

Influence of Protein Source on the Growth of Lambs

Research Article

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ABSTRACT

The aim of the present study was to evaluate the influence of roasted soybean and sunflower meal on the consumption and growth performance of lambs from the Blackhead Plevan Breed. The results indicated that the addition of roasted soybean caused the lambs to grow significantly faster than those fed sunflower meal ($P<0.01$). Adding roasted soybean to the feed caused lambs to intake significantly less maize and roughage, while intake more protein feed at the same time. Combined with the significantly higher growth rate ($P<0.01$), lambs receiving roasted soybean exhibited lower expenditure of dry matter, concentrated feed and raw protein for 1 kg of growth, compared to lambs who were fed with sunflower meal ($P<0.01$). The intake amount of dry matter had a significant effect on the average daily gain in lambs consuming roasted soybean, with a high correlation coefficient ($r=0.645$). In both groups of lambs, raw protein and FUG feed units for growth intakes significantly affected the animals' growth performance.

KEY WORDS average daily gain, lambs, roasted soybean, sunflower meal.

INTRODUCTION

Growing animals have high requirements towards the energy and protein content of feeds, which make up 80% of total production expenses (Harb and Habbab, 1989; Abo Omar, 2002). Soy is a primary source of protein in animal feeds and its production reaches up to 2/3 of the global production of protein animal feed (Weightman, 2013). Soy's participation as a protein source is important regardless of category and production type. The reason for this is the high raw protein content, the good amino acid profile and the high digestibility (Cervantes-Pahm and Stein 2008; Johnson, 2008; Baker and Stein, 2009). Soy participates in the animals' feed as a protein additive, soy meal, yet there are cases of using roasted soybean. Roasted soybean is distinguished by lower content of raw protein as well as other nutrients (calcium, potassium, zinc), compared to soybean

meal. Roasting the soybean prevents the degradation of the protein by the microorganisms within the rumen, by blocking the enzyme attacks via the Maillard reaction (Handford, 2001). The study by Eweedah *et al.* (1997) indicated that thermal processing of the feeds reduced trypsin inhibitors content and urease activity, which reduced the degradation of protein, without changing the soy's chemical composition (Ramanzin *et al.* 1991). Nevertheless, both feeds have a balanced amino acid profile compared to other oleaginous feeds, despite the deficiency in sulfur-containing amino acids (Todorov *et al.* 2007). The limitations imposed upon animal protein additives in animal feeds (Wilkins and Jones, 2000) indicates that the usage of protein from grain and bean plants will considerably increase in the future (Hanbury *et al.* 2000). The aim of this study was to evaluate the influence of roasted soybean and sunflower meal on the intake and growth of lambs.

MATERIALS AND METHODS

The experiment was conducted in 2015 with 10 male lambs of the Plevan Blackhead Breed at 56 days of age, with an average body weight of 22.8 kg. The indicated number of animals was divided into two groups of 5 animals each, with each lamb being kept and fed within an individual cage with size $1.4 \times 0.7 \text{ m}^2$ for a duration of 28 days. The duration of the experiment was 28 days. The lambs in the first group were fed soybean roasted at $135 \text{ }^\circ\text{C}$ (as a primary protein source), corn and alfalfa hay, while in the second group, the primary protein source was replaced by sunflower meal.

During the experiment, concentrated feeds were placed within through-type containers, where the feeds were separated from one another with small barriers, so that the animals would be able to choose. The used concentrated feeds were placed with a ratio of 1:1 in increasing quantities, so that there would be 5-10% leftovers from both feeds every day.

The feed leftovers for each lamb were measured every day at 08:00, after which the new amount for the day was determined. Feeds were provided twice a day – at 08:30 in the morning and at 16:00 in the afternoon. Throughout the entire test period, the animals had free access to water and rock salt licks.

