. Side-products. Meat, fat, bone ratios. Nutrient value. Heavy metals.*

Contents

1 Introduction

The purpose of the project was to provide interested bodies with reliable information on nutrient composition, yields and new opportunities.

Little information on yields and nutrient value of Icelandic lamb meat were limiting factors for marketing since sales agents and consumers requested this information. It was important to take into account the progress in sheep farming and changing composition of lamb carcasses due to breeding.

Meat processing plants, innovation companies, and sales agents abroad will use the results from the project. Comparable information is always available for lamb meat from other countries.

Sheep breeding programs in Iceland are based on extensive centralised sheep recording and farm management software and consultation run by the Icelandic Agricultural Advisory Centre. It is also based in the Icelandic version of the EUROP carcass grading scheme implemented in 1998.

Icelandic sheep farming has made considerable progress over the last decades. Meat productivity has increased about 30% per ewe over the last 20 years and carbon footprint has lowered by 25-30% (Jóhannes Sveinbjörnsson and Daði Már Kristófersson 2021).

In 2002 36.6% of the production was in carcass conformation class O, 52% in class R and 8,7% in class U. In 2018, only 6.8% of the production was in class O, and 56% in class R, and 32.5% as class U. This progress means that information on meat, fat, bone ratio of carcasses and products and chemical composition of products must be updated.

Lamb carcasses in most common EUROP classes are now heavier, with more muscle, and less fat than before. The processing has also changed. Products such as sirloin, ribeye, prime and topside are now common in supermarkets, but were almost unknown 20 years ago.

Research on yields of Icelandic lamb carcasses and products has been very limited. Only one survey, carried out 2003-2004, covered the EUROP classification of Icelandic lamb carcasses (Ásbjörn Jónsson and Óli Þór Hilmarsson, 2007). Results have been reported in the Icelandic Meat Buyers Guide.[1]

The nutrient composition of lamb meat and side-products has been based on old data, but it will also be updated in the Icelandic Food Composition Database (ÍSGEM).[2] The new data presented in this report, will strengthen product development and marketing of Icelandic lamb meat in Iceland and

[1] Lambakjöt « Kjötbókin (kjotbokin.is)
[2] Íslenski gagnagrunnurinn um efnainnihald matvæla (ÍSGEM) - Matís (matis.is)

abroad. The information will be used by the meat and slaughter industry, innovators, sales agents, and other interested parties, such as farmers and small businesses that process lamb meat and side-products. The data will benefit planning, cost and profit calculations for improved processing and price calculations of products. Small businesses in the innovation side-product sector need the data on chemical composition of the products. Retail stores, speciality markets, restaurants and canteens use the nutrient data for improved labelling and information. The results will be useful for teaching and research in agriculture, meat industry and catering.

Utilisation of side-products is among the most important opportunities to increase income of the sheep sector in the future. Companies in Iceland and abroad have started to use side-products from the sheep industry for production of valuable products for human consumption. Earlier the side-products were of little use and even disposed of. Examples of lamb organs and side products that can increase in value are as follows: liver, kidneys, heart, bones, fat, tripe, gullet, lung, and testicles. All data that confirm the wholesomeness of lamb meat and products are therefore very important.

The Icelandic version of the EUROP lamb carcass classification

In Iceland all lamb carcasses are visually classified in slaughterhouses by trained evaluators. Carcass conformation is evaluated by using the five main EUROP classes and a six-point scale for fatness with the main classes 1, 2,3,4,5 as well as subclass 3+.

The fat classification is partly dependent on a measurement of tissue depth over the 12th rib (GR). The GR measurement is made on the whole carcass using a digital needle probe that measures tissue thickness over the rib about 11 cm from the middle of the saddle.

Further information can be found in regulation no 500/2017 on quality evaluation, classification and labelling of slaughtering products.[3] Descriptions of individual classes are as follows:

Conformation classes (shape and development)

E: Excellent conformation. All configurations very convex.
U: Very good conformation. Configurations mostly convex.
R: Good conformation. Configurations mostly straight.
O: Fairly good conformation. Configurations somewhat concave.
P: Poor conformation. All configurations concave or very concave.

Fat classes (Fat cover)	Tissue depth over the 12th rib
1: Very little fat.	<5 mm
2: Litle fat.	<8 mm
3: Normal fat.	<11 mm

[3] 500/2017 – Reglugerð um gæðamat, flokkun og merkingu sláturafurða. (island.is)

3+: Much fat.	<14 mm
4: Very much fat.	<18 mm
5: Excessive fat.	>18 mm

The project

A survey of meat, fat, bone, and tendon ratios of Icelandic lamb was carried out during the slaughter season 2022. Chemical composition of meat, organ foods, and side-products was determined. The purpose of the project was to provide new data for Icelandic lamb composition and make the data available in databases and elsewhere.

Lamb carcasses from the following EUROP classes were selected for the survey: O-2, R-2, R-3, U-2, U-3, U-3+, and E-3. These EUROP classes represented 92% of the Icelandic lamb meat production according to the lamb meat classification 2021. Nine carcasses from each class were sampled, a total of 63 carcasses.

Lamb carcasses were selected during three different slaughtering dates, in two slaughterhouses, one in South-Iceland and one in North-Iceland. Sampling was carried out twice in the slaughterhouse in North-Iceland. A meat classification specialist from the Icelandic Food and Veterinary Authority confirmed that the EUROP classification of each carcass was correct and not on the borderline of classification. The carcasses were divided in two equal longitudinal halves the day after slaughtering. One half was divided into leg, forequarter, saddle, and flank according to the traditional cutting method. The other half was first sorted into three carcass weight ranges, light carcasses below 14.5 kg, medium 14.5 – 16.8 kg, and heavy 16.9 – 19.0 kg, and then used for preparation of different meat products.

Studying of side-products was of special importance, which can provide new opportunities including wholesome foods and food supplements. Side-products have been used as low-priced feed or have been used as disposal with considerable cost. Disposal of animal side-products has been forbidden, therefore, it is very important to use the side-products for production of valuable goods.

For comparison, a study in Norway on the EUROP classification outcomes for lamb carcasses, can be studied (Johansen et al. 2006). This study was much more extensive than the survey presented in this report.

The project was funded by the Icelandic Food Innovation fund (is. Matvælasjóður). Matis caried out the project for Icelandic Lamb ehf that was the grantee and Hafliði Halldórsson was responsible for the project. Óli Þór Hilmarsson worked on sampling, handling of samples, and precision deboning. He selected lamb meat products for the project in cooperation with meat industry and Icelandic Lamb ehf.

Ólafur Reykdal organised chemical analysis, worked on data and wrote the report. Guðjón Þorkelsson was a consultant for the project and worked on sampling and the report. Helgi Briem carried out statistical analysis. Staff at the Matis chemistry department carried out analysis of proximates, inorganic compounds, and fatty acids.

2 Sampling and methods

2.1 Collection of samples

Lamb carcasses were collected during the slaughter season 2022. Samples were collected in the SS slaughterhouse at Selfoss, and twice at the slaughterhouse of SAH Afurðir at Blönduós. The basis of sampling was three carcasses each slaughtering day for each EUROP class. Table 1 shows the number of carcasses for the selected EUROP classes. Seven classes were sampled (E-3, U-3+, U-3, U-2, R-3, R-2 and U-2) which represented 92% of the lamb meat production in Iceland according to the meat classification 2021 (Table 2). Four of the EUROP classes represented 80% of the meat production. The table shows also that the ratios for EUROP classes were similar 2023. Total number of carcasses in the survey were 63 (3 slaughtering days × 3 carcasses × 7 EUROP classes). Einar Kári Magnússon, meat classification specialist at The Icelandic Food and Veterinary Authority, provided data on results from national lamb carcass classification and confirmed the correct EUROP classification of selected carcasses. Einar was responsible for the EUROP classification of carcasses. Weight of selected carcasses was recorded according to the labelled weight. The weight of half carcasses was determined.

Table 1. Number of lamb carcasses per EUROP conformation class and fat class.

Conformation	Fat classes						
classes	1	2	3	3+	4	5	Total
E			9				9
U		9	9	9			27
R		9	9				18
O		9					9
P							
Total		27	27	9			63

Table 2. Results from EUROP classification of lamb carcasses per class (%) 2021 and 2023. Results (%) are based on carcass weights.

Class	2021 %	2023 %
E 3	3,4	5,4
U 2	12,2	12,2
U 3	21,7	24,4
U 3+	5,5	6,3
R 2	30,5	27,0
R 3	15,9	14,7
O 2	3,2	1,9
Total	92,4	91,9

Sampling of organ foods and side-products was carried out in three slaughterhouses, SS at Selfoss, KS at Sauðárkrókur and Norðlenska at Húsavík. Samples included liver, kidneys, heart, lung, testicles, gullet, sweetbread, spleen, and blood. Samples were collected from at least four lambs in each slaughterhouse. Each sample was 1 heart, 2 kidneys etc. Sampling was carried out four times each slaughtering day so that the four samples would not be from the same farm. All types of samples were not necessarily collected from the same lamb. Origin of samples was recorded. The samples were frozen in the slaughterhouse and then sent to Matis. Sampling was carried out during the period October 3rd to October 24th 2022.

2.2 Precision deboning

Precision deboning was carried out to determine yields of lamb meat cuts and lamb meat products. Results for meat, fat, bones, and tendons were reported. *Dissection* is a more precise method to determine the yields, since small knifes are used to remove all small pieces of meat from bones, and fat is separated very precisely. Precision deboning was, however, fully satisfactory for the purpose of this project.

Lamb meat cuts

Nine carcasses for each EUROP class (see Table 1) were split longitudinally in the middle of the carcass and weighted. The right part of each carcass was divided into leg, forequarter, saddle, and flank according to descriptions in the Icelandic Meat Byers Guide.[4] Precision deboning was then used to determine the ratios of meat, fat, bones, and tendons for each meat cut. Examples can be seen in Figures 1 and 2.

The following measurements were carried out on the right part of the carcasses.

Carcass measurements:

- Legs: Length of leg with hock, maximum perimeter, maximum diameter.
- Saddles: Length, width, distance from centre.

Weighing: Carcasses without packaging, not frozen and before deboning, right and left legs, right and left part of saddle, flank, and forequarter. A Marel balance with 1 g precision was used.

[4] Kjötbókin (kjotbokin.is)

- From legs: Deboned leg, shank, material for processing, fat, and bones.
- From saddles: Loin, tenderloin, material for processing, bones, fat on top, total fat.
- From flanks: Deboned, trimmed flanks and bones.
- From forequarters: Deboned forequarter, fat, and bones.

Figure 1. Saddle, EUROP class E-3, carcass no 1440, Selfoss slaughterhouse 12.10.2022.

Figure 2. Precision deboning of saddle, resulting in meat, fat, bones, and tendons.

Lamb meat products

Another part of the project was to study lamb meat products that are common today but were not available at the time of earlier studies. Since carcasses were sorted by three weight ranges for the study of meat products, different implementations were possible. The meat industry was involved in

selection of products suitable for different weight ranges. Meat products were photographed for dissemination.

Selection and division of carcasses were carried out in slaughterhouses but precision deboning, preparation of meat products, photography and chemical analysis were carried out in the Matis building Reykjavík.

2.3 Processing of samples for chemical analysis

Precision deboning of lamb meat cuts delivered 252 samples (4 meat cuts × 7 classes × 9 carcasses). It was not possible to carry out chemical analysis on so many samples due to cost. Therefore, samples from all carcasses were combined for each meat cut and each EUROP class. Samples for chemical analysis were 28 (4 meat cuts × 7 classes).

Precision deboning of lamb meat products was carried out for three samples of each product. Each sample was made from one carcass but the three samples for the same product were made from carcasses of the same weight range but could be from different EUROP classes. The three samples for each meat product were combined for one composite sample for chemical analysis. The number of different meat products was 27.

All meat samples were homogenised in the Matis building Reykjavík. After precision deboning, meat and fat were combined in a sample that was mixed carefully (Figures 3 and 4). After that, samples were homogenised in a homogeniser (Figure 5). Portions of a homogenised sample were further homogenised in a laboratory mixer and frozen in plastic boxes.

Figure 3. After deboning and weighing of meat, fat, bones, and tendons, meat and fat were mixed together for analysis.

Figure 4. The figure shows a sample after first mixing.

Figure 5. After the first mixing, samples were homogenised in a homogeniser shown in the figure.

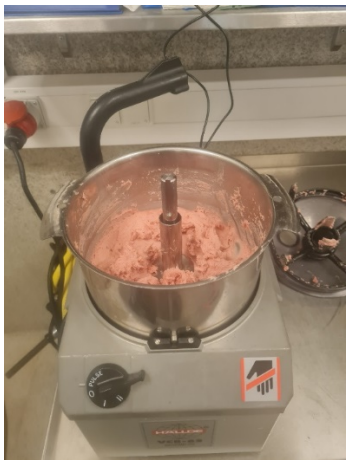

Figure 6. Final homogenisation was carried out in a laboratory homogeniser.

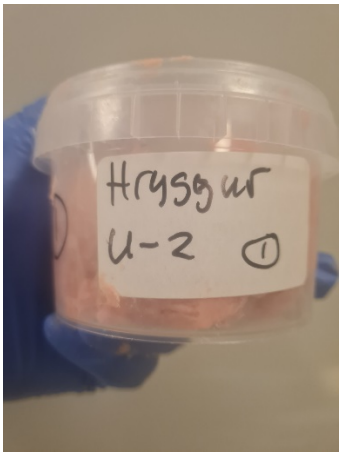

Figure 7. Each sample was delivered in four boxes to the Matis chemistry laboratory.

Lamb organ foods and side-products

Samples of organ foods and side-products were trimmed, and extra tissues were removed. Outer fat tissues on hearts were not removed since this is the common method for cooking. Top and bottom parts of testicles were removed, together with membrane and fat tissue. All fat tissues were removed from kidneys. It was not possible to homogenise tripes in available homogenisers, therefore, one third of each tripe was used for the sample and cut into pieces which were freeze dried before analysis.

Table 3. Information on samples of lamb organ foods and side-products. Samples for each organ food and side-product (9-24 samples) were combined to prepare one composite sample for analysis. Average weights of samples refer to 1 liver, 2 kidneys etc.

Sample	No of samples	Definitions of samples	Average sample weight g
Liver	16	1 liver	445
Kidneys	16	2 kidneys	84
Heart	16	1 heart	155
Lung	16	1 lung	113
Testicles	9	2 testicles	191
Tripe	12	a slice from 1 tripe	162
Gullet	12	1 gullet	12
Sweetbread	21	1 sweetbread	20
Spleen	24	1 spleen	36
Blood	16	ca. 250 mL	250

2.4 Analytical methods

Chemical analyses were carried out by Matis except for analyses of vitamins which were carried out by Eurofins in Germany.

Proximates

Protein was calculated from the total amount of nitrogen (nitrogen × 6.25) which was determined by the method of Dumas.[5] Samples were evaporated to gas in a heating vial. Nitrogen compounds in the gas were transformed to molecules. The conversion factor of 6.25 was used for all samples as required by the regulation on food labelling (No 1294 / 2014).[6] This conversion factor is generally used for meat.

Fat in lamb meat was determined by petroleum ether extraction after acid hydrolysis.[7] This method releases compounds bound to the fat, making the total amount of fat soluble in petroleum ether which is evaporated. For fat analysis of organ foods and side-products, the acid hydrolysis was not carried out, otherwise the procedure was the same.

[5] ISO 16634-1:2008 (E).

[6] Regulation EU No 1169/2011 (Icelandic version no 1294/2014) on the provision of food information to consumers 1294/2014 – Reglugerð um miðlun upplýsinga um matvæli til neytenda. (island.is)

[7] NMKL method no. 160, 1998.

Ash was determined as the residue after heating in a furnace at 550°C according to method description ISO 5984.[8] About 2 g sample was used.

Water. Samples were dried in an oven and the weight loss calculated as percent waster of the original sample.[9] Drying was carried out at 103 ± 2 °C for 4 hours.

Fatty acids

Fatty acid analysis started by methylation of fat which had been extracted by the method of Bligh and Dyer.[10] The methylation was carried out according to the method of AOCS Ce1b-89 (97).[11] The fat was weighted into a test tube, sodium hydroxide was added and the mixture was heated to 100 °C. Boron trichloride was added and heating was continued. A standard was added, and the sample kept in a closed tube before injection to the column of a gas chromatograph.

For the separation and analysis of fatty acid methyl esters, a Varian 3900 GC gas chromatograph with 30 m column (fused silica capillary column, Omega WaxTM 250, 30 m × 25 mm × 25 mm µm film), a flame ionisation detector and data processing system, was used. Helium was used as a carrier gas. The procedure was according to AOAC method no 996.06.[12] Peaks on chromatograms were linked to fatty acids based on the use of standards. Results for fatty acids were reported as ratios (%) of total fatty acid methyl esters.

Inorganic elements

Homogenised samples were freeze dried. Then samples were digested by heating in a microwave oven (UltraWave, Milestone). This method was based on the method of Sloth[13] and method description of NMKL no. 186-2007.[14] 150-200 mg (precision 0,1 mg) were weighted into a tube for digestion and 1

[8] ISO, 2022. Animal feeding stuffs – Determination of crude ash. ISO Standard 5984. Geneva, Switzerland: The International Organization for Standardization.

[9] ISO, 1999. Determination of moisture and other volatile matter content. ISO Standard 6496. Geneva, Switzerland: The International Organization for Standardization.

[10] Bligh, E.G. and Dyer, W.S., 1959. A rapid method of total lipid extravtion and purification. Can. J. Biochem. and Physiol. 37: 911.

[11] AOCS, 1997. Fatty acid composition by GLC. Marine oils. A.O.C.S. Official Method Ce 1b-89. Official Methods and Recommended Practices of the AOCS. American Oil Chemists' Society. Champaign, Illinoise, USA.

[12] AOAC, 2005. Fat (Total, saturated, and unsaturated) in foods. In K. Helrich (Ed.), Official Methods of Analysis of the Association of Official Analytical Chemists. AOAC Official Method 996.06. Association of Official Analytical Chemists, Arlington, USA.

[13] Sloth, J.J., K. Julshamn, A.K. Lundebye, 2005. Total arsenic and inorganic arsenic content in Norwegian fish feed products. Aquaculture Nutrition 11: 61-66.

[14] Nordisk Metodikkomité for Næringsmidler (NMKL), 2007. Trace elements – As, Cd, Hg, Pb and other elements. Determination by ICP-MS after pressure digestion. Method no. 186-2007.

mL nitric acid was added together with 1 ml hydrogen peroxide. The tube was closed and placed in a microwave oven until the sample was digested and only clear liquid left. The next step was to pour the liquid into 50 mL polypropylene tubes and dilute to 50 mL. The elements were analysed in an ICP-MS inductively coupled plasma mass spectrometer (ICP-MS), model Agilent 7900 (Agilent Technologies, Waldbronn, Germany). Reference materials, with known concentration of the elements, were included each time analysis were carried out. Blank samples were analysed to check possible background levels and contamination during sample treatment.

Vitamins

Samples for analysis of vitamins B_1- and B_{12} together with folate were sent to Eurofins WEJ GmbH in Hamburg Germany which outsourced to analysis to an accredited laboratory. Vitamin B_1 was determined according to method EN 14122-2014 with modifications, using LC-FLD. Vitamin B_{12} was determined according to method reported in J. AOAC 2008, vol 91 No 4, using LC-UV/DAD. Folate was determined according to method NMKL 111: 1985, 870, using nephelometry.

2.5 Statistical analysis

The R-statistical software was used for statistical analysis. One-way analysis of variance was used to study differences between carcass classes.

3 Results – Precision deboning

3.1 Lamb cuts

Results from precision deboning of lamb legs, forequarters, saddles, and flanks are reported in this chapter. Table 4 shows the radios of meat, fat and bones calculated for the total weight of lamb cuts per EUROP class. Table 5 reports detailed information, including wastage and carcass weight. Tables 6-10 report results from statistical analysis. Data for each lamb meat cut are presented in Tables 11-22. Tables 23-24 show results from size (cm) measurements of lamb legs and saddles.

