LIPID COMPOSITION OF LAMB MEAT, AFFECTED BY GENOTYPE AND SEX

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Background

In the last two decades the breeding of sheep in Slovenia has grown up. According to Zagožen (1984), humid climate allows production of meat and milk, but not very high quality wool. Sheep breeding has, therefore, been directed to more meaty crossbreeds, which has enabled the consumption of lamb meat to increase. For the consumers, this trend creates refreshment to nutrition as well as gastronomy.

Lamb meat is a category of red meats, which nutritionally is not highly appreciated because of high fat content and fairly high proportion of saturated fatty acids (SFA). In comparison to other red meats, lamb contains the highest proportion of SFA (52.1%) (beef (44.9%); pork (42.5%)), the lowest proportion of monounsaturated fatty acids (MUFA) (40.5%) (pork (47.9%); beef (49.3%)), and an intermediate proportion of polyunsaturated faty acids (PUFA) (5.0%) (beef (4.3%); pork (8.3%)) (Southgate, 1993). Lipid content and composition of lamb meat are affected by different factors: genotype, animal fattening, animal live weight, age and sex. Breeds for meat production contain less fat than those for milk production (Wood *et al*., 1980, Croston *et al.*,1987, Fisher *et al.,*2000) and there are significant differences in FA composition between different milky breeds (Arsenos *et al.,* 2000). Animal age significantly affects intramuscular fat content (IMF), which is lower in meat of younger animals (Failla *et al*, 1996, Čepin & Žgur, 2003) as well as FA composition (higher degree of SFA, and lower degree of MUFA and PUFA as an animal gets older) (Cifuni *et al.,*2001). The data on the influence of animal sex on IMF content are: female animals contain more fat (Hammel and Laforest, 2000; Mc Clinton and Carson, 2000), but in other experiments no difference was found between sexes (Vergara *et al., 1999)*. There are no data concerning the influence of sex on the FA composition of lamb meat. Cholesterol content of lamb meat varies from about 60 mg/100g to 140 mg/100g (Sevi *et al.,* 1997, Arsenos *et al.,* 2000), and is dependent on the genotype, fatness, age and sex of the animal, as well as analytical method applied.

Objectives

The aim of this research was to investigate the effect of genotype and sex of lambs on the intramuscular fat (IMF) content, cholesterol content and fatty acid composition of meat.

Materials and methods

The experiment was conducted on 24 lambs of two genotypes: improved autochthon Jezersko-Solcavska breed (JSR) and crossbreed between Jezersko-Solcavska and Texel breed (JSR×T). 12 animals (6 male and 6 female) represented each genotype. Lambs were raised by the same farmer under the same feeding system, and were slaughtered at 33–52 kg live weight, at the age range from 91 to 159 days. Left *Longissimis dorsi* muscle from the 7th to the last thoracic vertebra was removed from each carcass 24 h *post mortem,* and the subcutaneous fat was trimmed off. The loins were homogenized with a blender, packed into polyethylene bags and frozen at –21 ºC±1°C until analysed.

Intramuscular fat (IMF) content was determined using the method described in AOAC Official Methods 991.36 Fat (Crude) in Meat and Meat Products (A.O.A.C. 991.36., 1997). The fatty acid composition was determined using the modified *in situ* transesterification method after Park and Goins (1994), as well as the capillary Gas-Liquid Chromatography. The cholesterol content was determined by the modified method adapted from Naeemi *et al.* (1995), as well as with HPLC. All analyses were made in duplicate.

The data were statistically analysed by the least squares method using the GLM procedure (SAS Software. Version 8.01, 1999). The statistical model for IMF content, fatty acid composition and cholesterol content of

lamb included the effects of genotype (G_i; i=JSR, JSR×T), sex (S_j; j=male, female) and repetition (R_k; k=1-6): $y_{ijkl} = \mu + G_i + S_j + R_k + e_{ijkl}$.

Results and discussion

Results of studied effects (genotype and sex) on the quality parameters of lamb meat are presented in table 1.

Lamb meat of two genotypes (JSR + JSR×T) and both sexes contained 2.2 g of intramuscular fat (IMF) and 67.5 mg of cholesterol per 100 g. The IMF content was not influenced by genotype, but was significantly lower in male animals (1.90% vs. 2.45%), which is in accordance with statements of Hammel and Laforest (2000) and McClinton and Carson (2000). The cholesterol content was not affected by genotype or sex, and the relatively low concentrations found correspond with literature (Arsenos *et al.,*2000).

