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Amino acid composition of lamb meat from the North East Bulgarian fine fleece breed and its crossbreds with Australian merino and Ile de France from internal breeding

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Abstract. A comparative analysis of amino acid composition of lamb meat from the North East Bulgarian fine fleece breed (I gr.) and its crossbreds from internal breeding with 25% heredity from the Australian merino (II gr.) and Ile de France (III gr.) breeds was conducted. Upon starting the experiment lambs were equal and during the experiment they were placed under similar conditions of feeding and rearing. To establish the amino acid composition of meat slaughtered analyses were performed at 100 and 130 days of age. From the carcass of each slaughtered animal individual mean samples were taken. Studies were carried out in the Research Laboratory of the Faculty of Agriculture at Trakia University. As a result of the studies the following conclusions were made: the amino acid composition of meat from lambs of the Ile de France crosses with the Ile de France productive line. Along with increase of wool yield and improvement of the quality traits of wool in fine fleece sheep breeding, meat yield is of particular economic importance both in quantitative and qualitative aspect. For Bulgaria, as well as for other countries with continental climate, it is necessary to use the Australian merino breed as a corrector of the qualitative traits of wool. However, the issue about the effect of heredity from Australian merinos on the quantitative and qualitative characteristics of meat in crossbreds, especially in animals from internal breeding, is not totally clear.


Keywords: lambs, crossing, internal breeding, meat, amino acid content of meat and amino acid index of meat

Introduction

The processes of improvement of modern fine fleece sheep breeds aim at applying specific selection approaches for improvement of the traits that are of economic significance for the productive line. Along with increase of wool yield and improvement of the quality traits of wool in fine fleece sheep breeding, meat yield is of particular economic importance both in quantitative and qualitative aspect. For Bulgaria, as well as for other countries with continental climate, it is necessary to use the Australian merino breed as a corrector of the qualitative traits of wool. However, the issue about the effect of heredity from Australian merinos on the quantitative and qualitative characteristics of meat in crossbreds, especially in animals from internal breeding, is not totally clear.

Studies on crossing fine fleece ewes with rams of the Australian merino breed in Russia were carried out by Kravchenko (1988) and Moroz (1993) with the Grozenska breed, Moroz and Ibrimirov (1992) and Zulaev (1992) with Stavropol breed, Zubkov et al. (1995) with Kavkaz breed, Ozhivov (1990) and Galatov (1991) with Soviet merino breed, Danilenko (1989) and Shlompe (1989) with Askaniyska breed, etc. In Bulgaria similar research on crossbreeding of fine fleece ewes with rams from the Australian merino breed are conducted by Stoyanov et al. (1982), Boykovski (1994-1995), Slavov (2007) – with North East Bulgarian fine fleece breed, Tsenkov et al. (1995), Slavova (2000) with the Thracian fine fleece breed, Lazarov and Iliev (1997) IIiev (1999) and– with the Karnobat merino breed, etc.
Bulgarian fine fleece breed and its crossbreds from internal breeding with 25% heredity from the Australian merino and Ile de France breeds – internal breeding.

Material and methods

The experiment to study the amino acid composition of meat was carried out with 42 lambs divided into 3 groups of 14 animals each - I group - North East Bulgarian fine fleece (NEFF); II group - ¼-blood crossbreds with Australian merino (AM) – internal breeding - ½AM IB - Φ ¼AM (Φ NEFF x σ ¼AM) x σ ¼AM (Φ NEFF x σ ¼ AM) and III group - (Φ NEFF x σ ¼AM) – blood crossbreds with Ile de France (IIF)– internal breeding - ¼IIF IB - Φ ¼IIF (Φ NEFF x σ ¼ IIF) x σ ¼IIF (Φ NEFF x σ ¼IIF).

The experiment was carried out on the territory and with the animals owned by Dobrudzha Agricultural Institute – town of General Toshevo, Dobrich area. Upon starting the experiment lambs were made equal by age (44-46 days old), gender (equal number of males and females), type of birth (equal number of singles and twins), age of weaning (33 – 36 days), age of mothers and number of lambings (3 yrs – II lambing).

During the experiment the lambs were placed under equal conditions of raising and subjected to intensive fattening until they were 130 days old. Feeding is ad libitum, with starter mixture for fattening lambs containing per 1 kg 1.22 FUG (6.72 MJ), 106.1 g PDI, lucerne hay containing per 1 kg 0.61 FUG (3.12 MJ) and 79.9 g PDI, as well as corn silage containing per 1 kg 0.30 FUG (1.68 MJ) and 19.9 g PDI (Todorov and Dardzhonov, 1995).

