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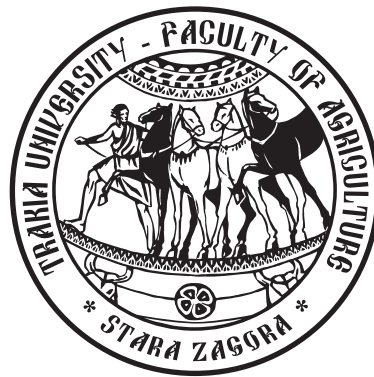
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Effect of dried distillers' grains with solubles from corn (DDGS) fed on fattening lambs

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Abstract. The objectives of our study were to evaluate chemical composition and the effects of dried distillers' grains with solubles (DDGS) on feed intake, growth and gain efficiency of fattening Synthetic Bulgarian Dairy Population lambs. Thirty-two lambs (16.69 ± 2.53 kg initial body weight and 59 days of age) were separated by weight and sex into one of 2 pens and assigned to treatments ($n=2$). Diets were formulated to meet crude protein, energy, calcium and phosphorus requirements. Treatments were isonitrogenous, isocaloric and with balanced calcium/phosphorus ratio. The basal diet consisted of roughage - meadow hay, triticale, corn grains and a trace mineral - vitamin mix. Protein forage was 37.58% DDGS vs. 26.33% sunflower meal on a diet basis (16 lambs/diet¹). Feed intake was monitored daily. Body weight was monitored every 2 weeks. Feed intake, average daily gain and gain efficiency were determined following 82-day long trial. Final body weight and average daily gain were significantly affected by DDGS ($p < 0.001$) treatments. Total DMI was greater in lambs fed DDGS diet as compared with lambs fed sunflower meal diet. Results indicated that DDGS is a viable feedstuff for fattening lambs without any compromise to performance.

Keywords: fattening lambs, gain efficiency, feed conversion

Keywords: DDGS – dried distiller's corn grains with solubles, SFM – sunflower meal, BW – body weight, ADG – average daily gain, MH – meadow hay, CD – control diet, ED – experimental diet, DM – Dry matter, EE – ether extract, CP – crude protein, CF – crude fibers, DMI – dry matter intake

Introduction

Grain by-products are potential feedstuff alternatives to grains and traditional soybean and sunflower meals in lamb diets. Smaller farmers needed feeds that are economical and easily managed. The increased availability of Dried Distillers' Grains with Solubles (DDGS), a co-product of bioethanol industry from corn, has created both challenges and opportunities for the livestock industry. The DDGS can provide relatively high levels of protein, energy, highly digestible fiber and minerals (Lemenager et al., 2006). Also it's an excellent source of energy and protein (Lardy, 2003). Approximately 55% of crude protein is a rumen undegradable protein (Ham et al., 1994; Kleinchmit et al., 2005), which could replace animal by-products for the source of bypass proteins. However, there is very limited research and few experiments evaluating the usage of DDGS in lamb diets (Held, 2006; Iliev et al., 2008; Schauer et al., 2008) are reported. With the expansion of the bioethanol industry DDGS could be freely available and relatively inexpensive compared with other feedstuffs that are commonly used in sheep diets. In view of these facts it's necessary to design comparative studies with other commonly used vegetable-based protein supplements for intensive meat production.

The objectives of the current study were to determine the chemical composition and effect of co-products from the bioethanol industry via substitution of dietary protein rates of sunflower meal (SFM) with DDGS on dry matter (DM) intake, growth performance and gain efficiency of fattening SBDP lambs.

Materials and methods

Experimental animals

The study was conducted at the Institute of Animal Science, Kostinbrod. The experiment began on February 02, 2011 and ended on May 01, 2011, total duration of 88 days. Thirty-two lambs were allowed to suckle for an average of 59 days (16.69 ± 2.53 kg initial BW). After weaning they were separated by weight and sex into 2 groups (16 lambs/group). Each group was assigned to different dietary treatment: DDGS replaced partly corn grain and SFM, respectively.

Experimental diets and methods

The experimental scheme is shown in Table 1. The concentrate mixes containing DDGS and SFM as a protein source, were formulated to be isonitrogenous and isocaloric. The DDGS replaced corn and sunflower meal in the concentrate mixes. The lambs were offered 36% meadow hay (MH) and 64% concentrate mix (as-fed basis) separately. The basal diet was formulated to meet and exceed all nutrient requirements of fattening lambs (NRC, 2007). The nutrient composition of DDGS, SFM, MH and concentrate mixes are shown in Tables 2 and 3. Feed was offered twice daily. Concentrate mixtures (offered at 8.00 and 14.00 h) and roughage (offered at 10.00 and 16.00 h) were fed separately throughout the experimental period. Feed intake was adjusted weekly to allow an excess of 5% of their anticipated intake expressed as fed basis. Animals had free access to water. Body weight (BW) was recorded every 2 weeks in the morning. The initial and final BW were used to calculate average

