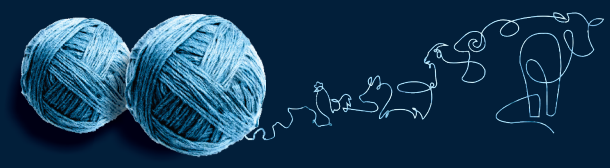
12th
INTERNATIONAL
SYMPOSIUM

MODERN TRENDS IN LIVESTOCK PRODUCTION



PROCEEDINGS

9 -11 October 2019, Belgrade, Serbia

Institute for Animal Husbandry
Belgrade - Zemun, SERBIA

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Proceedings of the 12th International Symposium
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ALTERNATIVE SOURCES OF PROTEIN IN LAMB DIET

Dragana Ružić-Muslić, Milan P. Petrović, Zorica Bijelić, Violeta Caro Petrović, Nevena Maksimović, Bogdan Cekić, IvanĆosić

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Review paper

Abstract: The high price of protein nutrients as well as import orientation have triggered the demand for alternative protein sources in the feeding of lambs. In addition, it is necessary to take into account the degree of degradability of proteins. In order to ensure optimal amino acid pool for high genetic capacity of lamb growth, it is important to provide a protein fraction that avoids degradation in the rumen. An excellent source of protein that slowly degrades in the rumen is fish meal. However, given the recommendation of its non-use, the effects of the use of Eko fish meal, as a fishmeal substitute in diet of lambs of average body weight of about 14 kg and age of 30 days, were examined. The source of protein did not significantly affect the growth rate and the efficiency of food utilization in the lambs of MIS population in fattening ($P>0.05$), suggesting that fish meal can be successfully replaced by Eco Fish Meal. As an alternative to soybeans, in diet for lambs in fattening, the following were used: sunflower meal with the addition of fibrolithic enzyme, lupine, fodder peas, fodder beans were used, while in the more exotic areas the following were used: castor cake, pomegranate peel, product obtained after rice fermentation without any harmful effect on the biological efficiency of growth and food conversion.

Key words: alternative sources of protein, lambs, soybean, fish meal

Introduction

Protein, in addition to energy, is a key determinant in the nutritional concept of lambs in fattening. The dominant source of protein in rations of younger ruminant categories is soybean. However, the high price, import orientation, fluctuations in production, global presence as genetically modified food, etc., impose the need for alternative protein sources *(Hadad, 2006; Hani et al., 2019).* Protein sources differ in terms of the amino acid profile as well as the degree of degradability *(Gleghorn et al., 2004; Bateman et al., 2005).* Dietary proteins reaching the small intestines of ruminants consist of two protein fractions:

microbial and protein non-degradable at the level of rumen. The microbial protein is created by the action of rumen microflora that breaks the dietary protein into peptides, amino acids and ammonia, after which these substances are used for the synthesis of their own proteins *(Ružić-Muslić, 2006).* During the degradation and synthesis there are some losses, (usually about 20%, but sometimes higher). A reduced amount of amino acids reaches the place of digestion and adoption of proteins, which means that the microbiological synthesis of proteins from the usual sources of protein and energy can not meet the needs of high-production meat breeds (*Ružić-Muslić et al., 2007, 2011-b*). Therefore, in order to provide the optimal amino acid pool for a particular production, it is necessary to provide a protein fraction that avoids degradation in the rumen (*Ružić-Muslić et al., 2007, 2011, 2014*). The correct selection of protein sources can affect the volume and rate of protein degradation in the rumen *(Grubić et al., 1992).*

Bearing all this in mind, the aim of this paper was to present results related to the effects of the use of alternative protein sources in nutrition of lambs in fattening.

The influence of protein source on the production performance of lambs in fattening

In search of alternative, environmentally friendly, sources of protein, *Alves et al. (2016)* have carried out studies on 40 male lambs, with average body weight of about 19.8 kg. Lambs were divided into 4 groups. As sources of protein in lamb rations, soybeans, castor cake, sunflower cake and sunflower seed were used. In analogue feeding treatments, the following average daily gains were achieved: 0.217; 0.190; 0.171; 0.135 kg. In spite of the higher content of lignin in the castor cake, which reduces the rate of degradation of the fibers in the rumen, and increases the retention time, which reduces the consumption of dry matter, compared to soybean, there was no significant difference in the realized gain in lambs in these treatments. However, in the treatment with sunflower cake and seed, as sources of protein, significantly lower growth compared to soybean was achieved, which resulted from lower digestibility of dry matter, related to higher content of ether extract and ADF.

