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EVALUATION OF THE EFFECT OF BREED AND LINE ON SLAUGHTER VALUE AND QUALITY OF LAMB MEAT

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Abstract

The aim of our experiment was to evaluate to what degree carcass value and quality of lamb meat are effected by selected breeds (Zwartbles, Suffolk, Romney Marsh) and lines (Zbyšek, Ztepl, Záblesk, Ewebank Armani, President, Romeo, Avatar). Suffolk breed rams were found to have ($p \leq 0.05$) the lowest weight at slaughter (37.47 ± 4.10 kg) and also carcass weight (15.23 ± 1.78 kg). Romney Marsh's carcasses had a significantly higher degree of fat cover (3.6 ± 0.4), kidney fat ratio was 0.78 ± 0.17 % and the percentage of fat from the right leg was 2.50 ± 0.61 %. The conclusively ($p \leq 0.01$) highest ratio of the right leg was recorded in the Suffolk breed (17.00 ± 0.79 %). The highest ratio of the leg of carcass among the lines was found in the President line (17.53 ± 0.66 %). Meat of the Suffolk line had the significantly ($p \leq 0.01$) highest ratio of dry matter, intramuscular fat, protein and ash. Among the lines, this trend was similar in favor of the Suffolk's line. The Zwartbles breed had the lowest ($p \leq 0.01$) ratio of fat and dry matter in the meat. The value of pH, lightness ($L^* = 51.55 \pm 1.66$) and color spectrum b* (13.12 ± 0.46) of meat was conclusively ($p \leq 0.01$) the highest in the Zwartbles breed, while the redness indicator (7.56 ± 1.45) was conclusively the lowest for this breed. Statistically ($p \leq 0.01$), the meat of the Suffolk breed had the most potent red color ($a^* = 11.87 \pm 1.24$) and the highest water-holding capacity (81.57 ± 1.87).

Keywords: lamb, carcass, linie, Zwartbles, Suffolk, Romney Marsh

INTRODUCTION

Sheep breeding has a long history in the Czech Republic and is inherent in our country. In 2016, 218 493 sheep were kept in our country. Of this number, 129 491 were ewes. 23 686 ewes were involved in performance control. The majority of the kept breeds are those of combined utility type, followed by meat breeds. Dairy and reproductive breeds are represented in smaller numbers in our country (Bucek *et al.*, 2017). The main purpose of sheep breeding in our country is the production of meat, or the sale of live lambs. When selling live lambs, the buyers place higher financial value on lambs of those breeds, for which a low percentage of fat in carcass is typical. The Suffolk or Romney Marsh are therefore a suitable alternative for beginner breeders in our conditions however in case of the Romney Marsh it is necessary to terminate fattening at a live weight of 35 kg due to the storage of subcutaneous and intermediate fat. The Dutch breed Zwartbles also enjoys growing popularity among new breeders. The increase in livestock numbers is evident especially in holdings where performance control has been applied.

In the context of performance control, the height of subcutaneous fat and the depth of the longest back muscle in the selected meat and combined breeds of sheep are monitored ultrasonographically, wherein the animals with low height of subcutaneous fat and simultaneously with sufficient height of the longest back muscle corresponding to the weight and age of the individual are predicted to receive good evaluation. The importance of this action for successful breeding on meat performance is also confirmed by Teixeira *et al.* (2006).

There are a number of factors, whether external or internal, which effect carcass value and meat quality. Out of internal influences, breed plays a significant role according to Dobeš *et al.* (2007), Simeonov *et al.* (2014), Turner *et al.* (2014), Souza *et al.* (2016), Komprda *et al.* (2012) and Jandasek *et al.* (2014). The aim of this study was to evaluate the effect of the breed and line on slaughter value and quality of lamb meat.

MATERIALS AND METHODS

The experiment was carried out on a farm, whose pastures lie on the border of the Zlín and South Moravian regions. Sheep of the Suffolk, Romney Marsh and Zwartbles breed are kept here under the same conditions. Performance control is applied in all herds, which makes them purebred breeds. The winter feed consisted of meadow hay, clover-grass silage and the addition of barley scrap at a dose of about 150 g/subject/day. Additionally, the animals had access to mineral lick and water *ad libitum*. Sheep breeding took place from mid-March to mid-April. The experimental lambs were male animals that were reared under their mothers until the age of 100 days. After reaching 100 days of age, the lambs were weaned from the ewes and fattened separately. The feed ration of the lambs consisted exclusively of breast milk in the first weeks of their life. Following the development of proventriculus, the lambs started receiving identical feed rations as their mothers. No supplementary feed of the lambs with the aid of „nurseries“ was used.

