

# The effect of lamb genotype on growth, basic characteristics of carcass value and the chemical composition of meat

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## Abstract

The aim of the study was to determine the effect of genotype on the growth, basic characteristics of carcass value and chemical composition of the *Quadriceps femoris* muscle in lambs reared under organic farming conditions. The experimental animals were 24 single male crossbred lambs. Three different genotypes of Suffolk-sired crossbreds were included in the experiment: F1 Suffolk (SF) x Charollais (CH) (SF 50 CH 50; n = 8), F11 Suffolk x Charollais (SF 75 CH 25; n = 8) and F1 Suffolk x Improved Wallachian (IW) (SF 50 IW 50; n = 8). All the lambs were reared in a single flock under the same conditions during the course of the study, with no significant differences in nutrition or management. The study showed that genotype did not have any conclusive effect on average daily gain or carcass yield at the age of slaughter. However, compared to other genotypes, the SF 75 CH 25 crossbred lambs displayed a significantly lower live weight at slaughter, lower carcass weight and lower content of kidney fat. In terms of the chemical composition of the *Quadriceps femoris* muscle, genotype had no significant effect on the content of dry matter, intramuscular fat and ash. This factor did, however, have a significant effect on protein content. Finally, it should be added that the meat of all the studied groups of lambs can be considered lean in view of the fact that the limit of 5% intramuscular fat content was not exceeded in any of the groups.

*Carcass value, chemical composition of meat lambs, crossbreeds, growth*

## Introduction

The breeds Suffolk (SF) and Charollais (CH) are important breeds of sheep reared in the Czech Republic, with the SF breed being the most numerous purebred breed currently reared here. Sheep of the SF breed are reared in the Czech Republic in essentially all production areas, either as purebreds or with rams of this breed being used as sires for commercial crossbreeding with the aim of improving growth properties and carcass value. Sheep of the CH breed, in contrast, are reared primarily in favourable climatic conditions, and generally in purebred form. This breed has also recently begun to be reared in submontane and mountainous regions. It should, however, be stated in regard to the above that lambs of this breed are not especially woolly at birth, and in unfavourable climatic conditions this fact may lead to hypothermia or a poor state of health. For this reason, many farms in submontane and mountainous regions have begun using ewes of the CH breed in commercial crossbreeding with rams of the SF breed. Improved Wallachian (IW) sheep are a minority breed in this country, where part of the population is used for milk production. Nevertheless, the majority of the IW population is reared for the production of slaughter lambs. Commercial crossbreeding is often applied for this purpose, with SF rams being used relatively frequently for this crossbreeding.

The growth and carcass value of lambs are influenced, first and foremost, by nutrition, health, breed and gender (Da Cunha et al. 2000; Kuchtík and Horák 2001).

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The chemical composition of lamb meat is also influenced primarily by the above factors (Kuchtík et al. 1996), though Kremer et al. (2004) state that the live weight of lambs at slaughter is also a relatively important factor.

The aim of this study was to evaluate the influence of various genotypes on the growth, basic indicators of carcass value and chemical composition of the *Quadriceps femoris* muscle in lambs reared under organic conditions.

#### Materials and Methods

The study was conducted on an organic sheep farm in Růžďka, Czech Republic. The pastures on which the lambs were reared are located at an altitude of between 365 and 738 metres above sea level. The average annual temperature was 7.0 °C and the average annual rainfall 880 mm. A total of 24 single rams of the following crossbreeds were evaluated: F1 Suffolk x Charollais crossbreeds (SF 50 CH 50; n = 8), F11 Suffolk x Charollais crossbreeds (SF 75 CH 25; n = 8) and F1 Suffolk x Improved Wallachian crossbreeds (SF 50 IW 50; n = 8). The lambs were born in a barn in the second half of January. All the lambs were reared in the barn with their mothers from birth until the end of April. The lambs' daily feed ration at this time was comprised of their mothers' milk (*ad libitum*), with the lambs also having unlimited access to the feed given to their mothers. The lambs were weaned during the course of the last ten days in the month of April. All the lambs were reared on the pasture from 1<sup>st</sup> May until slaughter. Their daily feed ration at this time was comprised of pasture (*ad libitum*), meadow hay (*ad libitum*) and an organic mineral lick (*ad libitum*). All the lambs were reared in a single flock under the same conditions during the course of the study, with no significant differences in their nutrition or management.

Live weight, age at slaughter and daily average gain were evaluated on the day of slaughter. Carcass weight, carcass yield and proportion of kidney fat were evaluated the following day after the carcasses had cooled for around 24 hours, and samples of *Quadriceps femoris* muscle taken for subsequent chemical analysis. Chemical analyses were performed by standard laboratory methods. Statistical analysis was performed with the use of STATISTICA CZ version 6.

#### Results and Discussion

From Table 1, it is evident that genotype had a significant effect on the live weight of the lambs at slaughter and cold carcass weight, with the highest live weight at slaughter and carcass weight being found in the SF 50 CH 50 crossbreeds. In contrast, the lowest live weight at slaughter and the lowest carcass weight were found in SF 75 CH 25 crossbreeds. Genotype did not, however, have a conclusive effect on the lamb growth, with the average daily gains ranging from 190.8 g to 198.3 g depending on the given group. In general terms, however, the average daily gains were relatively low in all the groups of SF crossbreeds in comparison with the results stated for various SF crossbreeds by Bianchi et al. (2003) and Snowden and Duckett (2003). The relatively low average daily gains seen in the lambs in our study can be explained by their relatively extensive nutrition and relatively unfavourable climatic conditions (high rainfall and low night temperatures) during the course of the study. On the other hand, however, it should be added that the average daily gains we found in lambs are comparable with the gains seen in SF crossbreed lambs stated by Fantová and Čislíková (1991) and Da Cunha et al. (2000).

