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EFFECT OF INCLUDING DRIED DISTILLERS GRAIN WITH SOLUBLE IN GROWING LAMBS DIET ON DIGESTIBILITY, SOME RUMEN PARAMETERS, BLOOD CONSTITUENTS AND PERFORMANCE

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ABSTRACT

The present study was conducted to determine the effects of dried distillers grains with soluble (DDGS) inclusion in lamb fattening diets replacing (partially or totally) soybean meal (SBM) as a protein source and corn as an energy source on growth performance, digestibility, rumen liquor traits, some blood plasma constituents, and economic efficiency. Twenty ¾ Romanov × ¼ Rahmani male lambs at about three months of age were divided randomly into four experimental groups with average live weight (17.7 ± 0.7 kg). Each lamb's group was randomly assigned for one of four experimental diets and was fed in group feeding in mash form. The complete diets comprised 40% clover hay (CH) and 60% concentrate feed mixture (CFM) containing 0% DDGS (T1, control), 10% DDGS (T2), 15% DDGS (T3) or 20% DDGS (T4). The main results showed that the DDGS contained 29% CP, 10% EE, 10% CF, 46% NFE ,5% ash, 18% ADF, 44% NDF, 26% hemi-cellulose, 14% cellulose, 4.1% ADL and 12% NFC. All the total mixed diets had nearly equal values for chemical nutrients except that of NFE content. The inclusion of DDGS in lamb's diets at 10, 15 and 20% resulted in better digestion coefficients of all nutrients and nutritive value as TDN and DCP% in comparison with the control group. The same trend was found also in the concentrations of energy (DE, ME and NE Mcal /kg). Ruminal pH values and NH_3-N were slightly changed among treatments. However, VFA's concentrations (meq/100ml) was gradually increased ($P \geq 0.05$) with elevating the DDGS level in the diets. The lambs of T1 and T2 recorded nearly similar values of average daily gain; ADG (163.1 and 161.3g), however, those of T3 and T4 had higher ADG (181.0 and 192.0g) than the control by about 11.0 and 17.7%, respectively. The intake of TDN and DCP were gradually increased with elevating DDGS level in the diet from 0 up to 20%. The DDGS inclusion in lamb diets did not show positive effects concerning feed conversion as g TDN or g DCP/g gain, meanwhile, the lambs of T3 and T4 recorded better values of DM conversion than the control (T1) by about 7.1 and 9.8%, respectively. Economic efficiency was gradually improved with elevating DDGS level in the diet where it was better for T2, T3 and T4 groups than the control (T1) by about 11.0, 34.6 and 45.6%, respectively. It may be concluded that in general, the inclusion of DDGS instead of corn and SBM at any level resulted in better performance, feed utilization and economic efficiency.

Keywords: DDGS, lambs, digestibility, nutritive value, rumen fermentation, blood constituents, feed cost, economic efficiency.

INTRODUCTION

The prices of all animal feedstuffs in Egypt are highly increased especially for corn and soybean meal to be 2-3 folds during the last five years. The cost of feeding cattle is rising steadily because of increased forage and grain costs (NASS, 2008). It may be economical to partially replace forage and/or grains with by-products. Therefore, by-products from the ethanol industry are gaining popularity as feedstuffs in the cattle industry of their availability, nutritive value and cost (Leupp, 2008).

The dried distiller's grain with soluble (DDGS) is recently imported to the Egyptian market as a new feed ingredient for animal feeding. This material is a strange ingredient for animal and poultry keepers; therefore, it is not accepted well from them irrespective of its nutritional and economic values.

A primary ethanol industry co-product; DDGS, is an excellent source of energy and protein for beef cattle and sheep (Lardy, 2003). Some information is available on feeding DDGS to cattle (Pederson *et al.,* 2007); however, limited research has been done on rabbits (Gabr *et al.*, 2008), sheep or goats (McEachern, 2008). The value of DDGS will increase if it can be used to replace all of or a portion of the crude protein content in growing rations for sheep and goats, which is normally occupied by cottonseed meal, soybean meal, or alfalfa meal. Energy constituents of the rations could also be altered from Milo or corn to DDGS if the desired effects are achieved by the replacement. Little research has evaluated the inclusion of DDGS as a replacement for concentrate in lamb finishing rations (Schauer *et al.,* 2008). It was reported that DDGS could be included at levels up to 22.5% of a finishing ration with no negative effects on lamb performance or carcass traits (Schauer *et al.,* 2008). The main objectives of this study were to determine the effects of DDGS inclusion in growing lamb diets replacing (partially or totally) soybean meal (SBM) as a protein source and corn as an energy source on their growth performance, digestibility, rumen parameters, some blood plasma constituents and economic efficiency.

