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FATTENING PERFORMANCE AND CARCASS CHARACTERISTICS OF LAMBS FED DIETS WITH DIFFERENT SHARES OF NON-DEGRADABLE PROTEIN

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Abstract

The effects of the level of non-degradable protein in diet on fattening performance and carcass characteristics of intensively fattened lambs are presented in the paper.The aim of this study was to determine the optimal level of non-degradable protein in the diet of weaned lambs fattened intensively.The experiment was conducted on 60 lambs of MIS population weaned at 60 days of age, divided into three groups.The effect of the use of three concentrated mixtures which differed in terms of the share of non-degradable protein at the rumen level was studied: 43% (I), 51% (II) and 58% (III).The average daily gain of lambs included in the treatments I : II : III was 0.169 : 0.205 : 0.227 kg, respectively. Conversion of dry matter (kg/kggain) on analogue treatments was 4.54 : 3.71 : 3.30; energy (MJ NEM/kg): 33.77 : 29.37 : 26.25; total protein (g/kg): 732 : 596 : 549. Values of yield of warm carcass with offal, observed per treatments I : II : III were as follows: 58.70 : 58.02 : 57.42%. Meat yield of category I (thigh, loin) on analogue treatments amounted to 37.27 : 37.35 : 37.51%, category II (back, shoulder, neck) 33.9 : 32.67 : 32.83% and category III (chest with a forearm and shanks): 27.78 : 29.59 : 29.10%. The ratio of muscle and bone tissue in the treatments with 48 : 51 : 58% non-degradable protein was 2.5:1; 2.9:1; and 2.8:1.This research has shown that the best fattening performance was achieved by lambs on treatment with 58% RUP while meat yield and morphological composition of the carcass side were not under significant influence of the studied treatment.

Key words*: lambs, non-degradable protein, gain, carcass characteristics.*

INTRODUCTION

Protein in foods that reach the small intestine of ruminants represent sum of two protein fractions: microbial protein and protein non-degradableat the rumen level (Ma et al., 2015;Rezaei et al., 2014; Ma et al., 2013; Zuo et al., 2011;Ramos et al., 2009; Webster et al., 2003). Microorganisms in the reticulo-rumen break down dietary proteins to peptides, amino acids and ammonia, and subsequently use these substances for the synthesis of own proteins. With each of these processes of decomposition and synthesis certain losses occur which ultimately means that reduced amount of amino reaches the place of digestion and adoption of proteins (Grubić et al.,1992). If the extent of degradation is larger proportionally lower is the amount of amino acids that directly remains for the animal (Grubić et al.,1992). The specific role of amino acids absorbed from the small intestine of lambs is protein synthesis, which contributes to increase of physical tissues. In order to ensure the optimal amount of amino acids for a particular production, it is necessary to provide in the diet for lambs protein fraction, which avoids degradation in reticulo-rumen (non-degradable protein). This is especially important in intensive fattening of lambs, since with the increasing genetic capacity of lambs also their requirements increase, especially in this part of the protein that passes through the rumen undegraded and together with the microbial protein reaches the duodenum (Ružić-Muslić, 2006).

MATERIALS AND METHODS

The trial included 60 lambs of MIS population weanedat the age of 60 days, divided in 3 homogeneous groups. The average body mass of lambs at the beginning was about 18.0 kg, and at the end of trial around 35.0 kg. Lambs were fed fodder mixtures,in a group and ad libitum, while the amount of hay was limited and equally distributed to animals. Three isoprotein feed mixtures were studied which differed in terms of the share of non-degradable protein in the reticulo-rumen: 43: 51: 58%. Nutrient calculation was performed based on

the French system recommended by INRA (1988) and Obračević (1990). The structure of the feed mixtures used is shown in Table 1, and their nutritional value in Table 2.

Changes in body weight, the total gain, the average daily gain, feed conversion and nutrients, are controlled at 15 day intervals. At the end of the trial, to determine the yield and quality of the meat, 18 animals were randomly selected (6 per each treatment).

Table 1. Structure of concentrate mixtures for fattening of weaned lambs (%)

Feeds	Levels of non-degradable protein(%)		
	43	**51**	**58**
Corn	73	79	82
Sunflower meal	23	5	7
Soybean meal	0	12	0
Fish meal	0	0	7
Livestock lime	2	2	2
Salt	1	1	1
Premix	1	1	1

Table 2. Nutritional value of mixtures

Nutritional indices	Levels of non-degradable protein (%)		
	43	**51**	**58**
Dry matter, g kg-1(*)	870	860.5	860.8
OFU(*)	1.2	1.2	1.2
NEM,MJ(*)	7.51	7.98	7.91
UFV(**)	0.99	1.05	1.04
Total protein,g/kg(*)	142	137	141
RUP	**43**	**51**	**58**
PDIN/g/animal/day(**)	102	103	107
PDIE/g/animal/day(**)	102	112	118
Ashes(*)	25	23	27
Ca,g(*)	8.4	8.2	10.6
P,g(*)	4.6	3.7	5.0

RUP- rumen non-degradable protein; PDIN - protein digested in small intestine depending on the fermenting nitrogen; PDIE - protein digested in small intestine depending on the fermenting organic matter.
**INRA (1988)*Obračevic (1990)

The following relevant parameters were recorded at slaughtering and usual primary processing, carried out in in the experimental slaughterhouse of the Institute for Animal Husbandry: pre-slaughter mass of the animals, the mass of warm carcass with head and edible by-products.