After the termination of fattening (120 days of age), rams of the Zwartbles breed (n = 18), including the lines Zbyšek, Ztepl and Záblesk, rams of the Suffolk breed (the Ewebank Armani and President lines) and rams of the Romney Marsh breed (the Romeo and Avatar lines) were weighed and transported to a commercial abatoir. Each line was represented by 6 rams. A professionally qualified classifier performed a subjective assessment of conformation and fat cover according to the SEUROP (Commission Regulation EEC 461/93) method. Carcasses were stored in a refrigerated box at + 4 ° C for 24 hours. Subsequently, cold weighing of carcasses, including kidneys and kidney fat, kidneys, kidney fat and the right leg for the purpose of determining the carcass value was performed. The percentages of the individual parts of the carcass were calculated from the obtained weights. As a part of our experiment, the proportion of meat, fat and bone from the total weight of the right leg was also determined. Simultaneously, a sample of meat weighing approximately 300 g was taken from this hind (all four parts of MQF, *m. rectus femoris, m. vastus lateralis, m. vastus medialis* and *m. vastus intermedius* constituted one meat sample) for the purpose of determining the nutritional and technological characteristics of the meat.

The analyzes were carried out in the laboratory of the Department of Animal Breeding of Mendel University in Brno. For determination of dry matter content, 5 g of meat was separated and mixed with dried sea sand. This process was followed by drying in a drying oven for 2 hours at 60 °C and consequently for 5 to 7 hours at 103 °C to constant weight. After that, the sample was cooled in the desiccator and weighed. The amount of intramuscular fat was determined by extraction with diethyl ether in the extraction extension of the Soxlet apparatus. Following the 6 hour long extraction, the extraction agent was evaporated and chilling in the desiccator was carried out. The Kjeldalha method, in which the content of nitrogenous substances is determined first, was used to determine the protein content. The meat sample was boiled along with sulfuric acid in the presence of a catalyst. Nitrogenous substances contained in the meat were transformed into ammonia, respectively bound as ammonium sulphate. Next, distillation of this compound with sodium hydroxide to boric acid was carried out. An excess of boric acid was found through titration and then the nitrogen content (ammonia) was determined by subtracting the original amount of boric acid from the final measured excess of this acid. The obtained value of nitrogenous substances was multiplied by a factor of 6.25. The determination of ash content was found by burning a determined sample volume in an electric oven at a temperature of 550–600 °C for 8 hours. Thereafter, the samples were placed in a desiccator, where they were cooled. The remainder of the sample was weighed and the mass percentage of ash in the individual meat samples was determined.

Determination of the water-binding capacity of meat was performed according to Honikel (1998), where 2 g of meat from the individual samples were used. The method of Hornsey (1956) was used to determine the content of muscle pigments. Determination of the pH value was performed by a puncture probe with the pH340/SET-1 device. Determination of the color of the meat was performed according to the method of Dračková *et al.* (2016) based on the L* (lightness), a* (red/green color), b* (yellow/blue color), which were measured using a Minolta CD – 2600d photospectrometer on a pre-separated piece of meat.

Statistical results were obtained by means of analysis of variance using STATISTICA CZ version 12, according to the following model:

$$Y = \mu + B_i + L_j + e_{ij}$$

In which
μ…arithmetic mean
Bi...effect of breed (Suffolk, Romney Marsh, Zwartbles)
Lj...effect of line of breeding (Zbysek, Ztepl, Zablesk, Ewebank Armani, President, Romeo, Avatar)
eij…residual error.
The HSD test was used to analyse differences between means.

RESULTS AND DISCUSSION

The evaluation of the effect of breed and line on carcass value indicators are listed in Tab. I.

Conclusively, ($p \leq 0.05$) the lowest weight before slaughter was found in rams of the Suffolk breed (SF), namely 37.47 ± 4.10 kg. In the case of animals of the Zwartbles (ZW) and Romney Marsh (K) breed, this weight was 41.06 ± 6.04 kg and 42.08 ± 2.51 kg respectively.