Table 4. Meat, fat, and bone ratios in lamb carcasses per EUROP class. Calculations are based on combined data for legs, forequarters, saddles, and flanks. Number of carcasses was 63.

Classes	Meat (%)		Fat (%)		Bone (%)	
	Average	SD	Average	SD	Average	SD
E-3	61,5	2,01	15,2	2,14	16,3	0,98
U-2	62,2	2,65	12,9	2,78	17,3	1,50
U-3	60,1	1,99	16,4	2,49	16,6	1,02
U-3+	54,9	2,43	23,0	3,03	16,3	1,32
R-2	58,7	2,66	14,5	2,91	18,8	0,95
R-3	56,0	1,60	19,4	2,20	17,3	1,03
O-2	59,2	1,70	11,8	2,34	21,1	0,90

Data for different EUROP classes can be compared in Table 6. Meat yield (meat ratio) for all lamb carcasses was 59.0 (50.7-67.3) %, fat ratio was 16.2 (9.7-28.0) %, bone ratio was 17.7 (13.4-22.1) % and tendon ratio was 6.3 (4.4-8.1) %. Wastage was on the average 1.1%.

The last comparable survey of lamb meat classification was carried out 2004-2005. At that time average meat yield of lamb carcasses was 59.6% (range 47.7% - 74,6%) (Ásbjörn Jónsson and Óli Þór Hilmarsson 2007). Meat yield was calculated for each meat cut and all cuts were used to calculate yield for whole carcasses. Fat ratio was on the average 18.8% and bone ratio 17.7%. Tendons are only 3.9% and wastage is not included. It is interesting that the fat ratio is 2% lower in the present study compared to the 2004-2005 survey. If wastage is excluded from calculations shown in Table 6, the meat yield is almost the same in both surveys. A review in English on lamb meat yield is available from 2020 (Ólafur Reykdal and Óli Þór Hilmarsson 2020).

Table 5. Meat, fat, bone, and tendon ratios (%) of lamb carcasses (combined legs, forequarters, saddles, and flanks). Carcass weights are presented for information. Wastage is calculated as difference and is due to loss during deboning. Number of carcasses for each class is 9 and total number of carcasses is 63. Two values for wastage were rejected due to too much deviation.

Classes		Carcass weight kg	Meat %	Fat %	Bone %	Tendon %	Wastage, total %
E-3	Average	19.160	61,5	15,2	16,3	6,1	1,2
	SD	1.777	2,0	2,1	1,0	0,5	0,6
	Minimum	17.900	59,6	11,0	14,8	5,4	0,9
	Maximum	22.700	65,6	18,4	17,7	6,9	2,5
U-3+	Average	20.169	54,9	23,0	16,3	4,8	1,1
	SD	1.820	2,4	3,0	1,3	0,3	0,3
	Minimum	18.120	50,7	17,6	13,4	4,4	0,7
	Maximum	24.300	59,2	28,0	17,9	5,4	1,6
U-3	Average	19.164	60,1	16,4	16,6	5,8	1,1
	SD	975	2,0	2,5	1,0	1,1	0,2
	Minimum	17.600	56,7	13,9	14,9	4,4	0,8
	Maximum	20.700	62,3	21,6	17,8	8,1	1,3
U-2	Average	15.496	62,2	12,9	17,3	6,6	0,9
	SD	823	2,6	2,8	1,5	0,7	0,1
	Minimum	14.320	59,6	9,7	14,8	5,6	0,8
	Maximum	16.800	67,3	17,6	19,0	7,8	1,1
R-3	Average	15.838	56,0	19,4	17,3	6,8	1,2
	SD	893	1,6	2,2	1,0	0,7	0,1
	Minimum	13.860	53,8	15,7	15,4	5,9	1,1
	Maximum	16.700	58,5	22,1	19,0	7,7	1,3
R-2	Average	13.851	58,7	14,5	18,8	6,9	1,2
	SD	754	2,7	2,9	0,9	0,5	0,3
	Minimum	12.920	55,5	9,7	17,2	6,3	0,7
	Maximum	15.440	62,2	18,4	20,2	7,7	1,6
O-2	Average	13.578	59,2	11,8	21,1	7,1	0,9
	SD	3.476	1,7	2,3	0,9	0,5	0,4
	Minimum	11.240	56,2	9,7	19,6	6,5	0,0
	Maximum	22.600	61,3	16,4	22,1	7,7	1,2
All	Average	16.751	59,0	16,2	17,7	6,3	1,1
	SD	3.032	3,3	4,4	1,9	1,0	0,3
	Minimum	11.240	50,7	9,7	13,4	4,4	0,0
	Maximum	24.300	67,3	28,0	22,1	8,1	2,5

Results from statistical analysis can be viewed in Tables 6-10. The influences of conformation classes and fat classes on ratios of meat, fat, and bones can be seen. It is noteworthy that there is a significant difference between the fat ratios (conformation classes U and R) and the fat classes (Table 7). This supports that the EUROP classification in slaughterhouses was carried out correctly. Detailed results from the statistical evaluation are reported in Appendix 3.

Table 6. Meat ratios (%) per EUROP conformation class and fat class. Different letters represent significant differences (p< 0,05).

Conformation classes	Fat classes		
	2	3	3+
E		61,5[a]	
U	62,2[a]	60,1[a]	54,9[c]
R	58,7[b]	56,0[c]	
O	59,2[b]		

The carcass classes can be divided into three groups based on meat ratio (Table 7). Highest meat ratios were found for classes E-3, U-2 and U-3, but lowest meat ratios were found for classes R-3 and U-3+. Classes R-2 and O-2 had meat ratios in between.

Fat ratios depend strongly on fat classes according to the Icelandic EUROP classification (See Figures V3-2 and V3-3 in Appendix 3). Difference between fat classes 3 and 3+ is much greater than between fat classes 2 and 3 (Table 8). Conformation classes had more influences on bone ratio than fat classes (Appendix 3).

Table 7. Fat ratios (%) per EUROP conformation class and fat class. Different letters represent significant differences (p< 0,05).

Conformation classes	Fat classes		
	2	3	3+
E		15,2[b]	
U	12,9[a]	16,4[b]	23,0 [c]
R	14,5[a]	19,4[b]	
O	11,8[a]		

Table 8. Bone ratios (%) per EUROP conformation class and fat class. Different letters represent significant differences (p< 0,05).

Conformation classes	Fat classes		
	2	3	3+
E		16,3[a]	
U	17,2[a]	16,6[a]	16,3[a]
R	18,8[b]	17,3[ab]	
O	21,1[c]		

Conformation describes the shape and quantity of muscles and fat on the bones in a carcass. It can be seen in Tables 10 and 11 that conformation classes and fat classes also influence the ratios of meat plus fat.

The ratio of meat plus fat is lowest for class O-2 but highest for class U-3+, the effect of the fat ratio is most important since the meat ratio was considerably higher in class O-2 than in class U-3+. Conformation classes have noticeable effects although the difference between classes E and U was not significant.

Table 9. Meat plus fat ratios (%) in lamb carcasses per EUROP class.

Class	Average	SD
E-3	76,7	1,04
U-2	75,1	2,03
U-3	76,6	1,57
U-3+	77,9	1,36
R-2	73,1	1,18
R-3	75,4	1,80
O-2	70,9	1,05

Table 10. Meat plus fat ratios (%) per EUROP conformation class and fat class. Different letters represent significant differences (p< 0,05).

Conformation classes	Fat classes		
	2	3	3+
E		76,7[e]	
U	75,1[be]	76,6[e]	77,9[c]
R	73,1[b]	75,4[d]	
O	70,9[a]		

Detailed information on yields (g and %) of meat, fat, bones and tendons in lamb legs, forequarters, saddles, and flanks is reported in Tables 11-22. Meat yield for legs was 61-73%, for forequarters 50-68%, for saddles 45-72% and for flanks 34-62%. Average meat yield was highest for class U-2 except for forequarters which had a bit higher yield for class E-3. Conformation classes U and R show clearly how the fat ratio changes according to definitions of fat classes. These effects can be seen more clearly for saddles and flanks than for forequarters and legs. Results for all samples can be seen in Appendices 1 and 2.

Lamb legs

Table 11. Yields for lamb legs per EUROP class. Values are averages for 9 samples per class.

Class	Weight (g)				Ratios (%)			
	Meat	Fat	Bones	Tendons	Meat	Fat	Bones	Tendons
E-3	2259	296	537	227	67,1	8,9	16,0	6,7
U-3+	2128	442	560	205	63,2	13,1	16,6	6,1
U-3	2184	345	526	154	67,1	10,6	16,2	4,8
U-2	1864	208	458	151	68,9	7,7	16,9	5,6
R-3	1708	300	457	175	63,9	11,2	17,1	6,6
R-2	1561	203	443	148	65,8	8,5	18,6	6,2
O-2	1455	158	440	130	66,0	7,2	20,0	5,9

Table 12. Yields (g) for all samples of lamb legs.

	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
Average	2848	1880	279	489	170	2817
SD	494	336	108	63	43	485
Minimum	1931	1279	108	390	104	1918
Maximum	4057	2856	592	678	325	4004
Number	63	63	63	63	63	63

Table 13. Yields (%) for all samples of lamb legs.

	Meat %	Fat %	Bones %	Tendons %	Sum %
Average	66,0	9,6	17,4	6,0	98,9
SD	2,6	2,7	1,7	1,1	0,4
Minimum	60,7	5,1	14,2	3,1	98,2
Maximum	73,2	16,2	21,8	8,0	100,6
Number	63	63	63	63	63

Lamb forequarters

Table 14. Yields for lamb forequarters per EUROP class. Values are averages for 9 samples per class.

Class	Weight (g)				Ratios (%)			
	Meat	Fat	Bones	Tendons	Meat	Fat	Bones	Tendons
E-3	2123	587	672	172	59,5	16,5	18,9	4,8
U-3+	2048	874	699	132	54,0	23,0	18,4	3,5
U-3	2154	612	675	193	58,8	16,7	18,4	5,3
U-2	1694	429	559	176	58,9	14,9	19,4	6,1
R-3	1578	562	564	186	54,1	19,3	19,3	6,4
R-2	1459	391	535	178	56,3	15,1	20,7	6,8
O-2	1339	318	549	155	56,2	13,3	23,0	6,5

Table 15. Yields (g) for all samples of lamb forequarters.

	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
Average	3113	1771	539	608	170	3088
SD	578	354	191	93	34	578
Minimum	2128	1150	230	471	84	2111
Maximum	5039	2769	1140	925	291	5004
Number	63	63	63	63	63	63

Table 16. Yields (%) for all samples of lamb forequarters.

	Meat %	Fat %	Bones %	Tendons %
Average	56,8	17,0	19,7	5,6
SD	3,2	3,8	2,0	1,3
Minimum	49,8	10,4	14,8	2,4
Maximum	68,1	27,2	25,3	7,8
Number	63	63	63	63

Lamb saddles

Table 17. Yields for lamb saddles per EUROP class. Values are averages for 9 samples per class.

Class	Weight (g)				Ratios (%)			
	Meat	Fat	Bones	Tendons	Meat	Fat	Bones	Tendons
E-3	885	299	233	65	58,8	20,0	15,6	4,4
U-3+	833	511	277	47	49,6	30,4	16,3	2,7
U-3	818	333	255	53	55,4	22,5	17,2	3,6
U-2	739	225	218	50	59,1	18,1	17,4	4,0
R-3	674	373	235	51	52,3	29,3	18,1	4,0
R-2	596	231	216	49	53,6	20,9	19,4	4,3
O-2	525	172	217	43	54,7	18,0	22,4	4,4

Table 18. Yields (g) for all samples of lamb saddles.

	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
Average	1329	724	306	236	51	1317
SD	264	145	113	52	12	253
Minimum	768	420	117	136	21	795
Maximum	2009	1184	587	434	79	1979
Number	63	63	63	63	63	63

Table 19. Yields (%) for all samples of lamb saddles.

	Meat %	Fat %	Bones %	Tendons %	Sum %
Average	54,8	22,8	18,0	3,9	99,5
SD	5,4	6,1	3,5	0,8	6,0
Minimum	44,5	13,6	11,9	1,3	97,1
Maximum	71,5	46,0	28,8	5,7	146,0
Number	63	63	63	63	63

Lamb flanks

Table 20. Yields for lamb flanks per EUROP class. Values are averages for 9 samples per class.

Class	Weight (g)				Ratios (%)			
	Meat	Fat	Bones	Tendons	Meat	Fat	Bones	Tendons
E-3	575	247	102	117	54,2	23,8	9,7	11,2
U-3+	536	505	112	103	42,6	39,1	8,8	8,3
U-3	521	263	107	143	50,2	24,6	10,2	13,9
U-2	434	116	85	125	56,6	14,8	11,2	16,2
R-3	431	282	98	117	45,6	30,0	10,5	12,6
R-2	365	156	86	93	51,5	21,6	12,0	13,2
O-2	304	72	86	106	52,9	12,4	15,0	18,4

Table 21. Yields (g) for all samples of lamb flanks.

	Weight	Meat	Fat	Bones	Tendons	Sum
	g	g	g	g	g	g
Average	910	452	234	97	115	898
SD	256	114	154	22	32	254
Minimum	481	225	25	56	46	477
Maximum	1598	778	800	181	203	1586
Number	63	63	63	63	63	63

Table 22. Yields (%) for all samples of lamb flanks.

	Meat	Fat	Bones	Tendons	Sum
	%	%	%	%	%
Average	50,5	23,8	11,0	13,4	98,7
SD	6,0	10,2	2,4	4,3	0,4
Minimum	33,7	4,9	7,0	4,0	97,6
Maximum	61,7	50,1	16,9	23,5	99,5
Number	63	63	63	63	63

Dimensional measurements of cuts

Tables 23 and 24 report sizes (cm) determined for samples of lamb legs and saddles.

Table 23. Dimensional measurements of lamb legs per EUROP class. Each measurement is an average for 9 samples per class.

Class		Length cm	Width cm	Perimeter cm
E-3	Average	45,3	17,4	43,4
	SD	0,8	0,8	1,6
	Minimum	44,5	16,0	41,5
	Maximum	47,0	19,0	46,0
U-3+	Average	46,7	17,3	43,3
	SD	1,9	1,3	2,0
	Minimum	44,0	14,0	41,0
	Maximum	50,0	18,5	47,5
U-3	Average	46,3	16,7	42,9
	SD	2,0	0,9	1,2
	Minimum	43,0	15,0	41,0
	Maximum	50,0	18,0	44,5
U-2	Average	43,6	16,3	40,2
	SD	2,7	0,8	1,3
	Minimum	38,0	15,0	38,0
	Maximum	46,5	18,0	42,5
R-3	Average	45,4	15,9	40,3
	SD	1,6	0,9	1,1
	Minimum	43,0	14,5	38,0
	Maximum	48,0	17,5	42,0
R-2	Average	44,6	15,6	37,8
	SD	1,7	1,0	1,3
	Minimum	42,0	14,0	36,5
	Maximum	47,0	18,0	41,0
O-2	Average	45,1	14,8	35,9
	SD	2,0	0,6	1,0
	Minimum	42,0	14,0	34,0
	Maximum	48,0	16,0	38,0

Table 24. Dimensional measurements of lamb saddles per EUROP class. Each measurement is an average for 9 samples per class.

Classes		Length cm	Width from centre cm
E-3	Average	31,4	12,2
	SD	1,7	0,7
	Minimum	29,0	11,0
	Maximum	34,0	13,5
U3+	Average	33,5	12,2
	SD	1,4	0,7
	Minimum	31,0	11,0
	Maximum	36,0	13,0
U-3	Average	32,6	12,1
	SD	1,5	0,9
	Minimum	30,0	10,5
	Maximum	35,0	13,0
U-2	Average	30,6	12,3
	SD	1,3	0,8
	Minimum	29,0	11,0
	Maximum	33,0	13,5
R-3	Average	32,5	12,4
	SD	1,4	0,5
	Minimum	31,0	11,5
	Maximum	35,0	13,5
R-2	Average	31,6	12,1
	SD	1,1	0,4
	Minimum	29,0	11,5
	Maximum	33,0	13,0
O-2	Average	29,4	12,0
	SD	1,3	0,7
	Minimum	27,5	11,0
	Maximum	31,0	13,0

3.2 Lamb products

The meat industry is developing and therefore data for new lamb meat products were needed. People working in the industry were contacted and they suggested lamb meat products for analysis. Possible export of lamb meat products was considered. The selected products are listed in Table 25. Results from precision deboning of 30 lamb meat products are reported in Tables 26 and 27.

Table 25. Lamb meat products studied in the project.

	Product no in the Icelandic Meat Buyers Guide	Carcass weight ranges		
		light	medium	heavy
		< 14.5 kg	14.5 – 16.8 kg	16.9- 19.0 kg
Saddle				
Loin with fat cap	LM1.1.11		1	1
Tenderloin	LM1.1.17		1	
Loin	LM1.1.6		1	
Rack	LM1.1.4		1	
Frenched rib roast	LM1.1.24		1	
Rack of lamb, 13 ribs	LM1.1.9	1	1	
Leg				
Sirloin	LL1.1.3		1	
Chump and knuckle tip removed, tail off.	LL1.1.13	1	1	
Hind leg with the full chump (ABO[1])	LL1.1.5			1
Shank	LL1.1.2			1
Deboned leg without top side and shank	LL1.1.6		1	1
Top side	LL1.1.7		1	1
Forequarter				
Shoulder	LF1.1.17			1
Prime	LF1.1.15		1	1
Ribeye	LF1.1.16		1	1
Foreshank	LF1.1.3		1	1
Neck	LF1.1.4		1	1
Square-cut shoulder (SQ)[2]	LF1.1.6		1	1
Flank				
Flanks, 13 ribs	LM1.1.22	1	1	
Number of samples		3	16	11

1) A hind leg with the full chump, aitch bone and knuckle tip removed leaving the leg, shank and femur bone remaining.
2) Square-cut shoulders from whole or split forequarter after removal of neck, loin, breast, and shank.

Each lamb meat product was prepared from one of the three carcass weight ranges: light carcasses below 14.5 kg, medium carcasses 14.5 – 16.8 kg, and heavy carcasses 16.9 – 19.0 kg. For each product three samples were prepared from the same carcass weight range, but not necessarily from the same EUROP class (See Tables 26 and 27). Each sample was prepared from one carcass. Information on yield for heavy carcasses is useful since carcass weight will likely continue to increase in the coming years. These results might indicate new opportunities for increasing productivity in the industry.

Wastage found in the precision deboning was generally small (1-2%). However, there are exceptions for the following products where recorded weight was not realistic for calculations of wastage: Top side, deboned leg without top side and shank, shoulder, prime, and humerus (arm bone).

Table 26. Yields (g) for lamb products. Three samples were prepared for each product from the same carcass weight range. Carcass weight ranges are: Light carcasses below 14.5 kg, medium carcasses 14.5-16.8 kg, heavy carcasses above 16.8 kg.

