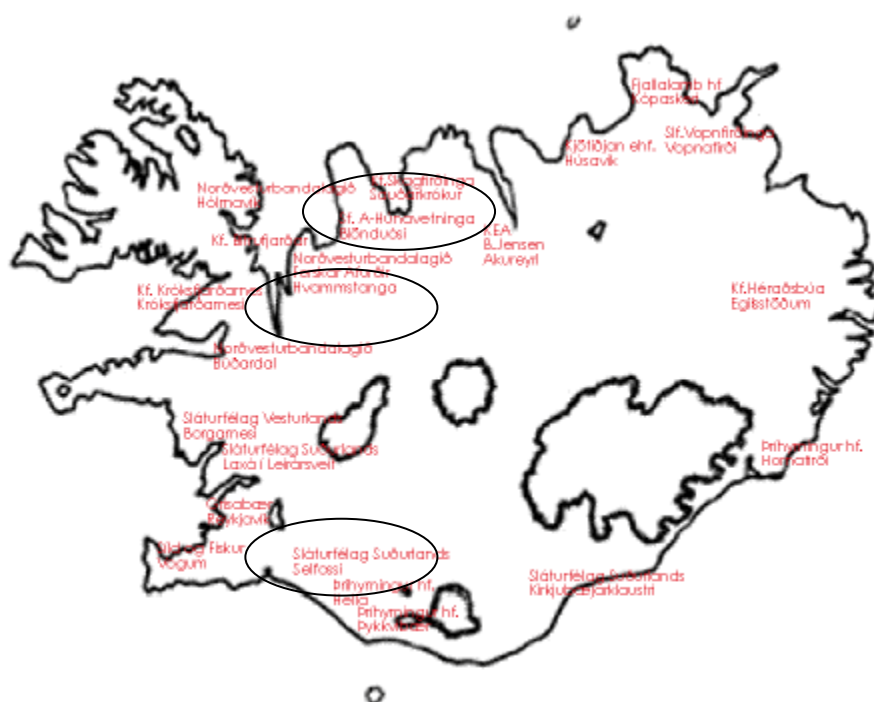


# Meat Producers LTD

## Information on Icelandic Horse Meat



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## I. HISTORICAL BACKGROUND

Horsemeat has been eaten in Iceland ever since the settlement of the Vikings in the 9<sup>th</sup> century. Horses were sacrificed and the meat eaten at religious festivals. But horsemeat consumption was considered pagan banned when Christianity became the national religion in the year 1000. People were gradually made to believe that it was against god and a crime to eat the meat. Many rather died of hunger than to commit such a sin, which could lead to condemnation. ( Jónas Jónasson 1961). But there were always some poor people that ate horsemeat and they were held in contempt for it. They were said to smell of horsemeat. It was believed that those people died younger than other people did.

This changed during the 19<sup>th</sup> century. The first law and regulations to authorize horse meat for human were set in Denmark in 1807 and special facilities were built for slaughtering, processing and selling horse meat. Other countries followed ( Sweden 1852, France 1866 and Italy 1928) and during the nineteenth century many horsemeat butchers were in business in the big cities on the continent of Europe. (Lindberg.,R.A.,1983, Paleari.M.M.,el al.,1992). But it was not until the last decades of the 19<sup>th</sup> century that people started eating horsemeat in few places in Iceland. But this custom gained popularity and became quite common during the 20<sup>th</sup> century. ( Arnór Sigurjónsson, 1950). The horses were slaughtered at the farms and in slaughterhouses throughout the country.

## II. PRODUCTION AND CONSUMPTION OF HORSE MEAT IN ICELAND

The production horse meat increased between 1935 - 1955 from 200 tons to 1250 tons a year and the consumption from 1 to 9 kg /person/year. The total meat consumption was between 65 - 75 kg/person/year. ( table 1). The reasons for this were :

- the prejudice against horse meat was slowly disappearing in some of the population.
- the urbanization of the country created a meat industry which needed an inexpensive production bearing in mind there were almost no pigs in Iceland during the first decades after world war two and cattle farming was mainly for milk

production.

- lack of lamb meat in the forties and fifties because of the killing off sheep in many areas of the country due the “maedi”- disease, but also because of export of lamb meat..

**Table 1.** Meat production and consumption of horse meat in Iceland 1935 - 1999

Year	Production tons/year	Export tons/year	Consumption, kg/head/year	
			horse meat	All meat
1935	135		1,1	54,5
1940	893		7,3	73,0
1950	1140		9,0	69,0
1960	908		7,0	
1970	1015		6,5	
1980	996	183	4,0	65,0
1990	707	64	2,6	65,0
1995	940	258	2,5	60,0
1999	1070	480	1,9	67,8

(From The Yearbook of Icelandic Agriculture and the Agricultural Production Board in Iceland).

Horse meat is still an acceptable meat in Iceland but is regarded to be of lesser quality than other meat and sometimes it has been treated accordingly during storage and processing. Processing and marketing of horsemeat has not followed the drastic changes in lifestyles and food consumption during the last decades of the century. The consumption has declined in 40 years from 9 kg/person /year in 1955 to 2,5 kg/person/year in 1995, which is about 4 % of the total meat consumption. This is comparable to horse meat consumption in Belgium, France, Italy, Holland but the consumption in other western European countries is 0,1 - 0,2 kg/person/year. ( Rossier 1988). But the production has only gone down from 1200 tons to 900 - 1100 tons/year. A considerable amount of the meat of horses is now exported to Italy and Japan. Horsemeat production in Iceland is not great on the world scale of 550.000 tons. ( Paleari.M.A.,1992). Table 2. shows the production in more detail.

