OPTIMIZING THE USE OF DRIED DISTILLERS GRAINS WITH SOLUBLE IN SHEEP PRODUCTION.

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SUMMARY

This study was designed in order to optimize using dried distillers' grains with soluble (DDGS) in sheep feeding. Three total mixed rations (TMR) were formulated to contain 10, 20 and 30% DDGS compared with the control TMR_1 (no DDGS). Digestibility trials were conducted with three Barki rams for each TMR, while rumen fermentation trials were conducted with three fistulated female Barki ewes for each TMR. Feeding trials were applied with twenty late pregnant Barki ewes (last 4-6weeks of gestation period) at 2nd and 3rd seasons, the ewes were divided into four similar groups (5 ewes each), where milk production, milk composition, feed intake and following up of the new born lambs were also studied. Data showed that: 1- Inclusion of DDGS resulted in increasing Ether extract content, neutral detergent fiber, acid detergent fiber, cellulose and hemicellulose; 2- Increasing levels of DDGS in TMR had followed by increasing concentration of Ileu, Met and Val amino acids; 3- Nutrients digestibility and DCP value were found to be higher ($P< 0.05$) with 10 and 20% DDGS rations, while TDN value was higher ($P< 0.05$) only for 20% DDGS containing ration, not only that, but it was higher ($P< 0.05$) for N-balance and N utilization as well; 4- Rumen fermentation showed that NH_3-N concentration was decreased ($P< 0.05$) with DDGS rations; while VFA was not affected; 5- Acetic (A) acid was higher with the inclusion of DDGS in rations, but propionic (P) acid was less and higher in A/P ratio for 30% DDGS ration compared with other rations, while butyric acid was not affected; 6- More microbial nitrogen (MN) syntheses was found with 20% DDGS TMR, followed by 10% DDGS and control TMR, while 30% DDGS had the less MN content; 7- The control, 10% and 20% DDGS rations had more degradable fraction (b) and ED of DM than 30% DDGS containing TMR, while soluble fraction (a) was not affected; 8- Soluble fraction (a) of CP degradability was not affected among TMR's, b fraction was significantly less for 30 % DDGS containing ration as well; control ration had showed more CPED, while increasing level of DDGS found to decrease CPED; 9- Feeding ewes 20% DDGS ration resulted in more lamb's birth weight, weaning weight, gain and ADG compared with other tested rations. In the meantime, ewes showed produced more milk, more 4%FCM, feed conversion and feed efficiency. These were reflected on milk fat, protein and SNF contents. So, it could be recommended to include DDGS up to 20 % in the TMR's for ewes in order to get good performance and feed efficiency.

Keyword: *dried distillers' grains with solubles, digestibility, degradability, lactating ewes, growth performance.*

INTRODUCTION

During early lactation in the dairy cattle or sheep, a large supply of available amino acids (AA) reaching the small intestine is critical to maintaining high milk yields. Increased AA can be provided through increase concentrations of protein in the diet or decrease protein degradability in the rumen. The use of some feed by-products as protein supplements can provide a source of less degradable protein compared to oilseed meals. Distillers dried grains with solubles (DDGS) produced from the grains fermentation in alcohol industry could be considered as protein source. In alcohol industry approximately one-third of the dry matter is recovered in co-products, which resulted in an increase of protein, fat, fiber, and P concentrations 3-fold in the DDGS compared with grains itself (Gibb *et al.* 2008). Distillers products have been recognized as ingredients with desirable qualities for dairy cattle or sheep for many years (Penner and Christensen, 2009).These qualities apparently accrue to their low amount of soluble carbohydrates, high net energy, digestible fiber and protein of low rumen degradability (RUP), as well as to unidentified factors (May *et al.* 2009 and Leupp *et al.* 2009). Distiller's grains had a consider value of 55 percent of CP as RUP in most cases (Kononoff *et al.* 2007). Research has indicated that the digestible energy (DE), metabolizable energy (ME), and net energy for lactation (NE_L) of DDGS were 1.81, 1.63, and 1.00 Mcal/lb DM, respectively. Schroeder, (2003) has focused on distillers grains as an alternative protein for soybean meal, the most widely used protein supplement today. However, in addition to their protein content, corn co-products are also an excellent source of energy, attributed to their high content of digestible neutral detergent fiber (NDF) and fat. Distillers grains contain 40 to 45 percent NDF, which is highly digestible, thus it can replace other dietary starch and reduce the risk of ruminal acidosis because of its added fiber (Penner *et al.* 2009). DDGs are high in potassium, phosphorus, and sulfur and care must be taken when feeding DDGs at the upper limits of the recommendation. Current recommendations are to keep dietary concentrations of sulfur below 0.3% of DM when animals are fed concentrate diets, or 0.5% of DM when fed high-forage diets (NRC, 2007). Schauer *et al.* (2005, 2006) and Huls *et al.* (2006, 2008) reported that DDGS can be included at levels up to 22.5% of a finishing ration with no negative affect on lamb performance or carcass traits. When priced competitively on relative feed value, distillers grains can be a cost-effective addition to dairy rations. Distillers' grains can be priced based on protein and energy in comparing the price of soybean meal and corn as standards for both nutrients (Garcia and Taylor, 2002).