MATERIALS AND METHODS

This study was conducted at the Animal Production Unit, Research and Agricultural Experiments Center, Faculty of Agriculture, Mansoura University from July 2007 to January 2008.

Twenty ¾ Romanov × ¼ Rahmani male lambs at about three months of age were divided randomly into four experimental groups, five animals each. Each group was housed in a separate well-ventilated pen. All groups had nearly equal average live weight (17.7±0.7kg). Each lamb's group was randomly assigned to one of four experimental diets and was fed in group feeding for 24 weeks. All total mixed diets were formulated to cover the nutritional requirements for growing lambs that grow about 200g daily according to NRC (1985). The total mixed diets contained 40% good quality clover hay (CH) from the 3^{rd} cut as well as 60% concentrates feed mixture (CFM). The CFM contained DDGS at 0.0% (CFM_1), 10% (CFM_2), 15% (CFM_3) or 20% (CFM_4). The composition of the experimental CFM and total mixed diets are presented in Table 1. Daily amount of total mixed feeds was offered for animals in two equal meals at 8 a.m. and 3 p.m. in mash form. Clean drinking water was available all the time.

Table 1: Composition of concentrate feed mixtures (CFM) and total mixed diets.

Ingredients (%)	CFM*				Total mixed diets			
	1	2	3	4	T1	T2	T3	T4
Yellow corn	40.0	35.0	32.5	30.0	24.0	21.0	19.5	18.0
SBM (44%)	10.0	5.0	2.5	0.0	6.0	3.0	1.5	0.0
DDGS	0.0	10.0	15.0	20.0	0.0	6.0	9.0	12.0
Wheat bran	28.0	28.0	28.0	28.0	16.8	16.8	16.8	16.8
Rice bran	15.0	15.0	15.0	15.0	9.0	9.0	9.0	9.0
Molasses	5.0	5.0	5.0	5.0	3.0	3.0	3.0	3.0
Lime stone	1.0	1.0	1.0	1.0	0.6	0.6	0.6	0.6
Salt	1.0	1.0	1.0	1.0	0.6	0.6	0.6	0.6
CH**	-	-	-	-	40	40	40	40
Total	100	100	100	100	100	100	100	100

***CFM_1: contained 0 % DDGS, CFM_2: contained 10% DDGS, CFM_3: contained 15% DDGS and CFM_4: contained 20% DDGS.**
**** CH: clover hay.**

Animals were weighed bi-weekly before the morning feeding. Daily amount of total mixed feeds were changed bi-weekly according to live weight change. The digestibility trials were conducted at the end of the feeding trial. It consisted of 14 days as an adaptation period to the metabolic cages and 5 days as a collection period. Rumen liquor samples were collected at the end of the digestibility trial using a rubber stomach tube before feeding (0 hr) and at 3 and 6 hrs post morning feeding. Rumen liquor samples were strained through four layers of cheese cloth at each sampling time for immediate determination of rumen pH with Orion 680 digital pH meter. Ammonia-N was determined in rumen liquor according to Conway (1962). Total volatile fatty acids concentrations were determined in rumen liquor according to Warner (1964).

Chemical analyses of total mixed diets, clover hay (CH), DDGS and feces were carried out according to A.O.A.C. (1990). Fiber fractions were determined after Goering and Van Soest (1970).

The gross energy (GE) values of complete experimental diets were calculated after MAFF (1975) as follows: The gross energy (GE) (MJ/kg DM) = 0.0226 CP + 0.0407 EE + 0.0192 CF + 0.0177 NFE.

The digestible energy (DE) was calculated as:

DE (Mcal/kg DM) = TDN (%) × 0.04409 (NRC, 1985).

The metabolizable energy (ME) was calculated as:

ME (Mcal/kg DM) = 0.82 × DE (Mcal/kg DM) according to NRC (1985). Metabolizability was also calculated as ME / GE (%) (Abbott and Maxwell, 2002).

Net energy was calculated according to NRC (1998) as follows:

NE (Mcal/kg DM) = 0.025 (TDN %) – 0.12.