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Table 1. Experimental scheme

Forage	Control Diet (CD)		Experimental Diet (ED)	
	Sunflower meal (SFM)		DDGS	
	(g)	(%)	(g)	(%)
Roughage				
Meadow hay	320.00	36.64	320.00	35.58
Concentrate mixture				
Protein source	230.00	26.33	338.00	37.58
Triticale	150.00	17.17	150.00	16.68
Corn	150.00	17.17	60.00	6.67
Vitamin-mineral mix*	23.42	2.68	31.50	3.50
Roughage	320.00	36.64	320.00	35.58
Concentrate mix	530.00	63.36	548.00	64.42
Total ration	873.42	100.00	899.50	100.00

* Provided the following per kg of diet: manganese – 60.0 mg, iron – 1.3 mg, copper – 1.0 mg, iodine – 1.6 mg, zinc – 60.0 mg, cobalt – 1.0 mg. Vit.A – 5000IU, Vit.D – 2000 IU, Vit.E – 10.0 mg.

daily gains (ADG). The daily feed intake was monitored throughout the feeding period and gain efficiency was calculated.

Chemical analysis

Composite samples of hay, concentrate mixes and also DDGS and SFM were analyzed for DM, ether extract (EE), crude protein (CP) (Kjeldahl Nx6.25), crude fibers (CF), ash, Calcium and Phosphorus (Sande, 1979; AOAC, 2002).

Statistical analysis

Feed intake and dry matter intake (DMI) (average per lamb), average daily gain, gain efficiency and other parameters were analyzed using MS Office 2007.

Results and discussion

Diet composition

The chemical composition of MH and DDGS and other ingredients of concentrate mixes are given in Table 1. One of the concerns with DDGS is nutrient variability as just any other co-

product (Olintine, 1986; Spiehs et al., 2002; Nuez-Ortín and Yu, 2010). Kononoff and Christensen (2007) reported that DDGS content of CP varied by 26.6–33.9%, EE by 10–15.9%, NDF by 28.6–38.4%, phosphorus by 0.77–1.06 and sulfur by 0.46–0.83%. In the current study, the nutrient content of DDGS was within the lower range of the reported values.

SFM had higher CP content (37.2% of DM) than DDGS (26.4%). Approximately similar values about DDGS were observed by Noblet et al. (1993). On the contrary, relatively lower % was found by MAFF (1990); Al-Suwaiegh et al. (2002); Macken et al. (2004); Gibb et al. (2008); Stalker et al. (2009) and Uwituze et al. (2011). Also significantly lower values were published by Carvalho et al. (2005); Iliev et al. (2008) and Zarnela.pdf (2005).

Among the studied feedstuffs, DDGS has the highest level of EE (11.46% DM). This result is in the range noted by Uwituze et al. (2011) and Zarnela.pdf, (2005) but lower than the values found by Tjardes et al. (2002); Kessen et al. (2005); Stalker et al. (2009). Mosier et al. (2006) found higher values. DDGS was particularly poor in CF (7.3%). The observed values corresponded to those reported by Noblet et al. (1993), but were lower than those found by Moujahed et al. (2009); Tjardes et al. (2002) and Zarnela.pdf (2005).

Table 2: Chemical composition of feedstuffs used in the experiment*

Feedstuffs	DM	Chemical composition (DM basis %)					
		CP	EE	CF	Ash	Calcium	Phosphorus
Roughage							
Meadow hay	84.74	8.46	1.09	35.78	5.80	0.42	0.20
Concentrate mixture*							
Sunflower meal	86.32	37.24	0.82	20.84	7.50	0.44	1.22
DDGS	87.42	26.40	11.46	7.30	4.40	0.10	0.93
Triticale	83.57	12.04	1.44	3.72	1.85	0.06	0.35
Corn	81.66	7.38	2.71	3.17	1.04	0.06	0.21

* All values except DM are on DM basis.

In spite of our efforts to maintain diets of lambs diet ratio between MH and concentrate mix within the proportion 36:64, the actual intake ratios were different. The initial hay/concentrate ratio for the SFM and DDGS diets were 36.6:63.4 and 35.6:64.4,

respectively, but the final were 32.8:67.2 and 30.97:69.03 (for SFM and DDGS supplemented diet, respectively).