The carcasses were identified/marked using numbers that were placed on the carcasses during slaughtering procedure. After cooling for 24 hours at a temperature of 0 to + 4^0C, the weight of cold carcass with head and offal was determined as well as net mass of cooled carcass without offal and subsequently carcasses were cut along the spinal line into two symmetrical carcass sides.

The meat yield was calculated based on the ratio of pre-slaughter body weight of lambs and mass of warm carcasses with head and offal and net mass of cooled carcasses without offal. Then, the left carcass sides were cut into the major carcass parts and their weights recorded by the method stipulated in the Rulebook on cutting and categorization of mutton ("Official Gazette of SFRY" no. 34 of 1974).

The meat of category I includes the thigh and sirloin. Back, shoulder and neck are category II meat, and chest with a forearm and shanks are categorized as category III meat. The tissue ratio of the carcass side (morphological composition) was studied using the three rib cut (9th, 10th and 11th rib), by way of dissection and measurement of specific muscle, fat, bone and connective/binding tissue.

Statistical analysis of the data was performed using the computer program Stat.Soft, Inc. (2003). STATISTICA (data analysis software system), version 6, using standard mathematical - statistical methods.

RESULTS AND DISCUSSIONS

Data on average fattening parameters by dietary treatments are shown in Table 3.The highest daily gain (0.227kg) and the lowest conversion of dry matter (3.30 kg) were realized by lambs on treatment with 58% RUP in the mixture. Results similar to ours, in regard to the effects of non-degradable protein source are reported by (Orskov et al., 1971; Miller, 1978; Grubić et al.,1991; Walz et al., 1998; Peter et al., 2000; Memiši et al., 2002; Grubić et al., 1991).

In the analysis of the relationship between average daily gains and protein values of the diet expressed by the total digestible and degradable proteinsin the diet, we have found the highest correlation coefficient (r = 0.76) between the daily gain and the share of non-degradable protein in the diet, slightly lower between gain and crude proteins (r = 0.72) and the lowest between gain and digestible proteins (r = 0.68).

Table 3.Production performance of fattening lambs

Traits	Levels of non-degradable protein (%)		
	43	51	58
Initial body mass (beginning of the trial), kg	18.12	18.08	18.17
Age of lambs at the beginning of the trial, days	60	60	60
Final body mass (end of the trial), kg	30.78a	33.52b	35.17b
Total gain, kg	12.70a	15.40b	17.00b
Average daily gain, kg	0.169a	0.205b	0.227b
Utilization of dry matter r kg/kg of gain	4.54	3.71	3.30
Utilization of total proteins g/ kg of gain	732	596	549
Utilization of NEM, MJ/kg of gain	33.77	29.37	26.25

Difference between a and b is statistically significant at the level ($P<0.01$)

With the increase of the share of non-degradable in total proteins, there was a reduction in energy consumption by 4.4-7.5 MJ NEM for each kilogram of gain. Data on feed conversion and conversion of nutrients which are obtained in these studies, are consistent with the results of other authors (Kozarovski, 1988; Grubić et al., 1992; Mekić, 1994; Grubić et al., 1991) in their examination of the effect of concentrate mixture with a share of NP in total proteins of 38: 55: 62%, have recorded conversion of DM on analogue treatments of 3.75: 3.44: 3.30 kg. In fattening of Ile de France genotype lambs reared to 90 days of age with concentrate mixtures containing different shares of NP in total proteins (40: 50: 60%), Mekić (1994) has found that with increasing levels of RUP the consumption of concentrates decreased: 2512: 2493: 2357 g per kilogram of gain of lambs.

Table 4. Average values of carcass mass and yield

Traits	Levels of non-degradable protein (%)		
	43	51	58
Lamb pre-slaughter mass, kg	30.78±4.73	33.52±4.99	35.17±5.34
Warm carcass mass with offal, kg	18.07±2.86	19.45±3.02	20.19±3.31
Warm carcass yield with offal,%	58.70±1.14	58.02±1.65	57.42±1.47
Cold carcass yield with offal, kg	56.49±1.37	55.97±1.78	55.38±1.22
Cold carcass mass without offal, kg	15.44±2.22	17.21±2.40	17.36±2.57
Cold carcass yield without offal, kg	46.45±1.25	46.14±1.72	45.42±1.27

The established differences in meat yield values ranged within the limits of random deviation ($P>0.05$), which means that different levels of RUP in diets for lambs had no significant effect on the observed trait (Table 4).