When comparing the effect of line on the weight of the animals before slaughter, in the case of the ZW breed the Ztepl line was found to have a conclusively ($p \leq 0.01$) higher weight (44.78 ± 6.18 kg) than the Záblesk line (35.07 ± 3.89 kg). The weight of the Záblesk line and Ewebank Armani animals before slaughter was significantly lower ($p \leq 0.05$) in comparison to the Zbyšek and Romeo lines, and furthermore in case of the Ewebank Armani line also in comparison to the Ztepl line. Carcass weight among the studied breeds was significantly ($p \leq 0.01$) the lowest in the SF breed (15.23 ± 1.78 kg). Jandasek *et al.* (2014) reported a higher carcass weight (16.6 ± 0.99 kg) for the same breed in their study, at a slaughter weight of 34.00 ± 1.62 kg. Similarly, according to the results of the work by Turner *et al.* (2014), who published a lamb carcass weight of 18.7 ± 0.9 kg at slaughter weight 36.7 ± 1.3 kg, it can be stated that the rams of the SF breed in our experiment had the lowest growth potential. Carcass weight of the ZW and K breeds was 18.11 ± 2.95 kg and 19.45 ± 0.86 kg respectively. These results do not correspond with studies by Komprda *et al.* (2012), in which the authors failed to prove the effect of breed on carcass weight. Concerning the comparison between individual lines, carcass weight was logically the lowest in the lines of the SF breed. For lambs of the President line, carcass weight was significantly ($p \leq 0.01$) lower, namely 14.61 ± 0.62 kg. The second conclusively ($p \leq 0.05$) lowest weight was found in the animals of the Záblesk line (15.58 ± 2.30 kg). The results of our study show that the K breed had a conclusively ($p \leq 0.01$) higher carcass yield (46.32 ± 2.54 %) than the SF breed (40.75 ± 3.14 %); the ZW breed also significantly ($p \leq 0.01$) lagged (43.88 ± 1.55 %) behind the K breed. On the other hand, when comparing carcass yield between the combined breed ZW and the meat breed SF, the results showed conclusive ($p \leq 0.05$) differences in favor of the ZW breed. These carcass yield results were not expected, as SF is a meat breed whose carcass yield typically reaches 46 %. The lambs of the President line had the very lowest carcass yield among the evaluated lines (38.67 ± 2.60 %). The line of the same breed, Ewebank Armani, had a significantly ($p \leq 0.05$) higher carcass yield (42.83 ± 2.13 %). The lines of the ZW and K breeds had significantly ($p \leq 0.01$) higher harvest yields than the President line. The very highest carcass yield was found in the Avatar line (47.18 ± 1.93 %), these values being significantly ($p \leq 0.05$) higher than in the Zbyšek and Ewebank Armani lines.