By examining the effects of three sources of protein (soybean meal, sunflower meal, sunflower meal with added fibrolytic enzyme) on the performance of Shami kids of average body weight of 17.0 kg, *Titi (2003)* has determined following values for body weight: 30.23 kg, 29.68 kg, 36.38kg, daily gain: 0.155kg; 0.142 kg; 0.221 kg, respectively. The food conversion ratio was 6.61, 7.59, 4.70 kg/kg of gain, respectively. Therefore, the use of sunflower meal with the addition of fibrolytic enzymes has induced significantly ($P<0.05$) higher

daily gain and more favourable food conversion ratio compared to the other two treatments. The superiority of this treatment is based on the fact that fibrolytic enzymes affect the reduction of fiber content and improve dry matter digestion, which results in providing enough energy for the growth of rumen microflora *(Lewis et al., 1995).* The use of sunflower meal, as nutrient with best price on the market, is recommended in the diet of lambs, with the addition of fibrolytic enzymes, as a substitute for soybean.

Given that the production capacity of ruminants today is significantly improved, microbiological protein synthesis from common sources of protein and energy can not meet the needs of proteins in such animals, which means that the optimal ratio between proteins that degrade under the action of microflora of the rumen -degradable and proteins that avoid degradation in the rumen -non-degradable protein, must be provided *(Grubić et al., 1991).*

Fishmeal is an excellent source of high quality protein that degrades slowly in the rumen *(Can et al., 2005)* and has an excellent amino acid profile. Substitution of soybean, as a highly degradable protein source, with fish meal, improves the average daily gain and efficiency of food utilization (*Orskov et al., 1970, Beerman et al., 1986).Orskov et al.(1970)* have conducted research on lambs in fattening. As a protein source, fish meal was used in mixtures: 1, 6 and 12%. The achieved average daily gains in the above treatments are: 191, 270, 330g, respectively. *Beerman et al. (1986),* in their study of the effect of replacing soybean with 3% of fish meal, in diet for fattening lambs, have found improvement in average daily gain and food conversion ratio - 441 g and 3.52 kg, compared to - 350 g and 3.90 kg, in treatment without fish meal. In the research of *Urbaniak (1994),* the effects of different sources of protein were compared: blood meal, fish meal, soybean meal and casein, in isoprotein and isoenergetic diets for lambs of Polish Merino breed, of average body weight about 25 kg. In analogous treatments, average daily intake values were realized: 181, 197, 175 and 114 g. Results in concordance with the above mentioned are reported by *Ponnampalam et al. (2005),* emphasizing the effect of fish meal as a superior source of protein, compared to alfalfa hay, canola and soybean meal, on increased consumption of dry matter and average daily gain in lambs in fattening. The part of this answer can be attributed to improved fiber digestion in the rumen, which is the result of the availability of amino acids and ammonia for microflora action. Thus, the microbial protein is not sufficient to satisfy the metabolic requirements for amino acids, so the use of protein sources with high content of non-degradable protein, has resulted in superior performances.

However, according to Commission Decision 9/2001 on the protection of BCE (OJEC, 2001), food containing fish meal can not be produced in plants that produce food for ruminants, which in some ways leads to the distance to fish meal

as a high-quality protein source. In order to find alternative protein sources, research was conducted in order to examine the possibility of using Eco Fish Meal as a substitute for fish meal, in rations for fattening lambs *(Ružić-Muslić, 2018).* The trial included 40 lambs of MIS population, divided into 2 groups of 20 animals, age 30 days and average body weight of about 14 kg. The lambs in treatment I received as a source of protein fish meal, while the animals in treatment II received Eco Fish Meal replacement for fish meal. This product contains domestic nutrients of known origin such as genetically unmodified and thermally processed flour of ground soybeans, soy protein isolate, gluten, livestock yeast with the addition of minerals, amino acids, vitamins, enzymes and other supplements. Table 1 shows the production performance of the experimental lambs.