Lamb products	Weight range	Class	Weight g	Meat g	Fat g	Bones g	Tendons g
Products from legs							
Leg &chump, w/o[1] aitch & tail bone	Heavy	E-3	2549	1877	164	289	189
Leg &chump, w/o aitch & tail bone	Heavy	U-3+	2968	2171	286	322	202
Leg &chump, w/o aitch & tail bone	Heavy	U-3	2657	1994	223	258	160
			2725	2014	224	290	184
Leg, deboned, w/o top side and shank	Heavy	E-3	1938	1214	139	449	120
Leg, deboned, w/o top side and shank	Heavy	U-3+	1360	967	120	160	106
Leg, deboned, w/o top side and shank	Heavy	U-3+	1705	1062	269	275	91
			1668	1081	176	295	106
Top side	Heavy	E-3	506	155	23		29
Top side	Heavy	U-3+	644	142	36		28
Top side	Heavy	U-3+	438	143	65		22
			529	147	41		26
Shank, trimmed	Heavy	E-3	398	207	5	118	63
Shank, trimmed	Heavy	U-3+	372	188	13	105	68
Shank, trimmed	Heavy	U-3+	501	255	31	139	75
			424	217	16	121	69
Leg, deboned, w/o top side and shank	Medium	R-3	474	208	17	106	62
Leg, deboned, w/o top side and shank	Medium	R-3	370	176	10	93	61
Leg, deboned, w/o top side and shank	Medium	U-3	410	191	12	104	59
			418	192	13	101	61

1) w/o: without

Lamb products	Weight range	Class	Weight g	Meat g	Fat g	Bones g	Tendons g
Leg, short-cut	Light	R-2	1702	1181	88	285	153
Leg, short-cut	Light	R-2	1549	1085	82	260	111
Leg, short-cut	Light	O-2	1399	946	56	202	119
			1550	1071	75	249	128
Leg, short-cut	Medium	R-3	1983	1352	201	305	108
Leg, short-cut	Medium	R-3	1682	1123	118	253	111
Leg, short-cut	Medium	R-3	1734	1265	94	271	134
			1800	1247	138	276	118
Sirloin	Medium	R-3	689	377	140	125	41
Sirloin	Medium	R-3	780	393	129	206	45
Sirloin	Medium	R-3	867	464	187	167	40
			779	411	152	166	42
Products from forequarters							
Foreshank	Heavy	E-3	308	140	13	103	48
Foreshank	Heavy	U-3+	283	117	22	103	34
Foreshank	Heavy	U-3	274	107	18	98	48
			288	121	18	101	43
Shoulder	Heavy	E-3	1707	1024	180		124
Shoulder	Heavy	E-3	1513	898	260		87
Shoulder	Heavy	E-3	1525	947	123		111
			1582	956	188		107
Ribeye	Heavy	E-3	193	168	11		10
Ribeye	Heavy	E-3	185	149	24		10
Ribeye	Heavy	E-3	180	147	12		14
			186	155	16		11
Ribeye	Medium	R-3	159	135	17		7
Ribeye	Medium	R-3	154	130	10		13
Ribeye	Medium	U-3	117	105	11		4
			143	123	13		8
Prime	Medium	U-2	430	313	53		28
Prime	Medium	U-2	385	249	70		9
Prime	Medium	R-2	396	273	67		10
			404	278	63		16
Prime	Heavy	E-3	408	251	81		50
Prime	Heavy	U-3+	357	176	50		25
Prime	Heavy	U-3+	283	142	49		25
			349	190	60		33

Lamb products	Weight range	Class	Weight g	Meat g	Fat g	Bones g	Tendons g
Shoulder, square cut	Medium	U-2	1832	1074	297	330	116
Shoulder, square cut	Medium	U-2	2547	1600	470	362	97
Shoulder, square cut	Medium	R-2	1683	1006	236	347	86
			2021	1227	334	346	100
Shoulder, square cut	Heavy	E-3	2256	1280	384		141
Shoulder, square cut	Heavy	U-3+	2916	1753	598		132
Shoulder, square cut	Heavy	U-3	2742	1559	423		209
			2638	1531	468		161
Neck	Heavy	E-3	501	251	81	112	50
Neck	Heavy	U-3+	335	176	50	80	25
Neck	Heavy	U-3	318	142	49	99	25
			385	190	60	97	33
Neck	Medium	U-2	265	142	32	72	17
Neck	Medium	U-2	279	145	35	84	13
Neck	Medium	R-2	297	138	35	99	23
			280	142	34	85	18
Humerus, arm bone	Medium	R-3	269	111	20	102	33
Humerus, arm bone	Medium	R-3	121	93	4	84	30
Humerus, arm bone	Medium	U-3	298	119	45	96	34
			229	108	23	94	32
Products from saddles							
Rib roast, frenched	Medium	U-2	719	332	165	174	42
Rib roast, frenched	Medium	U-2	727	368	151	150	44
Rib roast, frenched	Medium	R-2	550	272	96	140	37
			665	324	137	155	41
Rack of lamb, 13 ribs	Medium	U-2	1902	1130	200	419	132
Rack of lamb, 13 ribs	Medium	U-2	2761	1590	301	632	182
Rack of lamb, 13 ribs	Medium	U-2	2223	1376	342	338	130
			2295	1365	281	463	148
Rack of lamb, 13 ribs	Light	R-2	1765	982	295	360	105
Rack of lamb, 13 ribs	Light	R-2	2195	1197	453	397	120
Rack of lamb, 13 ribs	Light	O-2	2076	1187	318	406	141
			2012	1122	355	388	122

Lamb products	Weight range	Class	Weight g	Meat g	Fat g	Bones g	Tendons g
Loin with fat cap	Medium	U-2	572	469	56		42
Loin with fat cap	Medium	U-2	582	459	81		40
Loin with fat cap	Medium	R-2	553	449	61		36
			569	459	66		39
Loin with fat cap	Heavy	E-3	1015	855	113		42
Loin with fat cap	Heavy	E-3	792	623	121		39
Loin with fat cap	Heavy	E-3	876	691	121		54
			894	723	118		45
Tenderloin	Medium	U-2	189	146	29		16
Tenderloin	Medium	U-2	89	79	6		4
Tenderloin	Medium	R-2	113	103	5		3
			130	109	13		8
Rack	Medium	R-3	532	296	105	107	19
Rack	Medium	R-3	531	262	99	145	22
Rack	Medium	R-3	467	223	105	115	20
			510	260	103	122	20
Loin	Medium	U-2	925	569	172	128	47
Loin	Medium	U-2	896	559	170	113	48
Loin	Medium	R-2	724	463	108	101	48
			848	530	150	114	48
Products from flanks							
Flanks, 13 ribs	Light	R-2	1492	737	395	185	150
Flanks, 13 ribs	Light	R-2	1119	537	320	194	59
Flanks, 13 ribs	Light	O-2	1122	584	245	192	88
			1244	619	320	190	99
Flanks, 13 ribs	Medium	U-2	967	490	186	178	106
Flanks, 13 ribs	Medium	U-2	1462	794	290	228	132
Flanks, 13 ribs	Medium	U-2	1385	781	294	199	99
			1271	688	257	202	112

Table 27. Yields (%) for lamb products. Three samples were prepared for each product from the same carcass weight range. Carcass weight ranges are: Light carcasses below 14.5 kg, medium carcasses 14.5-16.8 kg, heavy carcasses above 16.8 kg.

Lamb products	Weight range	Class	Weight %	Meat %	Fat %	Bones %
Products from legs						
Leg &chump, w/o[1] aitch & tail bone	Heavy	E-3	73,6	6,4	11,3	7,4
Leg &chump, w/o aitch & tail bone	Heavy	U-3+	73,1	9,6	10,8	6,8
Leg &chump, w/o aitch & tail bone	Heavy	U-3	75,0	8,4	9,7	6,0
			73,9	8,2	10,6	6,7
Leg, deboned, w/o top side and shank	Heavy	E-3	62,6	7,2	23,2	6,2
Leg, deboned, w/o top side and shank	Heavy	U-3+	71,1	8,8	11,8	7,8
Leg, deboned, w/o top side and shank	Heavy	U-3+	62,3	15,8	16,1	5,3
			65,3	10,6	17,0	6,4
Top side	Heavy	E-3	30,6	4,5	0,0	5,7
Top side	Heavy	U-3+	22,0	5,6	0,0	4,3
Top side	Heavy	U-3+	32,6	14,8	0,0	5,0
			28,4	8,3	0,0	5,0
Shank, trimmed	Heavy	E-3	52,0	1,3	29,6	15,8
Shank, trimmed	Heavy	U-3+	50,5	3,5	28,2	18,3
Shank, trimmed	Heavy	U-3+	50,9	6,2	27,7	15,0
			51,1	3,6	28,5	16,4
Leg, deboned, w/o top side and shank	Medium	R-3	43,9	3,6	22,4	13,1
Leg, deboned, w/o top side and shank	Medium	R-3	47,6	2,7	25,1	16,5
Leg, deboned, w/o top side and shank	Medium	U-3	46,6	2,9	25,4	14,4
			46,0	3,1	24,3	14,7
Leg, short-cut	Light	R-2	69,4	5,2	16,7	9,0
Leg, short-cut	Light	R-2	70,0	5,3	16,8	7,2
Leg, short-cut	Light	O-2	67,6	4,0	14,4	8,5
			69,0	4,8	16,0	8,2

[1)] w/o: without

Lamb products	Weight range	Class	Weight %	Meat %	Fat %	Bones %
Leg, short-cut	Medium	R-3	68,2	10,1	15,4	5,4
Leg, short-cut	Medium	R-3	66,8	7,0	15,0	6,6
Leg, short-cut	Medium	R-3	73,0	5,4	15,6	7,7
			69,3	7,5	15,4	6,6
Sirloin	Medium	R-3	54,7	20,3	18,1	6,0
Sirloin	Medium	R-3	50,4	16,5	26,4	5,8
Sirloin	Medium	R-3	53,5	21,6	19,3	4,6
			52,9	19,5	21,3	5,4
Products from forequarters						
Foreshank	Heavy	E-3	45,5	4,2	33,4	15,6
Foreshank	Heavy	U-3+	41,3	7,8	36,4	12,0
Foreshank	Heavy	U-3	39,1	6,6	35,8	17,5
			41,9	6,2	35,2	15,0
Shoulder	Heavy	E-3	60,0	10,5	0,0	7,3
Shoulder	Heavy	E-3	59,4	17,2	0,0	5,8
Shoulder	Heavy	E-3	62,1	8,1	0,0	7,3
			60,5	11,9	0,0	6,8
Ribeye	Heavy	E-3	87,0	5,7	0,0	5,2
Ribeye	Heavy	E-3	80,5	13,0	0,0	5,4
Ribeye	Heavy	E-3	81,7	6,7	0,0	7,8
			83,1	8,4	0,0	6,1
Ribeye	Medium	R-3	84,9	10,7	0,0	4,4
Ribeye	Medium	R-3	84,4	6,5	0,0	8,4
Ribeye	Medium	U-3	89,7	9,4	0,0	3,4
			86,4	8,9	0,0	5,4
Prime	Medium	U-2	72,8	12,3	0,0	6,5
Prime	Medium	U-2	64,7	18,2	0,0	2,3
Prime	Medium	R-2	68,9	16,9	0,0	2,5
			68,8	15,8	0,0	3,8
Prime	Heavy	E-3	61,5	19,9	0,0	12,3
Prime	Heavy	U-3+	49,3	14,0	0,0	7,0
Prime	Heavy	U-3+	50,2	17,3	0,0	8,8
			53,7	17,1	0,0	9,4

Lamb products	Weight range	Class	Weight %	Meat %	Fat %	Bones %
Shoulder, square cut	Medium	U-2	58,6	16,2	18,0	6,3
Shoulder, square cut	Medium	U-2	62,8	18,5	14,2	3,8
Shoulder, square cut	Medium	R-2	59,8	14,0	20,6	5,1
			60,4	16,2	17,6	5,1
Shoulder, square cut	Heavy	E-3	56,7	17,0	0,0	6,3
Shoulder, square cut	Heavy	U-3+	60,1	20,5	0,0	4,5
Shoulder, square cut	Heavy	U-3	56,9	15,4	0,0	7,6
			57,9	17,7	0,0	6,1
Neck	Heavy	E-3	50,1	16,2	22,4	10,0
Neck	Heavy	U-3+	52,5	14,9	23,9	7,5
Neck	Heavy	U-3	44,7	15,4	31,1	7,9
			49,1	15,5	25,8	8,4
Neck	Medium	U-2	53,6	12,1	27,2	6,4
Neck	Medium	U-2	52,0	12,5	30,1	4,7
Neck	Medium	R-2	46,5	11,8	33,3	7,7
			50,7	12,1	30,2	6,3
Humerus, arm bone	Medium	R-3	41,3	7,4	37,9	12,3
Humerus, arm bone	Medium	R-3	76,9	3,3	69,4	24,8
Humerus, arm bone	Medium	U-3	39,9	15,1	32,2	11,4
			52,7	8,6	46,5	16,2
Products from saddles						
Rib roast, frenched	Medium	U-2	46,2	22,9	24,2	5,8
Rib roast, frenched	Medium	U-2	50,6	20,8	20,6	6,1
Rib roast, frenched	Medium	R-2	49,5	17,5	25,5	6,7
			48,7	20,4	23,4	6,2
Rack of lamb, 13 ribs	Medium	U-2	59,4	10,5	22,0	6,9
Rack of lamb, 13 ribs	Medium	U-2	57,6	10,9	22,9	6,6
Rack of lamb, 13 ribs	Medium	U-2	61,9	15,4	15,2	5,8
			59,6	12,3	20,0	6,5

Lamb products	Weight range	Class	Weight %	Meat %	Fat %	Bones %
Rack of lamb, 13 ribs	Light	R-2	55,6	16,7	20,4	5,9
Rack of lamb, 13 ribs	Light	R-2	54,5	20,6	18,1	5,5
Rack of lamb, 13 ribs	Light	O-2	57,2	15,3	19,6	6,8
			55,8	17,6	19,3	6,1
Loin with fat cap	Medium	U-2	82,0	9,8	0,0	7,3
Loin with fat cap	Medium	U-2	78,9	13,9	0,0	6,9
Loin with fat cap	Medium	R-2	81,2	11,0	0,0	6,5
			80,7	11,6	0,0	6,9
Loin with fat cap	Heavy	E-3	84,2	11,1	0,0	4,1
Loin with fat cap	Heavy	E-3	78,7	15,3	0,0	4,9
Loin with fat cap	Heavy	E-3	78,9	13,8	0,0	6,2
			80,6	13,4	0,0	5,1
Tenderloin	Medium	U-2	77,2	15,3	0,0	8,5
Tenderloin	Medium	U-2	88,8	6,7	0,0	4,5
Tenderloin	Medium	R-2	91,2	4,4	0,0	2,7
			85,7	8,8	0,0	5,2
Rack	Medium	R-3	55,6	19,7	20,1	3,6
Rack	Medium	R-3	49,3	18,6	27,3	4,1
Rack	Medium	R-3	47,8	22,5	24,6	4,3
			50,9	20,3	24,0	4,0
Loin	Medium	U-2	61,5	18,6	13,8	5,1
Loin	Medium	U-2	62,4	19,0	12,6	5,4
Loin	Medium	R-2	64,0	14,9	14,0	6,6
			62,6	17,5	13,5	5,7
Products from flanks						
Flanks, 13 ribs	Light	R-2	49,4	26,5	12,4	10,1
Flanks, 13 ribs	Light	R-2	48,0	28,6	17,3	5,3
Flanks, 13 ribs	Light	O-2	52,0	21,8	17,1	7,8
			49,8	25,6	15,6	7,7
Flanks, 13 ribs	Medium	U-2	50,7	19,2	18,4	11,0
Flanks, 13 ribs	Medium	U-2	54,3	19,8	15,6	9,0
Flanks, 13 ribs	Medium	U-2	56,4	21,2	14,4	7,1
			53,8	20,1	16,1	9,0

Table 28. Dimensional measurements for lamb products. Values are averages for three samples.

Lamb products	Carcass weight range	Length cm	Width cm	Perimeter cm
Products from legs				
Leg and chump, without aitch and tail bone	Heavy	39	17	43
Leg, deboned, without top side and shank	Heavy	19		31
Leg, deboned, without top side and shank	Medium	44		40
Leg, short cut	Light	32	50	36
Leg, short cut	Medium	28	16	39
Sirloin	Medium	11	17	38
Products from forequarters				
Foreshank	Heavy	17		22
Shoulder	Heavy	35		16
Ribeye	Heavy	13		18
Ribeye	Medium	13	12	12
Prime	Medium	13		19
Prime	Heavy	13		21
Shoulder, square cut	Medium	21	17	
Shoulder, square cut	Heavy	19	21	
Neck	Heavy	14		21
Neck	Medium	12		21
Humerus, arm bone	Medium	17		18
Products from saddles				
Rib roast, frenched	Medium	15	14	
Rack, 13 ribs	Medium	50	13	
Rack, 13 ribs	Light	51	13	
Loin with fat cap	Medium	30	7	
Loin with fat cap	Heavy	35	12	
Tenderloin	Medium	19		7
Rack	Medium	17	12	
Loin	Medium	19	13	
Products from saddles				
Flanks, 13 ribs	Light	49	19	
Flanks, 13 ribs	Medium	51	18	

4 Results – Chemical composition

4.1 Lamb cuts

Proximates

The proximates are protein, fat, water, and ash. Carbohydrates and dietary fibre are also classified as proximates but do practically not exist in untreated meat. Tables 29-32 report results for lamb leg, saddle, forequarter, and flanks. Calculated sum of proximates should be close to 100 when results are reported for 100 g sample. Some variation for the sum is common and an acceptable result is 100 ± 3 g/100g. The calculated sums for data in Tables 29-32 are close to 100. This indicates good analytical procedures, and carbohydrates and dietary fibre are not present or in trace amounts.

Generally, there are considerable differences between lamb meat classes for protein, fat, and water. In all cases, fat determined by chemical analysis, was related to the definitions of fat thickness for the fat classes 2, 3, and 3+. The ratio of fat analysed by the chemical method is a bit higher than the fat tissue determined by precision deboning. The explanation is that the chemical method includes fat within the muscle tissue.

Comparison to the lamb meat surveys 1992-94 (Ólafur Reykdal and Guðjón Þorkelsson 1994) and 2003-2004 (Ásbjörn Jónsson and Óli Þór Hilmarsson 2007) is not simple since samples for chemical analysis were not defined exactly alike.

Table 29. Proximate values and energy per 100g fresh lamb leg. Lamb leg for each class is a composite sample made from 9 carcasses.

Cut	Class	Energy		Protein	Fat	Ash	Water	Sum
		kJ	kcal	g	g	g	g	g
Leg	E-3	701	168	20,8	9,4	1,00	68,7	99,9
Leg	U-3+	868	208	19,7	14,4	1,10	65,6	100,8
Leg	U-3	785	188	20,7	11,7	1,10	67,7	101,2
Leg	U-2	674	161	20,7	8,7	1,10	70,0	100,5
Leg	R-3	818	196	19,8	13,0	1,00	66,5	100,3
Leg	R-2	684	164	20,2	9,2	1,00	69,4	99,8
Leg	O-2	635	152	20,4	7,8	1,10	71,1	100,4
Mean		738	177	20,3	10,6	1,06	68,4	100,4
SD		80	19	0,4	2,3	0,05	1,8	0,45
Min		635	152	19,7	7,8	1,00	65,6	99,8
Max		868	208	20,8	14,4	1,10	71,1	101,2

Table 30. Proximate values and energy per 100g fresh lamb forequarter. Lamb forequarter for each class is a composite sample made from 9 carcasses.

Cut	Class	Energy		Protein	Fat	Ash	Water	Sum
		kJ	kcal	g	g	g	g	g
Forequarter	E-3	1013	244	18,0	19,1	0,97	62,7	100,8
Forequarter	U-3+	1282	310	16,2	27,2	0,82	56,5	100,7
Forequarter	U-3	1030	248	17,7	19,7	0,88	61,7	100,0
Forequarter	U-2	946	228	18,4	17,1	0,91	64,3	100,7
Forequarter	R-3	1176	284	16,5	24,2	0,84	58,3	99,8
Forequarter	R-2	993	239	17,7	18,7	0,90	60,8	98,1
Forequarter	O-2	947	228	17,6	17,5	1,00	64,3	100,4
Mean		1055	254	17,4	20,5	0,90	61,2	100,1
SD		117	29	0,7	3,5	0,06	2,7	0,88
Min		946	228	16,2	17,1	0,82	56,5	98,1
Max		1282	310	18,4	27,2	1,00	64,3	100,8

Table 31. Proximate values and energy per 100g fresh lamb saddle. Lamb saddle for each class is a composite sample made from 9 carcasses.