The objective of this study was to determine the feeding value and fermentation parameters at different levels of dried distillers grains with solubles as part of total mixed rations (TMR's) in order to optimizing their use in sheep nutrition and evaluate their effect on sheep performance.

MATERIALS AND METHODS

This study was carried out at El-Nubaria Research Station, Animal Production Research Institute, Egypt. Corn Dried Distiller Grains with Solubles (DDGS) obtained from the commercial Egyptian company. Four TMR's were formulated to be isonitrogenous and isoenergetic as follow 1) TMR_1 without DDGS (control), 2) TMR_2 with

10% DDGS, 3) TMR_3 with 20% DDGS solubles and 4) TMR_4 with 30% DDGS. Compositions of tested TMR's are presented in Table (1) and chemical analyses of DDGS and TMR's are presented in Table (2).

Table (1): Feed ingredients (%) of experimental total mixed rations (dry matter basis).

Feed ingredients, %	TMR_1	TMR_2	TMR_3	TMR_4
Yellow corn	30	22	22	22
Soybean meal	12	6	3	--
Wheat bran	10	14	7	--
Dried distillers grains with solubles	0	10	20	30
Berseem hay	30	30	30	30
Wheat straw	10	10	10	10
Molasses	5	5	5	5
Limestone	1.5	1.5	1.5	1.5
Salt	1	1	1	1
Mineral premix	0.5	0.5	0.5	0.5

TMR_1: Control, TMR_2: containing 10%DDGS, TMR_3: containing 20%DDGS, TMR_4: containing 30%DDGS

Four digestibility and nitrogen balance trials were carried out using three Barki rams (45 ± 1.40 kg, in average) for each TMR consequently. Each trial lasted for four weeks; the first three weeks were as a preliminary period, followed by one week for feces and urine collection. Sheep were fed twice daily at 8 am and 3 pm, water was offered freely. Each animal was offered the tested TMR's according to NRC, (1994). Chemical composition of feeds, feces and urine were determined according to A.O.A.C (1995) methods. Sub samples (20%) of feces and urine were taken once daily then stored at – 18 °C until analyses. Fecal samples were dried at 60 °C for 72 hrs. Feed and fecal samples were ground through 1 mm screen on a Wiley mill grinder and a sample of 50 gm/ (ration/sheep) was taken for analysis. The samples of feed and feces were analyzed for crude protein (CP), crude fiber (CF), ether extract (EE) and ash, while the urine samples were analyzed for nitrogen (N) content according to AOAC (1995). Cell wall constituents (NDF, ADF and ADL) were determined according to VanSoest (1991). Hemicellulose and cellulose were calculated by differences. Amino acid analyzer (Model 121) was used for determination of amino acids in DDGS and TMR's as described by Moore *et al.* (1958).

Rumen liquor samples were taken at 0, 1, 3 and 6 hrs after the morning meal from three fistulated female Barki ewes (weighed 42.00 ± 1.5 Kg BW) for each TMR consequently. Collected rumen liquor was directly tested for pH using Orian 680 digital pH meter. Samples were strained through four layers of chesses cloth for each sampling time, while ammonia nitrogen (NH_3-N) was determined by using magnesium oxide (MgO) as described by the AL-Rabbat *et al.* (1971). Total volatile fatty acid (VFA's) concentration was estimated by using steam distillation methods (Warner, 1964).

The microbial nitrogen synthesized (gm N/d) in the rumen of sheep fed the experimental diets was calculated using the model equation justified by Chen *et al.* (1991) as follow: N supply (g/day) = «Pax70/ (0.83x0.116x1000) », where 70 of the N content (mg/mmol) is purines and Pa mmol/day is the microbial purine absorbed by the animal. The supply of microbial N was then calculated from Pa assuming that: digestibility of microbial purines equals 0.83 and the purine-N: total microbial N ratio is 0.116.

Nylon bags technique (Mehrez and Ørskov, 1977) was used to determine degradability of DM and CP for TMR's degradability. Two polyester bags (7 X 15 cm) with pore size of 45 µm were used for each incubation time. Approximately 6 g of air-dried TMR's (ground to 2 mm) were placed in each bag. All bags were incubated in the rumen of each sheep, then they were withdrawn after 3, 6, 12, 24, 48, 72 and 96h, rinsed in tap water until the water became clear, then they were squeezed gently. Microorganisms attached to the residual sample were eliminated by freezing at - 20°C (Kamel *et al.*, 1995). Zero-time washing losses (a) were determined by washing 2 bags in running water for 15 min. The degradation kinetics of DM and CP were estimated (in each bag) by fitting the disappearance values to the equation $P = a + b\ (1- e^{-Ct})$ as proposed by Ørskov and McDonald (1979), where P represents the disappearance after time t. Least-squares estimated of soluble fractions are defined as the rapidly degraded fraction (a), slowly degraded fraction (b) and the rate of degradation (c). The effective degradability (ED) for tested rations were estimated from the equation of McDonald (1981), where $ED = a + bc/(c + k)$, k is the out flow rate.