The genotype also did not have a conclusive effect on carcass yield, a finding that agrees with the results reported by Kuchtík and Horák (2001) and Gutiérrez et al. (2005). In contrast, Rhee et al. (2003) and Kremer et al. (2004) recorded a conclusive effect of genotype on this indicator. As far as the proportion of kidney fat is concerned, a conclusively higher proportion was found in SF 50 CH 50 crossbreeds. In our opinion, the proportions of kidney fat seen in the individual genotypes in our study were influenced, first and foremost, by the differing average live weight at slaughter of the individual groups of lambs. The proportions of kidney fat seen in our study ranged from 0.11 to 0.29%, which corresponds to the figures published by Archimede et al. (2008), whose study showed the proportion of kidney fat increasing gradually in dependence on the addition of concentrates.

Table 1. The effect of genotype on the growth and basic indicators of carcass value in lambs

Indicator	Genotype		
	SF 75 CH 25	SF 50 CH 50	SF 50 ZV 50
Live weight at birth [kg]	3.8 ± 0.38	4.1 ± 0.26	4.1 ± 0.33
Live weight at slaughter [kg]	32.1 <sup>Aa</sup> ± 1.08	38.4 <sup>B</sup> ± 1.70	37.1 <sup>b</sup> ± 1.67
Age at slaughter [days]	150.0 ± 16.5	181.0 ± 10.93	173.8 ± 12.78
Daily gain [g]	198.3 ± 12.09	190.8 ± 4.33	193.9 ± 9.16
Carcass weight [kg]	14.1 <sup>Aa</sup> ± 0.49	16.8 <sup>B</sup> ± 0.59	16.0 <sup>b</sup> ± 0.61
Carcass yield [%]	43.79 ± 0.33	44.10 ± 0.89	43.27 ± 0.94
Kidney fat [%]	0.11 <sup>A</sup> ± 0.02	0.29 <sup>B</sup> ± 0.05	0.20 ± 0.02

<sup>a,b</sup>:  $P \leq 0.05$ ; <sup>A,B</sup>:  $P \leq 0.01$ ; ( $\pm$  SEM)

Evaluation of the chemical composition of *Quadriceps femoris* muscle (Table 2) shows that genotype had no conclusive effect on the content of dry matter, intramuscular fat or ash. The content of dry matter was almost identical in all groups of SF crossbreeds, with values comparable with the figures published by Kuchčík et al. (1996) and Foti et al. (2005). The content of intramuscular fat in our study ranged from 2.1 to 2.7% which are values comparable with the figures found by Kuchčík et al. (1996) in various muscles in lambs of the Charollais and Merino breeds. The Food Advisory Committee (1990) states that the given muscle can be considered lean if the intramuscular fat content in the meat is lower than 5%. Respecting the above, it must be added that the lamb meat from all three studied groups of lambs can also be considered lean in view of the fact that the limit value of 5% intramuscular fat content was not exceeded in any group.

Table 2. The effect of genotype on the chemical composition of *Quadriceps femoris* muscle

Indicator [%]	Genotype		
	SF 75 CH 25	SF 50 CH 50	SF 50 ZV 50
Dry matter	23.42 ± 18.7	23.17 ± 26.0	23.22 ± 28.3
Intramuscular fat	2.69 ± 15.3	2.12 ± 22.7	2.28 ± 31.1
Proteins	19.24 <sup>a</sup> ± 19.4	19.79 <sup>b</sup> ± 10.2	19.701 <sup>b</sup> ± 13.6
Ash	1.12 ± 0.1	1.12 ± 0.1	1.49 ± 0.1

<sup>a,b</sup>:  $P \leq 0.05$ ; ( $\pm$  SEM)

The ash content seen in our study ranged from 1.1 to 1.2%, which are also values comparable with the figures given by Kuchčík et al. (1996). In conclusion, it must be said of the chemical composition of *Quadriceps femoris* muscle that while genotype significantly affected the content of protein in this muscle, this fact was, in our opinion, influenced first and foremost by both, the lowest live weight at slaughter and the lowest carcass weight in SF 75 CH 25 crossbreed lambs, in which the lowest protein content was also found. This explanation is also in agreement with the conclusions stated by Kremer et al. (2004).

### Conclusions

Our study showed that genotype had no conclusive effect on age at slaughter, average daily gain or carcass yield. Nevertheless, a significantly lower live weight at slaughter,

lower carcass weight and lower proportion of kidney fat were found in SF 75 CH 25 lambs. It can be stated in relation to the chemical composition of *Quadriceps femoris* muscle that genotype had no conclusive effect on the content of dry matter, intramuscular fat or ash. Nevertheless, this factor did have a significant effect on the protein content. Finally, we might add that the meat of all the groups of lambs studied can be considered lean in view of the fact that the limit of 5% intramuscular fat content was not exceeded in any group, and that all the studied genotypes can also be considered suitable for rearing in the given region.

#### Acknowledgements

This work was realised with the support of the project MSM 2B06108.

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