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EVALUATION OF CORN DISTILLERS DRIED GRAIN WITH SOLUBLES IN RUMINANT RTIONS AND ITS EFFECT ON MILK PRODUCTION

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ABSTRACT

The objective of this study was to investigate the use of distillers dried grains with solubles (DDGS) in rations of barki sheep and its effects on nutrient digestibility and milk production in lactating crossbred Friesian cows. Four total mixed rations (TMR) were formulated to contain 0, 10, 20 and 30% of corn DDGS. Digestibility trails were carried out using 3 meal barki sheep for each diet. Results showed that the animals fed TMR3 with 20% CDDGS recorded significant increase in digestibility of DM, OM and CP (69.69%, 72.97% and 70.89% respectively) compared to other ratios. The nutritive value as DCP increased significantly (P<0.05) with 20% DDGS total mixed ration. Rumen fermentation parameters were determined using 3 cannulated female barki sheep. The pH values increased, however total volatile fatty acid and ammonia nitrogen (NH_3-N) concentration decreased significantly (P<0.05) with supplement TMR2 andTMR4 (10 and 30% DDGS). While animal fed TMR1and TMR3 showed highest (P<0.05) of total volatile fatty acid. Values of the effective degradability (ED) of dry matter (DM) at assumed ruminal passage rate of (0.039h-0.043^{-1}) ranged from 43.67 to 46.45%, and exhibited significant decreased (P<0.05) with adding 10, 20, 30%DDGS respectively than control diet. The effective degradable crude protein (EDCP) and ruminal undegradable protein (RUP) ranged from 56.93to48.13% and from 43.07to51.86% respectively for DDGS containing ratios and control ration. A Lactation trial using 16 lactating dairy cows showed significant increase in milk yield and composition (FCM4%- fat) for the 20% DDGS containing rations compared with other diets.

INTRODUCTION

Distillers grains are considered good source of energy and protein for dairy cattle (Warner 1970). One bushel of corn produces approximately 18 pounds of DDGS. Corn ethanol production (dry milling) begins by grinding the corn into flour and adding enzymes and water. The starch of the dry corn becomes sugar and the resulting substance, called mash, is cooked and sterilized. Yeast is then added and fermentation takes place, after which the ethanol is removed through distillation. The remaining residues are then dried. The evaporation process produces condensed distiller's solubles, and the remaining solids are known as the distiller's grains fraction. These two residues are then dried, resulting in distiller's dried solubles and distiller's dried grains, respectively. These two products are blended by the ethanol plant to produce DDGS. Dairy cows fed DDGS are at least as productive (and sometimes more productive) as dairy cows fed diets of soybean meal Schingoethe (2007). Kelezer (2009) reported that feeding DDGS at 15, 20 and 30%DM to dairy cows presented no problems in items in dairy management. DDGS are low in lignin and starch and high in digestible neutral fiber compared with original corn grains as reported by Gilbery *et al* (2004). Feeding DDGS supplies both crude protein (CP) and energy for lactating dairy cattle. Also DDGS contains a valuable source of supplemental protein with high rumen undegradable 47% of crude protein as compared to 35% in soybean meal LIU *et al*., (2006). Proteins that resist degradation in the rumen and pass to the lower tract for digestion are called (bypass) protein. Kleinschmit *et al* (2006) have proposed that bypass protein is necessary for maximum production by young growing ruminants and high producing dairy cows. It also contains other nutrients recovered from fermented grains. These include low soluble carbohydrates, relatively high fiber, and high fat and factor that stimulate cellulose digestion in the rumen (Hatch1993). The nutrients in distiller's grains are closely related to the grains from which they are made. Most commercially valuable distiller's grains are produced predominantly from corn. The purposes of this work was to test the influence of three levels of distillers dried grains with solubles (from corn) on nutrients digestibility feeding, rumen fermentation, degradability of (DM and CP) and the lactation performance of dairy cattle.

MATERIALS AND METHODS

This work was conducted at Noubaria Experimental Station, Animal Production Research Institute, Agricultural Research center, Ministry of Agriculture and the Regional Centre for Food Feed Agricultural Research center, Ministry of Agriculture during 2012 – 2013.