Twenty late pregnant Barki ewes (last 4-6weeks of gestation period) at 2nd and 3rd seasons were used in this experiment .The ewes were divided into four similar groups (5 ewes each). The requirements of the ewes were calculated according to NRC (1994). After lambing ewes and lambs were weighed directly after 15hr and weighed at 15; 30; 45 and 60 days of age and the lambs were weaned at 60 days of age. The lambs were isolated out of their dams after the second meal at 3.0 pm till the next day. The Lambs were stayed 8 hr daily apart from their dams, then weighed before suckling and after suckling, then the ewes completely hand milk till stripping on the next day morning and milk yield was recorded. The ewes were milked at15; 30; 45 and 60 days from lambing milk samples were taken for calculating milk yield , milk component and analyzed for fat, total solid (TS), solid not fat (SNF), total protein (TP) and ash according to methods of Ling (1963), lactose was calculated by difference.

Statistical analyses:

Collected data were subjected to one way analysis of variance as described by Steel and Torrie (1980). Significant differences among means were separated using LSD test according to Duncan (1955). Statistical processes were carried out using the General Linear Models adapted by SAS (2000) for PC.

RESULTS AND DISCUSSION

Chemical analysis and composition:

Chemical analysis and cell wall constituents of the DDGS and experimental TMR's are presented in (Table 2). Ether extract (EE) content was increased by increasing the amount of DDGS in the TMR's. In the meantime, fiber fractions were increased as well, especially NDF, ADF, cellulose and Hemicellulose. However, the increase in fiber fractions contents could be resulted from the moderate contents of them in DDGS compared with corn as fiber content of corn is less than that of DDGS (2.30 *vs.* 7.95%).

Table (2): Chemical composition and fiber fractions of DDGS and experimental TMR's (on dry matter basis, %).

Item	DDGS	TMR_1	TMR_2	TMR_3	TMR_4
Chemical analysis:					
OM	95.44	89.96	89.69	89.67	89.48
CP	26.46	13.18	13.15	13.23	13.36
CF	7.49	15.24	15.49	15.68	15.74
EE	7.95	2.63	3.26	3.46	3.73
Ash	4.56	10.04	10.31	10.33	10.52
NFE	53.54	58.91	57.79	57.30	56.65
Fibre fractions:					
NDF	40.30	44.61	47.40	48.06	49.54
ADF	19.16	33.23	35.74	35.96	36.68
ADL	3.02	6.18	6.32	6.38	6.72
Hemicellulose	21.14	11.38	11.66	12.10	12.86
Cellulose	16.14	27.05	29.42	29.58	29.96

TMR_1: Control, TMR_2: containing 10%DDGS, TMR_3: containing 20%DDGS, TMR_4: containing 30%DDGS

Profile of essentials amino acids:

The profile of the most important essentials amino acids (EAA) contents of the corn; soybean; DDGS and TMR's are shown in Tables (3 and 4). It was clear that rations contained DDGS had greater concentrations of Ileu, Met and Val and lower concentrations of Lys compared with the control one (Table 4). The milk protein score (MPS; Schingoethe, 1996), which is a measure of protein quality based on the first limiting EAA of the feed, was greater in SBM (where Met first limiting) compared with DDGS (where Lys first limiting) and the MPS of WDDG was greater than that of the DDGS, due to the variability in Lys levels in DDGS (Spiehs *et al.* 2002). The greatest effect on the Lys concentration is the degree of heating, because this amino acids is the first one could susceptible to heat damage via a Maillard reaction with the ε –amino group. This may help in explain why the WDDG had a greater concentration of Lys compared to DDG. Lysine is usually the first-limiting AA for milk protein synthesis when feeding diets containing high levels of DDGS (up to 20% of diet) to dairy cattle/sheep (Liu *et al.* 2000 and Kleinschmit *et al.* 2006 , 2007). An accurate prediction of the quantity of metabolizable AA from DDGS will allow one to balance dairy rations with high DDGS inclusion rates without the concern of Lys deficiency that may decrease milk protein synthesis.

Table (3): Profile of the most important essentials amino acids contents (%) in Corn; Soybean and DDGS.

EAA,%	Corn	Soybean	DDGS
Lys.	0.25	2.68	0.81
Met.	0.19	0.65	0.47
Ileu.	0.36	2.86	1.96
Thr.	0.38	1.70	1.13
Val.	0.46	2.31	1.84

Table (4): Profile of the most important essentials amino acids contents (%) in the experimental TMR's.