No conclusive ($p \geq 0.05$) differences between the breeds or lines were found in the evaluation of conformation. In the case of statistical evaluation of fat cover, the animals of the K breed (3.6 ± 0.4 point) had highly conclusively ($p \leq 0.01$) higher values than those of the ZW breed (2.4 ± 0.5 point). Similarly, the animals of the SF breed (2.8 ± 0.7 point) were found to have a conclusively ($p \leq 0.05$) lower degree of fat cover than those of the K breed. In evaluation of the effect of lineage on the above mentioned trait, both lines of the K breed had a significantly ($p \leq 0.01$) higher degree of fat cover in comparison to the Ztepl and Záblesk lines and also to the carcasses of the Zbyšek line ($p \leq 0.05$). It is commonly known that animals of the K breed have a higher tendency to produce subcutaneous fat after reaching the live weight of 35 kg. In our study, the same statistical relationships between the monitored breeds were found for the indicator of kidney ratio of carcass weight of JUT, as in the case of comparison of the degree of fat cover. Liu *et al.* (2015) reported a 0.33 ± 0.02 % kidney ratio of total carcass weight in the Oulu breed at carcass weight of 17.72 kg. In the Romeo (0.78 ± 0.08 %) and Avatar line (0.8 ± 0.08 %), kidneys also constituted a significantly ($p \leq 0.05$) higher ratio of carcass weight than in the Ztepl line (0.64 ± 0.06 %). Janoš *et al.* (2018) reported a kidney fat ratio at 61 % for the Ztepl line. The conclusively ($p \leq 0.05$) lowest proportion of kidney fat was found in the ZW breed (0.56 ± 0.23 %). This indicator was 0.81 ± 0.26 % in the SF breed and 0.78 ± 0.17 % in case of the K breed. In the study by Kuchtík *et al.* (2004), the ratio of kidney fat in the Charollais breed was found to be 0.55 ± 0.09 % at an average slaughter weight of 40 kg. In our study, no significant ($p \geq 0.05$) effect of line on the kidney fat ratio was found. Another evaluated part of carcasses was the leg of the right half of the carcass. When assessing the right leg ratios, significant ($p \leq 0.01$) differences between the breeds studied by us (Tab. I) were discovered. The highest ($p \leq 0.01$) leg ratio was recorded in the rams of the SF breed (17.00 ± 0.79 %). In carcasses of the ZW rams, the leg ratio 16.20 ± 0.46 %, while the conclusively lowest leg ratio of the leg was found in the rams of the K breed. It was interesting to find out that the breed with the lowest carcass weight had the highest ratio of one of the most valuable parts such as the leg. In the case of specimen of the President line, the leg ratio was statistically ($p \leq 0.01$) highest (17.53 ± 0.66 %). On the contrary, the lowest leg ratio was recorded in the carcasses of the Romeo line (15.42 ± 0.21 %). A statistically highly significant ($p \leq 0.01$) difference was documented between this value and the leg ratio in both lines of the SF breed. The leg ration of the Romeo line was also significantly lower ($p \leq 0.05$) in comparison to the leg ration in subjects of the Ztelpl line (ZW breed). When assessing the ratio of leg meat, a conclusive difference of 95 % was found between the ZW and SF breeds. In the SF breed, the meat ratio was smaller by 1.75 % than that of the ZW breed. The leg meat ratio in rams of the K breed was 74.89 ± 1.45 %. In the President line, which had the significantly ($p \leq 0.01$) highest leg ratio, paradoxically the lowest meat ratio (71.81 ± 2.36 %) was found. The Zbyšek (75.29 ± 1.89 %), Ztepl (75.11 ± 1.16 %) and Romeo (75.02 ± 1.42 %) lines had a conclusively ($p \leq 0.05$) higher ratio of meat on the leg than in the case of the President line (71.81 ± 2.36 %). The effect of breed and line did not have a conclusive ($p \geq 0.05$) impact on the ratio of leg fat, however, the highest ratio of detachable fat (2.50 ± 0.61 %) was proven to be found in the K breed. Within the individual lines, the highest proportion of fat in was recorded the Ztepl line (2.71 ± 0.84 %) and the lowest in the Záblesk line (1.89 ± 1.02 %), also belonging to the ZW breed. The most significant ($p \leq 0.05$) bone ratio of the total leg weight was recorded in the SF breed (24.26 ± 2.74 %). In the case of the effect of line on the ratio of this tissue, a conclusive ($p \leq 0.05$) relation between the President and the Ztepl line was recorded, with the highest ratio being in the President line (25.07 ± 2.79 %) and the very lowest in the Ztepl line (ZW breed) (21.74 ± 1.43 %).

A sample of meat from the right leg was used to determine the nutritional and technological quality of the lamb meat. The results of chemical analyzes suggest significant differences in dry matter, protein, intramuscular fat and ash content (Tab. II). The highest ($p \leq 0.01$) content of dry matter was recorded in the SF breed (23.46 ± 0.48 %). The second highest ($p \leq 0.01$) content of dry matter was found in the meat of the K breed (22.21 ± 0.50 %). On the contrary, the lowest ($p \leq 0.01$) content of dry matter was found in lamb meat of the combined ZW breed. Difference between breeds was also proven by Komprda *et al.* (2012). The authors recorded identical statistical differences between the SF and ZW breeds. A similar development of results also occurred within the lines where the lines of the SF breed had a significantly ($p \leq 0.01$) higher dry matter content than those of the ZW and K breeds. Rams of the Romeo line had a higher