NFC=100 - CP - EE - Ash – NDF (Calsamiglia *et al.*, 1995)

Where NFC= Non fiber carbohydrates

At the end of the feeding trial, blood samples were collected before morning feeding and after 3 hrs post-feeding from jugular vein in heparinized test tubes, thereafter; they were immediately centrifuged at 4000 rpm for 15 minutes to separate plasma. Plasma constituents' concentrations were determined according to Armstrong and Carr (1964) for total protein (TP), Doumas *et al.* (1971) for albumen (A), Reitman and Frankel (1957) for AST and ALT and Bartels (1971) for creatinine (Cr). Globulin (G) was calculated by the difference between TP and A. The A/G ratio was also calculated. Statistical analysis of data was performed using SAS (2000), and the significant differences among means were detected by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Results of the chemical analyses of DDGS, CH and total mixed diets are presented in Table 2. The DDGS contained 29.0% CP, 10.0% EE, 10.0% CF, 46.0% NFE and 5.0% ash. The fiber fractions in DDGS were 18.0% ADF and 44.0% NDF, 26.0% hemi-cellulose, 14.0% cellulose, 4.1% ADL and 12.0% NFC. Similar values have been reported in NRC (2001) and Spiehs *et al.* (2002), but CP% was higher than the value 26.22% given by Gabr *et al* (2008). The clover hay (CH) contained (on DM basis) 17% CP, 3.0% EE, 26% CF, 43% NFE, 11% ash, 35% ADF, 45% NDF, 10% ADL, 10% hemi-cellulose, 25% cellulose and 24% NFC.

Table 2: Chemical analysis (%) of total mixed diets, clover hay (CH) and DDGS (on DM basis).

Ingred. (%)	Total mixed diets				CH	DDGS
	T1	T2	T3	T4		
OM	92.2	92.2	92.2	92.2	89.0	95.0
CP	15.9	16.0	16.1	16.2	17.0	29.0
EE	4.4	4.9	5.1	5.3	3.0	10.0
CF	14.5	14.8	15.0	15.2	26.0	10.0
NFE	57.5	56.5	56.0	55.5	43.0	46.0
ASH	7.8	7.8	7.8	7.8	11.0	5.0
Fiber fractions %, on DM basis :						
ADF	19.5	20.2	20.5	20.9	35.0	18.0
NDF	32.1	34.0	35.0	36.0	45.0	44.0
ADL	14.2	14.7	15.0	15.2	10.0	26.0
Hemicell.	12.6	13.9	14.5	15.1	10.0	14.0
Cellul.	5.3	5.5	5.5	5.6	25.0	4.1
NFC	39.8	37.3	36.0	34.7	24.0	12.0

All the total mixed diets had approximately equal values for chemical nutrients, except that of NFE content. The fiber fractions; NDF and cellulose were positively correlated with elevating DDGS level in the diets. The ADF, hemi-cellulose and ADL were slightly increased with elevating the DDGS level in the diets. The NFC was decreased gradually as DDGS level increased in the diets from 39.8% (T1) to 34.7% (T4).

The dry matter intakes (DMI) of lambs throughout the digestibility trials are shown in Table 3. The DMI as g/h/d or g/kg $BW^{0.75}$ were increased gradually with increasing DDGS level in the diets. The lambs fed 20% DDGS-contained diet (T4) consumed significantly (P≥0.05) more DM (g/h/d) than the other groups.

Table 3: Digestion coefficients* (%) of nutrients, nutritive values and energy concentration as affected by DDGS level in the tesed diets.

Items	Total mixed diets			
	T1	T2	T3	T4
Dry matter intake :				
g/h/d	1091.8±47.8	1153.8±58.6	1203.9±35.2	1278.2±126.4
g/kg $BW^{0.75}$	64.5±1.8	65.4±1.2	66.4±2.3	67.1±1.2
LBW, kg	43.5±1.9	46.0±2.5	47.7±1.8	51.0±3.5
Nutrients digestibility , %				
DM	63.5±4.0	71.7±1.9	68.5±3.0	71.3±5.6
OM	67.3±3.1	73.0±1.9	72.0±1.0	74.9±5.2
CP	69.1±4.1[b]	77.0±0.5[a]	74.2±2.7[a]	78.0±1.1[a]
CF	53.9±5.8[b]	65.5±2.1[a]	61.3±4.9[ab]	64.9±4.5[a]
EE	82.8±1.7	87.0±1.2	85.9±2.7	86.8±2.0
NFE	68.9±2.2	72.6±2.5	74.8±3.6	75.5±8.1
GE	70.7±1.2[b]	76.1±0.8[b]	74.4±2.5[a]	76.9±2.5[a]
Fiber fractions, %				
NDF	60.1±7.2	63.0±6.3	66.9±6.2	69.9±6.9
ADF	65.8±2.0[b]	70.0±1.3[a]	70.2±2.0[a]	72.1±2.9[a]
ADL	32.4±1.3	33.1±3.6	35.9±5.4	40.3±12.3
Cellulose	78.2±1.9	83.6±0.7	82.9±0.7	83.8±2.3
Hemicell.	51.3±9.0	52.9±7.8	62.3±7.1	66.9±7.2
NFC	70.3±0.9	78.6±1.2	73.9±4.3	76.7±8.2
Nutritive values :				
TDN %	66.7±1.7	72.6±1.0	72.8±1.4	74.7±3.1
DCP %	11.0±0.4[b]	12.4±0.1[a]	11.9±0.3[ab]	12.6±0.1[a]
NFC/DCP	3.62	3.00	3.00	2.75
Energy concentration **				
GE	4.385	4.410	4.423	4.436
DE	2.940	3.200	3.209	3.294
ME	2.412	2.625	2.632	2.701
NE	1.548	1.695	1.700	1.748
Metabolisability %				
ME/GE	54.9	59.4	59.5	60.8
Efficiency of ME utilization %				
NE/ME	64.2	64.6	64.6	64.7