Cut	Class	Energy		Protein	Fat	Ash	Water	Sum
		kJ	kcal	g	g	g	g	g
Saddle	E-3	1115	269	19,0	21,4	1,00	58,7	100,1
Saddle	U-3+	1484	359	15,7	32,9	0,70	50,1	99,4
Saddle	U-3	1196	288	18,1	24,0	0,90	57,7	100,7
Saddle	U-2	974	234	19,4	17,4	1,00	61,2	99,0
Saddle	R-3	1416	342	17,1	30,4	0,90	52,7	101,1
Saddle	R-2	1139	275	18,0	22,5	0,90	58,5	99,9
Saddle	O-2	1012	244	19,7	18,3	0,90	62,2	101,1
Mean		1191	287	18,1	23,8	0,90	57,3	100,2
SD		179	44	1,3	5,4	0,09	4,1	0,8
Min		974	234	15,7	17,4	0,70	50,1	99,0
Max		1484	359	19,7	32,9	1,00	62,2	101,1

Table 32. Proximate values and energy per 100g fresh lamb flank. Lamb flank for each class is a composite sample made from 9 carcasses.

Cut	Class	Energy		Protein	Fat	Ash	Water	Sum
		kJ	kcal	g	g	g	g	g
Flank	E-3	1209	292	17,9	24,5	0,84	57,5	100,7
Flank	U-3+	1662	402	14,0	38,5	0,68	45,2	98,3
Flank	U-3	1268	306	17,2	26,4	0,80	55,9	100,2
Flank	U-2	991	239	18,8	18,1	0,86	62,2	100,0
Flank	R-3	1534	371	14,9	34,6	0,76	50,2	100,4
Flank	R-2	1194	288	17,2	24,4	0,84	57,3	99,6
Flank	O-2	949	228	19,0	16,9	0,95	64,2	101,1
Mean		1258	304	17,0	26,2	0,82	56,1	100,1
SD		243	59	1,8	7,4	0,08	6,1	0,8
Min		949	228	14,0	16,9	0,68	45,2	98,3
Max		1662	402	19,0	38,5	0,95	64,2	101,1

Fatty acids

Data for fatty acid groups (%) in lamb cuts are shown in Table 33. Fatty acid proportions are not useful for labelling of foods, therefore the amounts (g) of fatty acids have been calculated and reported in Table 34. Results for individual fatty acids (% and g) are reported in Appendix 4. EUROP classes U-3, R-3 and R-2 were selected for fatty acid analysis. These classes represented 68% of the lamb meat production in 2021.

The proportions of fatty acids are similar for all lamb cuts. The amounts of fatty acids are variable, depending on the fat content as can be seen in Table 34. The results are useful for labelling of lamb meat, see explanations in Appendix 5.

Results for fatty acids in Icelandic lamb meat are available from the period 1993-2002 (Ylva Bergqvist 1995; Guðjón Þorkelsson et al. 2000; Ólafur Reykdal 2002). The data from 2002 represent only three samples and other data include mostly analysis of muscles. The fatty acid data in this report is important for food labelling and dissemination.

Table 33. Fatty acids (%) in lamb meat cuts. Results are fatty acid methyl esters. Samples are composite samples, each made from 9 samples.

Cut	Class	Saturated fa. %	Monouns. fa. %	Polyuns. fa. %	Polyuns. n6 %	Polyuns. n3 %	Polyuns. other %	Unknown fa. %	Sum %
Leg	U-3	47,1	42,1	6,3	2,0	3,8	0,6	4,4	100,0
Leg	R-3	46,2	45,6	5,8	1,8	3,5	0,5	2,4	100,0
Leg	R-2	44,8	42,7	7,8	2,7	4,5	0,6	4,7	100,0
Average		46,0	43,5	6,6	2,2	3,9	0,6	3,8	100,0
Forequarter	U-3	46,5	44,7	5,3	1,7	3,1	0,5	3,4	100,0
Forequarter	R-3	45,4	45,8	4,9	1,5	2,8	0,6	3,9	100,0
Forequarter	R-2	46,7	42,7	6,5	2,2	3,7	0,6	4,2	100,0
Average		46,2	44,4	5,6	1,8	3,2	0,5	3,8	100,0
Saddle	U-3	48,7	42,5	4,5	1,5	2,5	0,6	4,3	100,0
Saddle	R-3	47,9	43,8	3,9	1,3	2,1	0,6	4,4	100,0
Saddle	R-2	48,5	41,2	6,0	2,0	3,5	0,5	4,4	100,0
Average		48,3	42,5	4,8	1,6	2,7	0,5	4,4	100,0
Flank	U-3	48,5	42,8	4,2	1,4	2,3	0,6	4,5	100,0
Flank	R-3	49,1	43,1	3,8	1,2	2,1	0,5	4,0	100,0
Flank	R-2	49,4	41,1	5,1	1,8	2,7	0,5	4,4	100,0
Average		49,0	42,3	4,4	1,5	2,4	0,6	4,3	100,0
All samples Average		47,4	43,2	5,4	1,8	3,0	0,5	4,1	100,0

Table 34. Fatty acids and fat (g) per 100 g fresh lamb meat cuts.[1)] Results are fatty acid methyl esters. Samples are composite samples, each made from 9 samples.

Cut	Class	Fat	Saturated fa.	Monouns. fa.	Polyuns. fa.	Polyuns. n6	Polyuns. n3	Polyuns. other	Unknown fa.	Sum
		g	g	g	g	g	g	g	g	g
Leg	U-3	11,7	5,25	4,70	0,70	0,22	0,42	0,06	0,49	11,1
Leg	R-3	13,0	5,72	5,65	0,72	0,23	0,43	0,06	0,30	12,4
Leg	R-2	9,2	3,93	3,75	0,68	0,24	0,39	0,05	0,41	8,8
Average		11,3	4,97	4,70	0,70	0,23	0,41	0,06	0,40	10,8
Forequarter	U-3	19,7	8,73	8,39	1,00	0,32	0,59	0,09	0,64	18,8
Forequarter	R-3	24,2	10,5	10,6	1,12	0,34	0,65	0,13	0,90	23,1
Forequarter	R-2	18,7	8,32	7,61	1,15	0,39	0,66	0,10	0,75	17,8
Average		20,9	9,18	8,85	1,09	0,35	0,63	0,11	0,76	19,9
Saddle	U-3	24,0	11,13	9,72	1,03	0,33	0,57	0,13	0,98	22,9
Saddle	R-3	30,4	13,88	12,69	1,14	0,36	0,61	0,17	1,27	29,0
Saddle	R-2	22,5	10,39	8,82	1,30	0,44	0,76	0,10	0,94	21,5
Average		25,6	11,80	10,41	1,16	0,38	0,64	0,13	1,07	24,4
Flank	U-3	26,4	12,19	10,77	1,07	0,34	0,57	0,16	1,13	25,2
Flank	R-3	34,6	16,19	14,20	1,27	0,41	0,69	0,17	1,32	33,0
Flank	R-2	24,4	11,49	9,55	1,17	0,42	0,64	0,12	1,02	23,2
Average		28,5	13,29	11,51	1,17	0,39	0,63	0,15	1,16	27,1
All samples Average		21,6	9,81	8,87	1,03	0,34	0,58	0,11	0,85	20,6

[1)] Fatty acid conversion factor used all samples is 0.953.

Vitamins

Vitamin B_1, vitamin B_{12}, and folate were analysed in 6 samples. The results (Table 35) are different from the values reported in the national food composition database ISGEM. Therefore, new vitamin data was very much needed.

If the amount of a vitamin in 100g of a meat product is equal to or is above 15% of the nutrient reference value (NRV), the vitamin can be labelled as a part of the nutrition declaration.[15] It is of particular interest that the amount of vitamin B_{12} is about 60% of the NRV. Therefore, lamb meat is a good source of vitamin B_{12}, and this is important since most vegan foods do not contain this vitamin. Vitamin B_1 in the meat samples was below the NRV. Folate in two meat samples was below the quantification limit, likely due to degradation under poor storage conditions. Folate in the other samples were above 15% of the NRV.

Table 35. Vitamin values in 100g fresh lamb legs and lamb forequarters. Data are based on analysis of one composite sample made from 9 samples.

Meat cut	Class	Vitamin B_1 mg	Vitamin B_{12} µg	Folate µg
Leg	U-3	0,065	1,30	< 5 [1)]
Leg	R-3	0,083	1,61	37,5
Leg	R-2	0,090	1,60	< 5 [1)]
Average		0,079	1,50	
Forequarter	U-3	0,058	1,64	38,0
Forequarter	R-3	0,063	1,45	42,8
Forequarter	R-2	0,074	1,87	35,0
Average		0,065	1,65	38,6

[1)] < 5: Below limit of quantification (LOQ).

[15] Regulation EU No 1169/2011

Inorganic compounds

Inorganic compounds include minerals (Table 36), trace elements (Table 37) and the contaminants mercury, cadmium, lead, and arsenic (heavy metals, Table 38). Potassium and zinc are above 15% of the nutrient reference value (NRV), indicating the possibility of including these components in nutrient declarations of lamb meat.

The heavy metals mercury, cadmium, lead, and arsenic levels were below the quantification limits (Table 38) in the lamb meat samples. These results represent considerably lower concentrations than reported earlier (Ólafur Reykdal et al. 2000, Ólafur Reykdal et al. 2011). New analytical procedures have made more accurate results possible.

Table 36. Minerals in 100g fresh lamb meat. Data are based on analysis of one composite sample made from 9 samples.

Meat cut	Class	Sodium mg	Potassium mg	Phosphorus mg	Calcium mg	Magnesium mg
Leg	U-3	48	384	192	5,0	30
Leg	R-3	50	379	189	5,0	31
Leg	R-2	53	393	194	5,0	31
Average		50	385	192	5,0	31
Forequarter	U-3	56	348	164	7,0	18
Forequarter	R-3	58	320	154	7,0	18
Forequarter	R-2	62	333	158	9,0	18
Average		59	334	159	7,7	18
Saddle	U-3	51	337	165	9,0	19
Saddle	R-3	47	299	148	9,0	17
Saddle	R-2	52	324	159	9,0	18
Average		50	320	157	9,0	18
Flank	U-3	62	303	141	8,0	16
Flank	R-3	59	275	131	8,0	15
Flank	R-2	68	316	148	8,0	17
Average		63	298	140	8,0	16
All samples Average		56	334	162	7,4	21

Table 37. Trace elements in 100g fresh lamb meat. Data are based on analysis of one composite sample made from 9 samples.

Meat cut	Class	Iron mg	Copper mg	Zinc mg	Selenium µg	Nickel µg
Leg	U-3	1,59	0,103	2,84	7,0	9,0
Leg	R-3	1,56	0,107	2,77	8,0	4,0
Leg	R-2	1,47	0,103	2,60	< 6,2 [1)]	4,0
Average		1,54	0,104	2,74		5,7
Forequarter	U-3	1,39	0,073	3,55	< 8,0	4,0
Forequarter	R-3	1,44	0,083	3,45	8,0	3,0
Forequarter	R-2	2,08	0,142	3,84	9,0	10,0
Average		1,64	0,099	3,61		5,7
Saddle	U-3	1,32	0,084	2,09	< 9,0	4,0
Saddle	R-3	2,09	0,081	1,96	< 9,0	3,0
Saddle	R-2	1,36	0,083	2,07	< 9,0	3,0
Average		1,59	0,083	2,04		3,3
Flank	U-3	1,27	0,060	3,15	< 9,0	5,0
Flank	R-3	1,11	0,064	3,06	< 9,0	2,0
Flank	R-2	1,40	0,062	3,10	< 9,0	3,0
Average		1,26	0,062	3,10		3,3
All samples Average		1,51	0,087	2,87		4,5

[1)] Below the limit of quantification.

Table 38. Heavy metals in 100g fresh lamb meat. Data are based on analysis of one composite sample made from 9 samples.

Meat cut	Class	Mercury µg	Cadmium µg	Lead µg	Arsenic µg
Leg	U-3	< 0,4 [1)]	< 0,2	< 0,4	< 1
Leg	R-3	< 0,4	< 0,2	< 0,4	< 1
Leg	R-2	< 0,4	< 0,2	< 0,4	< 1
Forequarter	U-3	< 0,4	< 0,2	< 0,4	< 1
Forequarter	R-3	< 0,4	< 0,2	< 0,4	< 1
Forequarter	R-2	< 0,4	< 0,2	< 0,4	< 1
Saddle	U-3	< 0,4	< 0,2	< 0,4	< 1
Saddle	R-3	< 0,4	< 0,2	< 0,4	< 1
Saddle	R-2	< 0,4	< 0,2	< 0,4	< 1
Flank	U-3	< 0,4	< 0,2	< 0,4	< 1
Flank	R-3	< 0,4	< 0,2	< 0,4	< 1
Flank	R-2	< 0,4	< 0,2	< 0,4	< 1

[1)] Below the limit of quantification.

4.2 Lamb products

Nutrient values of lamb meat products are shown in Table 39. Only proximates were analysed. Results for fatty acids, vitamins and inorganic compounds reported in Chapter 4.1 can be used for meat products of similar fat and water content. See guidance in Appendix 5. The lamb meat products are diverse and offer opportunities for product development in the meat industry.

Table 39. Proximate values and energy per 100g fresh lamb meat products. Each product is a composite sample made from 3 samples. Each product was made from one of the three carcass weight ranges: Light weight below 14,5 kg, medium weight 14,5-16,8 kg and heavy weight above 16,8 kg.

Product	Weight range	Energy kJ	Energy kcal	Protein g	Fat g	Ash g	Water g	Sum g
Products made from legs								
Top side	Medium	575	137	21,4	5,7	1,10	72,1	100,3
Top side	Heavy	479	113	23,0	2,4	1,17	73,9	100,5
Leg, whole	Heavy	696	167	20,5	9,4	1,10	69,4	100,4
Leg, short cut	Light	636	152	20,9	7,6	1,13	70,9	100,5
Leg, short cut	Medium	684	164	20,2	9,2	1,10	69,4	99,9
Leg, deboned	Medium	743	178	20,0	10,9	1,00	68,7	100,6
Leg, deboned	Heavy	790	190	19,4	12,5	1,00	66,5	99,3
Sirloin	Medium	1052	254	17,7	20,3	1,00	61,4	100,4
Shank	Heavy	537	128	21,6	4,6	1,06	73,1	100,4
Shank	Medium	547	130	21,7	4,8	1,10	72,1	99,7
Products made from forequarters								
Foreshank	Heavy	682	163	20,5	9,0	1,00	69,8	100,3
Shoulder	Heavy	801	192	19,5	12,7	1,00	66,9	100,1
Ribeye	Medium	669	160	20,2	8,8	1,00	70,4	100,4
Ribeye	Heavy	857	206	20,4	13,8	0,90	65,3	100,4
Prime	Medium	852	205	18,8	14,4	0,90	66,6	100,7
Prime	Heavy	897	216	18,8	15,6	0,90	66,1	101,4
Shoulder, square cut	Medium	961	231	18,2	17,6	1,00	63,2	100,0
Shoulder, square cut	Heavy	1076	259	17,6	21,0	0,89	61,5	100,9
Neck	Medium	787	189	20,2	12,0	1,00	67,1	100,3
Neck	Heavy	880	212	18,9	15,1	1,00	64,9	99,9
Humerus, arm bone	Medium	769	184	20,0	11,6	1,00	68,1	100,7

Table 39 cont. Proximate values and energy per 100g fresh lamb meat products. Each product is a composite sample made from 3 samples. Each product was made from one of the three carcass weight ranges: Light weight below 14,5 kg, medium weight 14,5-16,8 kg and heavy weight above 16,8 kg.

Product	Weight range	Energy kJ	Protein kcal	Fat g	Ash g	Water g	Sum g	Product g
Products made from racks								
Rib roast, frenched	Medium	1202	290	17,8	24,3	0,90	59,2	102,2
Rack, 13 ribs	Medium	847	203	20,2	13,6	1,00	65,1	99,9
Loin, 13 ribs	Light	979	236	18,6	17,9	1,00	62,0	99,5
Loin with fat cap	Medium	664	159	21,2	8,2	1,10	69,7	100,2
Loin with fat cap	Heavy	851	204	20,9	13,4	1,00	65,4	100,7
Tenderloin	Medium	710	170	20,2	9,9	1,00	68,4	99,5
Rack	Medium	1114	269	18,1	21,8	0,90	59,1	99,9
Loin	Medium	984	237	18,7	18,0	0,90	62,8	100,4
Products made from flanks								
Flanks	Light	1324	320	18,4	27,3	0,83	55,4	101,9
Flanks, 13 ribs	Medium	1057	255	18,2	20,2	0,90	58,7	98,0

4.3 Lamb organ foods and side-products

Samples of organ foods and side-products were prepared as composite samples, each composite sample made from 12-24 primary samples, each of them made from one lamb carcass. The number of samples is reported in Table 3. Results for proximates are reported in Table 40. The relatively high levels of protein are noteworthy. It should be noted that the nitrogen-to-protein conversion factor of 6.25 was used in all cases for calculation of protein. This factor might overestimate protein in some cases. Carbohydrates are calculated as a difference (carbohydrates = 100 – protein – fat – ash - water) and might include other compounds than protein, fat, ash, and water, if present.

Data for sodium, iron, and selenium are shown in Table 41. Values for sodium can be used to calculate salt, see Appendix 5. The products are rich in iron and selenium, which are valuable nutrients. All the samples have significant amount[16] of iron per 100g except for the gullet and testicles samples. All the samples contain significant amount of selenium per 100g. When vitamins and minerals are equal to or above the defined significant level, it is allowed to add those elements to the nutrition declaration.

Results for heavy metals are reported in Table 42. Cadmium was found in livers and kidneys, but this element was below the quantification limit in other organs. Mercury, lead, and arsenic were below the quantification limit in the organs, except kidneys which contained mercury close to the quantification level.

Regulation EC No 1881/2006 sets maximum levels for contaminants in foodstuffs.[17] The maximum level for cadmium in meat is 0,050 mg/kg (5,0 µg/100g), for liver 0,50 mg/kg (50 µg/100g), and for kidneys 1,0 mg/kg (100 µg/100g). The maximum level for lead in meat is 0,10 mg/kg (10 µg/100g) and for organs 0,50 mg/kg (50 µg/100g). Maximum levels for mercury and arsenic have not been set. The levels of cadmium and lead in Icelandic lamb organ foods and side-products are much lower than the allowed maximum levels (Table 42).

Proximates and heavy metals were analysed in lamb organ foods and side-products 2009 (Guðjón Þorkelsson et al. 2011). Concentrations of proximates were similar to the results reported in the present project, except for lamb tripes, the explanation is expected to be different cleaning of the tripes. It is noteworthy that carbohydrate levels differ, indicating more glycogen in the livers in the

[16] See Appendix XIII in regulation EU No 1169/2011 on provision of food information to consumers, and the Icelandic version No 1294/2014.
[17] Regulation EC No 1881/2006. Regulation - 1881/2006 - EN - EUR-Lex (europa.eu)

present study compared to 2009. The levels of selenium and sodium were lower in the present study compared to the 2009 study. Mercury was detected in livers and kidneys in the 2009 study but not in other organs.

A study of inorganic elements in Icelandic lamb livers and kidneys was carried out 1991-92 (Ólafur Reykdal and Arngrímur Thorlacíus 2001). The concentrations of mercury were very low and comparable to the limit of quantification reported in Table 42. Concentrations of cadmium were similar to those reported in Table 42, and concentrations of iron were higher than reported for the present study. Inorganic elements in Icelandic foods were studied 1996 (Ólafur Reykdal et al. 2000). In this study, mercury concentration in kidneys was higher than in the present study.

Table 40. Proximates and calculated energy per 100g fresh weight lamb food organs and side-products. Carbohydrate is calculated as difference.

