AGRICULTURAL SCIENCE AND TECHNOLOGY

2017

An International Journal Published by Faculty of Agriculture, Trakia University, Stara Zagora, Bulgaria
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An International Journal Published by Faculty of Agriculture, Trakia University, Stara Zagora, Bulgaria
Carcass characteristics and technological properties of *Musculus Longissimus Lumborum* at lambs from the Bulgarian dairy synthetic population and its F1 crosses with meat breeds

N. Ivanov *, T. Angelova¹, S. Laleva¹, S. Ribarski², D. Miteva¹, D. Yordanova¹, V. Karabashev¹, I. Penchev²

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(Manuscript received 28 March 2017; accepted for publication 26 May 2017)

Abstract. The purpose of this study is to determine the effects of the breed on some of the carcass characteristics and the technological properties of *Musculus Longissimus Lumborum* in lambs from the Bulgarian Dairy Synthetic Population and its F₁ crosses with Ile de France and Mutton Charollais breeds. The scientific study took place at the Agricultural Institute of Stara Zagora, Bulgaria. Object of the study were lambs from the Bulgarian Dairy Synthetic Population and its crosses with Ile de France and Mutton Charollais breeds. The internal organs weight of the animals from the three groups was measured after their slaughter. In order to determine the meat/bones ratio, the left carcass halves were deboned. The eye muscle area and analyzed samples of *Musculus Longissimus Lumborum* was determined. The results show a slight variation in the weight of the internal organs of the animals from the three groups. The Mutton Charollais crosses come first in terms of eye muscle area (11.34 cm²), followed by the Ile de France crosses (11.21 cm²), and the lambs from the reference group come last with only 8.64 cm² (P ≤ 0.001). With regard to the meat/bones ratio, it was found out that in the Ile de France crosses it is the highest (2.90:1), followed by the Mutton Charollais crosses (2.68:1), and the lambs from the reference group (2.43:1) where it is the lowest (P >0.05). Ile de France crosses exhibited statistically significantly higher meat tenderness (P ≤ 0.001) and water-holding capacity (WHC) (P ≤ 0.01), while Mutton Charollais crosses – considerably higher cooking losses (P < 0.001) than control animals.

Keywords: cross lambs, meat quality, technological properties of the meat

Introduction

In recent years, the quality and safety of meat as main food product are becoming more and more significant. In the opinion of Joo et al. (2013), meat quality is of importance for both consumers and the meat industry. Furthermore, meat quality is of significant importance for consumers’ health. Meat consumers judge its quality according to its appearance and in this connection Cividini et al. (2009) point out that consumers are the last link in the lamb meat supply chain meaning that meat has to be able to satisfy their requirements. Meat juiciness, flavor and tenderness are considered the main factors determining its taste (Acebron and Dopico, 2000; Brewer and Novakofski, 2008; Amin et al., 2014).

The pH value of meat provides evidence for its quality. The pH values of the fresh meat range from 6.00 to 6.20, and those above 6.60 indicate that it is unfit for human consumption. Apart from being a criterion for the meat freshness, the measured pH values determine the meat colour, tenderness and its water absorption capacity (WAC) (Kerry et al., 2002).

Fresh meat quality to a bigger extent is dependent on its water-holding capacity (WHC) which from technological and economical point of view is important for the food industry but also for meat consumers at the time of meat purchase (Prevolnik et al., 2010). High water-loss rates are also linked to the quality of meat and meat products since they affect mainly its juiciness and tenderness. Apart from that, precious proteins, vitamins and minerals are lost with the water. When buying meat from the supermarket, the water lost due to bad WHC can be seen in the form of reddish liquid at the bottom of the pack (Otto et al., 2004).
was determined according to the formula below:

\[ MBR = \frac{a}{b} \]

where: MBR is the meat/bones ratio, a is meat weight after deboning the left carcass half, and b is bone weight after deboning.

The MLL eye muscle area was determined using a Planimeter, model 0393. The pH values were measured on the 24th hour after the slaughter using a Testo 205 pH meter. The water-holding capacity of the meat was determined using the traditional method introduced by Grau and Hamm (1953) and its WAC was determined by using the method introduced by Kiossev and Danchev (1979). The meat tenderness was measured with a penetrometer DSD VEB Feinmess (Dresden, Germany). The losses resulting from the thermal processing of the meat (cooking losses) was determined after cooking meat samples for 20 min at 150°C.

The results were processed by SYSTAT 13, graphic processing by Excel.