***Means within each row having similar letter are not significantly different at P≤0.05.**
**** Mcal/kg DM**

The inclusion of DDGS in lamb's diets at 10, 15 and 20% resulted in better digestion coefficients of all nutrients in comparison to the control group. The improvements in digestibility were significant (P≥0.05) for CP, CF, ADF and GE. The obtained results show (on the average) that the lambs of T4 had the best digestibility followed by those of T2, T3 and then T1 in a descending order. These results are in agreement with those reported by Leupp (2008), Leupp *et al*. (2006 & 2009).The nutritive values and energy concentrations of the experimental diets are shown in Table 3. The TDN and DCP% were gradually increased with elevating the DDGS level in the diets. The differences in DCP% due to DDGS level were significant (($P \geq 0.05$).

The NFC/DCP ratio was 3.62, 3.0, 3.0 and 2.75 for T1, T2, T3 and T4, respectively. The lambs in T2, T3 and T4 had the lowest ratios of NFC/DCP indicating to the highest protein utilization in these groups, compared with the control one.

Although the four mixed diets had approximately equal values of GE, the DE and ME concentrations, the DDGS-contained diets (10, 15 and 20%) were higher in previous parameters than the control (T1) by about 8.8, 9.1 and 12.0%, respectively. The corresponding superiority of NE content of DDGS-contained diets than the control was 9.5, 9.9 and 12.9%, respectively. The metabolizability (ME/GE) of DDGS-contained diets was better than that of the control by about 9.1% (on the average). However, the efficiency of ME utilization was not affected greatly by DDGS inclusion in diets. In this respect, Stock *et al.* (2000) suggested that the improved energy responses from feeding DDGS may be due to additional un-degradable intake protein (UIP), higher fat content, or potential for reducing acidosis.

Data of rumen parameters are shown in Table 4. Ruminal pH values were slightly changed among treatments where it ranged from 6.34 (T4) to 6.5 (T2). The same trend was found also for NH_3-N (mg/dl) where it varied between 11.6 (T3) and 12.7 (T1). However, VFA's concentrations (meq/100ml) was gradually increased ($P \geq 0.05$) with elevating the DDGS level in the diets.

Table 4: Effect of DDGS level and sampling time on rumen liquor traits*

DDGS level	Sampling time post-feeding (hrs.)			
	0	3	6	Average
pH value:				
T1 Control	6.99±0.14	5.85±0.03	6.34±0.01	6.39±0.75
T2 10 %	7.34±0.19	5.61±0.05	6.54±0.23	6.50±0.89
T3 15 %	7.15±0.07	5.55±0.05	6.36±0.10	6.35±0.83
T4 20 %	7.04±0.23	5.90±0.13	6.10±0.12	6.34±0.58
Average	7.13±0.20[a]	5.73±0.24[b]	6.35±0.19[ab]	
NH3-N (mg/100 ml)				
T1 Control	9.6 ± 0.9	15.9 ± 2.0	12.1 ± 1.0	12.5 ± 1.2
T2 10 %	10.7 ± 1.7	15.4 ± 2.1	11.9 ± 1.8	12.7 ± 1.2
T3 15 %	9.1 ± 0.4	13.8 ± 1.8	11.9 ± 1.1	11.6 ± 0.9
T4 20 %	10.3± 0.6	14.2 ± 1.7	12.1 ± 1.2	12.2 ± 0.9
Average	9.9 ± 0.5[C]	14.8 ± 0.9[A]	12.0 ±0.6[B]	
TVFA's m.eq/100 ml				
T1 Control	7.91±0.29	10.15± 0.38	9.48± 0.35	9.18± 1.12[b]
T2 10 %	8.46 ± 0.23	10.52± 0.23	9.95± 0.25	9.64± 0.98[ab]
T3 15 %	8.99± 0.35	11.62± 0.34	10.48± 0.18	10.36± 1.23[a]
T4 20 %	9.11 ± 0.28	12.81± 0.29	10.75± 0.25	10.89± 1.66[a]
Average	8.62 ± 0.66[c]	11.28± 1.18[a]	10.17± 0.6[b]	