In order to satisfy the animal's mineral and vitamin needs, they were provided with a mineral-vitamin premix for sheep, in quantities of 2% of the feed, mixed with concentrate. The mineral-vitamin premix used in the experiment contained: vitamin A (retinol): 150000 ME/kg; vitamin D₃ (cholecalciferol): 30000 ME/kg; vitamin E (DL-alpha tocopherol acetate): 225 mg/kg; Cu (copper sulfate): 180 mg/kg; iron-II-carbonate: 750 mg/kg; zinc (zinc oxide): 900 mg/kg; manganese (manganese-II-oxide): 900 mg/kg; iodine (Ca-iodate): 19.5 mg/kg; selenium (Na-selenite): 3 mg/kg and cobalt (Co carbonate): 7.5 mg. Body weight was measured in the morning of every seventh day until the end of the test period, with electronic scales and at the end of the experiment it was determined after a 24-hour food deprivation and 12-hour water deprivation. The chemical content of feeds (Table 1) was determined by the standard AOAC (2007). The statistical evaluation of the data was done by the software Statistica (2006). The groups were compared using t-test, as differences at ($P < 0.05$) were considered significant.

RESULTS AND DISCUSSION

The results indicated that the lambs receiving roasted soybean as a protein source grew at 0.262 g/day, which was by 19.1% higher than the growth exhibited by the lambs in the

second group, which were receiving sunflower meal ($P < 0.01$, Table 2). This allowed the lambs receiving roasted soybean to reach weight of up to 30.2 kg during the 28-day test period, with the differences being significant at ($P < 0.05$), (Table 2). According to Goelema (1999) the reason is the thermal processing of the soybean, which reduces protein degradability in the rumen and increases the amount of protein reaching the small intestines. The study by Antunović *et al.* (2009), which indicates that feeding lambs with roasted soybean leads to better supply of the body with amino acids and volatile fatty acids supported this thesis. In this case, higher protein absorption in the small intestines translates into greater animal weight gain, which is of importance in the intensive fattening of lambs (Ružić-Muslic *et al.* 2011).

During the first two weeks of the experiment, the difference between the lambs' weights was significantly higher in the animals receiving roasted soybean as a protein source (Figure 1).

After the second week, the lambs receiving sunflower meal grew significantly slower ($P < 0.05$, Figure 1) and throughout the 28-day period, they reached a body weight of 28.7 kg, which was by 4.7% less, compared to the weight of animals receiving roasted soybean. When the feed included roasted soybean, the lambs intake by 14% less corn, but by 14.4% more protein feed and by 32.9% less crude fibre, compared to the animals intake sunflower meal ($P < 0.01$, Table 3). According to Antunović *et al.* (2009), the inclusion of roasted soybean into the feed of fattening lambs affects their endocrine systems, achieving maximum protein synthesis.

In this case there are conditions for an increased amount of some amino acids in the plasma, which, according to Ganong (2001) leads to increased growth hormone secretion (GH). In the study of Breier *et al.* (2000) GH was the main metabolism and growth regulator of the animals after birth, regulating the key metabolic pathways of intermediate metabolism.

The thermal processing of the soybean prevents the degradation of the protein by microorganisms in the rumen, blocking the enzyme attacks through Maillard reaction among the amino groups of lysine and carboxylic compounds (Handford, 2001). Thermal processing of the soybeans prevents protein degradation in the rumen and increases its synthesis in the small intestines, which improves the animals' growth performance (Beever and Thomson, 1977; Stern *et al.* 1985).

When sunflower meal is included in the animals' feed, they intake more corn (Table 3). This affects the physiological processes within the rumen, reducing pH due to the occurrence of depression. Thus, the degradation of protein is reduced, hence the lower microbiological activity.

Table 1 Composition and nutritive value of feedstuffs (g.kg⁻¹ at natural moisture)

Chemical composition	Feeds			
	Corn	Alfalfa hay	Sunflower meal	Roasted soybean
Dry matter	871.1	873.2	870.1	871.8
Crude protein	87.4	69.2	381.2	337.0
Crude fibre	28.5	334.3	148.4	140.7
Crude fat	39.7	14.4	11.0	207.4
Minerals	26.2	91.3	85.3	49.4
Nitrogen-free extract	818.2	490.9	374.2	265.5
Feed units for growth (FUG)*#	1.49	0.51	0.98	1.43
Protein truly digestible in small intestine (PDI)*	91.07	59.16	129.97	155.29
Balance of protein in the rumen (BPR)**	-34.88	-10.67	185.25	118.06
Calcium	0.823	5.160	5.703	2.561
Phosphorus	2.087	1.337	13.782	5.195

* By *Todorov et al. (2007)*, corrected according to moisture content, FUG, crude fibre, PDI and BPR as per crude protein content.