Experimental Diets:

Four iso- nitrogenous and iso- calories total mixed rations (TMR) were formulated. one of the rations served as control and three contain corn dried distiller grains with soluble (CDDGS) at 10, 20, and 30% in the diets as follow 1) without CDDGS (control), 2) TMR2 with 10% CDDGS, 3) TMR3 with 20% CDDGS and 4) TMR4 with 30% CDDGS. Compositions of tested rations are presented in Table (1). Corn Dried Distiller Grains with soluble (CDDGS) obtained from the commercial Egyptian company.

Digestibility trails:

Digestibility trial was carried out using three cannulated Barki male sheep (47 kg, live body weight) were used in consecutive trials. The animals were fed in such a way to cover their maintenance requirements (NRC, 1985). Each digestibility trial lasted three weeks as preliminary period followed by 10 Days as a collection period. The animals were housed in metabolic cages and beneath each, a stainless steel screen having 4 mm mesh to retain feces but free passage of urine, which was collected through a funnel. The animals were fed twice daily at 8.00 hours and 16.00 hours. Water was available all time. Feed samples were collected and kept at +1°C ᵒ for proximate analysis. Feces and urine were collected quantitatively once a day before the morning meal at 8.00 am, and stored at – 10 °C. The ten days combined collection was sampled then kept for routine analyses. Fecal samples were dried at 60 °C for 72 hours (partial drying) and ground through a 1 mm screen on a Wiley mill grinder. They were 20 gm per sample per treatment per animal were composed and kept at - 18°C for analyses. Digestibility were determined and expressed on dry matter basis. Proximate analyses were carried out according to (A.O.A.C. 1995), crude protein (CP) by Kjeldahl, while nitrogen free extract (NFE) was calculated by difference. Fiber fraction (NDF, ADF and ADL) was determined as described by (Goering and Van Soest 1970). Hemicellulose and cellulose were calculated by differences.

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

Feed ingredients, %	Control	10% CDDGS	20% CDDGS	30% CDDGS
	Ration1	**Ration2**	**Ration3**	**Ration4**
Yellow corn	32	27	21	16
Soybean meal	16	11	7	3
Wheat bran	7	7	7	7
Corn dried distillers grains with solubles	0	10	20	30
Corn silage	30	30	30	30
Rice straw	7	7	7	7
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

Rumen fermentation trials:

Three female sheep fitted with permanent rumen fistula (with an average of 45 kg live body weight) were used in rumen fermentation and *in situ* study. Samples were taken at 0, 1, 3 and 6 hrs after the morning meal for each ration. Collected rumen liquor samples were directly tested for pH using Orian 680 digital pH meter. Samples were strained through four layers of chesse cloth for each sampling time, while ammonia nitrogen (NH3-N) was determined using magnesium oxide (MgO) as described by AL-Rabbat *et al*. 1971. Total volatile fatty acids (VFA's) concentration was estimated using steam distillation methods (Warner, 1964). Nylon bags technique was used to determine the disappearance of dry matter and crude protein in the rumen according to (Barrio *et al*. 1985).

In Situ trials:

Two polyester bags (100 % Dacron polyester 7 X 15 cm) with a mean pore size of 45 µm and a surface area of about 210 cm^2 were used at each incubation time. Approximately 3 g of the feed ingredient were placed in each bag. Bags were then incubated in the rumen of each sheep and removed after 3, 6, 12, 24, 48 and 72 hours after feeding. After the removal of the bags from the rumen, they were washed under a gently flowing tap water until the fluid was clear. Bags were drained, dried at 60 °C for 72 hours, cooled in desiccators and weighed. Dry matter, nitrogen and crude fiber content were estimated according to the method of (A.O.A.C. 1995).Two bags were washed in running water for 15 min. to determine the initial soluble fraction (a). The kinetics of DM and CP disappearances was studied by fitting the individual values to the following equation:

$$P = a + be^{-C\ (T-Lt)}$$

Proposed by (Orskov and McDonald 1979) where P represents the disappearance after time T, Lt is lag time until the start of the degradation. The, a, b and c are least-squares estimates of soluble fraction, the degradable fraction and the rate of degradation, respectively. The effective rumen degradability (ED) was estimated according to (Orskov and McDonald 1979). Rumen out flow rate (k) was assumed to be 0.05% per hour for concentrate (McDonald 1981a). **ED = a + bc/c+k.**