Results and discussion

Table 1 contains results with the weight of the internal organs of the lambs from the Bulgarian Dairy Synthetic Population and its crosses with Ile de France and Mutton Charollais breeds. The weight of the head without the skin for the lambs in both cross groups (0.91 kg) is higher than that of the lambs from the reference group (0.84 kg) (P > 0.05). The bigger weight of the head without the skin in the Ile de France crosses can be explained with the fact that this is a breed trait and their head is larger and with sharper outlines (Nedelchev, 2005). The weight of the body skin is the biggest in the Mutton Charollais crosses (2.74 kg) and the results with regard to the lambs from the Bulgarian Dairy Synthetic Population and the Ile de France crosses are almost the same, 2.30 kg and 2.29 kg, respectively (P > 0.05). The animals from the three groups do not differ significantly in terms of heart, liver, lungs, spleen and kidneys weight. There were no statistically significant differences between the three groups in the weight of visceral organs (Table 1).

The results with regard to MLL eye muscle area can be seen on Figure 1. The Mutton Charollais crosses show the highest score in terms of eye muscle area (11.34 cm²), followed by the Ile de France crosses (11.21 cm²) and the reference group lambs coming last with the smallest area of the eye muscle, i.e. 8.64 cm² (P ≤ 0.001). Higher values of the trait in crossbred lambs are attributed to the effect of meat type specialisation of Mutton Charollais and Ile de France sheep breeds. In other studies involving Ile de France (Cigai x Romanov sheep x Ile de France and Merino-fleisch x Ile de France) higher values of the eye muscle area are determined in comparison with those determined by us (Yankov and Todorova, 2006; Anev,

Table 1. Internal organs weight at the lambs from the three groups

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Group 1 BDSP - a</th>
<th>Group 2 BDSP x IIF - b</th>
<th>Group 3 BDSP x MC - c</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>MEAN±SD</td>
<td>n</td>
<td>MEAN±SD</td>
</tr>
<tr>
<td>Head weight with the skin, kg</td>
<td>3</td>
<td>1.23±0.05</td>
<td>3</td>
<td>1.37±0.15</td>
</tr>
<tr>
<td>Head weight without the skin, kg</td>
<td>3</td>
<td>0.84±0.05</td>
<td>3</td>
<td>0.91±0.10</td>
</tr>
<tr>
<td>Body skin weight, kg</td>
<td>3</td>
<td>2.30±0.05</td>
<td>3</td>
<td>2.29±0.27</td>
</tr>
<tr>
<td>Spleen weight, kg</td>
<td>3</td>
<td>0.06±0.01</td>
<td>3</td>
<td>0.08±0.03</td>
</tr>
<tr>
<td>Heart weight, kg</td>
<td>3</td>
<td>0.12±0.03</td>
<td>3</td>
<td>0.13±0.01</td>
</tr>
<tr>
<td>Liver weight, kg</td>
<td>3</td>
<td>0.47±0.03</td>
<td>3</td>
<td>0.47±0.02</td>
</tr>
<tr>
<td>Lungs weight without the trachea, kg</td>
<td>3</td>
<td>0.43±0.09</td>
<td>3</td>
<td>0.43±0.07</td>
</tr>
<tr>
<td>Kidney weight, kg</td>
<td>3</td>
<td>0.09±0.01</td>
<td>3</td>
<td>0.09±0.01</td>
</tr>
</tbody>
</table>

BDSP - Bulgarian Dairy Synthetic Population; IIF - Ile de France; MC - Mutton Charollais; n.s. (no significant)

Figure 1. Musculus Longissimus Lumborum eye muscle area at the lambs from the three groups

Figure 2. Meat/bones ratio at lambs from the three groups
Table 2. Technological properties of Musculus Longissimus Lumborum at lambs on the 24th hour after slaughter

<table>
<thead>
<tr>
<th>Group</th>
<th>Characteristics</th>
<th>n*</th>
<th>MEAN±SD</th>
<th>n*</th>
<th>MEAN±SD</th>
<th>n*</th>
<th>MEAN±SD</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 BDSP - a</td>
<td>pH values on the 24th hour post mortem</td>
<td>9</td>
<td>5.40±0.07</td>
<td>9</td>
<td>5.37±0.09</td>
<td>9</td>
<td>5.38±0.12</td>
<td>a:b**</td>
</tr>
<tr>
<td>Group 2 BDSP x IlF - b</td>
<td>WHC, %</td>
<td>9</td>
<td>19.19±3.59</td>
<td>9</td>
<td>23.73±1.07</td>
<td>9</td>
<td>23.35±3.60</td>
<td>a:***</td>
</tr>
<tr>
<td>Group 3 BDSP x MC - c</td>
<td>WAC/distilled water, %</td>
<td>9</td>
<td>7.91±3.69</td>
<td>9</td>
<td>7.60±3.54</td>
<td>9</td>
<td>7.17±6.73</td>
<td>a:c*</td>
</tr>
<tr>
<td></td>
<td>WAC/saline solution, %</td>
<td>9</td>
<td>14.33±6.43</td>
<td>9</td>
<td>15.77±2.57</td>
<td>9</td>
<td>13.46±3.65</td>
<td>n.s.</td>
</tr>
<tr>
<td></td>
<td>Meat tenderness values, P</td>
<td>15</td>
<td>236.47±1.69</td>
<td>15</td>
<td>330.80±52.69</td>
<td>15</td>
<td>240.00±70.57</td>
<td>a:b***</td>
</tr>
<tr>
<td></td>
<td>Cooking losses, %</td>
<td>9</td>
<td>41.75±2.92</td>
<td>9</td>
<td>43.96±2.32</td>
<td>9</td>
<td>45.02±2.27</td>
<td>a:c***</td>
</tr>
</tbody>
</table>