Sample	Energy		Protein	Fat	Carbohydrate	Ash	Water	Sum
	kJ	kcal	g	g	g	g	g	g
Liver	594	141	21,9	4,7	2,8	1,5	69,1	100,0
Kidney	373	89	15,1	2,6	1,2	1,3	79,8	100,0
Heart	609	146	16,4	8,7	0,5	0,9	73,5	100,0
Lung	358	85	17,0	1,6	0,6	1,3	79,5	100,0
Testicles	241	57	10,3	1,4	0,8	1,0	86,5	100,0
Blood	332	78	19,3	0,1	0,0	0,7	80,3	100,4
Tripe	538	129	13,0	8,3	0,6	0,8	77,3	100,0
Gullet	583	140	15,8	7,9	1,3	0,9	74,1	100,0
Sweetbread	431	102	18,2	2,5	1,7	1,7	75,9	100,0
Spleen	447	106	18,1	3,3	1,0	1,4	76,2	100,0

Table 41. Sodium, iron, and selenium per 100g fresh weight lamb organ foods and side-products.

Sample	Sodium	Iron	Selenium
	mg	mg	µg
Liver	52	9,97	26
Kidney	158	3,16	88
Heart	73	3,86	15
Lung	141	8,78	18
Testicles	92	0,76	35
Blood	160	46,1	24
Tripe	66	11,1	11
Gullet	115	1,41	8

Table 42. Heavy metals per 100g fresh weight lamb organ foods and side-products.

Sample	Mercury µg	Cadmium µg	Lead µg	Arsenic, total µg
Liver	< 1[1)]	3,9	< 1	< 1
Kidney	1	5,2	< 1	< 1
Heart	< 1	< 0,15	< 1	< 1
Lung	< 1	< 0,15	< 1	< 1
Testicles	< 1	< 0,15	< 1	< 1
Blood	< 3	< 0,5	< 3	< 3
Tripe	< 1	< 0,15	< 1	< 1
Gullet	< 1	< 0,15	< 1	< 1

[1)] < Below the quantification limit.

5 Conclusions and credits

The project results can be used by numerous parties: Abattoirs, meat processing plants, entrepreneurs, sales companies overseas, retail dealers, specialty shops, farmers slaughtering and processing at farm, small processing companies, restaurants, and canteens. The data will also be useful for teaching programmes in agriculture and meat industry. The results will benefit planning, and cost- and profit calculations for product prices. Results from chemical analysis will be used to improve nutrient declarations and provision of nutrient information to consumers.

Many companies can use the data to optimise current businesses and operation processes and find new opportunities for marketing new lamb products and utilise side-products to increase value. Small companies utilising lamb side-products, need reliable data for the chemical composition and wholesomeness of their raw material.

Consumers nowadays request reliable information on consumables, such as lamb meat. Information on nutrient content can increase the value of lamb meat and these data are very much needed for dissemination of opportunities in the lamb meat sector.

Reasoning for increasing the value of lamb meat and side-products need reliable data. Meat, fat, and bone ratios of lamb meat, together with chemical composition of the meat, are key issues for the work ahead.

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Appendix 1 – Precision deboning of lamb cuts – Weights (grams)

Meat, fat, bones, and tendons in lamb legs (weight, gram).

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
E-3	1	4057	2856	209	614	325	4004
E-3	2	3180	2077	290	586	198	3151
E-3	3	3686	2450	331	581	264	3626
E-3	4	3026	2075	232	477	205	2989
E-3	5	3126	2170	271	462	183	3086
E-3	6	3130	2071	248	552	208	3079
E-3	7	3327	2196	408	473	196	3273
E-3	8	3148	2054	356	495	216	3121
E-3	9	3574	2378	316	594	246	3534
Average		3362	2259	296	537	227	3318
SD		322	250	60	57	42	316
Minimum		3026	2054	209	462	183	2989
Maximum		4057	2856	408	614	325	4004

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-3+	1	3406	2182	442	544	205	3373
U-3+	2	2971	1915	350	489	180	2934
U-3+	3	3136	2010	410	516	183	3119
U-3+	4	4050	2463	592	675	256	3986
U-3+	5	3159	1919	451	576	180	3126
U-3+	6	3723	2514	307	678	192	3691
U-3+	7	3423	2109	553	501	226	3389
U-3+	8	3490	2136	558	568	201	3463
U-3+	9	2965	1904	312	497	218	2931
Average		3369	2128	442	560	205	3335
SD		338	215	102	68	24	331
Minimum		2965	1904	307	489	180	2931
Maximum		4050	2514	592	678	256	3986

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-3	1	3035	2036	310	517	138	3001
U-3	2	3048	1992	277	543	193	3005
U-3	3	3205	2135	312	526	201	3174
U-3	4	3460	2312	424	528	139	3403
U-3	5	3338	2337	365	509	104	3315
U-3	6	3509	2448	317	576	126	3467
U-3	7	3257	2213	354	526	107	3200
U-3	8	3385	2240	424	492	176	3332
U-3	9	3014	1940	321	516	200	2977
Average		3250	2184	345	526	154	3208
SD		177	161	49	22	37	173
Minimum		3014	1940	277	492	104	2977
Maximum		3509	2448	424	576	201	3467

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-2	1	2958	2103	152	516	168	2939
U-2	2	2780	1879	253	452	163	2747
U-2	3	2559	1686	196	495	161	2538
U-2	4	2536	1821	134	429	137	2521
U-2	5	2869	1958	231	488	163	2840
U-2	6	2681	1837	187	461	162	2647
U-2	7	2760	2019	144	433	149	2745
U-2	8	2581	1698	291	443	118	2550
U-2	9	2614	1772	285	403	134	2594
Average		2704	1864	208	458	151	2680
SD		139	134	56	34	16	138
Minimum		2536	1686	134	403	118	2521
Maximum		2958	2103	291	516	168	2939

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
R-3	1	2516	1648	200	445	192	2485
R-3	2	2737	1693	367	473	170	2703
R-3	3	2677	1656	299	496	204	2655
R-3	4	2718	1791	265	454	177	2687
R-3	5	2714	1746	322	476	138	2682
R-3	6	2732	1800	330	453	118	2701
R-3	7	2406	1502	260	428	192	2382
R-3	8	2748	1715	387	423	183	2708
R-3	9	2790	1821	271	469	200	2761
Average		2671	1708	300	457	175	2640
SD		119	93	55	22	27	116
Minimum		2406	1502	200	423	118	2382
Maximum		2790	1821	387	496	204	2761

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
R-2	1	2251	1460	188	424	161	2233
R-2	2	2499	1587	262	494	130	2473
R-2	3	2260	1562	154	426	131	2273
R-2	4	2366	1562	137	451	180	2330
R-2	5	2441	1579	201	468	161	2409
R-2	6	2218	1458	227	390	127	2202
R-2	7	2670	1714	224	515	191	2644
R-2	8	2352	1535	240	420	138	2333
R-2	9	2325	1591	196	400	116	2303
Average		2376	1561	203	443	148	2356
SD		135	72	38	40	24	129
Minimum		2218	1458	137	390	116	2202
Maximum		2670	1714	262	515	191	2644

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
O-2	1	2161	1389	134	471	147	2141
O-2	2	1931	1279	108	396	135	1918
O-2	3	2462	1597	178	490	163	2428
O-2	4	2171	1437	155	419	134	2145
O-2	5	2310	1596	164	422	104	2286
O-2	6	2353	1619	128	475	116	2338
O-2	7	2085	1363	145	413	145	2066
O-2	8	2137	1368	225	415	116	2124
O-2	9	2216	1449	181	456	112	2198
Average		2203	1455	158	440	130	2183
SD		148	115	33	32	18	144
Minimum		1931	1279	108	396	104	1918
Maximum		2462	1619	225	490	163	2428

Meat, fat, bones, and tendons in lamb forequarters (weight, gram).

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
E-3	1	4062	2553	513	761	213	4040
E-3	2	3386	2305	462	672	195	3634
E-3	3	4063	2421	692	738	184	4035
E-3	4	3492	2086	537	652	191	3466
E-3	5	3341	1955	525	660	171	3311
E-3	6	3452	1960	596	704	191	3451
E-3	7	3562	1994	713	648	168	3523
E-3	8	3343	1974	623	598	125	3320
E-3	9	3368	1856	623	617	112	3208
Average		3563	2123	587	672	172	3554
SD		276	229	80	50	31	284
Minimum		3341	1856	462	598	112	3208
Maximum		4063	2553	713	761	213	4040

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-3+	1	3781	2084	884	665	107	3740
U-3+	2	3380	1805	733	630	125	3293
U-3+	3	3485	1918	746	653	137	3454
U-3+	4	5039	2769	1140	925	170	5004
U-3+	5	3935	2055	967	742	131	3895
U-3+	6	3687	2107	646	784	127	3664
U-3+	7	3674	1938	998	543	148	3627
U-3+	8	3618	1802	962	675	157	3596
U-3+	9	3539	1958	791	670	84	3503
Average		3793	2048	874	699	132	3753
SD		467	275	148	102	24	471
Minimum		3380	1802	646	543	84	3293
Maximum		5039	2769	1140	925	170	5004

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-3	1	3415	1970	557	631	231	3389
U-3	2	3248	1904	514	640	167	3225
U-3	3	3620	2210	629	616	146	3601
U-3	4	3779	2190	769	637	151	3747
U-3	5	3928	2407	533	772	192	3904
U-3	6	3790	2290	537	728	205	3760
U-3	7	3944	2301	660	757	197	3915
U-3	8	3407	2012	649	545	160	3366
U-3	9	3831	2098	662	752	291	3803
Average		3662	2154	612	675	193	3634
SD		238	159	79	74	43	238
Minimum		3248	1904	514	545	146	3225
Maximum		3944	2407	769	772	291	3915

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-2	1	3015	1838	387	614	160	2999
U-2	2	2875	1743	387	526	187	2843
U-2	3	2903	1658	473	575	173	2879
U-2	4	2757	1672	326	578	164	2740
U-2	5	3179	1766	535	648	213	3162
U-2	6	3072	1747	471	622	213	3053
U-2	7	2772	1769	333	497	150	2749
U-2	8	2565	1464	428	479	180	2551
U-2	9	2765	1588	523	488	145	2744
Average		2878	1694	429	559	176	2858
SD		178	107	72	60	23	178
Minimum		2565	1464	326	479	145	2551
Maximum		3179	1838	535	648	213	3162

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
R-3	1	2492	1353	477	482	153	2465
R-3	2	3043	1615	631	604	165	3015
R-3	3	3131	1668	545	664	217	3094
R-3	4	2923	1643	524	549	180	2896
R-3	5	3057	1644	537	634	203	3018
R-3	6	3082	1653	655	545	208	3061
R-3	7	2650	1383	592	488	168	2631
R-3	8	2835	1519	608	494	195	2816
R-3	9	3046	1727	490	617	189	3023
Average		2918	1578	562	564	186	2891
SD		207	124	59	64	20	204
Minimum		2492	1353	477	482	153	2465
Maximum		3131	1727	655	664	217	3094

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
R-2	1	2550	1431	435	509	156	2531
R-2	2	2496	1424	342	540	171	2477
R-2	3	2559	1536	294	513	191	2534
R-2	4	2557	1514	285	573	160	2532
R-2	5	2655	1434	399	606	192	2631
R-2	6	2520	1325	468	506	190	2489
R-2	7	3009	1728	441	591	220	2980
R-2	8	2566	1347	497	509	185	2538
R-2	9	2405	1395	361	471	136	2363
Average		2591	1459	391	535	178	2564
SD		161	115	71	43	23	162
Minimum		2405	1325	285	471	136	2363
Maximum		3009	1728	497	606	220	2980

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
O-2	1	2439	1410	270	571	160	2411
O-2	2	2185	1262	230	528	152	2172
O-2	3	2640	1456	382	605	165	2608
O-2	4	2386	1358	327	536	143	2364
O-2	5	2513	1413	306	600	170	2489
O-2	6	2460	1375	256	622	191	2444
O-2	7	2128	1231	275	479	126	2111
O-2	8	2190	1150	398	484	138	2170
O-2	9	2516	1394	419	516	147	2476
Average		2384	1339	318	549	155	2361
SD		167	96	64	50	18	161
Minimum		2128	1150	230	479	126	2111
Maximum		2640	1456	419	622	191	2608

Meat, fat, bones, and tendons in lamb saddles (weight, gram).

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
E-3	1	1845	1184	306	261	78	1829
E-3	2	1402	800	281	226	73	1380
E-3	3	1654	994	377	199	65	1635
E-3	4	1391	802	260	244	64	1370
E-3	5	1452	813	277	275	70	1435
E-3	6	1360	789	298	206	53	1346
E-3	7	1336	791	305	168	57	1321
E-3	8	1536	877	330	242	69	1518
E-3	9	1520	916	255	272	60	1503
Average		1500	885	299	233	65	1482
SD		154	125	36	34	7	155
Minimum		1336	789	255	168	53	1321
Maximum		1845	1184	377	275	78	1829

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-3+	1	1643	801	499	264	52	1616
U-3+	2	1611	831	519	204	45	1599
U-3+	3	1785	903	536	265	58	1762
U-3+	4	2009	944	522	434	79	1979
U-3+	5	1842	844	541	373	65	1823
U-3+	6	1537	858	378	262	38	1536
U-3+	7	1640	844	553	210	21	1628
U-3+	8	1681	789	587	250	37	1663
U-3+	9	1419	685	461	230	30	1406
Average		1685	833	511	277	47	1668
SD		164	69	57	72	17	158
Minimum		1419	685	378	204	21	1406
Maximum		2009	944	587	434	79	1979

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-3	1	1391	802	293	234	46	1375
U-3	2	1388	804	297	216	48	1365
U-3	3	1562	906	320	252	62	1540
U-3	4	1501	758	430	252	45	1485
U-3	5	1542	846	244	366	68	1524
U-3	6	1418	838	266	246	51	1401
U-3	7	1546	860	368	252	51	1531
U-3	8	1492	775	409	240	51	1475
U-3	9	1460	770	369	239	56	1434
Average		1478	818	333	255	53	1459
SD		63	46	61	41	7	64
Minimum		1388	758	244	216	45	1365
Maximum		1562	906	430	366	68	1540

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-2	1	1298	828	201	208	46	1283
U-2	2	1313	739	269	227	62	1297
U-2	3	1261	696	240	244	55	1235
U-2	4	1390	832	197	287	58	1374
U-2	5	1300	746	219	258	57	1280
U-2	6	1111	611	186	244	56	1097
U-2	7	1209	799	178	174	43	1194
U-2	8	1210	705	265	180	43	1193
U-2	9	1147	692	270	136	33	1131
Average		1249	739	225	218	50	1232
SD		83	68	35	45	9	82
Minimum		1111	611	178	136	33	1097
Maximum		1390	832	270	287	62	1374

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
R-3	1	1331	752	354	168	32	1306
R-3	2	1305	581	369	266	62	1278
R-3	3	1434	687	365	291	65	1408
R-3	4	1352	689	380	213	52	1334
R-3	5	1264	615	353	235	42	1245
R-3	6	1566	703	449	325	62	1539
R-3	7	768*	549	353	178	41	1121
R-3	8	1337	659	396	213	49	1317
R-3	9	1481	831	339	225	56	1451
Average		1315	674	373	235	51	1333
SD		213	82	31	48	11	115
Minimum		768	549	339	168	32	1121
Maximum		1566	831	449	325	65	1539

* Likely wrong recording of weight.

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
R-2	1	1059	580	240	181	40	1041
R-2	2	1242	682	248	233	58	1221
R-2	3	1141	651	198	216	55	1120
R-2	4	1127	695	165	193	55	1108
R-2	5	1116	556	249	250	40	1095
R-2	6	1068	501	276	223	48	1048
R-2	7	1212	612	226	290	69	1197
R-2	8	998	477	279	199	32	987
R-2	9	1032	609	195	157	41	1002
Average		1111	596	231	216	49	1091
SD		76	71	36	37	11	76
Minimum		998	477	165	157	32	987
Maximum		1242	695	279	290	69	1221

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
O-2	1	1023	579	147	236	49	1011
O-2	2	954	566	156	181	41	944
O-2	3	1083	547	201	267	56	1071
O-2	4	1034	582	211	182	44	1019
O-2	5	1104	576	150	318	46	1090
O-2	6	879	504	176	195	44	919
O-2	7	839	472	117	200	39	828
O-2	8	803	420	201	151	23	795
O-2	9	944	482	188	221	41	932
Average		963	525	172	217	43	957
SD		101	55	30	48	8	96
Minimum		803	420	117	151	23	795
Maximum		1104	582	211	318	56	1090

Meat, fat, bones, and tendons in lamb flanks (weight, gram).

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
E-3	1	1264	778	208	118	145	1249
E-3	2	951	492	212	91	148	943
E-3	3	1293	756	254	129	142	1281
E-3	4	1047	566	241	109	120	1036
E-3	5	1122	600	304	114	91	1109
E-3	6	896	483	207	91	103	884
E-3	7	1115	587	294	96	124	1101
E-3	8	857	421	262	71	94	848
E-3	9	935	490	238	98	87	913
Average		1053	575	247	102	117	1040
SD		148	116	34	16	23	148
Minimum		857	421	207	71	87	848
Maximum		1293	778	304	129	148	1281

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-3+	1	1146	514	396	89	127	1126
U-3+	2	1034	444	423	99	59	1025
U-3+	3	1155	549	445	105	46	1145
U-3+	4	1490	591	663	105	110	1469
U-3+	5	1232	546	430	97	148	1221
U-3+	6	1387	636	486	129	123	1374
U-3+	7	1381	562	597	105	98	1362
U-3+	8	1598	538	800	181	67	1586
U-3+	9	1019	447	307	98	149	1001
Average		1271	536	505	112	103	1257
SD		192	59	144	26	36	191
Minimum		1019	444	307	89	46	1001
Maximum		1598	636	800	181	149	1586

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-3	1	791	450	153	68	110	781
U-3	2	869	486	163	99	112	860
U-3	3	1030	553	172	101	187	1013
U-3	4	1181	470	516	84	97	1167
U-3	5	1245	671	257	145	159	1232
U-3	6	1195	603	339	142	100	1184
U-3	7	1032	513	213	122	176	1024
U-3	8	1066	477	310	119	147	1053
U-3	9	1005	468	242	80	203	993
Average		1046	521	263	107	143	1034
SD		141	70	108	26	38	140
Minimum		791	450	153	68	97	781
Maximum		1245	671	516	145	203	1232

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
U-2	1	676	405	42	94	124	665
U-2	2	794	429	145	67	148	789
U-2	3	658	359	96	80	117	652
U-2	4	653	382	56	97	110	645
U-2	5	911	487	143	110	166	906
U-2	6	898	531	73	110	171	885
U-2	7	682	407	102	75	87	671
U-2	8	738	420	158	56	94	728
U-2	9	906	482	231	74	105	892
Average		768	434	116	85	125	759
SD		105	52	56	18	29	104
Minimum		653	359	42	56	87	645
Maximum		911	531	231	110	171	906

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
R-3	1	827	355	259	109	98	821
R-3	2	928	419	335	79	82	915
R-3	3	906	448	219	94	138	899
R-3	4	957	453	264	103	123	943
R-3	5	1124	521	366	114	108	1109
R-3	6	1061	488	349	101	112	1050
R-3	7	691	272	234	76	100	682
R-3	8	971	436	302	82	130	950
R-3	9	1003	491	209	127	165	992
Average		941	431	282	98	117	929
SD		120	72	55	16	23	118
Minimum		691	272	209	76	82	682
Maximum		1124	521	366	127	165	1109

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
R-2	1	752	368	210	85	75	738
R-2	2	683	349	143	92	89	673
R-2	3	653	361	104	72	104	641
R-2	4	721	434	70	88	116	708
R-2	5	841	423	224	103	80	830
R-2	6	733	349	218	81	73	721
R-2	7	714	368	136	95	102	701
R-2	8	702	315	201	89	85	690
R-2	9	603	321	96	65	110	592
Average		711	365	156	86	93	699
SD		62	38	55	11	15	62
Minimum		603	315	70	65	73	592
Maximum		841	434	224	103	116	830

Class	Sample No	Weight g	Meat g	Fat g	Bones g	Tendons g	Sum g
O-2	1	506	283	44	79	93	499
O-2	2	481	297	50	67	63	477
O-2	3	702	365	103	103	123	694
O-2	4	521	283	62	81	87	513
O-2	5	697	359	115	109	108	691
O-2	6	712	397	60	112	137	706
O-2	7	510	270	25	86	120	501
O-2	8	563	259	111	63	122	555
O-2	9	491	225	82	77	100	484
Average		576	304	72	86	106	569
SD		93	53	30	17	21	93
Minimum		481	225	25	63	63	477
Maximum		712	397	115	112	137	706

Appendix 2 – Precision deboning of lamb cuts – Proportions (%)

Meat, fat, bones, and tendons in lamb legs (proportions, %).