($p \leq 0.05$) dry matter content (22.28 ± 0.49 %) in meat than the those of the Zbyšek line (21.24 ± 0.41 %). Significantly ($p \leq 0.01$) lowest intramuscular fat content in our experiment was found in the ZW breed (0.88 ± 0.34 %). The SF breed had intramuscular fat content of 1.65 ± 0.41 % and a the K breed 1.49 ± 0.22 %. In ZW lines, the intramuscular fat content did not exceed 1.00 %. Differences between breeds in intramuscular fat content have also been published by Souza *et al.* (2016). In the meat of the Zbyšek line, the intramuscular fat concent was conclusively ($p \leq 0.01$) lower than in that of the Ewebank Armani, President and Avatar line. In the case of the Ztepl line, intramuscular fat content was 0.97 ± 0.37 %. The rams of the President line (SF breed) showed a higher incidence of intramuscular fat formation (1.73 ± 0.52 %). It can also be noted that both lines of the ZW breed had the lowest intramuscular fat content (Záblesk = 0.93 %; Zbyšek = 0.73 %). Our study also showed a conclusive ($p \leq 0.01$) effect of breed on protein content in lamb meat, wherein higher ratio of protein (20.33 ± 0.33 %) was found in the meat of the SF breed lambs, compared to the ZW (19.11 ± 0.32 %) and K breeds (19.36 ± 0.38 %). Hoffman *et al.* (2003) reported a protein content of 18.83 % for their group of monitored animals. The Study by Komprda *et al.* (2012) did not confirm the difference between the SF and ZW breeds. Both lines of the SF breed had a significantly ($p \leq 0.01$) higher protein content in the meat than those of the ZW and K breeds. In the case of ash, a difference between breeds was also noted.

Again, the highest ($p \leq 0.01$) ratio was found in the SF breed (1.15 ± 0.02 %). Pérez *et al.* (2002) reported ash content in the meat of the Suffolk breed at 1.11 ± 0.05 %. For the ZW breed, the ash ration was 1.12 ± 0.02 %. The lowest ($p \leq 0.01$) ash content was in the meat of the K breed (1.09 ± 0.01 %). No significant ($p \geq 0.05$) differences between lines within individual breeds were found in the line effect assessment, differences were recorded only between lines of different breeds. The meant of the animals of the Ewebank Armani and President lines had a nonsignificantly ($p \geq 0.05$) higher ash ratio than the Romeo and Avatar lines.

The selected technological properties of lamb meat are listed in Tab. III. In our study, there were significant differences among breeds between most monitored indicators. In the case of water binding, the conclusively ($p \leq 0.01$) highest values were recorded in the meat of the SF breed (81.57 ± 1.87 %). In the ZW breed there was a decline in the capacity of meat to bind free water. The lowest ($p \leq 0.01$) water-binding capacity was found in the K breed (72.90 ± 2.46 %). When comparing the effect of line on the indicator of water-binding capacity of meat, significant ($p \leq 0.01$) differences between the lines of the SF breeds and other monitored lines were found. For lines of the SF bree, the value for water-binding capacity was over 81 %. For other lines surveyed by us, this value ranged from 72.62 to 75.79 %. Compared to our results, the data presented in the work by Komprda *et al.* (2012) do not confirm the effect of the line on the capacity of meat to bind water. Myoglobin content was conclusively ($p \leq 0.01$) highest in the SF (2.85 ± 0.37 mg in 1 g of meat) and K breeds (2.91 ± 0.27 mg in 1 g of meat). ZW rams had the lowest ($p \leq 0.01$) content of myoglobin (1.80 ± 0.28 mg in 1 g of meat). In the context of the assessment of the impact of line on myoglobin content, significantly ($p \leq 0.01$) lower values were found in all ZW lines, below the level of 2 mg in 1 g of meat. In lines of the SF and K breeds, myoglobin content ranged between 2.70–3.08 mg in 1 g of meat. The pH level among the breeds studied by us was nonsignificantly ($p \geq 0.05$) lower in the SF (5.60 ± 0.10) and K breeds (5.59 ± 0.03) compared to the meat of the ZW breed (5.70 ± 0.04). The results of our study are contrary to the study by Komprda *et al.* (2012), who did not confirm the difference in pH values between the SF and ZW breeds. The pH values did not reach significant ($p \geq 0.05$) differences between the lines. The color of the meat can also be evaluated by the intensity of the color spectra L*, a*, b*. The effect of breed was evident for the indicator of meat lightness (L*). In our experiment, the value of this indicator was the highest ($p \leq 0.01$) in the ZW breed (51.55 ± 1.66). The meat of lambs of the SF and K breeds was darker (SF: L* = 40.85; K: L* = 40.28). Higher L* values were found by Souza *et al.* (2016) in their experiment; on the contrary, almost the same values for the Oulu breed were recorded by Liu *et al.* (2015). Regarding the effect of line, dominance ($p \leq 0.01$) of all lines of the ZW breed over the SF and K lines was apparent. The Záblesk line (L* = 52.26 ± 2.06) had the lightest meat and the Avatar line (L* = 39.81 ± 1.12) the darkest. This is also related to the color spectrum parameter a* (green–red color ratio). The most vivid ($p \leq 0.01$) red color was found in the meat of the SF breed (a* = 11.87 ± 1.24), while the meat of the ZW breed had a pinker hue (a* = 7.56 ± 1.45). Pannier *et al.* (2010) report that red meat is