BDSP - Bulgarian Dairy Synthetic Population; IlF - Ile de France; MC - Mutton Charollais;

n* - number of samples, * - Penetrant degrees, * - P ≤ 0.05, ** - P ≤ 0.01, *** - P ≤ 0.001; n.s. (no significant)

2009), however the lambs were slaughtered after reaching a bigger live weight, 30 - 31 and 40 kg, respectively.

The results with the meat/bones ratio in the lambs from the different groups are presented in Table 2. It can be seen that in terms of this characteristic, the two trial groups significantly surpass the lambs from the Bulgarian Dairy Synthetic Population. The highest scores are of the Ile de France crosses (2.90:1), followed by the Mutton Charollais crosses (2.68:1), and the lowest are the scores of the lambs from the reference group 2.43:1 (P > 0.05). In studies involving meat breed cross lambs (Cigai x Romanov sheep x Mutton Charollais and Cigai x Romanov sheep x Ile de France) slaughtered after reaching live weight of 32 - 34 kg, it has been found out that the meat/bones ratio for both lamb cross types is the same 3.14:1 (Yankov, 2008).

The technological properties of MLL in the lambs from the three groups are presented in Table 2. It can be seen that the values of the pH2 indicator in the three groups of lambs are very close and vary within normal limits of between 5.37 and 5.40. According to Devine et al. (1993), Gonçalves et al. (2004), Jandasek et al. (2014), the pH2, values are considered normal if they are below 5.80 - 5.90. The close pH2 values show that the post-mortem processes in meat occur at the same speed rate in the lambs from the three groups.

With regard to the meat WHC percentage, it can be seen that the two trial groups of animals show a higher score than those from the reference group. The higher percentage in the Ile de France crosses is determined also by other authors (Slavov et al., 2015). The MLL meat has the highest WHC in the Ile de France crosses (23.73%), the Mutton Charollais crosses show 23.35%, and this percentage is the lowest in the lambs from the reference group (19.19%). On the other side, this means that the water loss in the two trial groups of animals is higher than that of the animals from the reference group.

With regard to the water absorption capacity (WAC) of the meat in distilled water, there is no significant variation in the results of the animals from the different groups. More significant are the differences with regard to the WAC of the meat in saline solution. The highest score for the MLL in terms of WAC of the meat in saline solution is for the Ile de France crosses (15.77%), followed by the lambs from the Bulgarian Dairy Synthetic Population (14.33%) and the lowest score is for the Mutton Charollais crosses (13.46%) (P > 0.05).

The highest is the score in terms of MLL meat tenderness in the Ile de France crosses (330.80 P). The Mutton Charollais crosses and the lambs from the reference group have a similar score, 240.00 P and 236.47 P, respectively. We found out that the cooking losses are the highest in the Mutton Charollais crosses (45.02%), Ile de France crosses coming second (43.96%), and the lowest are the cooking losses in the lambs from the Bulgarian Dairy Synthetic Population (41.75%) (P ≤ 0.001). Dimitrov et al. (2009) also have found out that the Mutton Charollais crosses slaughtered after reaching a live weight of 35 kg have higher cooking losses than the source breed (Northeast Bulgarian Fine Fleece Sheep).

Conclusion

In both experimental groups, eye muscle areas were statistically significantly higher (P < 0.001) compared to control lambs. The highest is the score of the lambs from the Mutton Charollais crosses (11.34 cm²), followed by the Ile de France crosses (11.21 cm²), and the lowest is the score in the lambs from the reference group v 8.64 cm². The meat/bones ratio is the highest at the lambs from the Ile de France crosses (2.90:1), followed by the Mutton Charollais crosses (2.68:1) and the lowest score is that of the animals from the Bulgarian Dairy Synthetic Population group (2.43:1) (P > 0.05). Ile de France lamb crosses exhibited statistically significantly higher meat tenderness than Bulgarian Dairy Synthetic population lambs (P < 0.001). The Ile de France crosses had substantially higher water holding capacity values of meat (P < 0.01) as compared to control lambs. The Mutton Charollais crosses exhibited statistically significantly higher cooking losses (P < 0.001), as compared to the other two groups.

References


Nedelchev D, 2005. The breed Ile de France close. Livestock plus, 1, 24-26 (Bg).


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Carcass characteristics and technological properties of Musculus Longissimus Lumborum at lambs from the Bulgarian dairy synthetic population and its F1 crosses with meat breeds  
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