EAA,%	TMR_1	TMR_2	TMR_3	TMR_4
Lys.	0.62	0.55	0.49	0.47
Met.	0.20	0.21	0.22	0.23
Ileu.	0.68	0.70	0.75	0.84
Thr.	0.53	0.53	0.54	0.59
Val.	0.63	0.68	0.73	0.82

Digestibility and nitrogen balance trials:

Sheep fed rations contained 10% and 20% DDGS showed quite the same daily feed intake, in comparison with the control and that contained 30%DDGS (Table 5). The highest ($P< 0.05$) digestibility value of CP and EE was recorded for rations contained 20% DDGS, while the lowest digestibility value of CP and DM were obtained for ration contained 30%DDGS in comparison with control one. However, these results were reflected feeding values of experimental rations. The improvement in nutrients digestibility for ration contained 20%DDGS could be a result of better feed intake and nutritive value. Peter *et al.*(2000) observed a trend of a reduction in DM digestibility when corn DDGS was included over 20% of DM. Total tract digestibility of diets containing 40% wheat DDGS was 9% lower than it was reported for a wheat-based diet (Widyaratne and Zijlstra, 2007). The TDN and DCP values for 20%DDGS containing ration recorded significantly the highest value. Erickson and Klopfenstein (2007) documented that distillers' grains from corn provided more energy when fed at 10% than at 40% of diet DM. Nitrogen intakes in this study were near or slightly above requirements (NRC, 1994). Sheep with 20%DDGS and 10%DDGS group retained more nitrogen compared to control group being 6.80, 5.76 and 5.23 g/d, respectively. Differences in nitrogen retained values may be due to the differences in amino acids composition of protein sources and its digestibility. The higher percentage of dietary nitrogen retained noticed with ration contained 20%DDGS compared with the control, these may be due to the more digestible protein; it had higher ($P< 0.05$) nitrogen utilization this finding agreed with Kleinschmit *et al.* (2006). As, dietary nitrogen utilization (% N retained of N-intake) was obviously higher ($P< 0.05$) with ration contained 20%DDGS (24.75 %), than the control ration. However, the lowest value ($P< 0.05$) of dietary nitrogen utilization was recorded with ration contained 30%DDGS (16.31%).

Table (5): Dry matter intake (g/h/d), digestibility coefficients and nutritive values (TDN and DCP) of the experimental TMR's fed to sheep (means ± SE).

Item	Experimental rations			
	TMR_1	TMR_2	TMR_3	TMR_4
DM intake (g/h/d)	1249.9 ± 14.2^b	1282.05 ± 5.14^a	1298.6 ± 14.1^a	1257.9 ± 5.2^b
Digestion coefficients (%)				
DM	68.30 ± 0.27^a	67.71 ± 0.24^b	70.18 ± 0.37^a	65.48 ± 0.35^c
OM	70.07 ± 0.2^{ab}	69.17 ± 0.30^{ab}	71.37 ± 0.35^a	66.75 ± 0.36^c
CP	67.09 ± 0.28^b	68.46 ± 0.32^a	70.85 ± 0.88^a	64.27 ± 0.15^c
CF	58.38 ± 0.21^a	58.03 ± 0.03^a	58.36 ± 0.32^a	56.64 ± 0.86^b
EE	60.19 ± 0.07^b	61.32 ± 0.47^a	62.37 ± 0.08^a	60.27 ± 0.24^b
NFE	70.12 ± 0.21	69.42 ± 0.13	70.17 ± 093	69.32 ± 0.51
Nutritive values (%)				
TDN	62.64 ± 0.19^b	62.52 ± 0.11^b	63.75 ± 0.71^a	61.61 ± 0.27^b
DCP	8.84 ± 0.04^b	9.00 ± 0.04^a	9.37 ± 0.11^a	8.59 ± 0.02^b
Nitrogen utilization (g/h/d)				
N-intake (g/d)	26.36 ± 0.30	26.97 ± 0.11	27.49 ± 0.30	26.89 ± 0.12
N-absorbed (g/d)	17.69 ± 0.23^c	18.47 ± 0.13^b	19.47 ± 0.33^a	17.28 ± 0.05^c
N-retained (g/d)	5.23 ± 0.05^c	5.76 ± 0.07^b	6.80 ± 0.32^a	4.61 ± 0.08^d
as % of N-intake	19.85 ± 0.13^c	21.37 ± 0.20^b	24.75 ± 1.05^a	17.14 ± 0.23^d
as % of N-absorbed	29.48 ± 0.03^c	31.21 ± 0.21^b	34.91 ± 1.06^a	26.67 ± 0.40^d

[abcd] *means in the same row with different superscripts are significantly differ (P< 0.05).*

Ruminal fermentation:

Ruminal pH values were not significantly affected by the dietary TMR's (Table 6). This was agreed with the finding of Bargo *et al.* (2001) who reported that ruminal pH was not affected by level or source of protein. Ammonia nitrogen concentrations tended ($P < 0.05$) to be greater in sheep fed the control than DDGS containing rations. This may be because of the greater portion of soybean meal protein in the control diet, which is more degradable in the rumen than the protein in DDGS (Kleinschmit *et al.* 2005; Anderson *et al.* 2006 and May *et al.* 2009). Values of ruminal NH_3 – N concentration revealed that it was sufficient for microbial growth in all rations as described by Lu *et al.* (1990).On the other hand, rumen volatile fatty acids concentrations were not different($P < 0.05$), although the molar ratio of acetate :propionate was considerably increased with DDGS, reflecting a lower concentration of readily fermentable starch in such feedstuff. Schingoethe *et al.* (1999) found that acetate tended to be greater when cows fed diets contained DDGS compared with soybean meal ration; this could be resulted from the greater degradability of neutral detergent fiber in the DDGS. These contrasts with the finding of Al-Suwaiegh *et al.* (2002), who found no differences for propionate concentrations among treatments; however, there was a trend for cows fed the control diet to have slightly greater acetate to propionate ratio than those fed DDGS diets, and there were no differences due to DDGS concentrations. There are significant (P< 0.05) increases in the microbial nitrogen for TMR_3. DDGS are relatively low in RDP protein and high in RUP (NRC, 2007) and increasing its level in the total mixed ration over 20%, may limit and deficient ruminal N, therefore, limit MP synthesis and growth of cellulolytic bacteria. However, 20% of DDGS could be reasonably for good MP synthesis in the rumen. Subsequently, the limitation upon the cellulolytic bacteria could influence on fiber fermentation, digesta outflow, and forage intake (Gilbery *et al.* 2006).

Table (6): Overall mean of rumen parameters of sheep fed the experimental TMR's (means ± SE).

Item	Experimental rations			
	TMR_1	TMR_2	TMR_3	TMR_4
pH	6.24 ± 0.05	6.26 ± 0.08	6.29 ± 0.05	6.30 ± 0.07
NH_3-N concentration (mg/100mlR.L)	15.08 ± 0.09^a	13.92 ± 012^b	10.34 ± 0.35^c	8.11 ± 0.29^d
VFA concentration (meq/100 ml R.L)	11.92 ± 0.59	11.67 ± 0.32	11.45 ± 0.38	10.32 ± 0.84
Acetic acid, %	54.80 ± 0.66^b	59.10 ± 0.85^a	59.50 ±0.86^a	60.70 ± 1.07^a
propionic acid, %	24.71 ± 0.49^a	24.60 ± 0.73^a	24.56 ± 0.78^a	22.30 ± 0.63^b
Butyric acid, %	12.80 ± 0.13	11.30 ± 0.23	11.70 ± 0.17	11.90 ± 0.40
Acetic: propionic ratio	2.22 ± 0.02^b	2.40 ±0.04^b	2.43 ± 0.05^b	2.72 ± 0.03^a
Microbial N yield(g/d)	16.41 ± 0.21^b	16.56 ± 0.10^b	17.36 ± 0.17^a	15.63 ± 0.03^c

^{abc} *means in the same row with different superscripts are significantly differ (P< 0.05).*

Degradation kinetics:

Estimate ruminal degradation constants (a, b and c) fitted with rates of DM and CP disappearance for TMR's are presented in Table (7). It illustrated that degradable fraction "b", and effective degradability "ED" of DM for TMR contained 30%DDGS were less (P< 0.05) compared with other TMR's; these could be related to the less digestibilities of it in the rumen. Higher rate of degradation "c" and effective degradability "ED" of CP were noticed with the control ration, while the fraction b was less for ration contained 30%DDGS. The rate of degradation "c" and effective degradability "ED" of CP was notably decreased (P< 0.05) with increasing DDGS portion in TMR's. Clark *et al.* (1987) found that globulin is the majority contents of the protein in SBM, due to their low molecular weight; are highly degradable in the rumen, which explain the high percent of rumen degradable protein (RDP) and low proportion of rumen undegradable protein (RUDP) in the control. Also, they found that dried distillers corn protein consists primarily of prolamin and glutelin proteins, these proteins are highly resistant to ruminal degradation because they have a higher molecular weight and are held together by disulfide bridges, so it also could explain why TMR's contained of DDGS were found to be higher in the RUDP compared with control one. Kleinschmit *et al.* (2007) cited that proteins that resist degradation in the rumen and pass to the lower tract for digestion "bypass" is necessary for maximizing production by ruminants and high producing dairy animals.

They concluded that values of potential and effective degradability and rates of degradation of both DM and CP were affected by diet formulation and levels of fibrous carbohydrates rather than animal species.