I: *Carcass value*

Trait	Breed			Line						
			ZW		SF		K			
	Zwartbles (n = 18)	Suffolk (n = 12)	Romney Marsh (n = 12)	Zbyšek (n = 6)	Ztepl (n = 6)	Záblesk (n = 6)	Ewebank Ar. (n = 6)	President (n = 6)	Romeo (n = 6)	Avatar (n = 6)
	x̄ ± sx	x̄ ± sx	x̄ ± sx	x̄ ± sx	x̄ ± sx	x̄ ± sx	x̄ ± sx	x̄ ± sx	x̄ ± sx	x̄ ± sx
LWS (kg)	41.06^{a} ± 6.04	37.47^{b} ± 4.10	42.08^{a} ± 2.51	43.32^{a} ± 2.19	44.78^{Aa} ± 6.18	35.07^{Bb} ± 3.89	37.08^{b} ± 5.83	37.85 ± 1.63	42.48^{a} ± 2.48	41.67 ± 2.71
CCW (kg)	18.11^{A} ± 2.95	15.23^{B} ±1.78	19.45^{A} ± 0.86	18.78^{A} ± 1.25	19.95^{Aa} ± 3.24	15.58^{Bb} ± 2.30	15.86^{b} ± 2.37	14.61^{B} ± 0.62	19.27^{Aa} ± 0.73	19.63^{Aa} ± 1.01
CY (%)	43.88^{Ab} ± 1.55	40.75^{B} ± 3.14	46.32^{Aa} ± 2.54	43.35^{Ab} ± 1.52	43.98^{A} ± 1.31	44.30^{A} ± 1.89	42.83^{b} ± 2.13	38.67^{Bc} ± 2.60	45.47^{A} ± 2.95	47.18^{Aa} ± 1.93
Conformation score	3.8 ± 0.5	3.8 ± 0.4	3.5 ± 0.5	3.8 ± 0.4	4.0 ± 0.00	3.7 ± 0.8	3.8 ± 0.4	3.8 ± 0.4	3.3 ± 0.4	3.8 ± 0.4
Fatness score	2.4^{B} ± 0.5	2.8^{b} ± 0.7	3.6^{Aa} ± 0.4	2.5^{b} ± 0.5	2.3^{B} ± 0.5	2.3^{B} ± 0.5	3.0 ± 0.9	2.7 ± 0.5	3.7^{Aa} ± 0.4	3.6^{Aa} ± 0.5
Kidney (%)	0.68^{B} ± 0.07	0.7^{b} ± 0.07	0.79^{Aa} ± 0.08	0.7 ± 0.08	0.64^{b} ± 0.06	0.71 ± 0.06	0.7 ± 0.09	0.71 ± 0.05	0.78^{a} ± 0.08	0.8^{a} ±0.08
Kidney fat (%)	0.56^{b} ± 0.23	0,81^{a} ± 0.26	0.78^{a} ± 0.17	0.53 ± 0.19	0.56 ± 0.24	0.58 ± 0.28	073 ± 0.24	0.88 ± 0.29	0.86 ± 0.2	0.69 ± 0.06
Rump (%)	16.20^{B} ± 0.46	17.00^{A} ± 0.79	15.57^{C} ± 0.35	16.32^{Ba} ± 0.30	16.05^{B} ± 0.56	16.22 ± 0.53	16.48^{B} ± 0.52	17.53^{A} ± 0.66	15.42^{BCb} ± 0.21	15.72^{B} ± 0.40
Meat from the rump (%)	75.01^{a} ± 1.40	73.26^{b} ± 2.41	74.89 ± 1.45	75.29^{a} ± 1.89	75.11^{a} ± 1.16	74.64 ± 1.21	74,71 ± 1,49	71.81^{b} ± 2.36	75.02^{a} ± 1.42	74.75 ± 1.60
Fat from the rump (%)	2.20 ± 0.95	2.24 ± 0.78	2.50 ± 0.61	2.00 ± 0.91	2.71 ± 0.84	1.89 ± 1.02	2.17 ± 0.96	2.31 ± 0.65	2.58 ± 0.35	2.43 ± 0.83
Bone from the rump (%)	22.47^{b} ± 1.45	24.26^{a} ± 2.74	22.25^{b} ± 1.35	22.07 ± 0.87	21.74 ± 1.43	23.58 ± 1.42	23.44 ± 2.67	25.07^{a} ± 2.79	21.87 ± 1.31	22.63 ± 1.39