The obtained results are consistent with results of Mekić et al.(1999)who examined the effects of different shares of non-degradable protein (41: 50: 60%) in the total mass of diet on fattening and slaughter performance of lambs of genotype Ile de France until 88 days of age, and found that different levels of RUP protein have no significant impact on the meat yield value of warm carcass with offal, since the values obtained were: 54.16: 56.54: 57.36%. Also, Shahrbabak et al. (2009) suggest that different levels of non-degradable protein: 19.86: 26.47: 33.08 g/kg DM in diets for fattening Kermani lambs, did not affect the yield, weight of edible parts and the surface of the MLD. Al Jassim et al. (1991) point out that the effect of non-degradable protein in the rumen was greater in lambs compared to goats,especially in regard to the efficiency of feed utilization but not on the carcass quality.

Table 5. Yield of meat of different categories

Indicators	Levels of non-degradable protein (%)		
	43	51	58
Left carcass side, kg	7.69±1.12	8.63±1.27	8.65±1.28
I category meat, %	37.27±2.68	37.35±1.35	37.51±2.11
II category meat,%	33.19±2.21	32.67±1.68	32.83±1.36
III category meat,%	27.78±2.71	29.59±2.53	29.10±2.35

According to the data presented in Table 5, the share of I category meat (leg and loin) in the mass of the left carcass side in lambs on treatments 43: 51: 58% was as follows: 37.27: 37.35: 37.51%.

Meat of category II (back, shoulder, neck) were represented as follows: 33.19: 32.67: 32.83%. The relative share of meat of category III (breast with the forearm, shank) was: 27.78: 29.59: 29.10%. Thus, the studied nutritive treatment did not affect the mass of carcass sides and shares of different categories of meat, as realized differences were not statistically significant (P>0.05).This is consistent with the statements of a number of authors (Butterfield, 1988 quoted by Petrović, 2000; Shahrbabak et al., 2009), who point out that the variability in the quality of the meat mostly depends on the genotype and age of animals at slaughter, and less on the diet.

Table 6. Tissue ratio in three rib cut

Properties	Levels of non-degradable proteins,%		
	43	51	58
Mass of three rib cut, g	245.67±4.39	265.50±5.01	275.53±5.28
Ratio of certain tissues,%			
Muscle	43.52±4.61	42.27±1.80	41.92±3.12
Fat	26.68±6.68	31.76±3.07	30.68±4.42
Bone	28.23±6.33	25.06±3.14	25.93±5.60
Connective	1.19±0.64	0.93±0.52	1.01±0.53
Meat bone ratio (muscle and fat tissue together)	2.5 : 1	2.9 : 1	2.8 : 1

Morphological composition of the carcass sidewas determined by establishing the ratio of tissues in three rib cut, the values are presented in Table 6. The results of the relative share of certain tissues in three rib cut show that the levels of non-degradable protein in feed mixtures for lambs did not have a statistically significant impact on the morphological composition of carcass sides (P>0.05). However, the most favorable meat to bone ratio was recorded in the treatments with 51% and 58% RUP. Lambs on treatment with 43% RUP achieved 0.4 kg less meat per kg of bones than lambs on treatment with 51% NP and 0.3 kg less than lambs on treatment with 58%.

The confirmation of these results is found in studies ofŠokarovski et al. (1988), Tahirović and Mašnić (1979). The obtained results relating to the characteristics of the carcass and the share of certain tissues (muscle, fat, bone and connective tissue) showed that they were not influenced by dietary treatment, which is consistent with the results of Atti et al. (2007). The explanation lies in the fact that the lambs had similar weights of the empty carcasses and composition of carcasses, as they were slaughtered with similar finalbody weights. these parameters mainly depend on pre-slaughter body weight (Colomer-Rocher and Espejo, 1972; Atti et al., 2003).

CONCLUSIONS

Based on results obtained in the present study of the effect of different levels of non-degradable protein in the diet on fattening parameters and characteristics of the carcass of intensively fattened lambs, the following can be concluded:

The highest average daily gain (0.227 kg) was realized by lambs fed diet containing 58% RUP.The best DM conversion (3.30 kg/kg gain) was realized by lambs on treatment with 58% RUP.

The values for yield of warm carcass with offal, in the treatments 43: 51: 58% were as follows: 58.70: 58.02: 57.42%.

The most favorable meat to bone tissue ratio was recorded in the treatments with 51 and 58% of non-degradable protein, without statistical significance. The level of non-degradable protein in diets for weaned lambs had no significant effect on theyield of meat categories.

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