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
E-3	1	70,4	5,2	15,1	8,0	98,7
E-3	2	65,3	9,1	18,4	6,2	99,1
E-3	3	66,5	9,0	15,8	7,2	98,4
E-3	4	68,6	7,7	15,8	6,8	98,8
E-3	5	69,4	8,7	14,8	5,9	98,7
E-3	6	66,2	7,9	17,6	6,6	98,4
E-3	7	66,0	12,3	14,2	5,9	98,4
E-3	8	65,2	11,3	15,7	6,9	99,1
E-3	9	66,5	8,8	16,6	6,9	98,9
Average		67,1	8,9	16,0	6,7	98,7
SD		1,8	1,9	1,3	0,6	0,3
Minimum		65,2	5,2	14,2	5,9	98,4
Maximum		70,4	12,3	18,4	8,0	99,1

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
U-3+	1	64,1	13,0	16,0	6,0	99,0
U-3+	2	64,5	11,8	16,5	6,1	98,8
U-3+	3	64,1	13,1	16,5	5,8	99,5
U-3+	4	60,8	14,6	16,7	6,3	98,4
U-3+	5	60,7	14,3	18,2	5,7	99,0
U-3+	6	67,5	8,2	18,2	5,2	99,1
U-3+	7	61,6	16,2	14,6	6,6	99,0
U-3+	8	61,2	16,0	16,3	5,8	99,2
U-3+	9	64,2	10,5	16,8	7,4	98,9
Average		63,2	13,1	16,6	6,1	99,0
SD		2,1	2,4	1,0	0,6	0,3
Minimum		60,7	8,2	14,6	5,2	98,4
Maximum		67,5	16,2	18,2	7,4	99,5

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
U-3	1	67,1	10,2	17,0	4,5	98,9
U-3	2	65,4	9,1	17,8	6,3	98,6
U-3	3	66,6	9,7	16,4	6,3	99,0
U-3	4	66,8	12,3	15,3	4,0	98,4
U-3	5	70,0	10,9	15,2	3,1	99,3
U-3	6	69,8	9,0	16,4	3,6	98,8
U-3	7	67,9	10,9	16,1	3,3	98,2
U-3	8	66,2	12,5	14,5	5,2	98,4
U-3	9	64,4	10,7	17,1	6,6	98,8
Average		67,1	10,6	16,2	4,8	98,7
SD		1,8	1,2	1,0	1,3	0,3
Minimum		64,4	9,0	14,5	3,1	98,2
Maximum		70,0	12,5	17,8	6,6	99,3

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
U-2	1	71,1	5,1	17,4	5,7	99,4
U-2	2	67,6	9,1	16,3	5,9	98,8
U-2	3	65,9	7,7	19,3	6,3	99,2
U-2	4	71,8	5,3	16,9	5,4	99,4
U-2	5	68,2	8,1	17,0	5,7	99,0
U-2	6	68,5	7,0	17,2	6,0	98,7
U-2	7	73,2	5,2	15,7	5,4	99,5
U-2	8	65,8	11,3	17,2	4,6	98,8
U-2	9	67,8	10,9	15,4	5,1	99,2
Average		68,9	7,7	16,9	5,6	99,1
SD		2,4	2,2	1,1	0,5	0,3
Minimum		65,8	5,1	15,4	4,6	98,7
Maximum		73,2	11,3	19,3	6,3	99,5

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
R-3	1	65,5	7,9	17,7	7,6	98,8
R-3	2	61,9	13,4	17,3	6,2	98,8
R-3	3	61,9	11,2	18,5	7,6	99,2
R-3	4	65,9	9,7	16,7	6,5	98,9
R-3	5	64,3	11,9	17,5	5,1	98,8
R-3	6	65,9	12,1	16,6	4,3	98,9
R-3	7	62,4	10,8	17,8	8,0	99,0
R-3	8	62,4	14,1	15,4	6,7	98,5
R-3	9	65,3	9,7	16,8	7,2	99,0
Average		63,9	11,2	17,1	6,6	98,9
SD		1,7	1,8	0,8	1,2	0,2
Minimum		61,9	7,9	15,4	4,3	98,5
Maximum		65,9	14,1	18,5	8,0	99,2

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
R-2	1	64,9	8,4	18,8	7,2	99,2
R-2	2	63,5	10,5	19,8	5,2	99,0
R-2	3	69,1	6,8	18,8	5,8	100,6
R-2	4	66,0	5,8	19,1	7,6	98,5
R-2	5	64,7	8,2	19,2	6,6	98,7
R-2	6	65,7	10,2	17,6	5,7	99,3
R-2	7	64,2	8,4	19,3	7,2	99,0
R-2	8	65,3	10,2	17,9	5,9	99,2
R-2	9	68,4	8,4	17,2	5,0	99,1
Average		65,8	8,5	18,6	6,2	99,2
SD		1,8	1,5	0,8	0,9	0,6
Minimum		63,5	5,8	17,2	5,0	98,5
Maximum		69,1	10,5	19,8	7,6	100,6

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
O-2	1	64,3	6,2	21,8	6,8	99,1
O-2	2	66,2	5,6	20,5	7,0	99,3
O-2	3	64,9	7,2	19,9	6,6	98,6
O-2	4	66,2	7,1	19,3	6,2	98,8
O-2	5	69,1	7,1	18,3	4,5	99,0
O-2	6	68,8	5,4	20,2	4,9	99,4
O-2	7	65,4	7,0	19,8	7,0	99,1
O-2	8	64,0	10,5	19,4	5,4	99,4
O-2	9	65,4	8,2	20,6	5,1	99,2
Average		66,0	7,2	20,0	5,9	99,1
SD		1,7	1,4	0,9	0,9	0,2
Minimum		64,0	5,4	18,3	4,5	98,6
Maximum		69,1	10,5	21,8	7,0	99,4

Meat, fat, bones, and tendons in lamb forequarters (proportions, %).

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
E-3	1	62,9	12,6	18,7	5,2	99,5
E-3	2	68,1	13,6	19,8	5,8	107,3
E-3	3	59,6	17,0	18,2	4,5	99,3
E-3	4	59,7	15,4	18,7	5,5	99,3
E-3	5	58,5	15,7	19,8	5,1	99,1
E-3	6	56,8	17,3	20,4	5,5	100,0
E-3	7	56,0	20,0	18,2	4,7	98,9
E-3	8	59,0	18,6	17,9	3,7	99,3
E-3	9	55,1	18,5	18,3	3,3	95,2
Average		59,5	16,5	18,9	4,8	99,8
SD		3,7	2,3	0,8	0,8	3,0
Minimum		55,1	12,6	17,9	3,3	95,2
Maximum		68,1	20,0	20,4	5,8	107,3

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
U-3+	1	55,1	23,4	17,6	2,8	98,9
U-3+	2	53,4	21,7	18,6	3,7	97,4
U-3+	3	55,0	21,4	18,7	3,9	99,1
U-3+	4	55,0	22,6	18,4	3,4	99,3
U-3+	5	52,2	24,6	18,9	3,3	99,0
U-3+	6	57,1	17,5	21,3	3,4	99,4
U-3+	7	52,7	27,2	14,8	4,0	98,7
U-3+	8	49,8	26,6	18,7	4,3	99,4
U-3+	9	55,3	22,4	18,9	2,4	99,0
Average		54,0	23,0	18,4	3,5	98,9
SD		2,0	2,7	1,6	0,6	0,6
Minimum		49,8	17,5	14,8	2,4	97,4
Maximum		57,1	27,2	21,3	4,3	99,4

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
U-3	1	57,7	16,3	18,5	6,8	99,2
U-3	2	58,6	15,8	19,7	5,1	99,3
U-3	3	61,0	17,4	17,0	4,0	99,5
U-3	4	58,0	20,3	16,9	4,0	99,2
U-3	5	61,3	13,6	19,7	4,9	99,4
U-3	6	60,4	14,2	19,2	5,4	99,2
U-3	7	58,3	16,7	19,2	5,0	99,3
U-3	8	59,1	19,0	16,0	4,7	98,8
U-3	9	54,8	17,3	19,6	7,6	99,3
Average		58,8	16,7	18,4	5,3	99,2
SD		1,9	2,0	1,3	1,1	0,2
Minimum		54,8	13,6	16,0	4,0	98,8
Maximum		61,3	20,3	19,7	7,6	99,5

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
U-2	1	61,0	12,8	20,4	5,3	99,5
U-2	2	60,6	13,5	18,3	6,5	98,9
U-2	3	57,1	16,3	19,8	6,0	99,2
U-2	4	60,6	11,8	21,0	5,9	99,4
U-2	5	55,6	16,8	20,4	6,7	99,5
U-2	6	56,9	15,3	20,2	6,9	99,4
U-2	7	63,8	12,0	17,9	5,4	99,2
U-2	8	57,1	16,7	18,7	7,0	99,5
U-2	9	57,4	18,9	17,6	5,2	99,2
Average		58,9	14,9	19,4	6,1	99,3
SD		2,5	2,3	1,2	0,7	0,2
Minimum		55,6	11,8	17,6	5,2	98,9
Maximum		63,8	18,9	21,0	7,0	99,5

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
R-3	1	54,3	19,1	19,3	6,1	98,9
R-3	2	53,1	20,7	19,8	5,4	99,1
R-3	3	53,3	17,4	21,2	6,9	98,8
R-3	4	56,2	17,9	18,8	6,2	99,1
R-3	5	53,8	17,6	20,7	6,6	98,7
R-3	6	53,6	21,3	17,7	6,7	99,3
R-3	7	52,2	22,3	18,4	6,3	99,3
R-3	8	53,6	21,4	17,4	6,9	99,3
R-3	9	56,7	16,1	20,3	6,2	99,2
Average		54,1	19,3	19,3	6,4	99,1
SD		1,4	2,1	1,3	0,4	0,2
Minimum		52,2	16,1	17,4	5,4	98,7
Maximum		56,7	22,3	21,2	6,9	99,3

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
R-2	1	56,1	17,1	20,0	6,1	99,3
R-2	2	57,1	13,7	21,6	6,9	99,2
R-2	3	60,0	11,5	20,0	7,5	99,0
R-2	4	59,2	11,1	22,4	6,3	99,0
R-2	5	54,0	15,0	22,8	7,2	99,1
R-2	6	52,6	18,6	20,1	7,5	98,8
R-2	7	57,4	14,7	19,6	7,3	99,0
R-2	8	52,5	19,4	19,8	7,2	98,9
R-2	9	58,0	15,0	19,6	5,7	98,3
Average		56,3	15,1	20,7	6,8	99,0
SD		2,6	2,7	1,2	0,6	0,3
Minimum		52,5	11,1	19,6	5,7	98,3
Maximum		60,0	19,4	22,8	7,5	99,3

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
O-2	1	57,8	11,1	23,4	6,6	98,9
O-2	2	57,8	10,5	24,2	7,0	99,4
O-2	3	55,2	14,5	22,9	6,3	98,8
O-2	4	56,9	13,7	22,5	6,0	99,1
O-2	5	56,2	12,2	23,9	6,8	99,0
O-2	6	55,9	10,4	25,3	7,8	99,3
O-2	7	57,8	12,9	22,5	5,9	99,2
O-2	8	52,5	18,2	22,1	6,3	99,1
O-2	9	55,4	16,7	20,5	5,8	98,4
Average		56,2	13,3	23,0	6,5	99,0
SD		1,6	2,6	1,3	0,6	0,3
Minimum		52,5	10,4	20,5	5,8	98,4
Maximum		57,8	18,2	25,3	7,8	99,4

Meat, fat, bones, and tendons in lamb saddles (proportions, %).

Class	Sample No	Tenderloin %	Loin %	Meat, total %	Fat %	Bones %	Tendons %	Sum %
E-3	1	6,1	39,6	64,2	16,6	14,1	4,2	99,1
E-3	2	4,6	31,6	57,1	20,0	16,1	5,2	98,4
E-3	3	5,4	34,3	60,1	22,8	12,0	3,9	98,9
E-3	4	6,7	35,8	57,7	18,7	17,5	4,6	98,5
E-3	5	5,4	35,1	56,0	19,1	18,9	4,8	98,8
E-3	6	6,0	34,8	58,0	21,9	15,1	3,9	99,0
E-3	7	4,5	35,0	59,2	22,8	12,6	4,3	98,9
E-3	8	4,9	34,0	57,1	21,5	15,8	4,5	98,8
E-3	9	4,7	36,5	60,3	16,8	17,9	3,9	98,9
Average		5,4	35,2	58,8	20,0	15,6	4,4	98,8
SD		0,7	2,0	2,3	2,3	2,2	0,4	0,2
Minimum		4,5	31,6	56,0	16,6	12,0	3,9	98,4
Maximum		6,7	39,6	64,2	22,8	18,9	5,2	99,1

Class	Sample No	Tenderloin %	Loin %	Meat, total %	Fat %	Bones %	Tendons %	Sum %
U-3+	1	4,3	25,8	48,8	30,4	16,1	3,2	98,4
U-3+	2	4,2	29,4	51,6	32,2	12,7	2,8	99,3
U-3+	3	4,6	28,6	50,6	30,0	14,8	3,2	98,7
U-3+	4	4,2	26,5	47,0	26,0	21,6	3,9	98,5
U-3+	5	3,9	25,2	45,8	29,4	20,2	3,5	99,0
U-3+	6	5,1	33,2	55,8	24,6	17,0	2,5	99,9
U-3+	7	4,8	31,3	51,5	33,7	12,8	1,3	99,3
U-3+	8	3,6	28,6	46,9	34,9	14,9	2,2	98,9
U-3+	9	4,6	26,1	48,3	32,5	16,2	2,1	99,1
Average		4,4	28,3	49,6	30,4	16,3	2,7	99,0
SD		0,4	2,5	2,9	3,2	2,9	0,8	0,4
Minimum		3,6	25,2	45,8	24,6	12,7	1,3	98,4
Maximum		5,1	33,2	55,8	34,9	21,6	3,9	99,9

Class	Sample No	Tenderloin %	Loin %	Meat, total %	Fat %	Bones %	Tendons %	Sum %
U-3	1	5,1	29,3	57,7	21,1	16,8	3,3	98,8
U-3	2	5,1	29,7	57,9	21,4	15,6	3,5	98,3
U-3	3	3,9	32,7	58,0	20,5	16,1	4,0	98,6
U-3	4	4,8	30,7	50,5	28,6	16,8	3,0	98,9
U-3	5	4,6	34,2	54,9	15,8	23,7	4,4	98,8
U-3	6	5,6	35,8	59,1	18,8	17,3	3,6	98,8
U-3	7	5,6	50,6	55,6	23,8	16,3	3,3	99,0
U-3	8	4,3	30,6	51,9	27,4	16,1	3,4	98,9
U-3	9	4,8	28,9	52,7	25,3	16,4	3,8	98,2
Average		4,9	33,6	55,4	22,5	17,2	3,6	98,7
SD		0,5	6,4	2,9	3,9	2,3	0,4	0,3
Minimum		3,9	28,9	50,5	15,8	15,6	3,0	98,2
Maximum		5,6	50,6	59,1	28,6	23,7	4,4	99,0

Class	Sample No	Tenderloin %	Loin %	Meat, total %	Fat %	Bones %	Tendons %	Sum %
U-2	1	4,6	32,2	63,8	15,5	16,0	3,5	98,8
U-2	2	5,1	31,5	56,3	20,5	17,3	4,7	98,8
U-2	3	4,0	31,7	55,2	19,0	19,3	4,4	97,9
U-2	4	5,5	33,5	59,9	14,2	20,6	4,2	98,8
U-2	5	5,5	32,0	57,4	16,8	19,8	4,4	98,5
U-2	6	5,4	30,9	55,0	16,7	22,0	5,0	98,7
U-2	7	5,0	37,6	66,1	14,7	14,4	3,6	98,8
U-2	8	5,1	31,8	58,3	21,9	14,9	3,6	98,6
U-2	9	5,5	33,3	60,3	23,5	11,9	2,9	98,6
Average		5,1	32,7	59,1	18,1	17,4	4,0	98,6
SD		0,5	1,9	3,6	3,1	3,1	0,6	0,3
Minimum		4,0	30,9	55,0	14,2	11,9	2,9	97,9
Maximum		5,5	37,6	66,1	23,5	22,0	5,0	98,8

Class	Sample No	Tenderloin %	Loin %	Meat, total %	Fat %	Bones %	Tendons %	Sum %
R-3	1	4,6	29,6	56,5	26,6	12,6	2,4	98,1
R-3	2	3,8	24,4	44,5	28,3	20,4	4,8	97,9
R-3	3	4,4	25,0	47,9	25,5	20,3	4,5	98,2
R-3	4	4,5	26,6	51,0	28,1	15,8	3,8	98,7
R-3	5	4,0	29,2	48,7	27,9	18,6	3,3	98,5
R-3	6	3,4	25,3	44,9	28,7	20,8	4,0	98,3
R-3	7	6,1	40,0	71,5	46,0	23,2	5,3	146,0*
R-3	8	5,5	26,9	49,3	29,6	15,9	3,7	98,5
R-3	9	4,2	31,3	56,1	22,9	15,2	3,8	98,0
Average		4,5	28,7	52,3	29,3	18,1	4,0	103,6
SD		0,8	4,5	7,9	6,2	3,2	0,8	15,0
Minimum		3,4	24,4	44,5	22,9	12,6	2,4	97,9
Maximum		6,1	40,0	71,5	46,0	23,2	5,3	146,0

* Wrong recording of sample weight. See Appendix 1.

Class	Sample No	Tenderloin %	Loin %	Meat, total %	Fat %	Bones %	Tendons %	Sum %
R-2	1	5,2	28,0	54,8	22,7	17,1	3,8	98,3
R-2	2	4,8	28,4	54,9	20,0	18,8	4,7	98,3
R-2	3	5,3	26,6	57,1	17,4	18,9	4,8	98,2
R-2	4	7,2	30,9	61,7	14,6	17,1	4,9	98,3
R-2	5	4,5	29,5	49,8	22,3	22,4	3,6	98,1
R-2	6	4,2	27,2	46,9	25,8	20,9	4,5	98,1
R-2	7	4,3	28,2	50,5	18,6	23,9	5,7	98,8
R-2	8	4,3	27,2	47,8	28,0	19,9	3,2	98,9
R-2	9	5,2	31,4	59,0	18,9	15,2	4,0	97,1
Average		5,0	28,6	53,6	20,9	19,4	4,3	98,2
SD		0,9	1,6	4,9	4,0	2,6	0,7	0,5
Minimum		4,2	26,6	46,9	14,6	15,2	3,2	97,1
Maximum		7,2	31,4	61,7	28,0	23,9	5,7	98,9

Class	Sample No	Tenderloin %	Loin %	Meat, total %	Fat %	Bones %	Tendons %	Sum %
O-2	1	4,9	28,4	56,6	14,4	23,1	4,8	98,8
O-2	2	5,2	25,8	59,3	16,4	19,0	4,3	99,0
O-2	3	3,5	26,4	50,5	18,6	24,7	5,2	98,9
O-2	4	4,0	28,5	56,3	20,4	17,6	4,3	98,5
O-2	5	4,7	27,4	52,2	13,6	28,8	4,2	98,7
O-2	6	4,3	34,5	57,3	20,0	22,2	5,0	104,6
O-2	7	3,1	30,0	56,3	13,9	23,8	4,6	98,7
O-2	8	4,4	30,4	52,3	25,0	18,8	2,9	99,0
O-2	9	4,4	26,6	51,1	19,9	23,4	4,3	98,7
Average		4,3	28,7	54,7	18,0	22,4	4,4	99,4
SD		0,6	2,5	3,0	3,6	3,3	0,6	1,8
Minimum		3,1	25,8	50,5	13,6	17,6	2,9	98,5
Maximum		5,2	34,5	59,3	25,0	28,8	5,2	104,6

Meat, fat, bones, and tendons in lamb flanks (proportions, %).