**Table 2.** Production and sales of horsemeat in Iceland.

Year	Production	Domestic sales	Export	Waste
	tons	tons	tons	tons
1980	610.471	762.000	182.800	26.665
1981	911.190	750.000	71.800	11.160

1982	946.137	794.659	67.700	6.325
1983	969.686	743.703	108.000	22.104
1984	692.383	896.747	32.900	14.171
1985	796.859	798.373	20.700	11.100
1986	719.384	723.074	8.400	21.005
1987	652.381	696.044		133
1988	512.759	566.925		-1.870
1989	790.749	627.668	88.055	19.620
1990	638.434	666.290	64.683	11.132
1991	726.715	662.490	126.642	-6.273
1992	830.624	672.422	105.282	33.606
1993	821.976	666.426	88.332	26.620
1994	808.636	560.381	172.762	39.505
1995	987.847	668.240	346.386	18.486
1996	637.371	609.484	126.796	18.462
1997	724.634	553.305	139.389	10.437
1998	792.444		247.544	
1999	1054.649		515.128	

(From The Yearbook of Icelandic Agriculture and the Agricultural Production Board in Iceland).

### III. THE ICELANDIC HORSE BREED

The native Icelandic breed is the only breed of horses in Iceland. The horses are small pony-like. There are about 70 - 80,000 horses in the country, 20 - 30,000 geldings, 1-2,000 stallions, 40-45,000 mares, and 10 - 15,000 foals. About 4,000-6,000 foals and 3,000 - 5,000 adult horses are slaughtered each year. Very few farms produce horses purely for meat production. Foal and horse slaughtering is a part of the breeding process, a way to sort out undesired traits in the population of horses. (I.L. Salzmann, 1995). Many farmers have flocks of wild horses grazing wild pastures. The flocks are gathered in the autumn and this is when the slaughterhorses are selected. The flocks graze on wild uncultivated pasture in the summer and autumn. The horses are on the lowlands in the wintertime either indoors or outside and fed with hay.

### IV. HORSE MEAT INSPECTION, GRADING AND CLASSIFICATION

The Icelandic meat industry follows strict international procedures in hygiene and quality control. There are three slaughterhouses certified to export horsemeat to the European Union. Inspectors come almost every year for audits. Iceland is a part of the "European Economic zone". It means that we have to apply all laws and regulations regarding slaughter and health inspection of the European Union.

Horsemeat production and processing are a part of this industry. The horses are killed in houses that are also designed for slaughtering cattle and pigs. The different types of animals are killed on separate days. The Chief Veterinary Officer at the Ministry of Agriculture controls the meat inspection. He appoints veterinary officers to the individual slaughterhouses. Their role is to inspect both live animals and the meat and ensure that the market and the public only gets meat fit for human consumption. They stamp the meat and separate condemned meat from the rest of the meat. The Chief Veterinary Officer also signs health certificates for exported meat. The certificate guarantees that the meat has gone through the inspection procedures of the export country and a trichinosis test even though it has never been detected in horses in Iceland. The carcasses are stamped and labeled with an official Icelandic inspection stamp with the word "ICELAND" and the Export number of the slaughterhouse. Carton boxes of jointed and packaged meat are sealed with labels from the Chief Veterinary Officer with the export number of the slaughterhouse. In 1995 0,3 % of the meat was condemned and unfit for human consumption.

The horse carcasses are graded and classified on the basis of age, conformation and fat cover. ( Thorkelsson. G. and Hilmarsson.O.Th.,1994) . The age categories are :

**Table 5.** Age categories of Icelandic horse meat and % of meat produced in each category in 1995.

<b>Category</b>	<b>Age at slaughter</b>	<b>Label</b>	<b>%</b>
Young foals	up to four months	( Ufo )	0,0
Foal	four to twelve months	Fo	41,1
Chevaline	one to two years old	Tr	2,3
Young horse	three to six years	Uhr	0,0
Horse	over six years	Hr	56,2

The age category groups in the European Union are only two, that is under and over 12 months. This is the same in reality in Iceland as more than 97% of the meat is in the Fo and Hr groups. ( table 5).

There are two grades for conformation and muscularity.

- I = Muscular carcasses with a fairly good conformation
- II = Carcasses with a poor or very poor conformation and muscularity.

The fat classes are two or three depending on category. They are separated on basis of fat thickness over the middle of the third rib. ( Table 6)

**Table 6.** The fat classes of Icelandic horse meat. Maximum fat thickness over the middle of the 3rd rib.

	<b>Fat classes</b>		
	<b>A</b>	<b>B</b>	<b>C</b>
Fo I	20 mm	> 20 mm	
Tr I	25 mm	> 25 mm	
Hr I	30 mm	50 mm	> 50 mm

Carcasses, halves or quarters that are considered of less quality because of bruises, cuts or are torn or damaged in some way are also labeled with X or XX depending on the seriousness of the defects.

