

SLAUGHTER VALUE AND MEAT QUALITY OF LAMBS FATTENED SEMI-INTENSIVELY WITH DDGS AND LINSEED

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Abstract - The effect of the application of corn distillers dried grains (DDGS) in fattening lambs on slaughter value, culinary meat yield and meat quality were investigated. The lambs were fattened to 35 kg of body weight in three groups consisting of 50% of prolific-milk Koluda Sheep (KS) and crossbreed Ile de France x KS (IfxKS). After the growth period, six ram lambs from every feeding group (3 individuals of each origin; KS and IfxKS) were slaughtered. The lambs were fed with a dry mash at a rate of 3% body weight with addition of grass hay *ad libitum* or grazing on pasture for 5-6 hours a day. The control group was fed with dry mash with grass hay addition, while the experimental groups received a mixture of DDGS (50%), linseed (5%) and vitamin E (0.2%). Slaughter value, culinary meat yield and chemical composition, physicochemical and organoleptic characteristics of the raw and grilled meat were investigated. An increase in dressing percentage was found according to feeding with a mixture of oily components; while for grazing on pasture tend to larger loin "eye" area and carcass fatness were observed. IfxKS rams were characterized by larger "eye" of the loin and carcasses fatness. Investigated factors had no significant effect on the yield of the carcass culinary meat, raw meat chemical composition and its physicochemical characteristics, however influence of oil components and vitamin E on protein content increase was found in grilled meat. Nutrition with the experimental feed did not significantly affect the organoleptic evaluation of the grilled meat, regardless of the volumetric composition of forage type in daily dose.

Key Words – Biofuels co-products, Culinary meat

• INTRODUCTION

Among many genetic and environmental factors, the most effective strategies for developing culinary and dietary quality of meat are feeding methods of animals for slaughter; a type of feed, a level of nutrition and a fattening system. Although the primary aspects of the lambs meat have been investigated [1, 2], new research issues in this area are still appearing. One of them is to determine the application of associated products generated in the production of biofuels (such as cake and DDGS) effects, their impact on the results of fattening, slaughter value and meat quality as well. Due to the rapid increasing of a biofuel production from oilseeds and cereals, a large number of by-products appeared on the market, what creates the need for their rationally utilization primarily as a feed for farm animals. [3]. The effect of various factors on the yield and health quality of whole meat culinary parts, for both raw and thermal processed meat, has been relatively recently reported in the scientific literature [4, 5, 6]. A comprehensive understanding of both the dressing percentage and culinary value of meat (meat dishes) "on the plate", *i.e.*, ready for consumption, matters the most for food processing facilities and for the consumer as well. The aim of this study was to examine the influence of feeding the semi-intensively fattened lambs with dry mash enriched with DDGS and linseeds addition on performance and culinary meat quality according to the volumetric composition of forage type in daily dose and racial origin of the lambs.

• MATERIALS AND METHODS

The investigations were conducted on 18 lambs (rams) divided into three groups consisting of 3 individuals of prolific-milk line of Koluda Sheep (KS) and 3 half-breeds F₁ from crossing

Ile de France lambs with KS (IfxKS) each. After weaning at an average age of 8 weeks the lambs were fattened until reaching a slaughter weight of 35(±3) kg.

Lambs in all groups were fed with dry mash at a rate of *ca.* 3% of body weight with additional *ad libitum* grass hay feeding or grazing on pasture for 5-6 hours a day. Control group of the lambs (CH) received standard fodder (cereal components >50 % and 20% of rapeseed meal) with hay, while study groups were fed with fodder containing 50% of DDGS, 5% of linseed and 0.2% of vitamin E with hay (EH) or pasture (EP). Slaughter and post-slaughter value estimation were performed according to methodology by National Research Institute of Animal Production [7] Yield of culinary cuts from the right half-carcass was analyzed according to procedure of Institute of Agricultural and Food Biotechnology [8]. Chemical composition and physicochemical characteristic of raw and/or grilled leg meat samples were determined. Boneless meat from leg of the lambs shaped in nets with addition of 2% of salt has ripened for 24 hours at 4°C. 1.5cm-thick slices were cut from the central part of the component, and then grilled on both sides (for 5 min on each) on an electric toaster Expo Sernice GR 100.