a, b = p ≤ 0.05; A, B = p ≤ 0.01, LWS – live weight at slaughter, CCW – cold carcass weight, CY – carcass yield generally considered to be a significant source of valuable protein and iron in human nutrition. In the evaluation of indicator b* (yellow/blue color ratio), the value in the ZW breed (13.12 ± 0.46) was conclusively ($p \leq 0.01$) the highest. The SF breed (11.79 ± 1.07) had the second highest ($p \leq 0.01$) value of b* and the K breed the very lowest (9.76 ± 0.95). Komprda *et al.* (2012) does not list any conclusive ($p \geq 0.05$) differences for the color spectrum indicators a* and b* between the SF and ZW breeds. The effect of line on the value of the indicator a* was also noticeable. All ZW lines had significantly ($p \leq 0.01$) lower values compared to both SF lines. At the same time, the meat of the Ewebank Armani line (a* = 12.49 ± 1.38) was significantly ($p \leq 0.01$) redder than the meat of the Romeo (a* = 9.91 ± 0.56) and Avatar (a* = 9.52 ± 0.77) lines. Both lines of the K breed also had redder meat compared to that of the Záblesk line (a* = 6.60 ± 1.87). The effect of line on the b* indicator was also obvious. The significantly ($p \leq 0.01$) lowest value of the indicator b* (9.25 ± 0.76) was recorded in the lines Avatar and Romeo, contrary to all lines of the ZW and SF breeds.

II: *Nutritional quality of lamb meat*

Factor			n	Dry matter (%)	Intramuscular fat (%)	Protein (%)	Ash (%)
				x̄ ± sx	x̄ ± sx	x̄ ± sx	x̄ ± sx
Breed	Zwartbles		18	$21.38^{C} \pm 0.48$	$0.88^{B} \pm 0.34$	$19.11^{B} \pm 0.32$	$1.12^{B} \pm 0.02$
	Suffolk		12	$23.46^{A} \pm 0.48$	$1.65^{A} \pm 0.41$	$20.33^{A} \pm 0.33$	$1.15^{A} \pm 0.02$
	Romney		12	$22.21^{B} \pm 0.50$	$1.49^{A} \pm 0.22$	$19.36^{B} \pm 0.38$	$1.09^{C} \pm 0.01$
Line	ZW	Zbyšek	6	$21.24^{Bb} \pm 0.41$	$0.73^{A} \pm 0.12$	$19.16^{B} \pm 0.30$	1.12 ± 0.02
		Ztepl	6	$21.46^{B} \pm 0.51$	$0.97^{AB} \pm 0.37$	$19.05^{B} \pm 0.40$	1.12 ± 0.02
		Záblesk	6	$21.44^{B} \pm 0.58$	$0.93^{ABa} \pm 0.46$	$19.13^{B} \pm 0.31$	1.12 ± 0.02
	SF	Ewebank	6	$23.47^{A} \pm 0.36$	$1.58^{BDb} \pm 0.30$	$20.52^{A} \pm 0.31$	1.16 ± 0.01
		President	6	$23.46^{A} \pm 0.62$	$1.73^{CD} \pm 0.52$	$20.14^{A} \pm 0.25$	1.14 ± 0.03
	K	Romeo	6	$22.28^{Ba} \pm 0.49$	$1.45^{BD} \pm 0.27$	$19.40^{B} \pm 0.35$	1.09 ± 0.01
		Avatar	6	$22.14^{B} \pm 0.55$	$1.53^{BD} \pm 0.17$	$19.31^{B} \pm 0.44$	1.09 ± 0.02