99 % of the foal meat is in conformation group I , 80 % in fat class A and 19% in fat class B. The production is in a old traditional pattern. All the production is in the autumn and early winter with 66 % in the month of November, so most of the meat needs to be frozen. 98% of the meat of adult horses is in conformation grade I, 62% in fat class A, 29% in B and 8% in C. But the production is more or less even throughout the year. It used to follow the same pattern as the foal meat but it changed

in few year because of the demand from the Japanese buyers of horsemeat that only wanted very fresh meat all the year round.

## V. CUTTING AND DEBONING OF HORSE MEAT

The meat is cut in half parts and quarter parts in the slaughterhouse. It is a common practice to cut the flank and side of the hindquarter and discard it. The most common wholesale cuts are pistols and forequarters. The pistols and forequarters are deboned like beef into individual muscles, and trimmings. But the forequarter is also cut into smaller parts with bone which are cured and smoked. The exact method depends on the market for the meat.

Some of the foal meat is sold from the slaughterhouse or from farmers directly to consumers that debone and package the meat and put it their deep freezer. Some of it is deboned, packaged and frozen in meat processing plants . Most of the foal meat is frozen in quarters as most of the production is in one month of the year.

## VI. DOMESTIC MARKET AND PRICE OF HORSE MEAT

Fresh and thawed foal meat and to a much lesser extent horse meat is sold along with other meat in the chill cabinets and meat counters of the shops and supermarkets in Iceland. It is considered as cheap option to beef and is bought and consumed by a number of people. This unlike many European countries were horse meat is only sold in authorized shops which only sell horse meat, and these are kept quite separate from establishments where other types of meat are sold.

( Paleari.M.A.,1992). Table 7 shows the price of horse compared to other meat in Iceland. Foal meat is about 30-40% and horsemeat around 50% less expensive than beef . Still there is less and less demand for this meat , which means that the new consumers are not buying much horsemeat.

**Table 7 .** Wholesale price of meat in Iceland. In Ikr/kg

	<b>Foal</b>	<b>Horse</b>	<b>Beef</b>	<b>Lamb</b>	<b>Pork</b>	<b>Chicken</b>
Whole carcass	265	164	375	342	421	449
Top round	872		1208	1100	933	
Minced meat	389		540	525	426	



## VII. WEIGHTS AND YIELD

A carcass of foal meat weighs about 70 - 80 kgs and yields a about 62-65% on deboning with the flank included and 51-53% without the flank. ( table 8 ), which is much less than for beef carcasses. The proportion of bones and fat trimmings is higher in the foal carcasses.

**Table 8.** An example of the yield of deboned foal meat in % of carcass weight

	Fo I A	Fo I B
Flanks	11,3	12,4
Loin muscles	6,2	7,3
Tenderloins	1,4	1,5
Clod	1,8	1,9
Leg muscles	6,6	6,6
Stew meat ( cubes)	13,1	13,0
Minced meat	22,5	21,7
Yield with flanks	62,9	64,4
Yield without flanks	51,6	52,0

Carcasses of Icelandic horses weigh from 170 - 250 kgs and yield less on deboning than beef, because of much higher fat trimmings. The yield is less than has been reported for horsemeat in Europe ( Manfredini et al,1991) but similar to the yield of chevaline carcasses in the United States ( Roth M.D., 1995). Typical weights and yield of different cuts with connective tissue on is shown in table 9. The yield when the connective tissue has been removed is shown in table 10.

**Table 9.** Typical weights and % of cuts of Icelandic horse meat.

Icelandic name	Name	kg	%
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<b>Pístóla</b>	<b>Pistol</b>		
	Top round	3,65	4,18
Mjaðmasteik	Rump	3,5	4,01
Ytralæri	Outside	5,5	6,30
Klumpur	Knuckle	3,2	3,67
Hryggvöðvi	Striploin	5,8	6,64
Lundir	Tenderloin	1,4	1,60
Samtals	Sum	23,05	26,40
<b>Frampartur</b>	<b>Forequarter</b>		
Bógvöðvi	Clod	3,1	3,55
Háls	Neck	2,4	2,75
Framhryggur	Prime ribs	4,5	5,15
Bringa	Brisket	3,06	3,51
Samtals	Sum	13,06	14,96
Vinnsluefni	Trimnings	21	24,05
<b>Hlutaverð</b>	<b>kr/kg carcass</b>		
Í heild	Total	57,11	65,42

**Table 10.** The yield of Icelandic horse carcasses when the connective tissue is removed.

	% of quarter	% of side
<b>Front part (5/6)</b>		<b>42,94</b>
Clod	5,76	2,47
Brisket	5,56	2,39
Neck	13,15	5,65
Scapula muscles	4,76	2,04
Trimnings I	10,66	4,58
Trimnings II	15,76	6,77
Total	55,64	23,89
<b>Pistol (5/6)</b>		<b>57,06</b>
Filet	3,30	1,88
Striploin	12,64	7,21
Inside	6,72	3,84
Rump	7,25	4,14
Outside	12,36	7,05
Knuckle	6,07	3,46
Trimnings I	4,43	2,53
Trimnings II	7,48	4,27
Total	60,24	34,37
% yield		58,26