*** Means within each row or within each column within each trait having similar letter are not significantly different at $P \geq 0.05$.**

It was observed that the lambs fed DDGS-contained diets (15 and 20% DDGS) had higher (P≥0.05) values of ruminal VFA's concentration than the control group.

The sampling time had significant (P≥0.05) effects on ruminal parameters. The pH value was decreased after 3 hrs post-feeding (5.73) compared with that obtained immediately before feeding (7.13), then it increased again to reach 6.35 after 6 hrs post-feeding. On the other hand, the ruminal NH_3-N and VFA's concentrations were increased after 3 hrs post feeding compared with those before feeding and then slightly decreased after 6 hrs post-feeding. In this field, May (2008) observed decreases in ruminal ammonia concentration when feeding distillers dried grains to feedlot cattle. Mean ruminal pH of feedlot cattle fed high-grain diets is usually between 5.6 and 6.2 (Schwartzkopf-Genswein *et al.,* 2003). May *et al.* (2007) reported that ruminal pH was lower in cattle fed 25% of DM DDGS compared to cattle fed no DDGS as a partial replacement of steam-flaked corn (SFC) or dry rolled corn (DRC) in finishing diets. Steers fed 25% DDGS also had lower ruminal ammonia concentrations than steers fed 0% DDGS during the first 10 hours after feeding. Leupp (2008) found that the DDGS level in the diet had significant effects on ruminal pH and VFA concentration.

As for blood plasma constituents (Table 5), no significant differences among treatments were observed except that of activity of ALT (on average). Increasing level of DDGS in diet of lambs increased TP concentration, being the highest in T4, modest in T3 and the lowest in T2, which may indicate the beneficial effect of increasing plasma TP concentration by increasing level of DDGS up to 20% in diets of lambs. Kaneko (1989) reported that normal range of TP in sheep to be 6.0-7.9 mg/dl, however, Jawasreh *et al.* (2010) showed that it was 5.9-7.8 mg/dl.

Albumin concentration was higher in lambs fed different DDGS levels than in the control treatment. Such trend of increase in albumin concentration by dietary treatment was mainly associated with the observed changes in concentration of TP. The normal range of globulin was reported by Jawasreh *et al*. (2010) to be 3.2 – 5.0 g/dl. There was a tendency of higher values of globulin concentration in lambs fed 10 and 20% DDGS and lower values in those fed 15% DDGS than in the control treatment (Table 5), although there was a tendency of lower A/G ratio in lambs fed 10 and 20% DDGS (2.29 and 2.03) and higher ratio in those fed 15% DDGS (2.58) than in the control treatment (2.46).

Generally, the effect of corn and SBM replacement by DDGS in diets of lambs up to 20% revealed slight improvement in term of increased concentration of TP and their fraction in blood plasma within the normal range (Yousef, 2005), which may indicate the save usage of DDGS in diet of lambs up to 20% without any adverse effects on protein metabolism. Similar trend have been reported by Saleh *et al*. (2008). In addition, El-Ashry *et al.* (1996) concluded that the higher albumin concentration in the blood serum reflects no pathological disorders in liver. Also, Kazemi *et al*. (2009) found no significant changes in serum albumin between treatments contained ensiled barley distillers grains (BG) replacing corn silage at various levels in cow rations.

Table 5: Blood plasma constituents* (x±S.E) as affected by DDGS level in the diets and sampling time.