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
E-3	1	61,6	16,5	9,3	11,5	98,8
E-3	2	51,7	22,3	9,6	15,6	99,2
E-3	3	58,5	19,6	10,0	11,0	99,1
E-3	4	54,1	23,0	10,4	11,5	98,9
E-3	5	53,5	27,1	10,2	8,1	98,8
E-3	6	53,9	23,1	10,2	11,5	98,7
E-3	7	52,6	26,4	8,6	11,1	98,7
E-3	8	49,1	30,6	8,3	11,0	98,9
E-3	9	52,4	25,5	10,5	9,3	97,6
Average		54,2	23,8	9,7	11,2	98,8
SD		3,5	4,0	0,7	1,9	0,4
Minimum		49,1	16,5	8,3	8,1	97,6
Maximum		61,6	30,6	10,5	15,6	99,2

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
U-3+	1	44,9	34,6	7,8	11,1	98,3
U-3+	2	42,9	40,9	9,6	5,7	99,1
U-3+	3	47,5	38,5	9,1	4,0	99,1
U-3+	4	39,7	44,5	7,0	7,4	98,6
U-3+	5	44,3	34,9	7,9	12,0	99,1
U-3+	6	45,9	35,0	9,3	8,9	99,1
U-3+	7	40,7	43,2	7,6	7,1	98,6
U-3+	8	33,7	50,1	11,3	4,2	99,2
U-3+	9	43,9	30,1	9,6	14,6	98,2
Average		42,6	39,1	8,8	8,3	98,8
SD		3,9	5,8	1,3	3,4	0,4
Minimum		33,7	30,1	7,0	4,0	98,2
Maximum		47,5	50,1	11,3	14,6	99,2

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
U-3	1	56,9	19,3	8,6	13,9	98,7
U-3	2	55,9	18,8	11,4	12,9	99,0
U-3	3	53,7	16,7	9,8	18,2	98,3
U-3	4	39,8	43,7	7,1	8,2	98,8
U-3	5	53,9	20,6	11,6	12,8	99,0
U-3	6	50,5	28,4	11,9	8,4	99,1
U-3	7	49,7	20,6	11,8	17,1	99,2
U-3	8	44,7	29,1	11,2	13,8	98,8
U-3	9	46,6	24,1	8,0	20,2	98,8
Average		50,2	24,6	10,2	13,9	98,9
SD		5,3	7,8	1,7	3,8	0,2
Minimum		39,8	16,7	7,1	8,2	98,3
Maximum		56,9	43,7	11,9	20,2	99,2

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
U-2	1	59,9	6,2	13,9	18,3	98,4
U-2	2	54,0	18,3	8,4	18,6	99,4
U-2	3	54,6	14,6	12,2	17,8	99,1
U-2	4	58,5	8,6	14,9	16,8	98,8
U-2	5	53,5	15,7	12,1	18,2	99,5
U-2	6	59,1	8,1	12,2	19,0	98,6
U-2	7	59,7	15,0	11,0	12,8	98,4
U-2	8	56,9	21,4	7,6	12,7	98,6
U-2	9	53,2	25,5	8,2	11,6	98,5
Average		56,6	14,8	11,2	16,2	98,8
SD		2,6	6,0	2,4	2,8	0,4
Minimum		53,2	6,2	7,6	11,6	98,4
Maximum		59,9	25,5	14,9	19,0	99,5

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
R-3	1	42,9	31,3	13,2	11,9	99,3
R-3	2	45,2	36,1	8,5	8,8	98,6
R-3	3	49,4	24,2	10,4	15,2	99,2
R-3	4	47,3	27,6	10,8	12,9	98,5
R-3	5	46,4	32,6	10,1	9,6	98,7
R-3	6	46,0	32,9	9,5	10,6	99,0
R-3	7	39,4	33,9	11,0	14,5	98,7
R-3	8	44,9	31,1	8,4	13,4	97,8
R-3	9	49,0	20,8	12,7	16,5	98,9
Average		45,6	30,0	10,5	12,6	98,7
SD		2,9	4,6	1,5	2,4	0,4
Minimum		39,4	20,8	8,4	8,8	97,8
Maximum		49,4	36,1	13,2	16,5	99,3

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
R-2	1	48,9	27,9	11,3	10,0	98,1
R-2	2	51,1	20,9	13,5	13,0	98,5
R-2	3	55,3	15,9	11,0	15,9	98,2
R-2	4	60,2	9,7	12,2	16,1	98,2
R-2	5	50,3	26,6	12,2	9,5	98,7
R-2	6	47,6	29,7	11,1	10,0	98,4
R-2	7	51,5	19,0	13,3	14,3	98,2
R-2	8	44,9	28,6	12,7	12,1	98,3
R-2	9	53,2	15,9	10,8	18,2	98,2
Average		51,5	21,6	12,0	13,2	98,3
SD		4,2	6,6	1,0	2,9	0,2
Minimum		44,9	9,7	10,8	9,5	98,1
Maximum		60,2	29,7	13,5	18,2	98,7

Class	Sample No	Meat %	Fat %	Bones %	Tendons %	Sum %
O-2	1	55,9	8,7	15,6	18,4	98,6
O-2	2	61,7	10,4	13,9	13,1	99,2
O-2	3	52,0	14,7	14,7	17,5	98,9
O-2	4	54,3	11,9	15,5	16,7	98,5
O-2	5	51,5	16,5	15,6	15,5	99,1
O-2	6	55,8	8,4	15,7	19,2	99,2
O-2	7	52,9	4,9	16,9	23,5	98,2
O-2	8	46,0	19,7	11,2	21,7	98,6
O-2	9	45,8	16,7	15,7	20,4	98,6
Average		52,9	12,4	15,0	18,4	98,8
SD		4,7	4,5	1,5	3,0	0,3
Minimum		45,8	4,9	11,2	13,1	98,2
Maximum		61,7	19,7	16,9	23,5	99,2

Appendix 3 – Statistical analysis

This appendix reports results from statistical analysis of all data for meat, fat, and bones in lamb legs, forequarters, saddles, and flanks. Results are shown as boxplots in Figures V3-1 to V3-5. Explanations for the boxplots are as follows:

- Horizontal lines within boxes represent mediums.
- Bottom lines of the boxes represent Q1 (one forth), and upper line represents Q3 (three forth).
- Tops and bottoms of the vertical lines represent highest and lowest values.
- Outliers are single dots on the figures. The outliers are used in calculations.

Table V3-1. Meat, fat, and bone ratios for lamb carcasses per EUROP class. Number of carcasses was 63.

Classes	Meat (%)		Fat (%)		Bone (%)	
	Average	SD	Average	SD	Average	SD
E-3	61,5	2,01	15,2	2,14	16,3	0,98
U-2	62,2	2,65	12,9	2,78	17,3	1,50
U-3	60,1	1,99	16,4	2,49	16,6	1,02
U-3+	54,9	2,43	23,0	3,03	16,3	1,32
R-2	58,7	2,66	14,5	2,91	18,8	0,95
R-3	56,0	1,60	19,4	2,20	17,3	1,03
O-2	59,2	1,70	11,8	2,34	21,1	0,90

Analysis per EUROP class

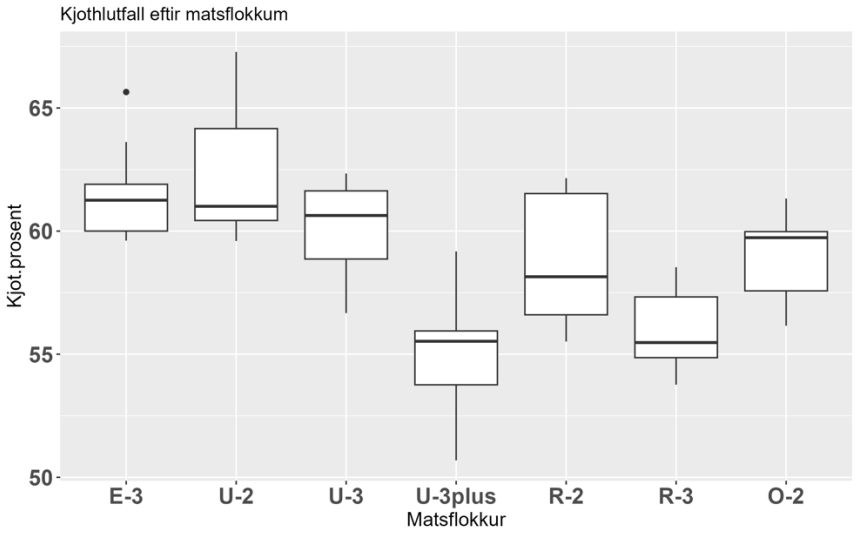

Figure V3-1. Meat ratios (%) per EUROP class.

Figure V3-1 shows that the classes E-3, U-3, and U-2 are not significantly different from each other, but U-3+ and R-3 are significantly lower than all other classes, but there is not significant difference between them (one way analysis of variance, F=13.88, df=2, P = 1.35e-09 ***). Variability within each class can easily been seen (lowest and highest values and one outlier).

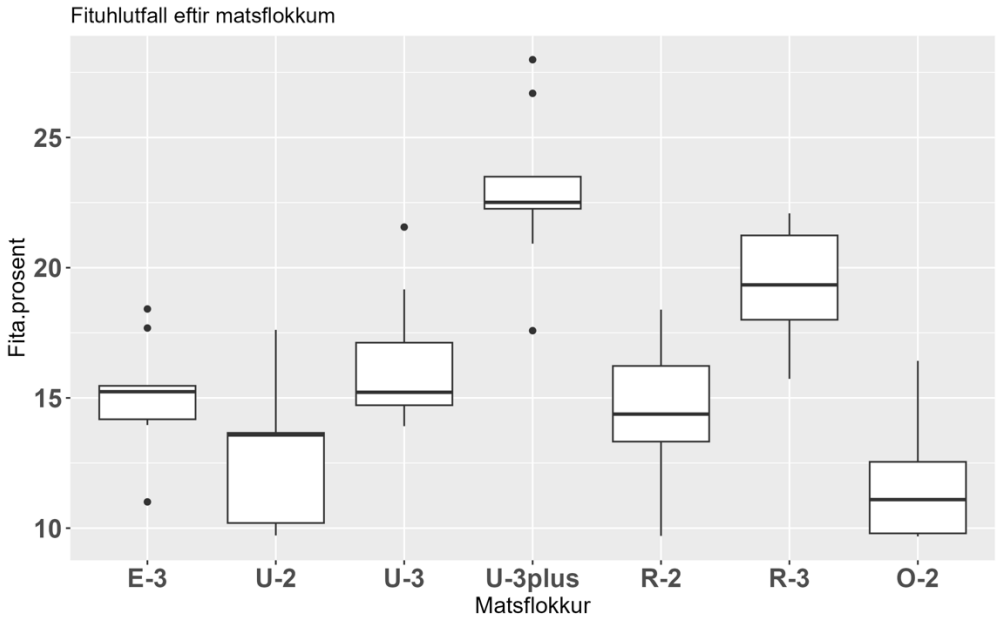

Figure V3-2. Fat ratios (%) per EUROP class.

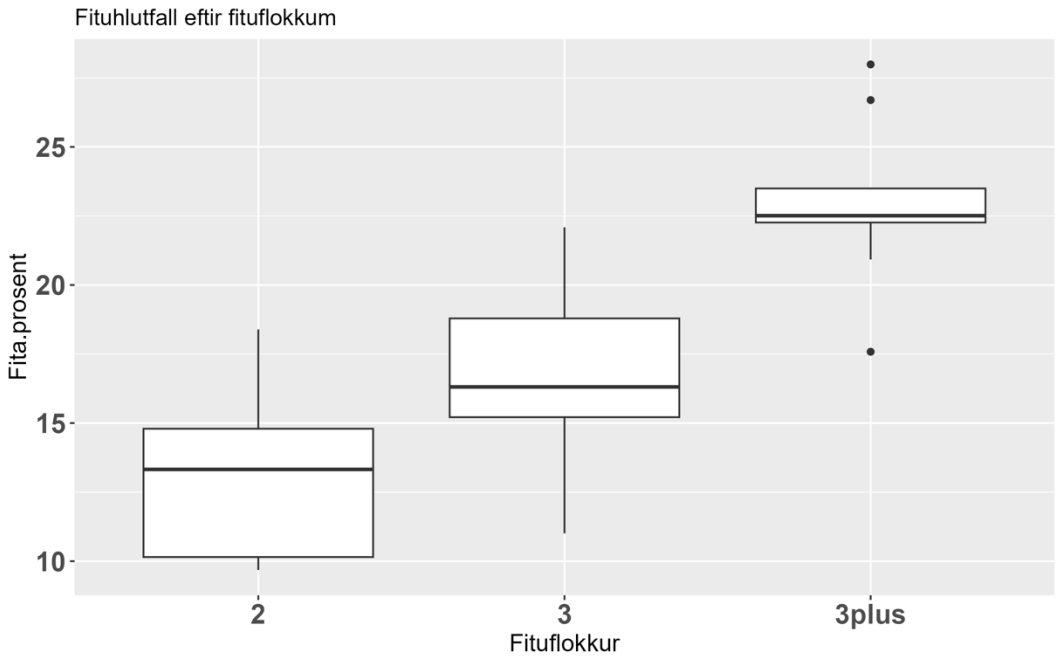

Figure V3-3. Fat ratios (%) per EUROP fat class.

Figures V3-2 and V3-3 show obvious differences between fat ratios per fat class for the EUROP classification carried out in Iceland. Difference between fat classes 3 and 3+ is much greater than between fat classes 2 and 3. Variability for fat ratios within classes is obvious, particularly for U-3+, where the ratio is in the range 15%-32%. Lamb carcasses in the Icelandic 3+ fat class, would in other countries that use the EUROP classification system, likely be classified as fat class 4-. This can easily be seen from the results presented here.

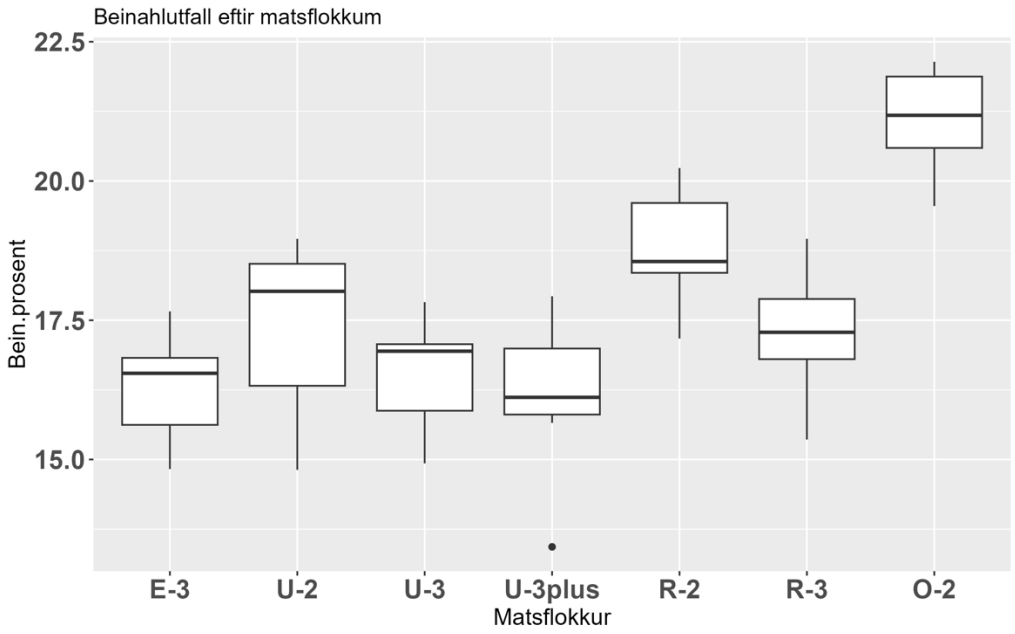

Figure V3-4. Bone ratios (%) per EUROP class.

Conformation class influenced bone ratios. Class O-2 shows significantly higher bone ratios than other classes (Figure V3-4). R-2 is significantly higher than all other classes except for O-2. Other classes E-3, U-2, U-3, U-3+ og R-3 are not significantly different from each other. Variability within classes is considerable.

Meat and fat per EUROP class

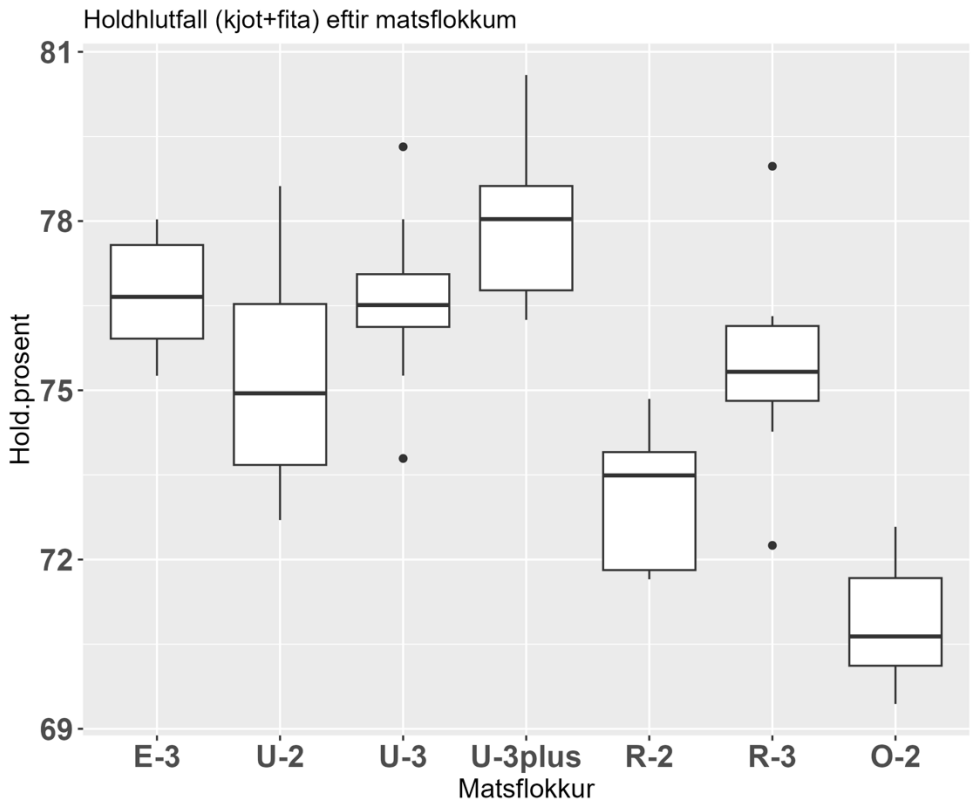

Figure V3-5. Ratios of meat plus fat (%) per EUROP class.

The ratio of meat plus fat is significantly lowest for class O-2, and highest for class U-3+. This can be explained by the fat ratios since meat ratios were considerably higher for O-2 than for U-3+. Conformation classes have obvious effects, although the difference between classes E and U was not significant.

