EVALUATION OF SELECTED PARAMETERS OF CARCASS QUALITY OF INTENSIVELY FATTENED HUNGARIAN MERINO AND GERMAN MUTTON MERINO LAMBS

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SUMMARY

In the Hungarian sheep sector most of the lambs produced belong to the Hungarian Merino (HM) breed. This breed has relatively weak meat production compared to other meat type merino breeds, such as German Mutton Merino (GMM) breeds. The authors' aim was to evaluate the carcass traits (slaughter weight, warm and cold carcass weights, dressing percentage), nutritive value (dry matter, protein and fat %), and meat quality (pH, colour, drip and cooking loss, and tenderness) of eight HM and eight GMM intensive fattened lambs. To compare meat quality and nutritive value *m. longissimus dorsi* from each slaughtered lamb were extracted. The average live weight at slaughter was 28.1 kg for HM and 31.4 kg for GMM lambs. The average warm carcass weight and dressing percentage of GMM lambs were 19.2% and 20.6% higher compared to HM lambs. In this study, there was no difference between the nutritive parameters (dry matter, fat and protein content) of the examined breeds. In contrast, shear force (2.11 kg) and L* (lightness) values (45.6) were more favourable in HM lambs compared to GMM lambs (2.73 kg and 41.6). In addition, the total colour difference (ΔE^*_{ab}) between HM and GMM lambs' meat samples was evaluated. The ΔE^*_{ab} value was 4.28, which was well perceptible for consumers. These meat quality information may be important for potential lamb meat consumers.

ÖSSZEFOGLALÁS

Abayné, H. E. – Bokor, B. – Szabó, R. T – Kovács-Weber, M. – Pajor, F. – Póti, P: INTENZÍVEN HIZLALT MAGYAR MERINÓ ÉS NÉMET HÚSMERINÓ BÁRÁNYOK EGYES VÁGÁSI TULAJDONSÁGAINAK ÉRTÉKELÉSE

A magyar juhágazatban a piacra értékesített bárányok többsége a magyar merinó fajtához tartozott. Ennek a fajtának viszonylag gyenge a hústermelése más hústípusú merinó fajtákhoz, például a német húsmerinó fajtába tartozó bárányokéhoz képest. A szerzők célja nyolc magyar merinó és nyolc német húsmerinó fajtájú intenzíven hizlalt bárány vágási tulajdonságainak (vágási súly, meleg és hűtött nyakalt törzs súlya, vágási százalék), hús összetételének (szárazanyag-, fehérje- és zsírtartalom), valamint a hús minőségének (pH, szín, csepegési és főzési veszteség, valamint porhanyósság) értékelése volt. A húsminőség és a hús összetétel összehasonlításához a bárányok *m. longissimus dorsi*-ból vett mintáit használták fel. A magyar merinó és a német húsmerinó bárányok átlagos élősúlya vágáskor 28,1 kg és 31,4 kg volt. A német húsmerinó bárányok átlagos meleg nyakalt törzs súlya 19,2% -kal és a vágási százaléka 20,6% -kal volt nagyobb a magyar merinó bárányokhoz képest. A vizsgálat során nem volt különbség a vizsgált fajták húsmintáinak kémiai összetétele (szárazanyag, zsír és fehérje) között. Ezzel szemben a nyíróerő (2,11 kg) és az L* (45,6) értékek kedvezőbbek voltak a magyar merinó bárányoknál a német húsmerinó bárányokhoz viszonyítva (2,73 kg és 41,6). A két fajtába tartozó bárányok húsmintáinak színértékei összehasonlítására a ΔE^*_{ab} értéket határozták meg. A ΔE^*_{ab} érték 4,28 volt, azaz jelentős, a fogyasztók számára is jól észrevehető színinger különbséget mutatott a két csoport mintái között. A húsminőségre vonatkozó információk fontosak lehetnek a potenciális bárányhúst fogyasztók számára.