Table 1. Performances of trial lambs

Indicators	I	II	Level of significance
Initial body weight (kg)	14.55±2.61	14.57±2.93	NS
Final body weight (kg)	31.95±3.28	30.75±3.59	NS
Total gain (kg)	17.40±2.34	16.18±1.96	NS
Average daily gain, g	320±39.09	283±32.73	NS

I Fish meal (RB)
II Eco Fish Meal (EFM)

It is evident that the source of protein did not significantly influence the growth rate and efficiency of the food utilization in the lambs of the MIS population in fattening (P>0.05), suggesting that fish meal can be successfully replaced by Eco Fish Meal.

Karamnejada et al. (2019) carried out studies on 24 male lambs, with average body weight of 16.3kg. The nutritional treatment involved the use of protein sources in diet, which differed in terms of the level of degradable protein in the rumen. The lambs in the control group consumed a meal where the soybean flour was used as a protein component, while the animals in the treatment II received a meal containing 21% of the pomegranate peel and soybean, and the lambs in the treatment III - also 21% of the pomegranate peel and urea. diet II had lower, and diet II higher level of protein degradable in the rumen. Lambs on these treatments achieved the average daily gain of 0.221, 0.210, 0.182, and food conversion ratio 5.08, 5.83, 6.80 kg/kg of gain, respectively. The digestibility of

the dry matter was 689, 656, 610 g/kg, respectively. Lower daily gain and poorer food conversion ratio in treatments with pomegranate peel are probably the result of a negative effect on digestibility. The complete substitution of soybean flour with urea has adversely affected the growth rate and consumption of foods in lambs. It is generally known that the urea maintains a high level of protein that rapidly degrade in the rumen, which is not desirable for growing lambs. According to *Grubić et al. (1991)*, for each level of productivity, it is necessary that there is an optimal relation between the fractions of rapidly degrading proteins and those that avoid the degradation in the rumen.

Hani et al. (2019) have compared the effects of soybean and an alternative source of protein (*vinasse*), a product obtained after alcoholic fermentation of rice, on the performance of Texel lambs, of initial weight of about 30.48 kg, in a 60-day fattening. The nutritional treatment involved the substitution of the soybean protein with vinasse proteins: 250, 500 and 750 g/kg of DM, in rations for lambs. Animals in treatment with 500 g of this product have achieved a higher daily gain (0.140 kg) compared to the control group, as well as more favorable food conversion ratio, higher profit and economic efficiency. Increased daily gain is due to improved apparent digestibility of raw proteins and digestible energy, which implies the production of energy for fermentation in the rumen and increases the synthesis of the microbial protein. On the other hand, this treatment resulted in reduced production of methane, which is a consequence of the inhibitory action of vinasse on protozoa and methanogenic bacteria.

As an alternative source of protein, legumes are used in nutrition of lambs. Grains of leguminose have a high protein content, a significant concentration of energy and calcium. Their proteins are highly degradable in the rumen. They are most often used as an alternative to soybean flour *(Tudisco et al., 2010).* In addition, they are strategically important both in terms of reducing greenhouse gas emissions and the use of nitrogen fertilizers *(Carrouée et al., 2003).*

Lupine is a prospective leguminous crop. Lupine seed contains (300-500 g kg^{-1}) of crude protein and (50-100 g kg^{-1}) of oil, *(Calabrò et al., 2015).* In terms of fatty acid composition, lupine contains about 50-60% oleic acid, 16-23% of linoleic acid, and 8-9% linoleic acid *(Boschin et al., 2008; Calabrò et al., 2015).* It does not contain many antinutritive factors, found in soybeans *(Kung et al., 1991).*

Fodder peas is characterized by a lower content of crude proteins, compared with lupine (25-26% of dry matter), but with a higher level of lysine and methionine *(Saastamoinen et al., 2013).* At the same time, it contains 12.7% oleic acid, 35.3% linoleic and 5.4% linolenic acid *(Grela and Günter, 1995).*

Lestingi et al. (2016), have compared effects of lupine, peas, lupine and peas together, in diets for lambs of average weight of 16 kg and age of about 38 days, on production performances. Animals in the treatment I received 250 g of

lupine seed, in the treatment II: 150 g of lupine + 150 g peas, while lambs in the treatment III received 300 g of pea seed. In analogous treatments, the following average daily gain values were achieved: 0.140, 0.180, 0.210 kg, respectively. The food conversion ratio was 5.86, 5.16, 4.08 kg/kg of gain, respectively. In view of the observed properties, there were no statistically significant differences between the nutritional treatments, although the pea proved to be superior nutrient, given the achieved gain and more favorable food conversion ratio. The explanation for this phenomenon lies in the fact that lupine contains alkaloids, which adversely affect the consumption, the conversion of food, and thus the gain in lambs.