The control of live weight of the experimental lambs was made at 14- day interval, with an accuracy of 100 g. Feed consumption was recorded daily and by periods. To establish the quantitative and qualitative traits of meat yield slaughter analyses were carried out – at 100 and 130 days of age, 4 lambs being slaughtered from each group with live weight close to the average for the groups. The slaughtering was carried out according to the requirements of Ordinance No. 27 (promulgated in SG No. 99/1999). The cutting of carcasses was carried out by methods applied in INRA.

Pooled samples of meat were taken from the carcass of each slaughtered animal for amino acid analysis. Studies were conducted in the Research laboratory at the Faculty of Agriculture University of Trakia University. Modern equipment was used and standard methods applied. Amino acid composition of meat was carried out by the ion exchange column chromatography method, by acid hydrolysis of the sample in 6 n solution of hydrochloric acid at 110°C for 24 hours. The residue is dissolved with buffer with pH 8.2. The Sulphur containing amino acids (methionine and cystine) were determined after oxidation of the sample with mixture of hydrogen peroxide and performic acid. Separation of amino acids (except tryptophan) was carried out with amino acid analyser (AminoAcid Analyser T 339M, Microtechna – Praha) and their quantity was determined by their elution volume and standard solution. The results obtained were processed statistically by software “Statistica for Windows” 2010 and the graphics were processed in Excel.

Results and discussion

In the meat of 100-day old lambs from the studied groups the highest is the amount of glutaminic acid and the lowest is that of the amino acid cystine (Table 1). The differences about the content of various amino acids in lamb meat by groups are in most cases mathematically proven. The highest values about amino acid content has lamb meat from the III group – ¼IIF internal breeding except for phenylalanine content. The lysine/arginine ratio that is related to protein atherogeneity is almost equal for lamb meat in all three groups – 1.31 – 1.37.

The total amount of nonessential and essential amino acids in meat, which are an indicator for its biological full-bodiness in the studied lamb groups at 100 days' age is the highest in lambs from III group – 18.07%. Their meat has the highest essential amino acid content – 6.87% and non-essential amino acid content – 11.2%, followed by the meat of purebred lambs (I group), with total amino acid content – 17.56% and, respectively, essential amino acid content – 6.63% and non-essential amino acid content – 10.93%. The meat of lambs from II group occupies intermediary position (Figure 1).

The results of the study show that at that age in all three groups the most deficient in comparison to the reference protein is the amount of amino acids methionine + cystine. In comparison to the egg protein again the most deficient are methionine and cystine. The chemical index of meat from the studied groups varies from 58.49% for III group; 59.06 for I group, to 5925 for II group (Table 2). Apart from the amount the methionine + cystine concerning the egg protein lower are the values of the following amino acids: threonine, leucine, isoleucine and valine. Only the lysine content and the amount of phenylalanine and tyrosine exceed the egg protein values.

The highest is the essential amino acid content in 100 g total protein – 41.92 g and the highest average indices in comparison to the reference protein – 116.44% and to the egg protein – 90.53% has lamb meat from III group. With the lowest values on these parameters is lamb meat from II group and that of purebred lambs has intermediary position.

Amino acid content in the meat of lambs aged 130 days, (except for glycine), is the highest in lamb meat from III group, followed by that of meat from the animals from II group. The lowest are the values in I group. The differences among groups in most cases are mathematically proven (Table 1). The lysine/arginine ratio varies within narrow boundaries – 1.41 – 1.46.

The total amount of nonessential and essential amino acids varies within 18.60% in III group and 17.17% in I group. The highest is the essential amino acid content in lamb meat from III group – 7.36%, and the lowest that of I group – 6.54%. Lamb meat of II group occupies intermediary position (Figure 2).

The values of the protein amino acid index in lamb meat at 130 days (Table 2) show that limiting amino acid compared to the reference protein in all studied groups is the amount of methionine + cystine with amino acid index of 87.71% in II group, 91.14% in I group and 95.43% in lamb meat of III group.

In comparison to the egg protein again the most deficient is the amount of methionine + cystine, the indices varying from 57.92% in II group to 63.02% in III group. Deficient in comparison to the egg protein are the other amino acids as well, except for lysine and phenylalanine + tyrosine.