INTRODUCTION

Sheep farming in Hungary has changed essentially in the past thirty years. Earlier, wool production was the main purpose of keeping sheep stocks. Nowadays, the lamb meat production has become the most important production goal. In the Hungarian sheep sector most (90%) of the sheep bred for the market belong to the Hungarian Merino breed. The other merino breed is German Mutton Merino. The main selection objective in German Mutton Merino is meat production and, while in Hungarian Merino presently meat plays a secondary role, earlier it was selected for wool production. The lambs are predominantly sold at South European markets as suckling lambs at a live weight of 16-22 kilograms. Most of the lambs are exported at Easter, Christmas and at Ferragosto, while domestic lamb consumption is negligible (0.3 kg/capita/year). On the other hand, western European markets demand heavy lambs (30 kg<) with large muscle weight. Most of the Hungarian Merino populations are not suitable for large weight lamb production due to their unfavourable muscle conformation and relatively high fat content. Hungarian Merino meat production is often improved by crossbreeding with meat type breeds (*Molnár and Jávor*, 2001; *Várszegi and Jávor*, 2001; *Pajor et al.,* 2009). Also selection for meat production within Hungarian Merino may successfully improve meat quality.

Meat quality is determined by various factors. From the consumers' point of view, meat colour and tenderness are the most important attributes. Consumers predominantly judge meat quality by its colour (*Khliji et al.,* 2010). The colour of sheep meat depends on its myoglobin content and not on the quantity of blood retained after bleeding (*Suman and Joseph*, 2013). The colour is influenced also by additional factors. Tenderness means gauging how easily the meat is chewed. The majority of studies evaluated Hungarian Merino weight gain (*Polgár et al.*, 2012, 2016; *Rádli et al.,* 2012; *Bene et al.*, 2017), slaughter value and S/EUROP qualification (*Toldi et al.,* 1999; *Pajor et al.,* 2009). Dressing percentage of German Mutton Merino lambs was higher than findings by *Arslan et al.* (2018) (48.5%) for heavy German Mutton Merino lambs (30kg<) under intensive fattening.

However, the meat quality traits (such as meat colour and tenderness) of lambs during intensive fattening are not well studied. The colour of the meat is important of the consumers, the thresholds of fresh category of meat is 34-35 for L* value and below 19 for redness (a*) value measured by Minolta Chroma Meter (*Hopkins*, 1996; *Khliji et al.,* 2010). Furthermore, chemical composition is one of the main components of meat quality. The near-infrared (NIR) spectra reveal useful information on the composition of the examined material, therefore NIR spectroscopy is one of the most promising solvent free analysing methods. Near infrared spectroscopy is increasingly used in quality control of agricultural and food products. It has been reported that the chemical composition of lamb meat is approximately 75% water and 25% dry matter, of which 18-20% is protein, 3-5% is fat, 1-1% are minerals and vitamins (*Vadáné*, 2002; *Zapletal et al.,* 2010).

Furthermore, there is no available literature data which meat quality traits are advantageous to Hungarian Merino lambs during intensive fattening compared to meat type merino breeds. These are will be interesting in later selection programs for meat production of Hungarian Merino.

In this study we compared the slaughter traits and meat quality of the Hungarian Merino and German Mutton Merinos.

MATERIALS AND METHODS

Experimental design

The study was carried out in a nucleus sheep herd in Törtel, Pest County of Hungary. Hungarian Merino (n=15) and German Mutton Merino (n=15) ram lambs were taken into fattening test. The placement of the lambs (keeping in small groups, sexes separated) and their feeding regime followed the recommendations of the Sheep Breeding Codex of the Hungarian Sheep and Goat Breeder's Association. The lambs' age at the beginning of the test was 56 days. During the fattening test, all lambs were fed *ad libitum* water and concentrate mix (150 g/kg DM crude protein and 7.20 MJ/kg DM and 4.80 MJ/kg DM net energy (NEm and NEg). The fattening test lasted 40 days. At the end of fattening performance period, from the pool of lambs (n=15-15), 8 Hungarian Merino and 8 German Mutton Merino lambs were randomly selected, than slaughtered and examined. Slaughtering and examination were carried out at the slaughterhouse of Kapos Ternero Ltd., Hetes, Hungary.