Table 1. Influence of genotype and sex on IMF (g/100g) and cholesterol (mg/100g) content and fatty acid composition (expressed as relative proportion) of the lamb meat (mean values)

Parameter		Breed			Sex		
		JSR (N = 48)	JSR×T (N = 48)	Sign.	Male (N = 48)	Female (N = 48)	Sign.
IMF (g/100g)		2.12	2.14	Ns	1.90	2.45	*
Cholesterol (mg/100g)		64.43	70.52	Ns	70.18	64.77	Ns
Fatty acid:							
Lauric	C 12:0	0.02	0.06	Ns	<0.01	0.08	*
Myristic	C 14:0	2.84	3.11	Ns	2.67	3.28	Ns
Myristoleic	C 14:1, n-5 c	1.79	2.83	Ns	2.79	1.83	Ns
Palmitic	C 16:0	29.67	29.43	Ns	30.04	29.06	Ns
Palmitoleic	C 16:1, n-7 c	2.65	2.54	Ns	2.72	2.46	Ns
Margaric	C 17:0	1.01	1.16	Ns	1.5	1.12	Ns
10-heptadecenoic	C 17:1, n-7 c	0.72	0.62	Ns	0.62	0.72	Ns
Stearic	C 18:0	17.71	6.39	Ns	18.29	15.82	Ns
Oleic	C 18:1, n-9 t	3.53	4.01	Ns	4.47	3.06	***
Oleic	C 18:1, n-9 c	24.73	21.65	Ns	17.39	28.98	Ns
Linoleic	C 18:2, n-6 c,c	10.66	11.44	Ns	13.27	8.83	***
γ-linolenic	C 18:3, n-6 c,c,c	0.40	0.51	Ns	0.33	0.58	Ns
α-linolenic	C 18:3, n-3 c,c,c	0.59	0.96	*	0.72	0.84	Ns
Gadolenic	C 20:1, n-9 c	0.25	0.26	Ns	0.23	0.28	Ns
11,14-eicosadienoic	C 20:2, n-6 c	2.75	3.22	Ns	23.76	2.19	***
Arachidonic	C 20:4, n-6	0.18	0.42	*	0.25	0.35	Ns
5,8,11,14,17-eicosapentaenoic (EPA)	C 20:5, n-3	0.35	0.87	Ns	0.86	0.36	Ns
Erusic	C 22:1, n-9 c	0.08	0.09	Ns	0.08	0.10	Ns
4,7,10,13,16,19-docosahexaenoic (DHA)	C 22:6, n-3	0.07	0.45	Ns	0.46	0.07	Ns
SFA		51.25	50.14	Ns	52.05	49.35	Ns
MUFA		33.74	31.99	*	28.31	37.43	Ns
PUFA		15.01	17.86	Ns	19.65	13.23	***
n-3		1.02	2.28	Ns	2.04	1.27	Ns
n-6		11.24	12.36	Ns	13.85	9.76	***
P/S		0.29	0.37	*	0.29	0.27	***
IA		1.07	1.07	Ns	1.08	1.06	Ns
n-6/n-3		6.56	5.12	*	6.10	5.50	Ns
HH		1.06	0.98	Ns	0.86	1.19	Ns

Sign. - Level of significance: *** – $P \leq 0.001$ highly statistically significant; ** – $P \leq 0.01$ statistically significant;
* - $P \leq 0.05$ statistically significant; Ns – $P \geq 0.05$ statistically not significant;
N=Number of observations;
P/S=PUFA/SFA;
AI=atherogenic index = (C12 + 4 C14 + C16 + trans FA) / (PUFA + C18:1 + MUFA) (Ulbricht *et all*., 1991);
HH=(C18:1 n-9 + C18:2 n-6 + C20:4 n-6 + C18:3 n-3 + 20:5 n-3 + C22:5 n-3 + 22:6 n-3) / (C14:0 + C16:0) (Santos-Silva *et all.,* 2002).

Fatty acid (FA) composition was affected by genotype and sex. The meat of JSR breed vs. JSR×T breed contain significantly higher proportion of α-linolenic (C18:3, n-3), arahidonic (C20:4, n-6) FA, higher MUFA and n-6/n-3 ratio and lower P/S ratio.

The meat of female lambs shows significantly higher total IMF content (2.45% vs. 1.90%) and higher proportion of lauric (C 12:0); proportion of oleic (C 18:1, n-9t), linoleic (C 18:2, n-6) and eicosadienoic acid (C 20:2, n-6c), but proportion of PUFA, n-6 FA and P/S index were significantly lower than in meat of male lambs.

The lambs tested in our experiment showed higher P/S indexes (0.3 – 0.4) than previously reported in literature (0.10 – 0.15) (Rowe *et al.,* 1999; Cifuni *et al*., 2001), reaching the minimum value recommended by Food Advisory Committee (Enser *et al.,* 1998).

Conclusions

Lamb meat of two genotypes (JSR + JSR×T) and both sexes contain 2.2 g/100g IMF and 67.5 mg/100g cholesterol. Neither parameter was affected by genotype or sex.

Fatty acid (FA) composition of meat lipids was affected by genotype and sex when expressed by the P/S ratio. JSR breed and female lambs had lower P/S ratio than the JSR×T breed and male lambs, respectively.

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