## VIII. THE CUTS OF ICELANDIC HORSEMEAT.

### *Leg muscles*



Outside

Weight	3,4 - 4,0 kg
% protein	
% fat	
% connective tissue	
% PUFA	
% omega-3 fatty acids	



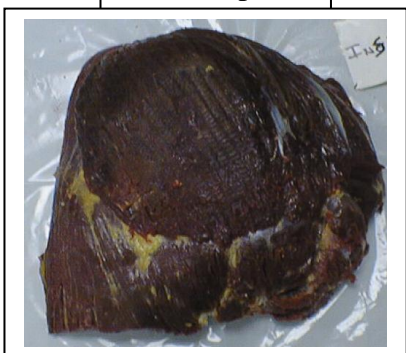
Knuckle

Weight	2,5 - 3,5 kg
% protein	
% fat	
% connective tissue	
% PUFA	
% omega-3 fatty acids	



Rump

Weight	3,4 - 4,2 kg
% protein	
% fat	
% connective tissue	
% PUFA	
% omega-3 fatty acids	



Top round

Weight	3,0 - 3,5kg
% protein	
% fat	
% connective tissue	
% PUFA	
% omega-3 fatty acids	

*Loin muscles*



Filet

Weight	1,4 - 1,8 kg
% protein	
% fat	
% connective tissue	
% PUFA	
% omega-3 fatty acids	



Striploin

Weight	5,5-6,5 kg
% protein	
% fat	
% connective tissue	
% PUFA	
% omega-3 fatty acids	

**Front part muscles**



Neck muscles

Weight	4,5 - 5,5 kg
% protein	
% fat	
% connective tissue	
% PUFA	
% omega-3 fatty acids	



Clod

Weight	1,8-2,4 kg
% protein	
% fat	
% connective tissue	
% PUFA	
% omega-3 fatty acids	

*Trimmings*

Weight	7-8% of side
% protein	
% fat	
% connective tissue	
% PUFA	
% omega-3 fatty acids	



Weight	7-8% of side
% protein	
% fat	
% connective tissue	
% PUFA	
% omega-3 fatty acids	

Trimmings II

## IX. THE CUTS OF ICELANDIC FOAL MEAT.

### *Leg muscles*

Outside

Weight	vantar
% protein	20,5
% fat	5,1
% connective tissue	0,8
% PUFA	28,0
% omega-3 fatty acids	18,1

Knuckle

Weight	vantar
% protein	20,8
% fat	2,1
% connective tissue	1,0
% PUFA	32,5
% omega-3 fatty acids	19,4

Rump

Weight	vantar
% protein	21,0
% fat	4,3
% connective tissue	0,7
% PUFA	29,2
% omega-3 fatty acids	18,3

Top round

Weight	vantar
% protein	21,2
% fat	2,3
% connective tissue	0,6
% PUFA	31,4
% omega-3 fatty acids	18,6

*Loin muscles*

Filet

Weight	vantar
% protein	19,8
% fat	4,6
% connective tissue	0,5
% PUFA	31,3
% omega-3 fatty acids	20,1

Striploin

Weight	vantar
% protein	21,6
% fat	3,0
% connective tissue	0,6
% PUFA	28,6
% omega-3 fatty acids	18,5

*Front part muscles*

Neck muscles

Weight	vantar
% protein	19,0
% fat	8,2
% connective tissue	1,4
% PUFA	28,5
% omega-3 fatty acids	19,5

Clod

Weight	vantar
% protein	20,5
% fat	0,7
% connective tissue	0,6
% PUFA	32,3
% omega-3 fatty acids	18,2

*Trimmings*

Trimmings I

Weight	vantar
% protein	19,6
% fat	5,9
% connective tissue	2,3
% PUFA	29,8
% omega-3 fatty acids	21,3

Trimmings II

Weight	vantar
% protein	19,8
% fat	4,6
% connective tissue	0,5
% PUFA	31,3
% omega-3 fatty acids	20,1



## X. CHEMICAL COMPOSITION OF ICELANDIC HORSEMEAT.

The chemical composition of Icelandic foal meat has recently been analyzed in a project on the influence of fatness score. Foal meat has more fat than beef. The same is true for the meat of older horses. ( Table 10). The Icelandic horsemeat differs from the horsemeat in Europe, which is leaner than beef. ( Manfredini.,1991, Roussier,1988 ).

**Table 10.** The influence of fat class on % protein, % fat and % collagen in fat trimmed muscles in the pistols of foal carcasses.

	Fat class	Protein	Fat	Total Collagen	Collagen/ Protein.
Striploin		%	%	%	%
	II	22,4	1,3	0,9	4,0
	A	21,6	3,0	0,6	2,8
	B	22,1	4,8	0,8	3,4
Top Round					
	II	21,8	1,2	0,7	3,3
	A	21,2	2,3	0,6	2,9
	B	22,4	2,5	0,6	2,9
Knuckle					
	II	21,1	1,1	1,2	5,7
	A	20,8	2,1	1,0	4,6
	B	20,7	2,2	0,9	4,3
Tenderloin					
	II	21,4	2,5	0,6	2,9
	A	19,8	4,6	0,5	2,5
	B	20,5	4,0	0,8	4,1
Rump					
	II	21,7	4,1	0,7	3,4
	A	21,0	4,3	0,7	3,5
	B	21,1	3,9	1,2	5,6
Outside					
	II	21,0	3,9	1,0	4,6
	A	20,5	5,1	0,8	3,9
	B	20,5	6,8	0,8	3,8

**Table 11.** The influence of fat class on % protein, % fat and % collagen in fat trimmed muscles in the pistols of foal carcasses.