Dry matter intake

No signs of acidosis, bloat, or urinary calculi were observed with

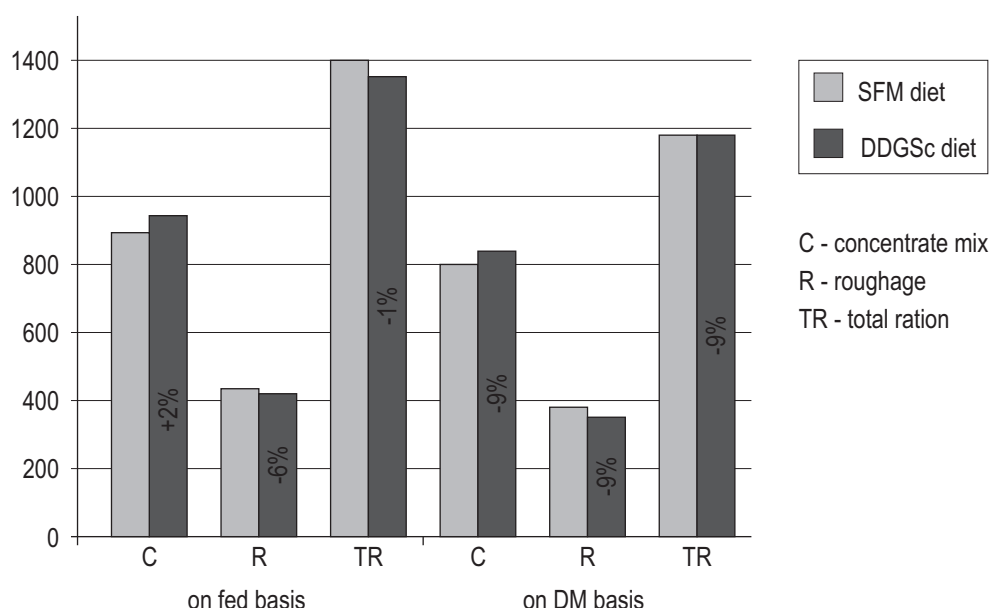


Figure 1: ADI of concentrate mixture, roughage and total ration on fed and DM basis

Table 3: Average daily intake of DM and nutrient ingredients^a

		Chemical composition (DM basis %)						
Item		DM						Phosphorus
			CP	EE	CF	Ash	Calcium	
Concentrate mix ^b	CD	764.36	188.4	13.30	95.63	35.42	0.20	0.62
	ED	799.16	180.4	68.70	51.92	29.50	0.07	0.62
Roughage	CD	327.31	32.68	4.21	138.20	22.40	0.19	0.09
	ED	353.81	35.32	4.55	149.40	24.22	0.18	0.08
Total ration	CD	1091.70	221.1	17.50	233.80	57.83	0.39	0.71
	ED	1152.98	215.7	73.20	201.30	53.72	0.25	0.70

a - All values are on dry matter basis except dry matter; b - Without premix.

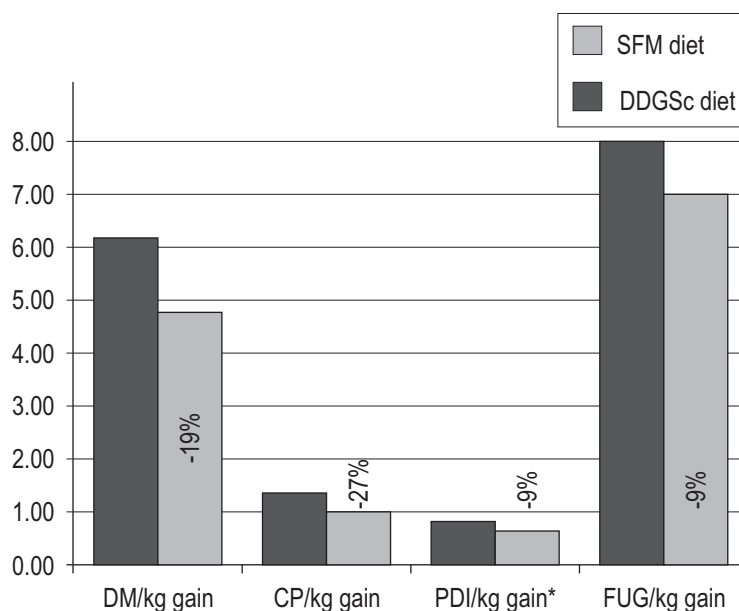
any dietary treatments. The feed intake reported as g.day⁻¹ was slightly affected (Figure 1) among treatments, when lambs were fed DDGS vs. SFM on a fed basis (1.35 and 1.36 kg, respectively). The total DMI reported as g.day⁻¹ was not different among treatments (Figure 1) – 1.15 kg. So, there were no apparent palatability problems associated with feeding dietary DDGS. The concentrate mix and hay intake were not similar (0.92 and 0.45 kg vs. 0.93 and 0.42 kg, respectively) among SFM and DDGS treatments. DDGS at 37.6 % dietary inclusion resulted in 6.35% fat in the diet DM, but the level of fat provided by DDGS inclusion was not high enough to depress DMI. When the concentration of fat exceeds 7-9 % of the diet DM, the DM intake is depressed (Morand-Fehr, 2005).