The highest is the essential amino acid content in 100 g total protein (43.49%) and the highest average indices in comparison to the reference protein (120.80%) and in comparison to the egg protein (93.93%) has lamb meat from III group. The lowest values on these parameters has lamb meat from II group and that of the purebred ones occupies intermediary position.

Taking into account the effect of age (from 100 to 130 days) we
### Table 1. Amino acid content in 100 g meat of lambs at 100 and 130 days

<table>
<thead>
<tr>
<th>Amino acids</th>
<th>MEAN ± SEM</th>
<th>CV</th>
<th>MEAN ± SEM</th>
<th>CV</th>
<th>MEAN ± SEM</th>
<th>CV</th>
<th>MEAN ± SEM</th>
<th>CV</th>
<th>MEAN ± SEM</th>
<th>CV</th>
<th>MEAN ± SEM</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age 100 days</strong></td>
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</tr>
<tr>
<td>Lysine</td>
<td>1.56** ± 0.041</td>
<td>5.31</td>
<td>1.44** ± 0.037*</td>
<td>6.94</td>
<td>1.60** ± 0.030**</td>
<td>3.79</td>
<td>1.56** ± 0.061</td>
<td>7.79</td>
<td>1.66 ± 0.081*</td>
<td>3.82</td>
<td>1.76** ± 0.074**</td>
<td>8.39</td>
</tr>
<tr>
<td>Threonine</td>
<td>0.80*** ± 0.011***</td>
<td>2.86</td>
<td>0.76*** ± 0.021*</td>
<td>2.86</td>
<td>0.82** ± 0.012**</td>
<td>2.88</td>
<td>0.67** ± 0.037***</td>
<td>1.09</td>
<td>0.78 * ± 0.031*</td>
<td>8.40</td>
<td>0.78** ± 0.038***</td>
<td>9.74</td>
</tr>
<tr>
<td>Valine</td>
<td>0.89** ± 0.015**</td>
<td>3.35</td>
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<td>0.94*** ± 0.023**</td>
<td>4.87</td>
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<td>3.19</td>
<td>1.05*** ± 0.032***</td>
<td>6.00</td>
</tr>
<tr>
<td>Methionine</td>
<td>0.39** ± 0.023*</td>
<td>11.77</td>
<td>0.37** ± 0.018</td>
<td>11.77</td>
<td>0.42** ± 0.011**</td>
<td>5.27</td>
<td>0.38** ± 0.019*</td>
<td>10.08</td>
<td>0.37** ± 0.026</td>
<td>14.14</td>
<td>0.44*** ± 0.011**</td>
<td>5.07</td>
</tr>
<tr>
<td>Isoleucine</td>
<td>0.81*** ± 0.015*</td>
<td>3.70</td>
<td>0.77*** ± 0.024***</td>
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<td>7.21</td>
</tr>
<tr>
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<td>1.49*** ± 0.029*</td>
<td>3.84</td>
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<td>6.04</td>
<td>1.49** ± 0.026**</td>
<td>3.46</td>
<td>1.57*** ± 0.056*</td>
<td>7.15</td>
</tr>
<tr>
<td>Phenylalanine</td>
<td>0.75*** ± 0.017**</td>
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<td>0.79*** ± 0.013</td>
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<td>0.77** ± 0.031*</td>
<td>7.92</td>
<td>0.75** ± 0.032</td>
<td>8.71</td>
<td>0.78* ± 0.040</td>
<td>10.25</td>
<td>0.82** ± 0.050*</td>
<td>12.28</td>
</tr>
<tr>
<td><strong>Age 130 days</strong></td>
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<td>6.00</td>
</tr>
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<td>12.28</td>
</tr>
</tbody>
</table>

**Essential amino acids**

**Non-essential amino acids**

Reliability among groups by age * at p<0.05 ** at p<0.01 *** at p<0.001, Reliability among groups with change of age * at p<0.05 ** p<0.01 *** p<0.001
Table 2. Amino acid indices of meat protein of lambs

