

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

**Bronisław Borys¹, Eugenia Grześkowiak², Dariusz Lisiak²,
Andrzej Borys², Karol Borzuta²**

¹National Research Institute of Animal Production, Experimental Station Koluda Wielka,

²Institute of Agricultural and Food Biotechnology Warszawa

e-mail: bronislaw.borys@onet.eu

Summary

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. After the growth period, six ram lambs from every feeding group (3 individuals of each origin) 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. Investigated factor 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: lamb, culinary meat, biofuels by-products

WARTOŚĆ RZEŻNĄ I JAKOŚĆ MIĘSA JAGNIĄT TUCZONYCH PÓLINTESYWNIE Z ZASTOSOWANIEM DDGS I NASION LNU

Streszczenie

Badano wpływ zastosowania suszonego wywaru kukurydzianego (DDGS) w tuczu jagniąt na wartość rzeźną, uzysk mięsa kulinarnego oraz jakość mięsa. Jagnięta tuczono do masy ciała 35 kg w 3 grupach; po 50% plenno-mlecznej owcy kołudzkiej (KS) oraz mieszańców Ile de France x KS (IfxKS). Ubito po 6 tryczków z grupy. Jagnięta żywiono mieszanką treściwą w ilości 3% masy ciała + siano z traw *ad libitum* lub wypas na pastwisku przez 5–6 godzin dziennie. Grupę kontrolną żywiono mieszanką standardową + siano z traw, a grupy doświadczalne mieszanką z DDGS (50%), nasionami lnu (5%) i witaminą E (0,2%). Badano wartość rzeźną, uzysk mięsa kulinarnego oraz skład chemiczny, cechy fizykochemiczne i organoleptyczne mięsa w stanie surowym i grillowanym. Przy żywieniu mieszanką z komponentami oleistymi stwierdzono wzrost wydajności rzeźnej, a przy wypasie na pastwisku tendencję do większego „oka” połównicy i otłuszczenia tuszy. Badany czynnik nie miał istotnego wpływu na uzysk mięsa kulinarnego z półtuszy, skład chemiczny mięsa surowego oraz jego cechy fizykochemiczne. Natomiast w mięsie grillowanym stwierdzono wpływ komponentów oleistych i witaminy E na wzrost zawartości białka. Żywienie mieszanką doświadczalną, niezależnie od rodzaju paszy objętościowej w dawce, nie wpływało istotnie na oceny organoleptyczne mięsa grillowanego.

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 [Borys, Pisulewski 2001; Wood et al. 2008], 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 biofuels 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 [Doppenberg, Piet van der Aar 2007]. 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 [Badiani et al. 2004;

Borys 2005; Borys et al. 2006; Kosulwat et al. 2003; Vicenti et al. 2004]. 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.

MATERIALS AND RESEARCH METHODS

The investigations were conducted on 18 lambs (rams) divided into three groups consisting of 6 individuals of prolific-milk line of Koluda Sheep (KS) and their crossing (If x KS) Ile de France rams (50% KS and 50% If x KS. 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 [Nawara et al. 1963] Yield of culinary cuts from the right half-carcass was analyzed according to procedure of Institute of Agricultural and Food Biotechnology [Borzuta, Strzelecki 2001]. Chemical composition, physicochemical and organoleptic characteristic of raw (after 24h post mortem) and/or grilled (after 48h post mortem) 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. 1.5 cm-thick slices were cut from the central part of the component, and then grilled on both sides (for 5min 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 - result was passed as a percentage content of free water in meat), 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 were measured for tenderness using ZWICK 0.5 equipment with Warner – Bratzler (WB) head 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 feeding 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
Wartość rzeźna jagniąt

Trait <i>Cecha</i>	Group <i>Grupa</i>		
	CH	EH	EP
Finish body weight; kg <i>Końcowa masa ciała; kg</i>	33.80	34.44	34.57
Carcass dressing; % <i>Wydajność rzeźna; %</i>	41.8 a	43.8	45.2 a
Loin "eye" area; cm ² <i>Powierzchnia „oka” polędwicy; cm²</i>	12.4	12.1	13.9
Fat over the ribs; mm <i>Warstwa tłuszczu nad żebrami; mm</i>	4.2	4.5	5.4

aa - $P \leq 0.05$

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).