	Fat class	Protein	Fat	Total Collagen	Collagen/ Protein.
Clod		%	%	%	%
	II	20,5	0,7	0,8	4,1
	A	20,5	2,8	0,6	3,1
	B	21,3	3,3	0,8	3,6
Prime ribs					
	II	18,6	7,2	1,3	7,1
	A	17,8	13,0	1,4	7,6
	B	17,8	13,1	0,9	5,1
Neck					
	II	20,1	5,0	2,6	13,1
	A	19,0	8,2	1,4	7,5
	B	19,1	7,8	2,0	10,4

**Table 12.** The influence of fat class on % protein, % fat and % collagen in fat trimmed muscles in the pistols of foal carcasses

	Fat class	Protein	Fat	Total Collagen	Collagen/ Protein.
Fat trimmings		%	%	%	%
	A	5,9	79,2	2,8	46,6
	B	8,1	76,1	3,7	45,7
Flank trimmings					
	A	15,8	22,8	1,5	9,3
	B	18,1	19,5	1,4	7,6
Lean trimming II					
	A	19,1	11,5	1,5	7,9
	B	20,2	10,4	2,0	10,0
Lean trimmings I					
	A	19,6	5,9	2,3	11,5
	B	20,8	7,4	2,0	9,5

The protein content of the muscles in the pistol is high, highest in the striploin but lowest in the tenderloin. Fat marbling increases with higher fat class especially in the striploin, tenderloin, top round and outside but not in the rump. Muscle type influences the fat content. The average fat content is 3,0% in the striploin, 2,0 % in the top round, 1,8 % in the knuckle, 3,7% in the tenderloin, 4,1% in the rump and 5,3% in the outside muscles. Connective tissue measured as collagen is very low but there is a difference between muscle types. It is lowest in the most expensive cuts, tenderloin, striploin and top round and higher in less expensive cuts, outside, rump

and knuckle. The amount and type of collagen determines the toughness/tenderness of the meat, which is most influential factor in the pricing of different cuts of meat.

The clod has similar composition as the leg muscles., 20,8% protein, 2,3% fat and 0,7% collagen. The neck and prime ribs have less protein and more fat and connective tissue. The fat in the prime ribs is notably high 11% and the collagen is 1,2%. The neck has the highest amount of connective tissue, 2,0%

The trimmings have very variable composition and processing value.. Lean trimmings I from fat class A have about 20% protein, 5-7% fat and 2% collagen. The protein decreases with increased fat. Trimmings from flanks have about 20% fat, 17% protein and 1,5% collagen. The fat trimmings have about 80% fat, 7% protein and 3,0% collagen. The amount of collagen is less than in similar products of beef and lamb.

#### *The composition of the fat*

The Icelandic horse breed is adapted for surviving cold winters. The main type of feeding is grazing on wild, uncultivated pastures and concentrates are hardly used. The horses gather fat in the summer and autumn, which they slowly lose again during winter until spring. The meat of the old horse is rather fat with good marbling. The color of the fat can be from white to yellow due to the grazing and age of the horses.

The grazing plants are also adapted to the cold climate in Iceland. It influences both the amount of fat on the animals and inside the muscles as well as the composition of the fat. It is very soft with high amounts of omega-3 fatty acids and lower amounts of omega-6 fatty acids.

The proportion of saturated fatty acids does not increase with increased marbling like in beef and lambs. There is even a trend for more omega-3 polyunsaturated fatty acids as the fat in the product increases. There is no great difference between muscle types.

Type of feeding influences the fatty acid composition of the meat. Grazing plants in cold climates have more linolenic acid ( C18:3 omega 3) than plants in warmer climates which contain more of linolenic acid ( C18:2, omega 6). This can easily be seen when the results from Iceland are compared to results from other research. Figure 1. Shows the proportion of C18:3 in different research on horsemeat. There are similar results in three of the papers but in two of them the amount of C18:3

are much less. Instead they are higher in C18:2 and the others lower as can be seen in figure 2.

The fatty acid composition of the foal meat is nutritionally very favorable but it also means that the risk of oxidation is high. Care must be taken in the processing and distribution of the meat. And the exposure to oxygen should be excluded as soon as possible and high temperatures and exposure to light should be avoided all times. The fatty acid composition also indicates that there may be some flavor differences between horsemeat that can be traced to production systems and types of feeding. This in turn leaves back the question of consumer's preferences and market demands.