1 FUG= 6 MJ NE.

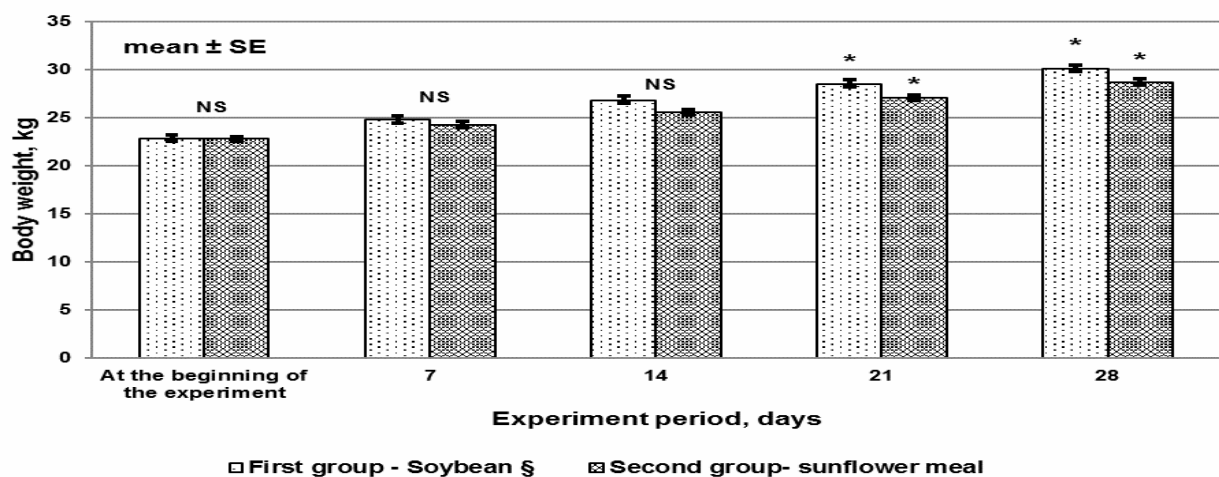
Table 2 Growth of the lambs (Mean±SE)

Parameters	Group 1	Group 2	Significance
	roasted soybean	sunflower meal	
Body weight, kg			
-in the beginning of the trial	22.817±0.417	22.800±0.246	NS
-at the end of the trial	30.155±0.350	28.725±0.342	*
-average daily gain	0.262±0.012	0.212±0.004	**

* (P<0.05) and ** (P<0.01).

NS: non significant.

SE: standard error.

**Figure 1** Growth of the lambs during the experimental period

* (P<0.05); NS: non significant and §: roasted soybean

Intake in more protein feed by the lambs in the first group, combined with the higher growth rate, was the cause for lower concentrated feed (by 20%) and lower of crude protein intake (by 17.8%) per 1 kg of growth (P<0.01), compared to the animals of the second group (Table 3). In their study, *Ružić-Muslic et al. (2011)* also indicated a higher dry matter intake per 1 kg of growth when sunflower meal was included in the lambs' feed. Tracing the feed intake per weeks, the amount of feed consumed by the groups was significantly higher for the lambs receiving roasted

soybean only during the first and last weeks (Figure 2).

During the second and third week of the experiment, intake was higher in lambs receiving sunflower meal, yet the difference from the animals in the first group was insignificant (Figure 2). The dry matter intake had a significant effect on the average daily gain of lambs consuming roasted soybean (P<0.01, Figure 3), as a result of which a significant correlation coefficient was detected ($r=0.645$), whereas in the lambs receiving sunflower meal, there was a moderate correlation ($r=0.438$, Figure 3).