Table (7): Degradation kinetics of DM and CP in the rumen of sheep fed the experimental TMR's (mean ± SE).

Item	Experimental rations			
	TMR_1	TMR_2	TMR_3	TMR_4
		DM		
a	22.05 ± 0.17	23.18 ± 0.18	23.59 ±0.55	23.67 ± 0.29
b	52.71 ± 0.73^a	50.27 ± 1.17^a	49.96 ± 0.95^a	45.68 ± 0.29^b
c	0.043 ± 0.002^a	0.041 ± 0.003^b	0.039 ±0.002^c	0.039 ±0.002^c
EDDM	46.45 ± 0.48^a	45.82 ± 0.0.33^a	45.50 ± 0.24^a	43.67 ± 0.51^b
		CP		
a	21.89 ± 0.51	21.96 ± 0.33	21.70 ± 0.31	21.68 ± 0.20
b	57.80 ± 0.13^a	55.46 ± 0.15^a	54.27 ± 0.63^a	50.94 ± 0.11^b
c	0.077 ± 0.001^a	0.067 ± 0.003^b	0.060 ± 0.001^c	0.055 ± 0.001^d
EDCP	56.93 ± 0.16^a	53.72 ± 0.26^b	51.30 ± 0.08^c	48.36 ± 0.17^d
RUP	43.07 ± 0.17^d	46.28 ± 0.30^c	48.70 ± 0.15^b	51.64 ± 0.13^a

[abcd] means in the same row with different superscripts are significantly differ ($P < 0.05$).
a: soluble fraction (%).
b: potentially degradable fraction (%)
c: rate of degradation (% h^{-1}).
ED: effective degradability= a + [bc/c + k], where k is passage rate .
RUP = 100 - ED (Orskov and McDonald, 1979).

Performance of lambs:

A significant increase in birth weight (kg); weaning weight (kg); gain (kg) and ADG (g) of approximately 7; 17; 22 and 22%, respectively was observed for lambs from ewes fed 20% DDGS containing ration when compared to the control one (Table 8).On the other hand, no differences between TMR_4 contained 30% DDGS and control ration. Schauer *et al.* (2006) reported a significant increase in performance of lambs with increasing level of DDGS 22.5% in the ration. Buckner *et al.* (2007) conducted a feedlot cattle study comparing 10, 20, 30, and 40% levels of DDGS to a corn control rations. He found maximum ADG with 20 to 30% DDGS containing rations and while, maximum G:F was between 10 to 20% DDGS containing rations. However, many researchers suggested that DDGS can be an effective replacement of concentrate with no affect in livestock performance compared to control rations. Schauer *et al.* (2005) provided up to 15% of the total finishing ration as DDGS and observed no negative affects on animal performance. Similarly, Huls *et al.* (2008) replaced up to 22.9% of the ration with DDGS and found no difference in lamb performance or carcass traits.

Table (8): Performance of lambs suckling their dams fed the experimental TMR's (mean ± SE).

Item	Experimental rations			
	TMR_1	TMR_2	TMR_3	TMR_4
No. of lambs	5	5	5	5
Birth weight(kg)	3.70 ± 0.06^b	3.58 ± 0.05^b	3.95 ± 0.05^a	3.73 ± 0.05^b
Weaning wt.(kg)	11.69 ± 0.30^b	12.07 ± 0.20^b	13.70 ± 0.22^a	11.51 ± 0.11^b
Gain (kg)	7.99 ± 0.25^c	8.49 ± 0.17^b	9.75 ± 0.19^a	7.78 ± 0.10^c
ADG(g)	133.20 ± 4.09^c	141.50 ± 2.85^b	162.50 ± 3.13^a	129.60 ± 1.63^c

[abc] means in the same row with different superscripts significantly differ (P< 0.05).

Milk yield and milk composition:

Milk yield, 4%FCM, DMI, feed conversion and feed efficiency of ewes fed TMR's rations are presented in Table (9).The results indicated the positive effect of DDGS up to 20% could be observed on milk yield compared to the control group and non-significant effect between ration contained 30%DDGS and control group. Values of 4%FCM production take the same trend as that of milk yield. It is cleared that 4%FCM production of TMR's contained 10% and TMR's 20%DDGS was significantly increased (P< 0.05) by about 9.59 % and about 30.80 %, respectively when compared with control group. The increase in milk production of ewes fed TMR with 20% DDGS could be due to the high feeding value of DDGS; therefore, may have a real advantage for supporting higher milk production. Also, DDGS may contain some unidentified compounds that enhance rumen function and animal performance. This finding consistent with previous research (Powers *et al.* 1995; Nichols *et al.* 1998; Al-Suwaiegh *et al.* 2002 and Hippen *et al.* 2010). DDGS has been shown to usually cause a decrease in DMI and milk yield but only when it was fed in level excess on 20% of total DM (Hippen *et al.* 2003, 2004; Kalscheur *et al.* 2004). Data of feed conversion as gDMI/g4%FCM indicated that it was improved by 7.01 % and 20.78 % with rations contained 10%DDGS and 20% DDGS, respectively compared with the control group. While, no significant differ between ration contained 30%DDGS and control group.