Sampling time, h	Total mixed diets				average
	T1	T2	T3	T4	
Total protein (g/dl)					
0	7.33±0.7	7.54 ± 0.3	7.51±0.1	8.09± 0.5	7.61±0.5
3	7.09±0.4	7.25 ± 0.0	7.13± 0.3	7.72± 0.7	7.30±0.4
average	7.21±05	7.40±0.23	7.32±0.29	7.90±0.56	
Albumin (g/dl)					
0	5.22±0.1	5.22± 0.3	5.30± 0.1	5.53± 0.2	5.32±0.2[a]
3	4.92±0.4	5.04± 0.3	5.15± 0.3	5.06± 0.5	5.04±0.3[b]
average	5.07±0.3	5.13± 0.27	5.23± 0.25	5.29± 0.41	
Globulin (g/dl)					
0	2.11±0.7	2.31± 0.2	2.20± 0.1	2.56± 0.3	2.30± 0.4
3	2.17±0.1	2.21± 0.2	1.98± 0.6	2.66± 0.2	2.25± 0.4
average	2.14±0.4	2.26± 0.2	2.09± 0.4	2.61± 0.2	
Albumin/Globulin ratio					
0	2.64±0.9	2.28± 0.3	2.41± 0.1	2.17 ± 0.2	2.37±0.5
3	2.27±0.2	2.30± 0.3	2.76±0.8	1.90±0.1	2.31±0.5
average	2.46±0.6	2.29±0.3	2.58±0.6	2.03±0.2	
Creatinine (mg/dl)					
0	1.60±0.2	2.33±0.4	1.70±0.7	1.47±0.1	1.78±0.5
3	1.30±0.2	1.63±0.4	1.50±0.1	1.57±0.3	1.50±0.3
average	1.45±0.2	1.98±0.5	1.60±0.5	1.52±0.2	
Activity of AST (U/l)					
0	121.3±22	98.3±16	111.0±2	130.7±28	115.3±21
3	103.0±24	116.3±6	124.3±16	130.7±24	118.6±20
average	112.2±23	107.3±15	117.7±13	130.7±24	
Activity of ALT (U/l)					
0	15.0±11	19.0±7.0	26.7±9.8	23.3±7.1	21.0±8.9
3	14.3±10	24.3±2.5	32.7±3.2	25.3±3.5	24.2±8.4
average	14.7±9.5[b]	21.7±5.5[ab]	29.7±7.3[a]	24.3±5.1[a]	

*** Means within each row or within each column within each trait having similar letter are not significantly different at P≥ 0.05.**

Overall mean of creatinine concentration was 1.98, 1.60, 1.52 and 1.45 mg/dl in T2, T3, T4 and T1, respectively, which were within the normal range (0.9 – 2.0 mg/dl) given by Jawasreh *et al.* (2010) with sheep.

An increased AST activity in lambs fed 15 and 20% DDGS and decreased activity in lambs fed 10% DDGS was observed as compared to the control treatment. Only inclusion of DDGS in diets of lambs at levels of 15 or 20% led to gradual increase in AST activity, being more pronounced with the highest DDGS level. The overall mean of ALT activity showed significant (P<0.05) increase in lambs fed 15 and 20% DDGS and insignificant increase in lambs fed 10% DDGS as compared to the control treatment.

In comparison with the present results, Saleh *et al*. (2008) reported marked increase in AST activity in blood serum of lambs fed 10 and 20% corn gluten feed (CGF)-contained rations compared to the control, but this increase was significant.

The lambs of T1 and T2 recorded nearly similar values of average daily gain (ADG), however, those of T3 and T4 had higher ADG than the control by about 11.0 and 17.7%, respectively (Table 6).

Table 6: Daily gain, feed intake and feed conversion, feed cost (*LE*/kg gain) and economic efficiency (%) as affected by DDGS level in the diet of lambs at 0-24 weeks post feeding.

Traits	Experimental diets			
	T1	T2	T3	T4
Initial wt. kg	17.6±4.1	17.8±3.9	17.7±2.3	17.6±2.4
Final wt. kg	45.2±5.2	44.9±6.4	48.0±6.2	50.3±3.1
ADG, g	163.1±15.7	161.3±20.1	181.0±28.3	192.0±9.3
Feed intake:				
DMI : g/h/d	1198.7	1180.6	1230.0	1278.1
g/kg $BW^{0.75}$	90.40	89.10	89.65	94.70
TDNI g/h/d	799.5	857.1	895.4	954.7
g/kg $BW^{0.75}$	60.3	64.7	65.3	70.8
DCPI : g/h/d	131.73	145.92	147.11	161.68
g/kg $BW^{0.75}$	9.93	11.01	10.72	11.99
Feed conversion:				
g DM/g gain	7.35	7.32	6.80	6.66
g TDN/g gain	4.90	5.31	4.95	4.97
g DCP/g gain	0.81	0.90	0.81	0.84
Price of daily gain*:				
(*LE*)	3.26	3.23	3.62	3.84
Feed price:**				
(*LE*/kg)	1.62	1.56	1.54	1.51
Daily feed cost:				
LE	1.94	1.84	1.89	1.93
Economic efficiency:				
%	68.0	75.5	91.5	99.0
% of control	100.0	111.0	134.6	145.6