Lactation trials: Sixteen lactating crossbred Friesian cows (515 kg in average) were with previous milk records (12 kg/ d in average) were allotted randomly into four groups (four animals each). The requirements of the cows were calculated according to NRC (2001). Rations were fed twice a day at 8.00 am and 16.00 p.m. Trial lasted 30 days as preliminary period followed by one week as a collection period. Cows were milked twice daily and milk samples were collected from each cow morning and evening. Actual milk yields were recorded daily and milk samples were taken (100 ml) and kept at 4 °C for latter analysis. Milk samples were chemically analyzed for fat percentage according to Gerber's method as described by (Ling 1963), total solids percent (TS), total protein and ash according to the A.O.A.C. (1995). Lactose was determined according to a rapid method for the determination of lactose in milk and cheese described by (John *et al*. 1957). Solid not fat (SNF) was calculated by differences solids percent (TS),). Fat corrected milk (4 %) was calculated according to (Gaines and Davidson 1923) using the following equation:

FCM = M *(0.4 + 0 .15* F) Where M = milk yield, F = fat yield

Statistical analysis: Data were statistically analyzed using the least squares analysis of variance using General Linear Models (GLM) procedure (SAS, 2000). The model describing each trait was assumed to be:

$$Y_{ijk} = \mu + D_i + T_j + e_{ijk}$$

Where: Y_{ijk} is the observation on individual k, and µ is the Overall mean. D_i is a fixed effect of the i^{th} diet, and T_j is a fixed effect of the j^{th} time, and eijk is a random error assumed to be normally distributed with mean = 0 and variance = σ^2.Duncan's Multiple Range Test (Duncan, 1955) was used to compare among means of each trait. The model describing production traits using Latin Square was as follows:

$$Y_{ijk} = \mu + D_i + R_j + C_k + e_{ijk}$$

Where: R_j is a fixed effect of the j^{th} raw, C_k is a fixed effect of the k^{th} column.

RESULTS AND DISCUSSION

The chemical composition of DDGS and the four experimental rations are presented in table (2). The results of proximate analysis for DDGS recorded values of 27.64% crude protein (CP), 8.76% ether extract (EE), 7.66% crude fiber (CF), 5.97% ash and 49.97% nitrogen free extract (NFE). Crude protein value of DDGS was they close to that reported by (Choi *et al*.2008) (27.53) and lower than that (30%) recorded by (Spiehs *et al*. 2002). Ether extract (EE) value of DDGS obtained in this study (8.76%) was lower than that (10.5%) those reported by (Spiehs *et al*. 2002). This value of EE content of DDGS (8.76%) was almost similar to the value reported by (NRC 1994). These differences could be mainly due to processing technologies condition. Crude fiber (CF) content of DDGS 7.66% was high than that (5.30%) reported by (Martinez-Amezcua *et al*.2007) and was in agreement with that of 7.80% reported by (Lumpkins *et al*.2004). Also NDF content of DDGS was 37.78% which was in agreement with (Spiehs,*et al*., 2002), who found that NDF of DDGS range from37 to 48%. This result led to the increasing NDF and Hemicellulose linearly with DDGS increasing in diets.

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

Items	CDDGS	Ration1	Ration 2	Ration 3	Ration 4
Chemical analysis:					
DM	88.75	89.43	89.38	89.77	89.54
OM	95.03	90.67	90.69	90.61	89.48
CP	27.64	14.08	14.01	14.22	14.24
CF	7.66	14.78	14.66	14.72	14.69
EE	8.76	2.11	2.38	2.66	2.80
Ash	5.97	9.03	9.31	9.05	9.98
NFE	49.97	60.00	59.64	59.35	58.29
Fiber fractions:					
NDF	37.78	37.91	39.61	41.85	43.10
ADF	19.33	22.04	21.10	21.60	22.39
ADL	3.23	2.92	3.90	4.10	4.21
Hemicellulose	18.45	15.89	18.51	20.25	20.70
Cellulose	16.10	19.12	17.20	17.50	18.19