**Table 13.** Fatty acid composition of fat trimmed muscles in the pistol of Icelandic foal carcasses

Muscle type	% fat	% saturated fatty acids	% unsaturated fatty acids	% polyunsaturated fatty acids	% omega 6 fatty acids	% omega 3 fatty acids
Striploin II	1,3	37,1%	30,3%	28,7%	10,5%	18,0%
Striploin IA	3,0	36,8%	31,9%	29,0%	9,1%	19,6%
Striploin II B	4,8	36,3%	33,3%	27,9%	9,7%	18,0%
Average	3,0	36,8%	31,9%	28,6%	9,7%	18,5%
Topround II	1,2	35,0%	28,1%	31,5%	12,3%	18,9%
Topround IIA	2,3	35,0%	29,9%	31,7%	12,8%	18,6%
Topround IIB	2,5	35,0%	29,6%	31,2%	12,3%	18,5%
Average	2,0	35,0%	29,2%	31,4%	12,5%	18,6%
Knuckle II	1,1	33,8%	27,9%	33,2%	12,8%	20,2%
Knuckle IA	2,1	33,5%	29,9%	31,9%	12,9%	18,8%
Knuckle IB	2,2	33,9%	29,0%	32,3%	13,0%	19,1%
Average	1,8	33,7%	28,9%	32,5%	12,9%	19,4%
Tenderloin II	2,5	35,6%	28,0%	32,4%	11,4%	20,8%
Tenderloin IA	4,6	35,7%	30,8%	31,2%	10,8%	20,0%
Tenderloin IIB	4,0	36,0%	29,2%	30,3%	10,6%	19,4%
Average	3,7	35,8%	29,3%	31,3%	10,9%	20,1%
Rump II	4,1	36,4%	29,2%	29,7%	10,4%	19,1%
Rump IA	4,3	36,0%	31,4%	27,9%	9,8%	17,9%
Rump IB	3,9	36,3%	31,4%	30,0%	10,5%	19,2%
Average	4,1	36,2%	30,7%	29,2%	10,2%	18,7%
Outside II	3,9	38,83%	29,56%	28,00%	9,00%	18,86%
Outside IA	5,1	35,64%	32,67%	28,53%	8,97%	19,26%
Outside IB	6,8	37,74%	33,13%	27,41%	8,20%	19,07%
Average	5,3	37,4%	31,8%	28,0%	8,7%	19,1%

**Table 14.** Fatty acid composition of fat trimmed muscles in the forequarter of Icelandic foal carcasses

Muscle type	% fat	% saturated fatty acids	% unsaturated fatty acids	% polyunsaturated fatty acids	% omega 6 fatty acids	% omega 3 fatty acids
Clod II	0,7	34,7%	23,3%	35,4%	17,9%	17,3%
Clod IA	2,8	35,7%	31,4%	30,7%	11,8%	18,6%
Clod IB	3,3	35,4%	29,6%	30,9%	11,9%	18,8%
Average	2,3	35,3%	28,1%	32,3%	13,9%	18,2%
Prime ribs II	7,2	38,3%	27,1%	31,7%	9,8%	21,6%
Prime ribs IA	13,0	37,1%	32,5%	28,8%	7,6%	20,8%
Prime ribs IIB	13,1	39,3%	31,8%	27,7%	7,1%	20,4%
Average	11,1	38,3%	30,5%	29,4%	8,2%	20,9%
Neck II	5,0	38,7%	26,4%	30,1%	10,2%	19,5%
Neck IA	8,2	37,2%	32,5%	28,0%	7,8%	20,0%
Neck IB	7,8	40,5%	31,5%	27,2%	7,9%	19,1%
Average	7,0	38,8%	30,1%	28,5%	8,7%	19,5%

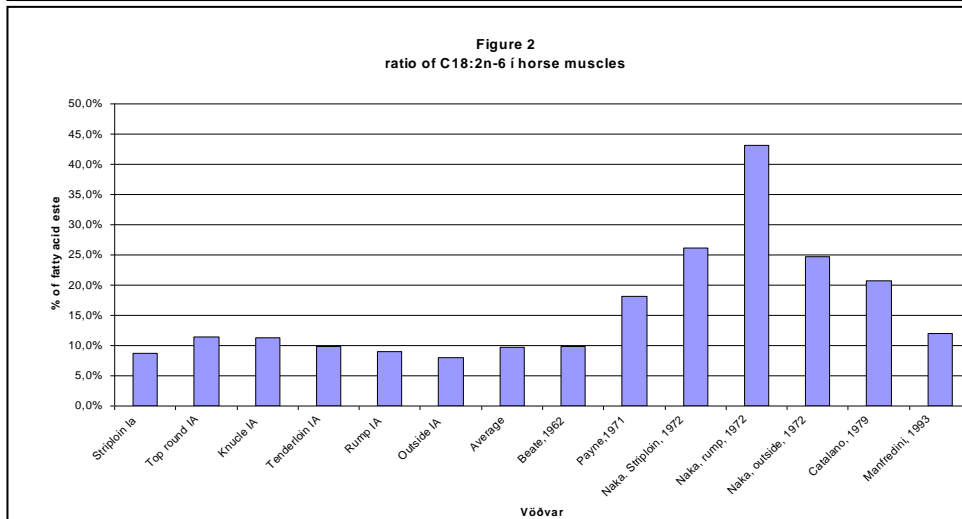
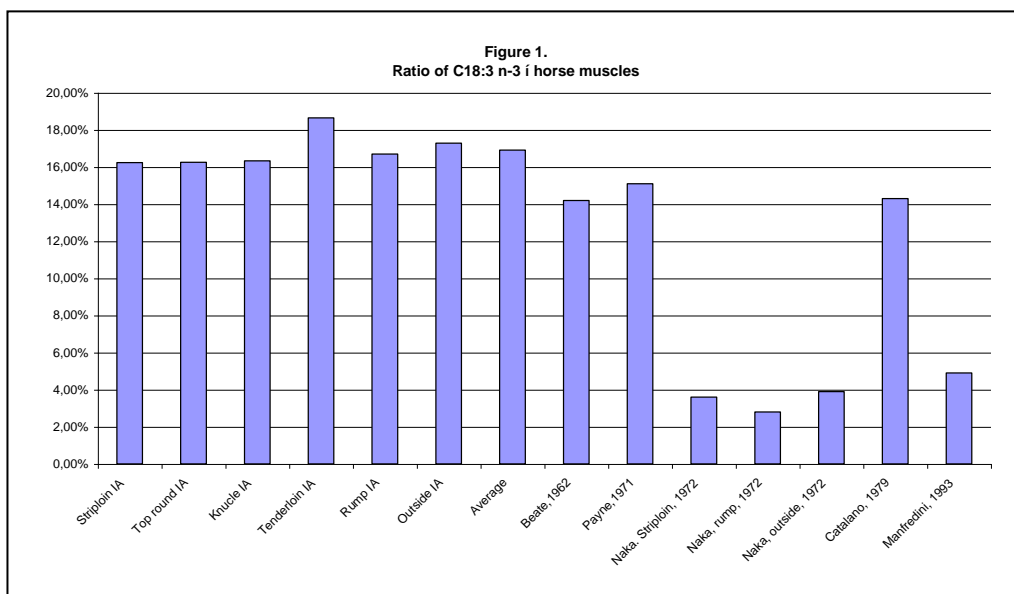
**Table 15.** Fatty acid composition of fat in the trimmings of Icelandic foal carcasses