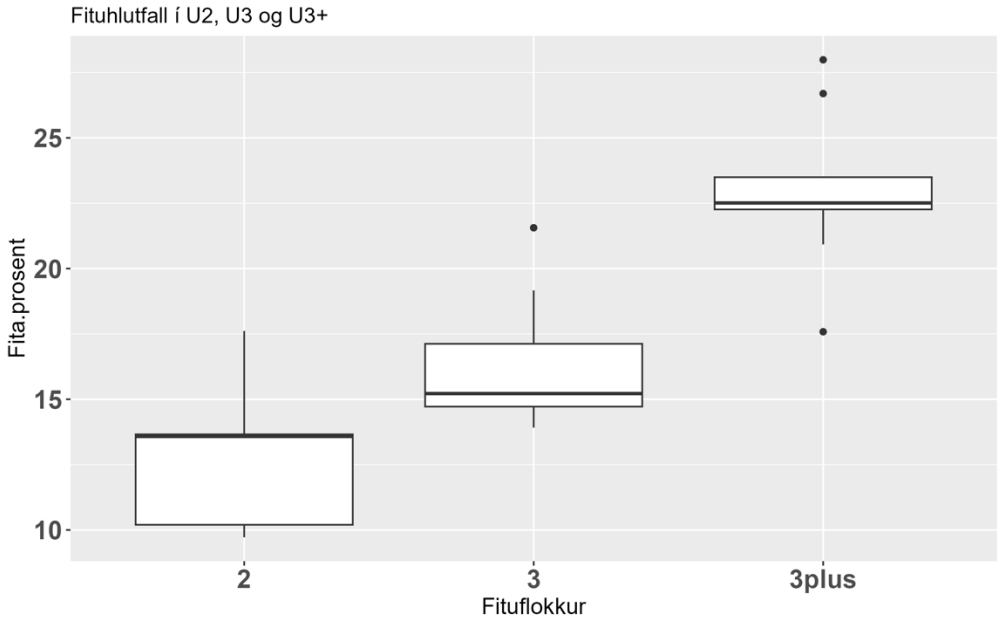

Figure V3-6. Fat ratios (%) for EUROP classes U-2, U-3, and U-3+.

EUROP fat classes presented in Figure V3-6, are significantly different from each other.

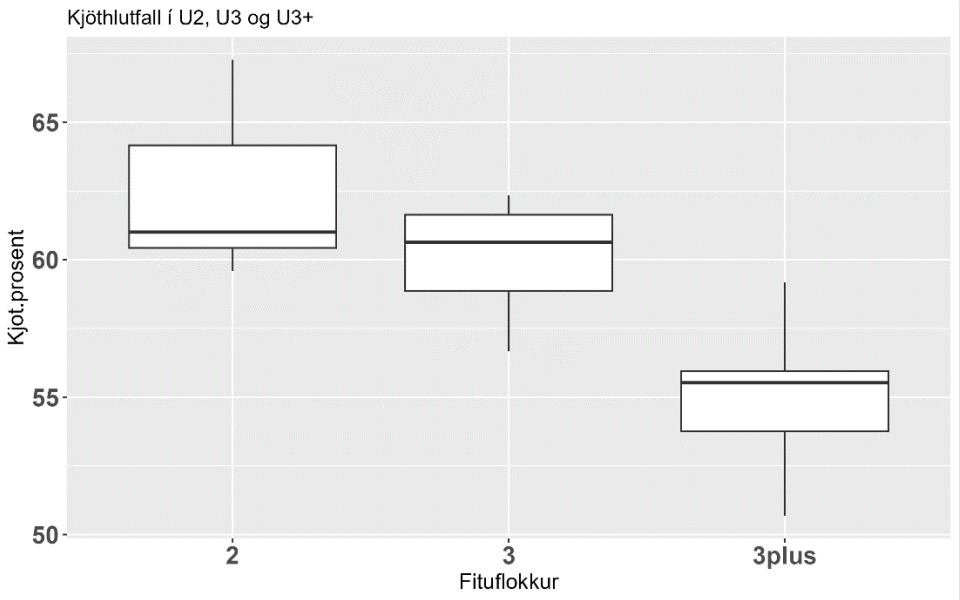

Figure V3-7. Meat ratios (%) for EUROP classes U-2, U-3, and U-3+

Class U-3+ has significantly lower meat ratio than U-2 and U-3 (one way analysis of variance: F= 20.95, df=2, P = 5.44e-06 ***).

Analysis of EUROP conformation classes

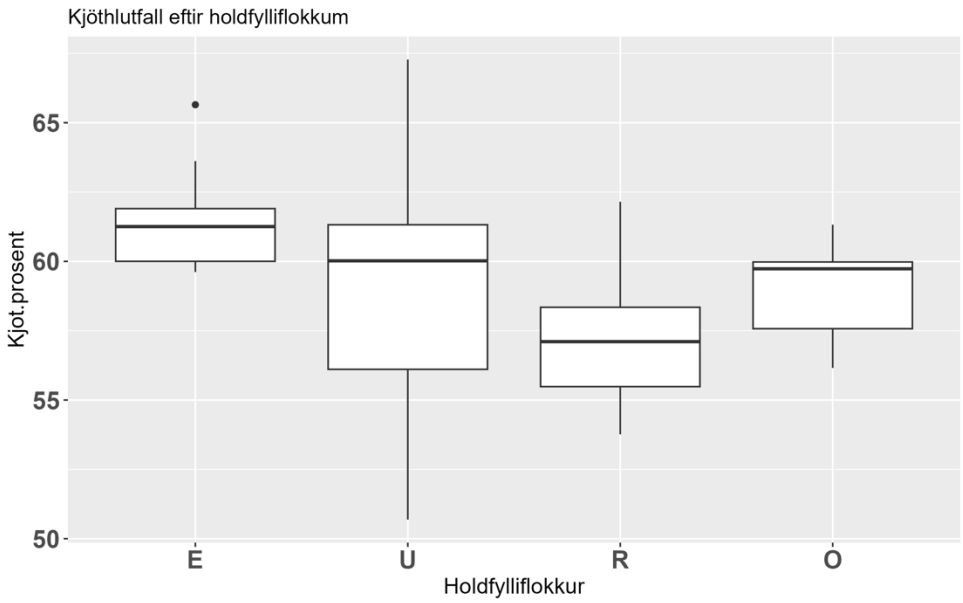

Figure V3-8. Meat ratios (%) per EUROP conformation class.

There is only significant difference between conformation classes R and E.

Appendix 4 – Fatty acids in lamb cuts

A. Results from fatty acid analysis of lamb meat cuts. Proportions (%) of fatty acids.

Table V4-1. Saturated fatty acids (%) in lamb meat cuts. Each sample is a composite sample made from 9 sub-samples.

Meat cuts	Classes	C10:0	C12:0	C14:0	C15:0	C16:0	C17:0	C18:0	C20:0	Sum
Leg	U-3	0,26	0,34	4,37	0,51	22,68	1,31	17,45	0,20	47,12
Leg	R-3	0,30	0,41	4,83	0,58	22,56	1,22	15,96	0,29	46,15
Leg	R-2	0,22	0,33	4,07	0,53	21,45	1,18	16,79	0,25	44,82
Average		0,26	0,36	4,42	0,54	22,23	1,24	16,73	0,25	46,03
Forequarter	U-3	0,30	0,41	4,83	0,58	22,56	1,22	16,36	0,24	46,50
Forequarter	R-3	0,27	0,37	4,45	0,50	21,77	1,19	16,60	0,29	45,44
Forequarter	R-2	0,25	0,36	4,49	0,58	21,86	1,24	17,61	0,29	46,68
Average		0,27	0,38	4,59	0,55	22,06	1,22	16,86	0,27	46,21
Saddle	U-3	0,29	0,36	4,51	0,62	22,68	1,45	18,49	0,28	48,68
Saddle	R-3	0,28	0,33	4,36	0,53	22,28	1,36	18,46	0,30	47,90
Saddle	R-2	0,27	0,34	4,40	0,62	22,17	1,38	18,98	0,29	48,45
Average		0,28	0,34	4,42	0,59	22,38	1,40	18,64	0,29	48,34
Flank	U-3	0,32	0,40	4,69	0,61	22,57	1,36	18,25	0,26	48,46
Flank	R-3	0,24	0,33	4,56	0,54	22,99	1,35	18,80	0,29	49,10
Flank	R-2	0,29	0,38	4,76	0,62	23,18	1,31	18,58	0,30	49,42
Average		0,28	0,37	4,67	0,59	22,91	1,34	18,54	0,28	48,99
All samples Average		0,27	0,36	4,53	0,57	22,40	1,30	17,69	0,27	47,39

Table V4-2. Monounsaturated fatty acids (%) in lamb meat cuts. Each sample is a composite sample made from 9 sub-samples.[1)]

Meat cuts	Classes	C14:1	C15:1	C16:1n7	C18:1(n9+n7+n5)	C20:1(n11+n9)	Sum
Leg	U-3	0,18	0,16	1,31	40,48	0,00	42,13
Leg	R-3	0,26	0,17	1,61	43,44	0,16	45,64
Leg	R-2	0,25	0,17	1,39	40,91	0,00	42,72
Average		0,23	0,17	1,44	41,61	0,05	43,50
Forequarter	U-3	0,26	0,17	1,61	42,67	0,00	44,71
Forequarter	R-3	0,21	0,18	1,51	43,88	0,00	45,78
Forequarter	R-2	0,27	0,18	1,49	40,74	0,00	42,68
Average		0,25	0,18	1,54	42,43	0,00	44,39
Saddle	U-3	0,23	0,19	1,29	40,60	0,20	42,51
Saddle	R-3	0,21	0,19	1,26	41,82	0,32	43,80
Saddle	R-2	0,24	0,19	1,29	39,43	0,00	41,15
Average		0,23	0,19	1,28	40,62	0,17	42,49
Flank	U-3	0,24	0,19	1,33	40,72	0,33	42,81
Flank	R-3	0,21	0,19	1,28	41,06	0,33	43,07
Flank	R-2	0,24	0,19	1,37	39,29	0,00	41,09
Average		0,23	0,19	1,33	40,36	0,22	42,32
All samples							
Average		0,23	0,18	1,40	41,25	0,11	43,17

[1)] The following fatty acids were not detected (reported as 0,00): C17:1, C22:1 (n11+n9), C24:1n9.

Table V4-3. Polyunsaturated fatty acids (%) in lamb meat cuts. Each sample is a composite sample made from 9 sub-samples.[1)]

Meat cuts	Classes	C16:3n4	C18:2n6	C18:3n3	C18:4n3	C20:3n3	C20:4n3	C22:5n3	C22:6n3 DHA	Sum
Leg	U-3	0,58	1,98	1,74	0,75	0,38	0,34	0,42	0,13	6,32
Leg	R-3	0,50	1,84	1,56	0,80	0,32	0,28	0,38	0,13	5,81
Leg	R-2	0,61	2,72	2,38	0,74	0,40	0,35	0,44	0,15	7,79
Average		0,56	2,18	1,89	0,76	0,37	0,32	0,41	0,14	6,64
Forequarter	U-3	0,50	1,71	1,69	0,77	0,21	0,16	0,30	0,00	5,34
Forequarter	R-3	0,57	1,48	1,48	0,85	0,14	0,11	0,24	0,00	4,87
Forequarter	R-2	0,55	2,18	2,22	0,85	0,20	0,16	0,30	0,00	6,46
Average		0,54	1,79	1,80	0,82	0,18	0,14	0,28	0,00	5,56
Saddle	U-3	0,56	1,46	1,64	0,64	0,00	0,00	0,20	0,00	4,50
Saddle	R-3	0,59	1,25	1,36	0,54	0,00	0,00	0,20	0,00	3,94
Saddle	R-2	0,47	2,03	2,21	0,75	0,16	0,15	0,27	0,00	6,04
Average		0,54	1,58	1,74	0,64	0,05	0,05	0,22	0,00	4,83
Flank	U-3	0,63	1,36	1,63	0,41	0,00	0,00	0,21	0,00	4,24
Flank	R-3	0,51	1,23	1,38	0,53	0,00	0,00	0,19	0,00	3,84
Flank	R-2	0,52	1,79	1,97	0,54	0,00	0,00	0,23	0,00	5,05
Average		0,55	1,46	1,66	0,49	0,00	0,00	0,21	0,00	4,38
All samples Average		0,55	1,75	1,77	0,68	0,15	0,13	0,28	0,03	5,35

[1)] The following fatty acids were not detected (reported as 0,00): C16:2n4, C18:3n4, C20:2, C20:4n6, C20:5n3 (EPA), C22:2.

B. Quantity (g per 100g) of fatty acids in lamb meat cuts. Calculated from analytical results reported in Appendix 4-A, fat content and the conversion factor 0,953.

Table V4-4. Saturated fatty acids (g per 100g) in lamb meat cuts. Calculations are based on % fatty acid, fat content and the conversion factor 0,953.

Meat cuts	Classes	C10:0	C12:0	C14:0	C15:0	C16:0	C17:0	C18:0	C20:0	Sum
Leg	U-3	0,03	0,04	0,49	0,06	2,53	0,15	1,95	0,02	5,25
Leg	R-3	0,04	0,05	0,60	0,07	2,79	0,15	1,98	0,04	5,72
Leg	R-2	0,02	0,03	0,36	0,05	1,88	0,10	1,47	0,02	3,93
Average		0,03	0,04	0,48	0,06	2,40	0,13	1,80	0,03	4,97
Forequarter	U-3	0,06	0,08	0,91	0,11	4,24	0,23	3,07	0,05	8,73
Forequarter	R-3	0,06	0,09	1,03	0,12	5,02	0,27	3,83	0,07	10,48
Forequarter	R-2	0,04	0,06	0,80	0,10	3,90	0,22	3,14	0,05	8,32
Average		0,05	0,08	0,91	0,11	4,38	0,24	3,35	0,05	9,18
Saddle	U-3	0,07	0,08	1,03	0,14	5,19	0,33	4,23	0,06	11,13
Saddle	R-3	0,08	0,10	1,26	0,15	6,45	0,39	5,35	0,09	13,88
Saddle	R-2	0,06	0,07	0,94	0,13	4,75	0,30	4,07	0,06	10,39
Average		0,07	0,08	1,08	0,14	5,47	0,34	4,55	0,07	11,80
Flank	U-3	0,08	0,10	1,18	0,15	5,68	0,34	4,59	0,07	12,19
Flank	R-3	0,08	0,11	1,50	0,18	7,58	0,45	6,20	0,10	16,19
Flank	R-2	0,07	0,09	1,11	0,14	5,39	0,30	4,32	0,07	11,49
Average		0,08	0,10	1,26	0,16	6,22	0,36	5,04	0,08	13,29
All samples Average		0,06	0,07	0,93	0,12	4,62	0,27	3,68	0,06	9,81

Table V4-5. Monounsaturated fatty acids (g per 100g) in lamb meat cuts. Calculations are based on % fatty acid, fat content and the conversion factor 0,953.

Meat cuts	Classes	C14:1	C15:1	C16:1n7	C18:1(n9+n7+n5)	C20:1(n11+n9)	Sum
Leg	U-3	0,02	0,02	0,15	4,51	0,00	4,70
Leg	R-3	0,03	0,02	0,20	5,38	0,02	5,65
Leg	R-2	0,02	0,01	0,12	3,59	0,00	3,75
Average		0,02	0,02	0,16	4,49	0,01	4,70
Forequarter	U-3	0,05	0,03	0,30	8,01	0,00	8,39
Forequarter	R-3	0,05	0,04	0,35	10,12	0,00	10,56
Forequarter	R-2	0,05	0,03	0,27	7,26	0,00	7,61
Average		0,05	0,04	0,31	8,46	0,00	8,85
Saddle	U-3	0,05	0,04	0,30	9,29	0,05	9,72
Saddle	R-3	0,06	0,06	0,37	12,12	0,09	12,69
Saddle	R-2	0,05	0,04	0,28	8,45	0,00	8,82
Average		0,05	0,05	0,31	9,95	0,05	10,41
Flank	U-3	0,06	0,05	0,33	10,24	0,08	10,77
Flank	R-3	0,07	0,06	0,42	13,54	0,11	14,20
Flank	R-2	0,06	0,04	0,32	9,14	0,00	9,55
Average		0,06	0,05	0,36	10,97	0,06	11,51
All samples Average		0,05	0,04	0,28	8,47	0,03	8,87

Table V4-6. Polyunsaturated fatty acids (g per 100g) in lamb meat cuts. Calculations are based on % fatty acid, fat content and the conversion factor 0,953.

Meat cuts	Classes	C16:3n4	C18:2n6	C18:3n3	C18:4n3	C20:3n3	C20:4n3	C22:5n3	C22:6n3 DHA	Sum
Leg	U-3	0,06	0,22	0,19	0,08	0,04	0,04	0,05	0,01	0,70
Leg	R-3	0,06	0,23	0,19	0,10	0,04	0,03	0,05	0,02	0,72
Leg	R-2	0,05	0,24	0,21	0,06	0,04	0,03	0,04	0,01	0,68
Average		0,06	0,23	0,20	0,08	0,04	0,03	0,04	0,01	0,70
Forequarter	U-3	0,09	0,32	0,32	0,14	0,04	0,03	0,06	0,00	1,00
Forequarter	R-3	0,13	0,34	0,34	0,20	0,03	0,03	0,06	0,00	1,12
Forequarter	R-2	0,10	0,39	0,40	0,15	0,04	0,03	0,05	0,00	1,15
Average		0,11	0,35	0,35	0,16	0,04	0,03	0,06	0,00	1,09
Saddle	U-3	0,13	0,33	0,38	0,15	0,00	0,00	0,05	0,00	1,03
Saddle	R-3	0,17	0,36	0,39	0,16	0,00	0,00	0,06	0,00	1,14
Saddle	R-2	0,10	0,44	0,47	0,16	0,03	0,03	0,06	0,00	1,30
Average		0,13	0,38	0,41	0,15	0,01	0,01	0,05	0,00	1,16
Flank	U-3	0,16	0,34	0,41	0,10	0,00	0,00	0,05	0,00	1,07
Flank	R-3	0,17	0,41	0,46	0,17	0,00	0,00	0,06	0,00	1,27
Flank	R-2	0,12	0,42	0,46	0,13	0,00	0,00	0,05	0,00	1,17
Average		0,15	0,39	0,44	0,13	0,00	0,00	0,06	0,00	1,17
All samples Average		0,11	0,34	0,35	0,13	0,02	0,02	0,05	0,00	1,03

Appendix 5 – Nutrient declarations

The methods for preparation and calculations of nutrient declarations are explained below, according to Regulation EU No 1169/2011 (Icelandic version no 1294/2014) on the provision of food information to consumers. Labelling of the following components is required: Energy, fat, saturated fat, carbohydrate, sugars, protein, and salt. The table below presents nutrient declaration for leg of lamb based on analytical data from the present study.

Nutrient value in 100 g lamb leg				
Energy	747	kJ	/ 179	kcal
Fat	11	g		
- of which saturated fat	4,6	g		
Carbohydrate	0	g		
- of which sugars	0	g		
Protein	20	g		
Salt	0,13	g		
			%NRV*	
Vitamin B_{12}	1,5	µg	60	

* % nutrient reference value

Data reported in this report can be used to prepare nutrient declarations for lamb meat, organ foods and side-products. However, carbohydrates, sugars and salt were not analysed. Carbohydrate and sugars can be set as zero for unprocessed meat. Carbohydrate in organ foods and side-products is reported, based on calculations. Salt can be calculated as 2.5 × sodium, take care to change units for sodium to g/100g. According to Table 37, sodium in lamb leg is 0.05 g/100g. The salt content is therefore 0.13 g/100g.

Saturated fat is calculated as follows:

Saturated fat g/100g = fat g/100g × f × % saturated fatty acids/100

The conversion factor f is used to convert total amount fat to total amount fatty acids. The conversion factor f = 0.910 is used for low fat meat (fat below 7 g/100g) but 0.953 for high fat meat (fat above 7 g/100g).

Saturated fat in lamb leg (g/100g) = 11 g fat/100g × 0.953 × 0.46 = 4.6 g/100g

The result is actually 4.6 g saturated fatty acids / 100 g, but the regulation allows reporting saturated fat for short.

For reporting vitamins and minerals under the nutrient declaration, it is required for solid foods that the amount is equal to or above 15% of the nutrient reference value (NRV) defined in regulation no 1294/2014.[18] Reporting of %NRV is required as shown in the table above. NRV should always be compared to amount in the final product being declared.

[18] 1294/2014 – Reglugerð um miðlun upplýsinga um matvæli til neytenda. (island.is)