After slaughter, the slaughter weight and the warm and cold carcass weight were measured and then the dressing percentage was calculated. The pH value was measured at the 45th minute and 24h after slaughtering, using a pH-value measuring device with pointed electrode (pH-STAR, Firma Matthäus, Germany).

After chilling, the *m. longissimus dorsi* muscle samples from the 12th-13th ribs, from the right half carcass was removed. Laboratory examinations were carried out at the Institute of Animal Husbandry of Hungarian University of Agricultural and Life Sciences, Gödöllő, Hungary.

The colour was expressed with the CIE Laboratory according to CIE system, measuring colour coordinates: lightness (L*), redness (a*) and yellowness (b*) by Minolta Chroma Meter CR 410. Values of L*, a*, b* represent lightness (ranging from 0=black to 99=white), redness (ranging from +=red to -=green) and yellowness (ranging from +=yellow to -=blue) respectively. The spectrophotometer was calibrated against a white calibration plate before the reading was taken. The total colour difference (ΔE^*_{ab}) between Hungarian Merino and German Mutton Merino lamb meat samples was calculated by the following formula:

$$\Delta E^*_{ab} = ((\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*))^{1/2}$$ (*Ohta and Robertson*, 2005).

The total colour difference (ΔE^*_{ab}) was evaluated by visual perceptibility scale of *Lukács* (1982), where ΔE^*_{ab} less than 1.5 – not perceptible; ΔE^*_{ab} from 1.5 to 3 – perceptible; ΔE^*_{ab} from 3 to 6 – well perceptible; ΔE^*_{ab} more than 6 – great perceptibility.

Drip loss was measured as follows, meat samples were suspended on plastic hooks and then placed into a refrigerator at 4°C. The initial weight of the sample and the weight after 24 hours were measured.

The meat samples were placed in vacuum sealed plastic bags and stored

frozen for one month. Following this period, the samples were defrosted at room temperature, wiped dry and then heated to 72 ºC in a Cucina HD 2430 contact grill (Philips, Germany). Temperature was measured in the centre of the meat with a TESTO 926 food temperature measuring instrument (TESTO AG., Germany). After the heat treatment the samples were weighted again to obtain the cooking loss.

From the heat treated steaks cooled to room temperature two elongate cores with 8x8 mm bases were removed and the crust created by the roasting was also cleared off. Five incisions were made on each core. The measurements were made with TA.XT Plus texture analyser equipped with a Warner Bratzler blade (60° angle, one mm thick, shearing speed: 250 mm/minute). Shear force was calculated on the basis of force per unit time (kg) diagram using Texture Exponent 32 software.

The nutritive components (percentage of dry matter, protein and fat content) of the meat (100 g of each samples) were determined by INSTALAB® 700 NIR analyser. The samples were homogenized with a blender, and the targeted parameters were measured in the NIR analyser.

Statistical analysis

Statistical analyses were performed with SPSS 23.0. Data distribution was tested by Kolmogorov-Smirnov test, which showed normal distribution, therefore parametric tests were carried out. F-test was used to check for homogeneity in the data. Sample means of the two breeds were compared with two-tailed T-test. Alpha was set at 0.05.

RESULTS AND DISCUSSION

Fattening and slaughter traits for the Hungarian Merino and German Mutton Merino ram lambs are shown in *Table 1*.

The live weight at weaning for Hungarian Merino ram lambs was 17.98 kg, and for German Mutton Merino ram lambs was 18.84 kg. Concerning the average daily weight gain, Hungarian Merino lambs were 15.5 % overdone by German Mutton Merino. The average daily weight gain in the present study were correspondent with the range of the results of Hungarian Merino (285-336 g/day) and German Mutton Merino (336-378 g/day) ram lambs during intensive feeding by previous reports (*Kukovics*, 1999; *Székely and Domanovszky*, 1999; *Székely et al*., 2004; *Póti et al.,* 2005; *Nagy and Domanovszky*, 2006; *Arslan et al.,* 2018).