a, b = $p \leq 0.05$; A, B, C = $p \leq 0.01$

III: *Technological quality of lamb meat*

Factor			N	Water-holding capacity (%)	Myoglobin (g.kg-1)	pH24	L*	a*	b*
				x̄ ± sx	x̄ ± sx	x̄ ± sx	x̄ ± sx	x̄ ± sx	x̄ ± sx
Breed	Zwartbles		18	$75.47^{B} \pm 1.93$	$1.80^{B} \pm 0.28$	5.70 ± 0.04	$51.55^{A} \pm 1.66$	$7.56^{B} \pm 1.45$	$13.12^{A} \pm 0.46$
	Suffolk		12	$81.57^{A} \pm 1.87$	$2.85^{A} \pm 0.37$	5.60 ± 0.10	$40.85^{B} \pm 1.34$	$11.87^{A} \pm 1.24$	$11.79^{B} \pm 1.07$
	Romney		12	$72.90^{C} \pm 2.46$	$2.91^{A} \pm 0.27$	5.59 ± 0.03	$40.28^{B} \pm 1.47$	$9.72^{B} \pm 0.68$	$9.76^{C} \pm 0.95$
Line	ZW	Zbyšek	6	$75.02^{B} \pm 1.93$	$1.99^{B} \pm 0.23$	5.69 ± 0.02	$50.54^{A} \pm 1.04$	$8.37^{B} \pm 1.09$	$12.95^{AB} \pm 0.43$
		Ztepl	6	$75.79^{B} \pm 2.39$	$1.85^{B} \pm 0.20$	5.71 ± 0.02	$51.85^{A} \pm 1.48$	$7.70^{B} \pm 0.75$	$13.26^{A} \pm 0.43$
		Záblesk	6	$75.61^{B} \pm 1.66$	$1.56^{B} \pm 0.24$	5.70 ± 0.06	$52.26^{A} \pm 2.06$	$6.60^{B} \pm 1.87$	$13.13^{A} \pm 0.55$
	SF	Ewebank	6	$81.43^{A} \pm 2.11$	$3.01^{A} \pm 0.31$	5.58 ± 0.11	$40.76^{B} \pm 0.91$	$12.49^{A} \pm 1.38$	$12.17^{B} \pm 0.19$
		President	6	$81.72^{A} \pm 1.80$	$2.70^{A} \pm 0.38$	5.62 ± 0.10	$40.93^{B} \pm 1.76$	$11.25^{A} \pm 0.76$	$11.42^{B} \pm 0.88$
	K	Romeo	6	$72.62^{B} \pm 1.82$	$2.74^{A} \pm 0.28$	5.58 ± 0.03	$40.75^{B} \pm 1.74$	$9.91^{B} \pm 0.56$	$10.28^{BC} \pm 0.88$
		Avatar	6	$73.18^{B} \pm 3.13$	$3.08^{A} \pm 0.10$	5.60 ± 0.01	$39.81^{B} \pm 1.12$	$9.52^{B} \pm 0.77$	$9.25^{C} \pm 0.76$

A, B, C = $p \leq 0.01$, L* – lightness index, a* – redness index, b* – yellowness index

CONCLUSION

The results of our study revealed conclusive evidence of the effect of breed and lineage on carcass value and quality of lamb meat. As far as carcass value is concerned, it should be noted that, according to subjective assessment, the Romney Marsh breed had a higher degree of fat cover than the Zwartbles and Suffolk breeds. This trend also applied to the ratio of kidney fat and the ratio of fat from the leg. Therefore, it can be concluded that the Romney Marsh breed has a higher prediction for the deposition of both subcutaneous and intermediate fat when being fattened to a higher slaughter weight. Furthermore, our study pointed to a certain predisposition of the Zwartbles breed for its expansion in pure form or as an alternative to crossbreeding with other breeds. The Zwartbles breed had the lowest degree of fat cover, kidney fat ratio, ratio of fat from the leg, intramuscular fat, where most of these indicators were highlighted by static significance. Thus, it is possible to state that the meat of the Zwartbles breed is typical of its leanness and lightness. The carcasses of the Suffolk breed provided the largest legs, however, there was less meat on the legs than in the other breeds. On the other hand, the percentage of protein in the meat of the Suffolk breed was conclusively the highest.

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