<table>
<thead>
<tr>
<th>Essential amino acids</th>
<th>Reference protein g/100g</th>
<th>Whole-egg protein g/100g</th>
<th>I Group g/100g total protein</th>
<th>II Group g/100g total protein</th>
<th>III Group g/100g total protein</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I Group Compared to refer. protein, %</td>
<td>Compared to egg protein, %</td>
<td>II Group Compared to refer. protein, %</td>
<td>Compared to egg protein, %</td>
<td>III Group Compared to refer. protein, %</td>
</tr>
<tr>
<td>Threonine</td>
<td>4.0</td>
<td>4.8</td>
<td>4.57</td>
<td>4.51</td>
<td>4.5</td>
</tr>
<tr>
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<td>8.8</td>
<td>8.16</td>
<td>8.09</td>
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<tr>
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<td>6.7</td>
<td>4.61</td>
<td>4.55</td>
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</tr>
<tr>
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<td>7.2</td>
<td>5.10</td>
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<td>5.07</td>
</tr>
<tr>
<td>Methionine+Cystine</td>
<td>3.5</td>
<td>5.3</td>
<td>3.13</td>
<td>3.14</td>
<td>3.14</td>
</tr>
<tr>
<td>Lysine</td>
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<td>6.2</td>
<td>8.88</td>
<td>8.76</td>
<td>8.76</td>
</tr>
<tr>
<td>Phenylalanine+Tyrosine</td>
<td>6.0</td>
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<td>7.28</td>
<td>7.27</td>
<td>7.27</td>
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<tr>
<td>Tryptophan</td>
<td>1.0</td>
<td>1.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>36.0</td>
<td>46.3</td>
<td>41.73</td>
<td>41.39</td>
<td>41.39</td>
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</tbody>
</table>

At 100 days

<table>
<thead>
<tr>
<th>Essential amino acids</th>
<th>Reference protein g/100g</th>
<th>Whole-egg protein g/100g</th>
<th>I Group g/100g total protein</th>
<th>II Group g/100g total protein</th>
<th>III Group g/100g total protein</th>
</tr>
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<tr>
<td></td>
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</tr>
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<td>3.92</td>
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<td>3.98</td>
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<tr>
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<td>8.8</td>
<td>8.35</td>
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<tr>
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<td>6.7</td>
<td>4.84</td>
<td>4.92</td>
<td>4.92</td>
</tr>
<tr>
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<td>5.61</td>
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<tr>
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<tr>
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</tr>
<tr>
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<td>6.86</td>
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<td>Total</td>
<td>36.0</td>
<td>46.3</td>
<td>41.71</td>
<td>41.39</td>
<td>41.39</td>
</tr>
</tbody>
</table>

At 130 days

Figure 1. Essential and nonessential amino acids in meat, %

find out that with its increase there are changes in the amino acid content of lamb meat by groups, the differences in the majority of cases being mathematically proven (Table 1). With age increase of both the total amino acid content in II and III group (Figures 1 and 2), and essential amino acid content is found, their values being the highest in III group – 6.87% at 100 days' age and 7.36% at 130 days, respectively.
Conclusions

Results obtained give reason to the following:
- ¼ ILF crossbreds have the highest total amino acid content and essential amino acid content in meat at the age of 100 and 130 days, 6.87% and 7.36%, respectively.
- The lysine/arginine ratio being related to protein atherogenicity, varies within narrow boundaries among groups and increases slightly with age – from 1.31 to 1.37 at the age of 100 days and from 1.41 to 1.48 at the age of 130 days.
- With the increase of age in crossbreds from internal breeding amino acid content in the total protein increases, that being the most pronounced in lambs from III group – from 41.92% to 43.92%.
- With the increase of age in crossbreds from internal breeding total protein increases – from 114.97% to 118.22% for II group and from 116.44% to 120.80% in III group. In purebred animals age-related changes are insignificant.
- Internal breeding of crossbreds with 25% heredity from the Ile de France breed has positive effect on the total amino acid content in the meat of lambs aged 100 and 130 days, its essential amino acid content and the level of total amino acid indices.
- Internal breeding of crossbreds with 25% heredity from Australian merino does not have an adverse effect on the levels of the studied traits.

References

Boykovski St, 1994-1995. Changes in some components of fleece from sheep from Australianised lines of the NEBFF breed, Shumen type. Genetics and Selection, 3-4, 156-163.
Crouse JD, 1983. The effects of breed, sex, slaughter weight and age on lamb meat flavor. Food technology, 264.
Feige Y and Lambert B, 1980. Lagestron de la rase Ile-de-France Butection Technique d’information, 351, 352, 555-564.
Lazarov V and Iliev M, 1997. Results from the introduction of blood from Australian merino sheep with fine fleece sheep from the Karnobat breed. Animal Science, 5-6, 25-27.
Slavova P, 2000. Study on the variability of selection traits in sheep from the Thracian fine fleece breed and possibilities for their improvement by crossing with Australian merino rams. Thesis for PhD, Trakia University of Stara Zagora.
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