It is well known that the value of the end-product is determined by the slaughter percentage, the slaughter weight and meat-quality. Concerning the warm carcass weight and dressing percentage, Hungarian Merinos lambs were 19.2% and 20.6% lower compared to German Mutton Merino. The dressing percentage of Hungarian Merino (51.26 %) in the present study was higher as compared to earlier studies: 48.64–49.9 % in *Pajor et al.* (2004, 2009) and 44-48 % in *Jávor et al.* (2006). In this study the dressing percentage of German Mutton Merino lambs was 54.8%. This value was higher than findings by *Arslan et al.* (2018) (48.5%) for heavy German Mutton Merino lambs (30kg<) under intensive fattening. The pH values obtained from the current study were within the acceptable range (*Teixeira et al.,* 2005; *Komprda et al.,* 2012). The final pH value and its decrease are

Table 1.

Fattening and slaughter traits of Hungarian Merino and German Mutton Merino lambs

Traits (1)	Hungarian Merino (n=8) (11)	German Mutton Merino (n=8) (12)	p-value (13)
Average weaning weight, kg (2)	17.98±1.89	18.84±1.74	N.S.
Average weight at the end of fattening, kg (3)	30.13±2.01	32.88±1.55	<0.05
Average weight gain, g/d (4)	303.75±56.40	350.94±57.29	N.S.
Average slaughter weight, kg (5)	28.13±2.70	31.38±2.13	<0.05
Average warm carcass weight, kg (6)	14.45±2.42	17.23±1.94	<0.05
Dressing percentage, % (7)	51.26±3.40	54.79±3.20	<0.05
pH at the 45th minute (8)	6.18±0.24	6.32±0.21	N.S.
pH at the 24 h (9)	5.76±0.08	5.77±0.07	N.S.
Average cold carcass weight, kg (10)	13.98±2.40	16.85±1.89	<0.05

N.S. no significant difference (13)

1. táblázat A magyar merinó és a német húsmerinó bárányok hizlalási és vágási tulajdonságai

tulajdonságok (1); átlagos választási súly (2); átlagos hizlalási súly (3); átlagos súlygyarapodás, g/nap (4); átlagos vágási súly (5); átlagos meleg nyakalt törzs súlya (6); vágási % (7); pH vágás után 45 perccel (8); pH vágás után 24 órával (9); átlagos hideg nyakalt törzs súlya (10); magyar merinó (11); német húsmerinó (12), p-érték (13); nincs szignifikáns különbség (13)

important for tenderness of meat (*Lambe et al.,* 2009). In this study, warm and cold carcass weights of Hungarian Merino and German Mutton Merino lambs were statistically significant ($p<0.05$) in favour of German Mutton Merino lambs.

Meat quality parameters by breed are summarised in *Table 2*.

In this study we found no difference in drip loss (water loss due to gravity) and cooking loss between the two breeds (*Table 2*). The average values of drip loss and cooking loss were 8.70% and 7.77%, 17.43% and 17.04% in Hungarian Merino and German Mutton Merino lambs, respectively. This is in concordance with earlier reports (*Schmidt et al.,* 2013), but other authors found higher values (*Teixeira et al.,* 2005). In the case of sheep meat, water holding capacity is not an important factor because its industrial use is negligible.

Hungarian Merino lamb meat had more lightness (45.6) compared with German Mutton Merino lambs (41.6). Lamb meat a* (redness) values were similar between Merino breeds in this investigation. Nevertheless, there was significant difference in the b* of the investigated lambs. The colour of meat is an important factor for consumers' shopping habit. During this decision, consumers evaluate the freshness and quality of meat visually (*Faustman and Cassens*, 1990). The thresholds of fresh category of meat is 34-35 for L* value and below 19 for redness (a*) value measured by Minolta Chroma Meter (*Hopkins*, 1996; *Khliji et al.,* 2010). The high L* and a* values in the present study are in keeping with the threshold limit of fresh meat category, consumers will consider Merino-meat colour as acceptable. Moreover, the total colour difference (ΔE^*_{ab}) between Hungarian

Table 2.