The current results emphasize that DDGS supplements up to 20% could improve the efficiency of protein and energy utilization in milk production as reported by Anderson *et al.* (2006). Moreover, adding 20-30% DDGS to dairy ewes rations significantly increased milk fat percentage (Table 10), this may be due to the high concentrations of polyunsaturated fatty acids in DDGS. Jenkins, (1998) and Helal *et al.* (2007) found that dairy animals fed high fat diets produced milk with higher fat percentage compared with the control diet. In addition, the effect of dietary fat on milk fat percentage depends on fat composition and the degree of saturation of the fatty acids in dietary fat; when DDGS contain high level of unsaturated fatty acids (18:1), which could be the reason for the higher milk fat percentage of cows fed DDGS containing diets (Janicek *et al.* 2008). Milk protein percentage was increased significantly ($P < 0.05$) with increasing concentrations of DDGS up to 20%. The increase in milk protein percentage in his study may be due to more energy being available or milk protein synthesis. Increases in milk protein percentage were also reported by Grings *et al.* (1992). No significant differences between TMR's containing DDGS and control for milk lactose percentage; milk ash and total solids percentages as well, but more ($P < 0.05$) solid not fat percentage was obtained with feeding 10 and 20% DDGS containing rations.

Table (9): Performance of ewes fed the experimental TMR's (mean ± SE).

Item	Experimental rations			
	TMR_1	TMR_2	TMR_3	TMR_4
No. of ewes	5	5	5	5
Weight of ewes(kg)	38.70 ± 0.63	38.90 ± 0.62	38.70 ± 0.71	38.80 ± 1.04
DMI g/h/day	1266.21 ± 7.33^{b}	1290.93 ± 11.85^{a}	1310.51 ± 8.99^{a}	1272.08 ± 13.50^{b}
Milk yield (g/h/day)	311.60 ± 9.34^{c}	340.50 ± 3.38^{b}	396.30 ± 2.11^{a}	298.40 ± 7.90^{c}
FCM(g/h/day)	328.89 ± 11.54^{c}	360.42 ± 5.40^{b}	430.18 ± 3.63^{a}	319.44 ± 10.31^{c}
Feed conv-1	4.06 ± 0.13^{a}	3.79 ± 0.05^{b}	3.31 ± 0.03^{c}	4.26 ± 0.15^{a}
Feed conv-2	3.85 ± 0.15^{a}	3.58 ± 0.06^{b}	3.05 ± 0.03^{c}	3.98 ± 0.16^{a}
Feed efficiency-3	0.259 ± 0.007^{c}	0.279 ± 0.004^{b}	0.328 ± 0.003^{a}	0.251 ± 0.009^{c}

[abc] means in the same row with different superscripts significantly differ (P< 0.05).

FCM=Fat corrected milk (4%); Feed conv-1= Feed conversion as g DMI/ g milk yield; Feed conv-2=Feed conversion as g DMI/ g FCM; Feed efficiency-3= Feed efficiency as on 4%FCM.

Table (10): Chemical composition (%) of milk produced by ewes fed the experimental rations (mean ± SE).

Item	Experimental rations			
	TMR_1	TMR_2	TMR_3	TMR_4
Fat %	4.37 ± 0.06^{b}	4.39 ± 0.04^{b}	4.57 ± 0.04^{a}	4.47 ± 0.05^{a}
Protein %	4.57 ± 0.04^{b}	4.72 ± 0.04^{a}	4.75 ± 0.05^{a}	4.60 ± 0.05^{b}
Lactose %	6.54 ± 0.11	6.58 ± 0.04	6.64 ± 0.02	6.61 ± 0.02
Ash %	0.85 ± 0.01	0.86 ± 0.02	0.88 ± 0.01	0.88 ± 0.06
Total solid %	16.33 ± 0.14	16.55 ± 0.45	16.84 ± 0.03	16.56 ± 0.11
Solid not fat %	11.96 ± 0.11^{b}	12.16 ± 0.43^{ab}	12.27 ± 0.07^{a}	12.09 ± 0.06^{b}

[abc] means in the same row with different superscripts significantly differ (P< 0.05).

CONCLUSION

DDGS could be a good source of protein, fat, essential amino acids, and energy for lactating dairy ewes, as it's considered as good UDP sources and can improve animal performance. Using good quality DDGS up to 20% in the ration could be partially replace corn grain, soybean meal and wheat bran in order to give maximum effect on ewes performance. Ewes fed DDGS up to20% had greater feed efficiency and milk yield, and improved milk component concentrations.