*** Price of one kg live BW was considered 20 *LE*.**
**** Feed price was calculated based on the average price of all ingredients throughout the complete experimental period taking in the account the price changes.**

The lambs fed 20 % DDGS (T4) had the highest values of DMI, TDNI and DCPI (g/h/d and g/kg $BW^{0.75}$). It was generally observed that TDNI and DCPI were gradually increased with elevating DDGS level in the diet from 0 up to 20%. The DDGS inclusion in lamb diets did not show positive effects concerning feed conversion as g TDN or g DCP/ g gain, meanwhile, the lambs of T3 and T4 recorded better values of DM conversion than the control (T1) by about 7.1 and 9.8%, respectively.

Drouillard *et al.* (1999) evaluated the differences in growth performance of steers when fed diets (60% concentrates: 40 % roughage) containing dry rolled corn (51.62%) and DDGS (53.36%). The ADG also was marginally higher for cattle fed the DDGS, but feed efficiency was not greatly different between them. During the growing phase, Trenkle (2004) observed that increasing DDGS level tended to linearly increase ADG. Similar results have been reported by Hutchens *et al.* (2006). Also, Schauer *et al.* (2005)

incorporated DDGS at levels up to 15% of the total diet and Hules *et al.* (2006) substituted up to 22.9% of the finishing diet with DDGS and found no differences in lamb performance.

Although the feed price (LE/kg) was gradually decreased with increasing DDGS level in the diet, the daily feed cost (LE) did not obviously changed except with T4 where it decreased by about 5.2%. Concerning economic efficiency, it was gradually improved with elevating DDGS level in the diet instead of corn and SBM where it was better for T2, T3 and T4 groups than the control (T1) by about 11.0, 34.6 and 45.6%, respectively (Table 6).

Hutchens *et al.* (2006) reported that goats fed either a commercial or DDGS-based by-product ration gained similarly during 56-day trial. Because the by-product-based rations cost was much less than the commercial ration, returns were increased by 15.8% and 10.7% for the 20% and 30% DDGS rations, respectively compared to the commercial ration. They showed that using DDGS-based ration would increase producer profitability when feeding growing and finishing goat kids. Likewise, Stalker *et al.* (2006) when replaced totally dry rolled corn (DRC) and SBM in steers' diet with DDG found that, the total cost ($/head) was decreased by about 40% with DDG diet than the control. Recent research indicates that sheep can be fed at higher levels of DDGS than that previously considered optimal without affecting carcass characteristics (Schauer *et al.,* 2008). This provides an opportunity for increase utilization of dried distillers' grains plus soluble in lamb finishing rations, potentially resulting in cheaper feed costs for lamb finishers (Neville *et al*., 2009).

From all the obtained results, it may be concluded that in general, the inclusion of DDGS instead of corn and SBM at any level ranging from 10 to 20% of CFM DM resulted in better performance, feed utilization and economic efficiency. Therefore, the lamb keepers can be advised to include DDGS in lamb diets throughout the growing and finishing phases at 20% of DM to obtain better results and more net return.

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تأثير ادخال مخلفات تقطير الذرة الجافة مع السوائل الذائبات في علائق الحملان النامية على القابلية للهضم ، بعض قياسات الكرش، مكونات الدم و الأداء الإنتاجي

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أجريت هذه الدراسة بهدف بحث تأثير الإحلال الجزئي أو الكلي لمخلفات تقطير الذرة الجافة مع السوائل الذائبات (DDGS) بدلا من كسب فول الصويا والذرة في علائق الحملان النامية علي أداء النمو , استهلاك العلف والاستفادة منه, هضم العناصر الغذائية, القيمة الغذائية, صفات سائل الكرش, بعض مكونات بلازما الدم, تكلفة التغذية وكذلك الكفاءة الاقتصادية.

تم تغذية أربعة مجموعات (بكل منها خمسة حملان) من الحملان (¾ رومانوف + ¼ رحماني) علي أربعة علائق تجريبية كانت نسبة الخشن إلي المركز بها 40 : 60.

غذيت كل مجموعة على أحدى العلائق التجريبية التالية:-

- العليقة الأولي: وهي مجموعة المقارنة (T1) وكانت عبارة عن 40% دريس البرسيم + 60% مخلوط مركز بدون مخلفات تقطير الذرة.
- العليقة الثانية (T2): وكانت عبارة عن 40% دريس البرسيم + 60% مخلوط مركز يحتوي علي 10% مخلفات تقطير الذرة.