Table 3 Intake of during experimental period (Mean±SE)

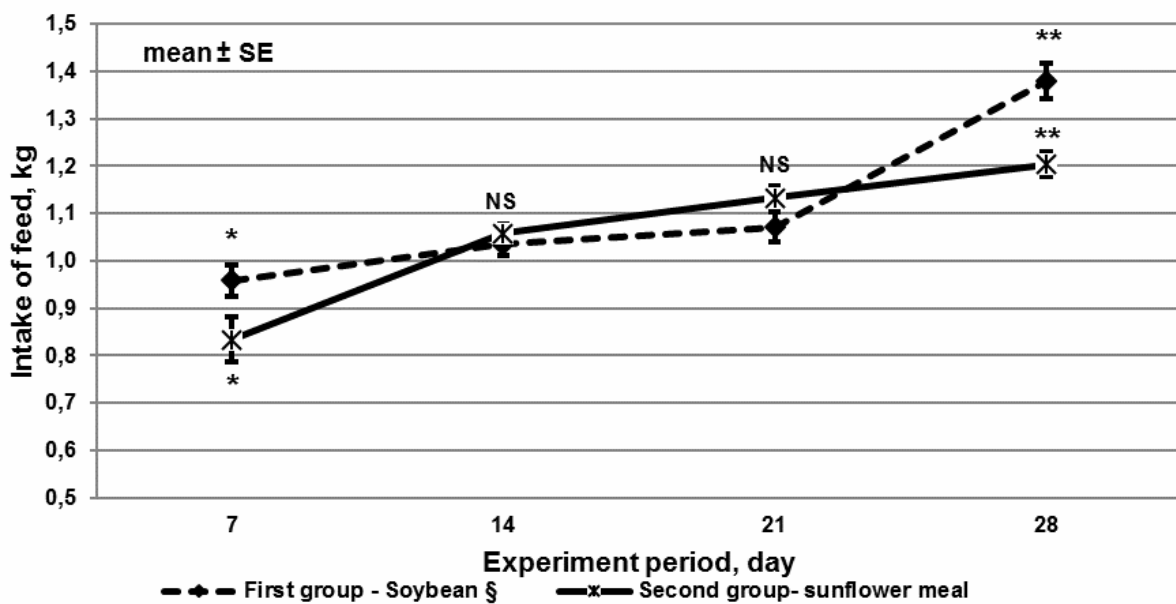
Parameters	Group 1 roasted soybean	Group 2 sunflower meal	Significance
Feed intake by animals (kg/day)			
Alfalfa hay, kg	0.213±0.010	0.143±0.007	**
Maize, kg	0.461±0.015	0.536±0.013	**
Soybean (roasted), kg	0.450±0.021	-	**
Sunflower meal, kg	-	0.385±0.012	**
Total, kg	1.124±0.024	1.064±0.022	**
Total DM, kg	0.980±0.021	0.927±0.019	NS
Energy and nutrients intake by animal per day			
Feed units for growth (FUG) [§]	1.439±0.032	1.249±0.026	**
Crude protein, g/kg DM	180.1±5.858	177.2±4.410	NS
Crude fat, g/kg DM	99.9±3.596	24.0±0.500	**
Crude fibre, g/kg DM	128.8±4.015	104.8±2.675	**
Protein truly digestible in small intestine, g/kg DM	108.5±2.748	93.5±1.975	**
Balance of protein in the rumen, g/kg DM	30.3±2.299	44.4±1.839	**
The expenses for feed, energy and protein per kg gain			
Dry matter, kg	3.740±0.119	4.373±0.088	**
Feed units for growth	5.492±0.172	5.892±0.122	NS
Concentrate feed	3.477±0.112	4.344±0.096	**
Crude protein	687.4±28.293	835.8±20.938	**
Protein truly digestible in small intestine	414.1±14.400	441.0±9.365	NS

** (P<0.01).

NS: non significant.

§ 1 FUG:= 6 MJ NE.

SE: standard error.

**Figure 2** Intake of feed during the experimental period

* (P<0.05); ** (P<0.01); NS: non significant and §: roasted soybean

There was a strong relationship between the crude protein intake and the animals' weight gain during the experimental period (P<0.01, Figure 4), as supported by the high correlation coefficients for both groups (r=0.786 in lambs consuming roasted soybean and r=0.853 in lambs receiving

sunflower meal). Intake of feed units for growth had a significant effect on the growth of both groups of lambs (P<0.01, Figure 5), with correlation coefficients r= 0.781 for the lambs consuming roasted soybean and r= 0.610 in the lambs consuming sunflower meal.