Table 2. Yield of culinary cuts
Uzysk wyrębów kulinarnych

Trait <i>Cecha</i>	Group - <i>Grupa</i>		
	CH	EH	EP
Weight of half-carcass; kg <i>Masa półtuszy; kg</i>	6.89 a	7.39	7.56 a
Yield of culinary cuts (%): <i>Uzysk wyrębów kulinarnych (%):</i>			
- total ¹ <i>- łącznie¹</i>	64.5	64.3	64.8
- in that: shoulder roulade <i>- w tym: rolada łopatkowa</i>	12.1	11.8	11.5
cervical roulade <i>rolada karkowa</i>	8.5	9.4	9.0
breast roulade <i>rolada piersiowa</i>	9.3	8.8	8.6
loin chops <i>czopsy jagnięce</i>	11.5 A	12.5	13.7 A
leg roast meat: <i>mięso pieczeniowe z udźca:</i>			
- with the bone <i>- z kością</i>	21.3	21.3	21.6
- boneless <i>- bez kości</i>	19.9	18.5	18.8
hind shank boneless <i>goleń tylna bez kości</i>	3.3	3.3	3.3

¹Total: shoulder roulade, cervical roulade, breast roulade, loin chops, leg roast boneless and back shank boneless

¹Łącznie: rolada łopatkowa, rolada karkowa, rolada piersiowa, czopsy jagnięce, mięso pieczeniowe z udźca bez kości i goleń tylna bez kości

AA – P≤0.01; aa – P≤0,05

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≤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.

According to investigations performed by Grześkowiak et al. [2004] and Borys et al. [2008] 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.

Chemical composition, physicochemical characteristic and organoleptic score of meat.
The investigated dietary factors 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 lambs feeding. 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% ($P \leq 0.05$).

Table 3. Chemical composition of meat; g/100g
Skład chemiczny mięsa; g/100g

Component <i>Składnik</i>	Group <i>Grupa</i>		
	CH	EH	EP
Raw meat <i>Mięso surowe</i>			
- water / - <i>woda</i>	73.4	73.2	73.8
- protein / - <i>białko</i>	20.2	20.1	19.2
- fat / - <i> tłuszcz</i>	5.2	5.5	5.8
Grilled meat - <i>Mięso grillowane</i>			
- water / - <i>woda</i>	60.7	58.3	59.0
- protein / - <i>białko</i>	28.7 a	31.1 a	30.2
- fat / - <i> tłuszcz</i>	9.4	9.4	9.6

aa - $P \leq 0.05$

Previous studies conducted by Grzeskowiak et al. [2004] and Borys et al. [2006] showed no effect of oily components (rapeseed, linseed and rapeseed oil cake) on the basic chemical composition of lamb meat. However, Kaczor et al. [2010] 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.

The resulted changes in the chemical composition of meat during thermal processing are supported by earlier investigations [Borys, Pisulewski 2001; Borys et al. 2008; Borzuta, Strzelecki 2001; Wood et al. 2008], 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 examined factor (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 in 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.

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 (Table 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 some tendency to increase of shear force 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.

Table 4. Physicochemical characteristic of meat
Fizyko-chemiczna charakterystyka mięsa

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

Table 5. Organoleptic score of meat
Organoleptyczna ocena mięsa

Evaluation <i>Ocena</i>	Group <i>Grupa</i>		
	CH	EH	EP
Total (max 20 pt) <i>Łączna (max. 20 pkt)</i>	18.2	18.2	17.8
- in that (1–5 pt): <i>- w tym (1–5 pkt):</i>			
- flavour / <i>zapach</i>	4.7	4.6	4.5
- juiciness / <i>soczystość</i>	4.6	4.5	4.6
- tenderness / <i>kruchość</i>	4.3	4.4	4.2
- palatability / <i>smakowitość</i>	4.7	4.7	4.5

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