Muscle type	% fat	% saturated fatty acids	% unsaturated fatty acids	% polyunsaturated fatty acids	% omega 6 fatty acids	% omega 3 fatty acids
Fat trimmings IA	79,2	39,4%	33,2%	27,0%	5,7%	21,1%
Fat trimmings I B	76,1	38,3%	27,1%	31,7%	9,8%	21,6%
Average	77,6	38,9%	30,1%	29,4%	7,8%	21,3%
Flank trimmings IA	22,8	38,5%	33,1%	27,5%	6,3%	21,0%
Flank trimmings IB	19,5	38,8%	31,6%	27,2%	6,5%	20,1%
Average	21,1	38,6%	32,4%	27,3%	6,4%	20,6%
Trimmings I Foreq.	5,9	38,2%	27,3%	32,4%	10,8%	21,3%
Trimmings I Pistol	7,4	38,4%	31,1%	28,4%	7,3%	20,8%
Trimmings II	11,5	37,3%	31,9%	29,1%	7,5%	21,3%
Trimmings II	10,4	37,6%	31,2%	29,4%	7,5%	21,7%
Average	8,8	37,9%	30,4%	29,8%	8,3%	21,3%

Table 16 contains the averages of each muscle and type of trimmings.

**Table 16.** Fatty acid composition of fat trimmed muscles and trimmings of Icelandic foal carcasses

Muscle type	% fat	% saturated fatty acids	% unsaturated fatty acids	% polyunsaturated fatty acids	% omega 6 fatty acids	% omega 3 fatty acids
Striploin	3,0	36,8%	31,9%	28,6%	9,7%	18,5%
Top round	2,0	35,0%	29,2%	31,4%	12,5%	18,6%
Knuckle	1,8	33,7%	28,9%	32,5%	12,9%	19,4%
Filet	3,7	35,8%	29,3%	31,3%	10,9%	20,1%
Rump	4,1	36,2%	30,7%	29,2%	10,2%	18,7%
Outside	5,3	37,4%	31,8%	28,0%	8,7%	19,1%
Clod	2,3	35,3%	28,1%	32,3%	13,9%	18,2%
Prime ribs	11,1	38,3%	30,5%	29,4%	8,2%	20,9%
Neck muscles	7,0	38,8%	30,1%	28,5%	8,7%	19,5%
Fat trimmings	77,6	38,9%	30,1%	29,4%	7,8%	21,3%
Flank trimmings	21,1	38,6%	32,4%	27,3%	6,4%	20,6%
Lean trimmings	8,8	37,9%	30,4%	29,8%	8,3%	21,3%



### *Protein quality*

Horsemeat has been claimed to have superior nutrition quality and digestibility of proteins compared to other types of meat. It has in many scientific papers been claimed to have a very favorable nutritional composition. ( Rossier, 1988 ) . It has a low fat content with high proportion of unsaturated fatty acids, high protein and iron content and a good amount essential amino acids ( Rossier, 1988). Table 17 shows the amino acid composition of the striploin of Icelandic foal compared to the top round of Italian horses.