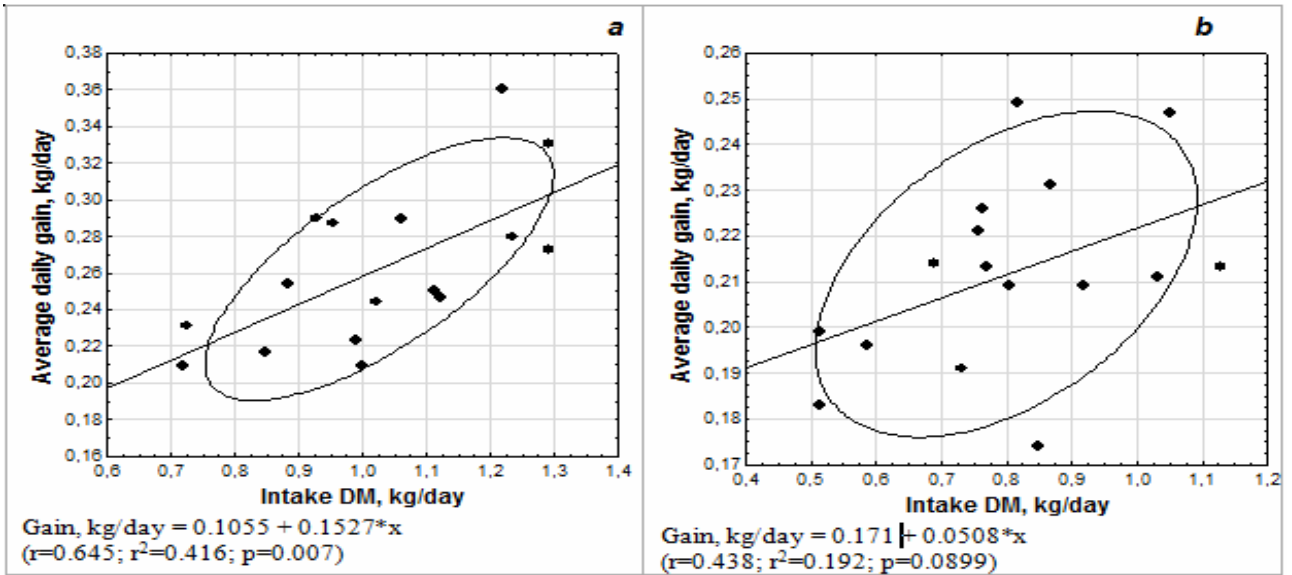


Figure 3 Effect of dry matter on average daily gain of lambs fed roasted soybean (a) and sunflower meal (b)