Representative samples of raw and grilled meat were subjected to assay for water content (by drying to constant weight at 105°C), protein (the Kjeldahl method on Tecator Instrument, PN-A-04018, 1975) and fat concentration (the Soxhlet method, PN-ISO 1444, 2000). Raw meat samples were evaluated by measurement of electrical conductivity (EC₂₄, PQM-1 KOMBI apparatus), pH₂₄ (PHM 80 Portable Radiometer with combined electrode), water-holding capacity (WHC, the Grau-Hamm method in modification by Pohja and Ninivaara), colour parameters: L*, a* i b* (Minolta CR 400) and also by estimation of marbling on a five-point descriptive scale (with 1 - imperceptible, and 5 - very strong/distinctive). Grilled meat samples were subjected to quantification of percentage of weight losses during thermal processing, and to organoleptic evaluation of flavour, juiciness, tenderness and palatability, using a 5-point descriptive scale. The results were processed by STATISTICA 8.0 software.

• RESULTS AND DISCUSSION

Slaughter value of lambs (Table 1.)

Higher efficiency of carcass dressing was obtained by lambs from the experimental groups, especially lambs grazing on pasture (EP), with a relatively equal the finish body weight in all food groups. The EP „pasture” lambs were also characterized by the largest loin "eye" area (larger than in groups CH and EH average by 13.5%, NS), with the largest carcass fatness measured over the ribs by 24.1% (NS) respectively.

Table 1 Slaughter value of lambs

Trait	Group		
	CH	EH	EP
Finish body weight; kg	33.80	34.44	34.57
Carcass dressing; %	41.8 a	43.8	45.2 a
Loin "eye"area; cm ²	12.4	12.1	13.9
Fat over the ribs; mm	4.2	4.5	5.4

aa - P≤0.05

Significantly higher dressing percentage was associated with increased external carcass fatness, which can be a result of a greater intake of fat in a daily dose, and also with increased "eye" area in the loin, which in turn can be related to the beneficial effects of animal movement during a pasture grazing when compared with the animals maintained in the building (groups CH and EH).

Racial origin of the lambs considerably differentiated only the loin "eye" area; KS - 11.9 cm² and IfxKS - 13.8 cm² ($P \leq 0.01$), with a tendency to increased carcass fatness in crossbreeds (4.4mm and 5.0mm respectively, NS). Results of slaughter value of IfxKS crossbreed lambs have been evaluated as generally profitable and were found similar to results obtained previously for the same crossing scheme in studies conducted by Borys [9].

Yield of culinary cuts (Table 2.)

Distinctive differences in the percentage yield of the carcass culinary cuts were found only for the loin chops, at the same both experimental groups revealed higher percentage values in comparison with the control group, and the difference of 2.2% between the EP "pasture" group and CH was significant at $P \leq 0.01$. Apart from minor differences in the yield of other culinary parts, there were no significant differences in the total yield of culinary cuts from the carcass. Racial origin of the lambs did not significantly influence the yield of investigated culinary meat cuts.

According to investigations performed by Grzeskowiak *et al.* [10] and Borys *et al.* [11] on the lambs fattened intensively to high weight standards, there were no effects of feeding oily components (rapeseed, linseed and rapeseed oil cake) on the yield of culinary cuts. Lack of significant effect of racial origin on the yield of culinary meat from carcass has been confirmed in other studies [12, 13] with applied similar patterns of commercial crossing.

Table 2 Yield of culinary cuts

Specification	Group		
	CH	EH	EP
Weight of half-carcass; kg	6.89 a	7.39	7.56 a
Yield of culinary cuts (%):			
- total ¹	64.5	64.3	64.8
in that:			
- shoulder roulade	12.1	11.8	11.5
- cervical roulade	8.5	9.4	9.0
- breast roulade	9.3	8.8	8.6
- loin chops	11.5 A	12.5	13.7 A
- leg roast meat:			
- with bone	21.3	21.3	21.6
- without bone	19.9	18.5	18.8
- back shank without bone	3.3	3.3	3.3

¹ including shoulder roulade, cervical roulade, breast roulade, loin chops, leg roast without bone and back shank without bone

AA - $P \leq 0.01$; aa - $P \leq 0.05$

Chemical composition, physicochemical characteristic and organoleptic score of meat.