**Table 17.** The amount of amino acids in the striploin of Icelandic foal and the top round of Italian horses. ( mg/100 g )

	Striploin A	Striploin B	Top round
% protein	21,6	22,1	19,8
<b><i>Essential amino acids</i></b>	g/100g	g/100g	g/100g
Histidine	1,01	0,89	0,90
Isoleucine	0,91	0,91	0,91
Leucine	1,55	1,53	1,52
Lysine	1,77	1,96	1,57
Methionine	0,47	0,48	0,48
Cystine	0,21	0,21	0,20
Phenylalanine	0,91	0,83	0,82
Threonine	0,85	0,84	0,84
Tryptophan	+	+	0,15
Tyrosine	0,81	0,80	0,67
Valine	0,99	1,00	0,96
<b><i>Non-essential</i></b>			
Alanine	1,18	1,18	1,18
Arginine	1,23	1,29	1,17
Aspartic acid	1,72	1,72	1,77
Glutamic acid	3,22	3,24	2,83
Glycine	0,88	0,90	1,04

Proline	0,58	0,62	0,89
Serine	0,71	0,70	0,69

The amount of amino acids in 100 g of meat depends on the amount of proteins, which are influenced, by the amount of fat. This can be corrected by calculating the amount of amino acids is calculated on the basis of nitrogen í the muscle as is done in table 18. The difference in proline can be explained by differences in the amount of connective tissue

**Table 16.** The amount of amino acids in the striploin of Icelandic foal and the top round of Italian horses. ( mg/ gN )

	Striploin A	Striploin B	Top round	Lamb meat	Potatoes
<b>Essential amino acids</b>	<i>g/g N</i>	<i>g/g N</i>	<i>g/g N</i>	<i>g/g N</i>	<i>g/g N</i>
Histidine	0,29	0,25	0,28	0,27	0,13
Isoleucine	0,26	0,26	0,29	0,28	0,16
Leucine	0,45	0,43	0,48	0,50	0,26
Lysine	0,51	0,55	0,50	0,53	0,26
Methionine	0,14	0,14	0,15	0,15	0,08
Cystine	0,06	0,06	0,06	0,08	0,08
Phenylalanine	0,26	0,23	0,26	0,25	0,34
Threonine	0,25	0,24	0,27	0,27	0,16
Tryptophan			0,05		
Tyrosine	0,23	0,23	0,21	0,22	0,18
Valine	0,29	0,28	0,30	0,30	0,23
<b>Non-essential amino acids</b>					
Alanine	0,34	0,33	0,37	0,39	0,18
Arginine	0,36	0,36	0,37	0,34	0,18
Aspartic acid	0,50	0,49	0,56	0,56	1,09
Glutamic acid	0,93	0,92	0,89	1,02	1,17
Glycine	0,25	0,25	0,33	0,31	0,16
Proline	0,17	0,18	0,28	0,24	0,16
Serine	0,21	0,20	0,22	0,24	0,18



The horsemeat has high amounts of essential amino acids especially lysine and threonine but so does the lamb meat also. But when combined with low amounts of connective tissue we can say the horsemeat has good easily digestible protein but not that it is superior in any way to other meat.

#### *Cholesterol og E- vitamin.*

The amount of cholesterol decreases with increased fat. This is very highly favorable for the marbled Icelandic horsemeat that also has high amounts of omega3 fatty acids. The amount of cholesterol is low in foal meat compared to other meat. ( 60 - 70 mg/100g)

**Table 19. The amount of cholesterol and vitamin E in some food products.**

	fat	Cholesterol	Alfa-	(Gamma+beta)-	Delta-
	g/100g	mg/100g	tokoferol	tokoferol	tokoferol
	g/100g	mg/100g	mg/100g	mg/100g	mg/100g
<b>Lamb meat</b>					
loin muscle	2,7	58	0,67	<0,03	<0,02
fat trimmed leg	7,3	71	0,71	<0,03	<0,02
loin chops	20,8	51	0,67	<0,03	<0,02
cutlets	28,0	48	0,79	<0,03	<0,02
Liver	5	317	0,36	<0,03	<0,02
Tallow	100	14	0,92	<0,03	<0,02
<b>Foal meat</b>					
Striploin B	3,0	46	0,44	<0,03	<0,02
Striploin A	1,3	60	0,27	<0,03	<0,02
Trimblings II	11,5	56	0,71	<0,03	<0,02
Fat trimblings	79,2	37	0,19	0,031	<0,02

#### *Vitamins and mineral*

B vitamins and minerals have also been analyses in foal meat.

**Table 20. B-vitamins in Icelandic Foal Meat.**

	No of collective samples	Fólasín	B1 vítamín	B2 vítamín	B6 vítamín

		µg/100g	mg/100g	mg/100g	mg/100g
Striploin IA	3	Nd *	0,07	0,27	0,15
Striploin IB	3	Nd	0,08	0,23	0,16
*) Nd: Non detectable, < 8 µg/100g for fólasín					

**Table 21. Minerals in Icelandic horse meat. ( mg/100g)**

	Striploin		Fat trimmings		Italy
	A	B	Fat A	Fat B	Top round
Calcium	4	4	5	4	3,77
Magnesium	28	28	4	4	28,9
Potassium	418	403	68	56	331
Sodium	37	37	27	24	74,2
Phosphate	216	222	40	33	231
Sulfur	219	226	53	38	
iron	4,6	9	em	em	3,89
manganese	0,02	0,02	0,06	0,09	
zinc	2,1	2,1	0,7	0,4	3,72
Copper	0,13	0,12	0,2	0,06	0,2

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