Lanza et al. (2003) have conducted comparative studies to compare the effects of soybean meal and pea (39 and 18% in the mixture), on the fattening performance and quality of the meat of Barbaresa lambs. The protein source has not significantly affected the average daily gain (0.218, 0.29, 0.250, respectively), food conversion ratio (4.7, 4.8, 4.1 kg), slaughter yield (50.1, 50.8, 51.2%), as well as physical and chemical properties of *M. longissimus dorssi*. Apparently, in all rations, the protein fraction was sufficient to meet the requirements of lambs in amino acids *(Ružić-Muslić et al., 2014).*

Morbidini et al. (2005) have examined the effect of soybean meal and beans on the performance of Italian Merino lambs. It was found that the use of beans in the meal resulted in a depressing effect on the performance of the lamb. The explanation lies in the greater content of NPN compounds and antinutritive factors. Therefore, the recommendations in the period after the early lamb weaning is: use in rations of proteins non-degradable at the level of rumen, since the rumen in this period is not fully functional and protein synthesis is less effective. In addition, for the same reasons, animals in this period are not able to neutralize possible anti-nutritional factors. The negative side of the leguminous grains is that a large part of them contains anti-nutritional factors: lecithin, trypsin inhibitors, tannins, saponins, phytase *(Ružić-Muslić et al., 2014).*

Conclusion

– Protein, in addition to energy, is a key determinant in the feeding concept of lambs in fattening.

– The dominant source of protein in rations for younger ruminant categories is soybeans.

– The high price, import orientation, production fluctuations, global presence as genetically modified food, imposes the need for alternative sources of protein.

– Fish meal is an extraordinary source of high-quality proteins, which are slowly degraded in the rumen, in the lamb diet.

– According to Commission Decision 9/2001 on the protection of BCE (OJEC, 2001), food containing fish meal can not be produced in plants producing food for ruminants, which in some ways leads to the distance to the fish meal.

– As alternative sources of protein, in the lamb fattening, the following can be used: Eco fish meal, sunflower meal with the addition of fibrolytic enzymes, lupine, peas, beans, without adverse effect on the biological efficiency of growth and food conversion.

Alternativni izvori proteina u ishrani jagnjadi

Dragana Ružić-Muslić, Milan P. Petrović, Zorica Bijelić, Violeta Caro-Petrović, Nevena Maksimović, Bogdan Cekić, Ivan Ćosić

Rezime

Visoka cena proteinskih hraniva kao i orjentacija na uvoz, inicirali su potražnju za alternativnim izvorima proteina, u ishrani jagnjadi.Pri tome, neophodno je voditi računa i o stepenu razgradivosti proteina.U cilju obezbeđenja optimalnog pula aminokiselina, za visoki genetski kapacitet rasta jagnjadi, veoma je važno obezbediti frakciju proteina koji izbegavaju razgradnju u rumenu.Odličan izvor proteina koji sporo degradiraju u buragu je riblje brašno. Međutim, obzirom na preporuku o njegovom nekorišćenju, ispitivani su efekti upotrebe korišćenja Eko fish meal (biljno visokoproteinsko hranivo), kao zamene za riblje brašno, u obrocima jagnjadi u tovu, prosečne telesne mase oko 14 kg i uzrasta 30 dana. Izvor proteina nije značajnije uticao na stepen rasta i efikasnost iskorišćavanja hrane kod jagnjadi Mis populacije u tovu ($P>0.05$) , što upućuje na zaključak da se riblje brašno uspešno može zameniti Eko fiš mealom. Kao alternativa soji, u obrocima

jagnjadi u tovu, korišćeni su: suncokretova sačma sa dodatkom fibrolitičkog enzima, lupina, grašak, pasulj, dok su na egzotičnijim područjima korišćeni: ricinusov kolač, kora od nara, proizvod dobijen nakon alkoholne fermentacije pirinča, bez štetnog uticaja na biološku efikasnost rasta i konverziju hrane.

Ključne reči: alternativni izvori proteina, jagnjad,soja, riblje brašno

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