The investigated dietary factors and the racial origin of the lambs did not have any significant influence on chemical composition of raw lamb meat from the leg (Table 3). Grilled meat cuts were characterized by a lower water content (average by 19.2%) and higher fat concentration (by 72.1%), with no significant differences depending on the feeding group and racial origin of the lambs. The grilling resulted in increase of protein content in lamb meat (by 51.3%), and also pronounced differences in protein content depending on the method of feeding were observed for grilled samples. The lamb meat from experimental groups was characterized by a higher concentration of this component in comparison with the control group, and the difference between CH and EH groups amounted to 8.4% ($P \leq 0.05$).

Previous studies conducted by Grzeskowiak *et al.* [10] and Borys *et al.* [13] showed no effect of oily components (rapeseed, linseed and rapeseed oil cake) on the basic chemical composition of lamb meat. However, Kaczor *et al.* [14] found that the meat of lambs fed with compound feed *ad libitum* and grazing on pasture when compared with meat of lambs

receiving hay in the sheep-fold, contained about 21.6% more intramuscular fat.

Table 3 Chemical composition of meat; g/100 g

Component	Group		
	CH	EH	EP
Raw meat			
- water	73.4	73.2	73.8
- protein	20.2	20.1	19.2
- fat	5.2	5.5	5.8
Grilled meat			
- water	60.7	58.3	59.0
- protein	28.7 a	31.1 a	30.2
- fat	9.4	9.4	9.6

aa - $P \leq 0.05$

Table 4 Physicochemical characteristic of meat

Trait	Group		
	CH	EH	EP
EC ₂₄ ; mS	2.7	3.0	3.9
pH ₂₄	5.71	5.80	5.75
WHC; %	30.0	28.9	28.5
Tenderness WB; N	59.6	66.5	64.1
Grilling losses; %	28.3	29.5	27.0
Marbling; <i>pt</i>	1.75	1.90	1.42
Colour: L*	44.4	42.8	42.2
a*	12.9	14.0	13.7
b*	3.5	3.4	2.7

The resulted changes in the chemical composition of meat during thermal processing are supported by earlier investigations [4, 5, 6, 13], which confirmed that the scale and character of these changes depends on many factors, including the heat treatment method and a type of meat cut.

Among the range of analyzed physicochemical traits, there were no statistically proven differences depending on two examined factors (Table 4). Pronounced relation was found for the measurement of tenderness. Lamb meat in the experimental groups was harder than in the control group (average by 9.6%, NS). Considerable distinctions were also found in the evaluation of marbling, which for the lambs grazing on pasture (EP) was average by 22.2% lower than for the other groups. However, there were no apparent differences in the measurement of meat lightness (L*), distinctive trend of increased redness participation (a*) in the lambs fed with a mixture of a large share of DDGS (on average by 7.4%, NS) and reduced the share of yellow colour (b*) in the “pasture” group meat (by an average of 21.7%, NS) were found. Deterioration of tenderness in IfxKS crossbreed meat was observed in comparison with KS rams meat (68.6 vs. 61.5N, respectively; NS) and increasing of marbling was also revealed (1.72 vs 1.50 points respectively; NS).

There were no significant and statistically confirmed differences found between the single organoleptic characteristic (flavour, juiciness, tenderness and palatability) as well as between total score of grilled meat in dependence on nutrition system and racial origin of the lambs (Table 5).

Table 5 Organoleptic score of meat

Evaluation	Group		
	CH	EH	EP
Total (max 20 <i>pt</i>)	18.2	18.2	17.8
- in that (1 - 5 <i>pt</i>):			

- flavour	4.7	4.6	4.5
- juiciness	4.6	4.5	4.6
- tenderness	4.3	4.4	4.2
- palatability	4.7	4.7	4.5

• CONCLUSION

In presented study it was found that under semi-intensive fattening of lambs, the application of dry mash with a high proportion of oil components has a positive effect on the slaughter value: an increase of protein content and a deterioration tenderness of grilled meat, with no differences in the evaluation of the meat organoleptic characteristic. Generally favorable results of feeding with mixtures of oily components were obtained for the fattening system of lambs grazing in the pasture than for the animals maintained in the fold or application of grass hay in the ration.

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