The intake of DDGS diets in the current study agrees with the reported data by other authors (Huls et al., 2006; Zelinsky, 2006; Schauer et al., 2008). They found no difference in feed intake and DMI in finishing lambs fed DDGS, which replaced a portion of grain

and protein source in the diet. There was difference in MH and concentrate mix DMI when lambs were fed with SFM and DDGS diets (0.77 and 0.38 kg vs. 0.80 and 0.35 kg, respectively). DDGS supplemented diet resulted in higher level of DMI supplied by the concentrate mix (3.3%) as compared with MH (6.5%).

Growth performance and gain efficiency

Average daily gains were 180 and 234 g.day⁻¹ for the diets containing SFM and DDGS, respectively (Table 4). The corresponding values for gain efficiency expressed as ADG/DMI (G:F) were 0.16 and 0.20 for lambs fed SFM and DDGS, respectively. There were significant differences among treatments in FBW, ADG and G:F ratios. Initial BW were not different among diets. The mean ADG of lambs in the current study were comparable to the values reported by other researchers (Ham et al., 1994; Estrada-Angulo et al., 2007; Loy et al., 2007; Iliev et al., 2008).



* - data based on your own analysis (Yosiffov et al., 2011)

Figure 2. Nutrient efficiency (kg/kg gain) of fattening lambs fed different SFM vs. DDGSc

There were differences among treatments (Figure 2) in values about DMI (6.06 vs. 4.91 kg), CP (1.28 vs. 0.94), PDI (0.78 vs. 0.71)

Table 4. Average daily gain (ADG) and Gain efficiency (G:F) of fattening lambs fed different protein source (SFM vs. DDGSc) (n=16, mean±SD)

Item	SFM	DDGS
Initial BW (kg)	16.78 ± 2.39	16.59 ± 2.74
Final BW (kg)	31.58 ^a ± 5.3	35.81 ^a ± 4.88
ADG (kg.day ⁻¹)	0.18 ^a ± 0.06	0.23 ^a ± 0.03
G:F ratio (ADG:DMI)	0.156	0.203

* Means within rows having superscript are significantly different at p<0.001.

and energy as FUG (7.94 vs. 7.26) per 1 kg It was observ ed gain were numerically higher in control diet with SFM inclusion than in the DDGS diet.

Conclusion

The results of this study indicate that can completely replace sunflower meal and a portion of corn in the supplement and up to 37.6% of the diet when feeding fattening lambs. The lack of detectable negative effect among treatments and the better performance of experimental group may be attributed to the inclusion of relatively high level of DDGS. Therefore, further studies are required to determine the maximum level of DDGS that can be included in diets for fattening lambs. Further researches are needed in order to investigate and evaluate the effects of DDGS on the physiological status, metabolism, rumen environment and meat quality traits. Sensory attributes are in relation to their acceptance by

consumers. However, the use of DDGS as an alternative feed supplement for fattening lambs depends on the relative price of DDGS, corn and protein supplements. Such alternatives could lead to cost effective animal feeding and cheaper products. Thus it could moderate the economic impact on the farm, respectively farmers.

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The manuscript should be structured as follows: Title, Names of authors and affiliation address, Abstract, List of keywords, Introduction, Material and methods, Results, Discussion, Conclusion, Acknowledgements (if any), References, Tables, Figures.

The title needs to be as concise and informative about the nature of research. It should be written with small letter /bold, 14/ without any abbreviations.

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The names of the authors should be presented from the initials of first names followed by the family names. The complete address and name of the institution should be stated next. The affiliation of authors are designated by different signs. For the author who is going to be corresponding by the editorial board and readers, an E-mail address and telephone number should be presented as footnote on the first page. Corresponding author is indicated with *.

Abstract should be not more than 350 words. It should be clearly stated what new findings have been made in the course of research. Abbreviations and references to authors are inadmissible in the summary. It should be understandable without having read the paper and should be in one paragraph.

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Todorov N and Mitev J, 1995. Effect of level of feeding during dry period, and body condition score on reproductive performance in dairy cows, IXth International Conference on Production Diseases in Farm Animals, Sept. 11 – 14, Berlin, Germany, p. 302 (Abstr.).

Thesis:

Penkov D, 2008. Estimation of metabolic energy and true digestibility of amino acids of some feeds in experiments with muscovy duck (*Carina moschata*, L). Thesis for DSc. Agrarian University, Plovdiv, 314 pp.

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