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معظمة الإستفاده من مخلفات تقطيرالحبوب المجففه فى إنتاجية الأغنام

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هذه الدراسة صممت بهدف معظمة الإستفاده من مخلفات تقطير الحبوب (المجففه مع ذوائبها) فى تغذية الأغنام وذلك بتكوين ثلاث مخاليط أعلاف متكامله تحتوى على مخلفات تقطير الحبوب بنسب 10 ،20 ، 30% مقارنة بالعليقه الكنترول(بدون مخلفات تقطير الحبوب). تم أجراء تجارب الهضم لمخاليط. العلائق المختبرة باستخدام ثلاثة كباش برقى لكل مخلوط علف بينما أجريت تجارب تخمرات الكرش بإستخدام ثلاثة نعاج برقى مزودة بفستيولات الكرش. أجريت تجارب التغذيه بإستخدام عشرون نعجه برقى فى المرحله الاخيره من الحمل (أخر 4-6 أسابيع من الحمل) ما بين موسم ثانى وثالث قسمت إلى أربع مجموعات متماثله وذلك لدراسة إنتاج اللبن ومكوناته وكمية الماكول ومتابعة الحملان المولوده حديثا.

وقد أشارت النتائج إلى ما يلى :-

1. إضافة DDGS لمخاليط العلائق أدت إلى زيادة محتواها من الدهن و الألياف القابله للتحلل فى الوسط المتعادل و الألياف القابله للتحلل فى الوسط الحامضى والسليلوز والهيميسليلوز.
2. زيادة نسبة DDGS فى مخاليط العلائق أدت إلى زيادة تركيز الأحماض الأمينيه (الإيزوليوسين والميثيونين و الفالين).
3. إضافة DDGS بنسبة 10 و20% من مكونات مخاليط العلائق أدت إلى زيادة معاملات هضم العناصر الغذائيه بينما أعلى قيمه للمواد الغذائيه المهضومه الكليه كانت فقط مع العليقه المحتويه على 20% من DDGS ليس ذلك فقط بل أعطت أعلى أتزان أزوتى وأعلى أستفاده من نيتروجين العليقه.
4. أظهرت قياسات تخمرات الكرش أنخفاض معنوى فى تركيز نيتروجين الأمونيا مع مخاليط العلائق المحتويه على DDGS بينما لم يتأثر تركيز الأحماض الدهنيه الطياره مقارنة بالعليقه الكنترول.
5. لوحظ أرتفاع تركيز حامض الأستيك فى المخاليط المحتويه على DDGS فى حين كان تركيز حامض البروبيونيك أقل ونسبه الأستيك : البروبيونيك أعلى فى مخلوط العلف المحتوى على 30% DDGS مقارنة بالعلائق الأخرى بينما لم يتأثر تركيز حامض البيوتريك بإختلاف العلائق.
6. سجل مخلوط العلف المحتوى على 20% DDGS أعلى تخليق للنيتروجين الميكروبى فى الكرش يليه مخلوط العلف المحتوى على 10% DDGS والعليقه الكنترول بينما سجل مخلوط العلف المحتوى على 30% DDGS أقل نيتروجين ميكروبى مخلق فى الكرش.
7. أظهرت نتائج درجة تحلل المادة الجافة فى الكرش أن العليقه الكنترول والمخاليط المحتويه على 10 و 20% DDGS أعطت أعلى قيمه للجزء بطئ التحلل وأعلى كفاءه لتحلل الماده الجافه مقارنة بمخلوط العلف المحتوى على 30% DDGS بينما وجد أن الجزء سريع التحلل لم يتأثر باختلاف العلائق.
8. لم يتأثر الجزء سريع التحلل للبروتين الخام باختلاف العلائق بينما حدث أنخفاض معنوى فى قيمة الجزء بطئ التحلل مع مخلوط العلف المحتوى على 30% DDGS وأظهرت العليقه الكنترول أعلى كفاءه لتحلل البروتين الخام فى الكرش فى حين أن زيادة نسبة DDGS فى مخاليط العلائق أدت إلى خفض كفاءة التحلل للبروتين الخام.

9. عند تغذيه النعاج على مخلوط العلف المحتوى على 20% DDGS فإن وزن الميلاد والفطام و الزياده فى الوزن ومعدل النمو اليومى للحملان الناتجه كانت أعلى مقارنة بباقى العلائق مع زياده فى كمية اللبن الناتج واللبن المعدل لنسبة دهن 4% وكل من معدل التحويل الغذائى والكفاءه الغذائيه و الذى تبعه زيادة فى محتوى اللبن من الدهن والبروتين والجوامد الصلبه اللادهنيه.

ومن خلال هذه الدراسه يمكن التوصيه بإضافة DDGS حتى 20% من مكونات مخلوط العلف المستخدم فى تغذية النعاج وذلك بهدف الحصول على أداء إنتاجى جيد وكذلك أعلى كفاءه غذائيه.