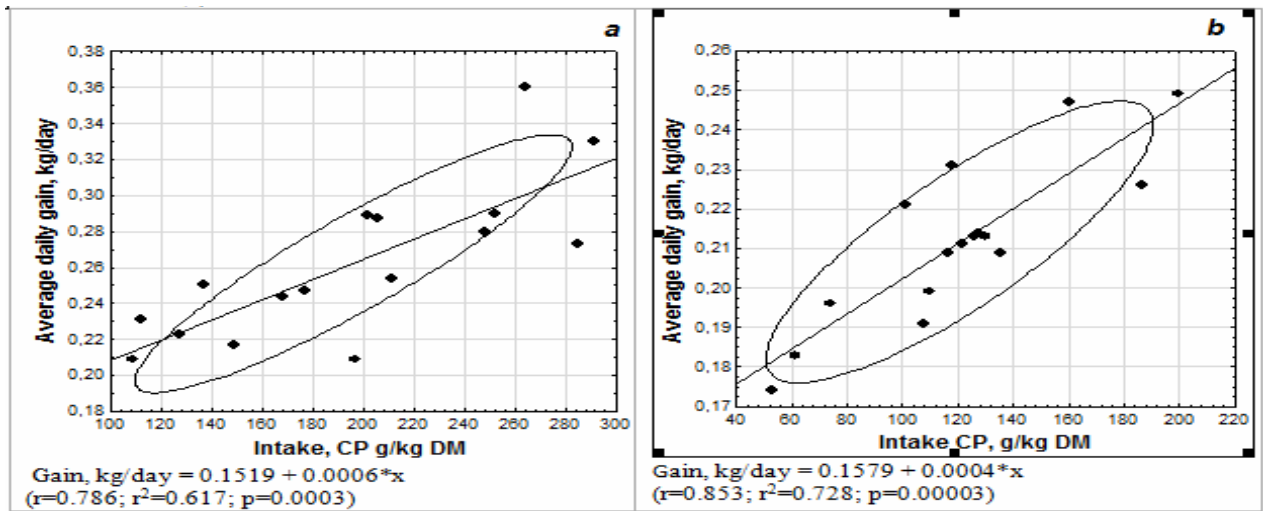


Figure 4 Effect of protein on weight gain of lambs fed roasted soybean (a) and sunflower meal (b)

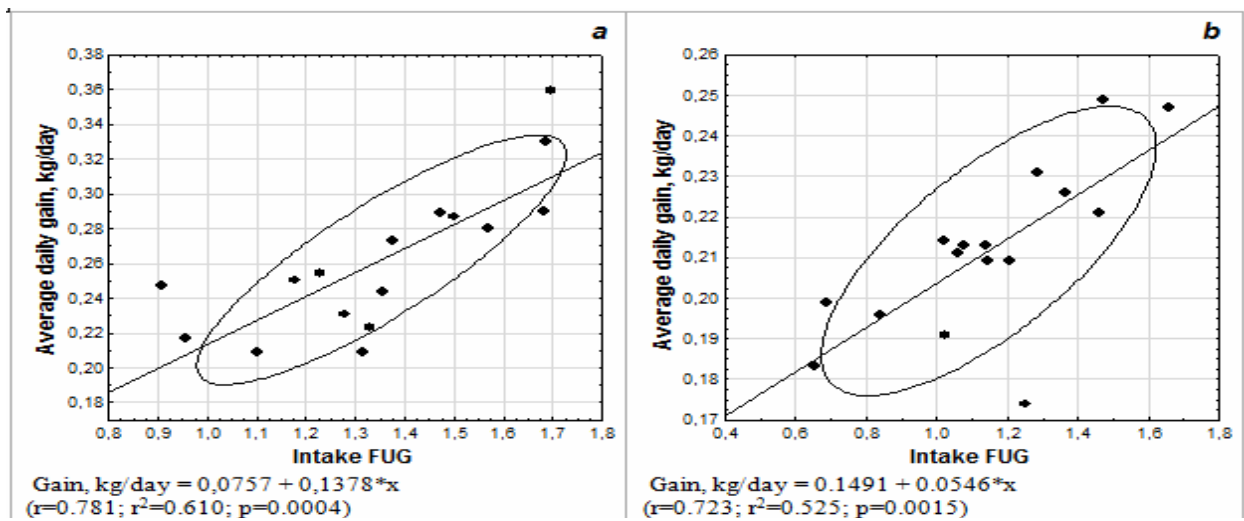


Figure 5 Effect of FUG on weight gain of lambs fed roasted soybean (a) and sunflower meal (b)

The average daily weight gain and dry matter, crude protein and energy intakes allowed us to derive linear equations, represented on Figures 3, 4 and 5.

CONCLUSION

When roasted soybean was added to the lambs' feed, they would grow significantly faster, compared to lambs fed sunflower meal ($P < 0.01$). When fed roasted soybean, lambs intake significantly less maize and crude fibre and significantly more protein feed, having a lower expenditure of dry matter, concentrated feed and crude protein per 1 kg of gain, compared to the lambs fed sunflower meal ($P < 0.01$). The dry matter intake had a significant effect on the average daily gain in lambs consuming roasted soybean ($r = 0.645$). In both groups of lambs, the crude protein and FUG intakes had a significant effect on the animals' growth performance.

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