- العليقة الثالثة (T3): وكانت عبارة عن 40% دريس البرسيم + 60% مخلوط مركز يحتوي علي 15% مخلفات تقطير الذرة.
- العليقة الرابعة (T4): وكانت عبارة عن 40% دريس البرسيم + 60% مخلوط مركز يحتوي علي 20% مخلفات تقطير الذرة.

أضيفت مخلفات تقطير الذرة في المخلوط المركز علي أساس المادة الجافة بمعدلات صفر, 10 , 15, 20% بدلا من الذرة الصفراء و كسب فول الصويا. واستغرقت تجربة التغذية 24 أسبوعا بالإضافة إلي 3 أسابيع لأجراء تجارب الهضم.

و أشارت أهم النتائج الي مايلي:

1- كان التحليل الكيماوي لمخلفات تقطير الذرة الجافة : 29% بروتين خام، 10% مستخلص اثيري، 10% الياف خام ، 46% مستخلص خالي الازوت، 5% رماد، 18% ADF، 44% NDF، 26% هيميسليلوز14% سليلوز، 4.1% ADL و 12% NFC. وتساوت تقريبا العلائق التجريبية المتكاملة في محتواها من العناصر الكيميائية فيما عدا المستخلص خالي الازوت وقد تزايدت بدرجات متفاوته مكونات الالياف مع زيادة مستوي مخلفات تقطير الذرة في العليقة.

2-أدي ادخال ال DDGS في علائق الحملان بمعدلات 10 ، 15 و 20% الي قيم أفضل لمعاملات هضم كل العناصر الغذائية بالمقارنة مع الكنترول. اختلفت قليلا قيم pH و NH_3-N في سائل الكرش بين المعاملات. في حين ازداد تدريجيا تركيز الاحماض الدهنية الطيارة بدرجة معنوية مع زيادة مستوي محلفات تقطير الذرة الجافة في العليقة. و قد كان لتأثير وقت أخذ العينة تأثيرا معنويا علي كل صفات سائل الكرش.

3- ازدادت تدريجيا قيم TDN% و DCP% مع زيادة مستوي DDGS في العليقة . وقد لوحظ نفس الاتجاه مع تركيزات الطاقة المهضومة، الطاقة الميتابولزمية (الممثلة) والطاقة الصافية وكذلك القابلية للتمثيل (ME/GE). أما كفاءة الاستفادة من الطاقة الميتابولزمية(NE/ME) فلم تتاثر بدرجة ملحوظة.

4-ازدادت تدريجيا المأكول من المركبات الكلية المهضومة وكذلك البروتين المهضوم (TDNI و DCPI)مع زيادة مستوي مخلف تقطير الذرة الجاف في العليقة. ولم يكن لهذه الاضافة تأثيرات ايجابية علي معدل تحويل كلا منهما، الا أن حملان المجموعتين T3 و T4 أظهرت قيما أفضل لمعدل تحويل المادة الجافة عن الكنترول بحوالي 7.1 و 9.8% علي التوالي.

5-- تساوت المعاملات T1 و T2 تقريبا في متوسط الزيادة اليومية في الوزن وقد كانت المعاملتين T3 و T4 أعلي من الكنترول بحوالي 11.0 و 17.7% علي التوالي

6- تحسنت تدريجيا الكفاءة الاقتصادية مع زيادة مستوي ال DDGS في العليقة بدلا من الذرة و كسب فول الصويا حيث كانت أفضل من الكنترول بحوالي 11.0 ، 34.6 و 45.6% للمجموعات T2 ، T3 و T4 علي التوالي.

تشير النتائج المتحصل عليها عموما الي أن احلال مخلفات تقطير الذرة الصفراء (DDGS) بدلا من الذرة الصفراء و كسب فول الصويا بأي معدل من 10 الي 20 % أدي الي نتائج أفضل في أداء النمو و الاستفادة من الغذاء وكذلك الكفاءة الاقتصادية مقارنة بعليقة الكونترول. ولهذا ننصح مربي الأغنام باعتبار مخلفات تقطير الذرة DDGS مادة علف يمكن أن تدخل في علائق الحملان خلال فترة التسمين من الفطام حتي التسويق للذبح بمعدل 20% من مخلوط العلف المركز للحصول علي نتائج أفضل و عائد اقتصادي أعلي.

قام بتحكيم البحث

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