Meat quality parameters of Hungarian Merino and German Mutton Merino lambs

Traits (1)	Hungarian Merino (n=8) (8)	German Mutton Merino (n=8) (9)	p-value (10)
Drip loss, % (2)	8.70±1.34	7.77±0.93	N.S.
Cooking loss, % (3)	17.43±0.62	17.04±0.69	N.S.
L*	45.63±1.82	41.56±1.02	<0.001
a*	15.25±1.26	15.15±1.20	N.S.
b*	6.89±0.68	5.59±0.67	<0.01
Dry matter, % (4)	26.49±4.03	26.25±3.40	N.S.
Protein, % (5)	18.18±3.11	17.92±2.94	N.S:
Fat, % (6)	6.03±0.53	6.00±0.50	N.S.
Shear force, kg (7)	2.11±0.46	2.73±0.55	<0.05

N.S. no significant difference (11)

2. táblázat A magyar merinó és a német húsmerinó bárányok húsminőségi tulajdonságai

tulajdonságok (1); csepegési veszteség (2); főzési veszteség (3); szárazanyag (4); fehérje (5); zsír (6); nyíróerő (7); magyar merinó (8); német húsmerinó (9), p-érték (10); nincs szignifikáns különbség (11)

Merino and German Mutton Merino lambs' meat samples was 4.28. This value was well perceptible for consumers according to the visual perceptibility scale of *Lukács* (1982).

Values of dry matter, protein and intramuscular fat content are within the normal ranges for lamb meats reported by other authors (*Komprda et al.,* 2012; *Kuchtik et al.,* 2012; *Mashele et al.,* 2017). This attribute is mainly influenced by the feeding regime, while the genetic influence is minimal (*Kupai and Lengyel*, 2005). There was no difference between the nutritive parameters of the examined breeds. In the present study, the intramuscular fat content was higher than in other reports, such as *Ugurlu et al.* (2017), but these reports suggested that intramuscular fat is necessary for meat tenderness. *Mashele et al.* (2017) suggested that the higher intramuscular fat content is a possible reason for higher lightness and higher yellowness values of meat measured by chromameter. Moreover, other authors reported that intramuscular fat could reduce the shear force values of meat samples (*Blumer*, 1963; *Wood,* 1985).

The tenderness is a major factor for consumer acceptability of meat, which is in concordance with *Bunch et al.* (2004). In our study, meat of the Hungarian Merino lambs was more tender (2.11 kg) than German Mutton Merino (2.73 kg), but both shear force results of examined genotypes were favourable compared to others. In this study, average shear force value was 2.42 kg, this was in concordance with the earlier reports of *Schmidt et al.* (2013) they found 2.31-2.75 kg shear force value, while *Teixeira et al.* (2005) reported that the meat tenderness values of Bragançano and Mirandesa sheep genotypes were 7.8 kg and 6.8 kg. *Ekiz et al.* (2009) analysed the meat characteristics of 5 genotypes (Turkish Merino, Ramlic, Kivircik, Chios and Imroz) and found significant differences in shear force

(from 3.66 to 5.05 kg) among them. On the other hand, *Shackelford et al.* (1991) reported that meat with higher than 5.50 kg of shear force value is considered tough by consumers. Our results are favourable for consumers, due to preferential shear force values of the Hungarian Merino and German Mutton Merino lambs, which were lower than the admissible value. *Thompson et al.* (2006) found that the main factors responsible for the tenderness of sheep meat are muscularity characteristics, age and the activity of the calpain-calpastatin enzyme complex. This fact can be partially explained by difference in the amount of muscle fibres (*Bünger et al.,* 2009).

CONCLUSIONS

It can be concluded that under intensive fattening, the German Mutton Merino lambs had higher warm and cold carcass weight and dressing percentage than Hungarian Merino lambs. However, the colour and tenderness of the Hungarian Merino lambs' meat were more favourable compared to German Mutton Merino lambs. Further research is needed to substantiate the feed requirements, sale figures and the profitability of the two breeds.

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