Digestibility coefficient and nutritive values:

The nutrients digestibility coefficients and nutritive values of experimental rations are represented in table (3). Dry matter (DM) and organic matter (OM) digestibility were lowest (P<0.05) for Ration 4, than other diets. Pavan *et al*., (2007) reported a linear decrease in apparent total tract digestibility of DM, and OM, in response to increasing DDGS supplementation in rations for steers. Higher (P<0.05) digestion coefficient of CP was obtained for Ration1 and Ration3 flowed by Ration2 flowed Ration4 with significant differences (P<0.05) among the four treatment. These results were in agreement with (Corrigan *et al*., 2009), who reported that decreasing CP digestibility when steers fed DDGS up to 20% of the ration (DM basis), that may be attributed to the heat damage would increase the concentration of ADIN (acid detergent insoluble nitrogen) in DDGS. Although, Ham *et al*. (1994) reported that as the ADIN content of DDGS increased, ruminal digestibility of CP decreased, However Leupp *et al* (2012)found that total tract CP digestion increased (linear; *P* < 0.001) with increasing DDGS; however, total tract OM digestion was not different (*P* = 0.74). Digestibility of CF increased significantly (P<0.05) with increasing DDGS and increasing fiber content. These results in agreement with those obtained by (Lemenager *et al*., 2006), (Birkelo *et al*., 2004), (NRC, 2001), and Islas and Soto-Navarro (2010), who reported linear increase (*P* < 0.001) of total NDF digestibility. Total intake (*P* < 0.01) and digestibility (*P* < 0.001) of EE were observed as DDGS supplementation increased. These increases were most likely due to the increase in the availability of NDF and EE associated with increasing DDGS supplementation amount. Furthermore, Jerry Shurson and Sally Noll (2004) reported that corn DDGS contains high amounts of NDF but low amounts of lignin. This makes DDGS a highly digestible fiber source for cattle, and reduces digestive upsets compared to corn. The highly digestible fiber in corn DDGS also allows it to serve as a partial replacement for forages and concentrates in diets for dairy and beef cattle. On the other hand, the present results in table (3) indicated that nutritive value as TDN increased significantly (P<0.05) with animals fed Ration1 and Ration2. While, animals fed Ration4 recorded the lowest value (P<0.05). Moreover, animals fed Ration1 and Ration3 recorded the highest values as DCP, followed by those fed Ration2, while Ration4 recorded the lowest DCP value (P<0.05). These results were closely related to those CP digestibilities.

Table (3): Digestibility coefficients and nutritive values of the experimental Rations fed to sheep (means ± SE).

Items	**Experimental rations**			
	Ration $_1$	**Ration $_2$**	**Ration $_3$**	**Ration $_4$**
Digestibility coefficients (%):				
DM	69.42 ± 0.31[a]	69.19 ± 0.33[a]	69.69 ± 0.21[a]	65.26 ± 0.24[b]
OM	72.81 ± 0.42[a]	73.47 ± 0.35[a]	72.97 ± 0.22[a]	69.33 ± 0.23[b]
CP	70.85 ± 0.35[a]	69.57 ± 0.21[a]	70.89 ± 0.22[a]	66.77 ± 0.23[b]
CF	63.04 ± 0.48[b]	63.38 ± 0.51[b]	64.66 ± 0.44[a]	65.72 ± 0.41[a]
EE	78.22 ± 0.11[b]	79.82 ± 0.77[a]	79.97 ± 0.22[a]	80.52 ± 0.39[a]
NFE	74.12 ± 0.21[a]	73.72 ± 0.13[a]	71.97 ± 093[b]	70.88 ± 0.51[b]
Nutritive values (%):				
TDN	67.48 ± 0.22[a]	67.15 ± 0.28[a]	67.10± 0.25[a]	65.55 ± 0.27[b]
DCP	9.97 ± 0.11[a]	9.75 ± 0.14[ab]	10.08 ± 0.11[a]	9.51 ± 0.02[b]

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

Rumen fluids parameters and total VFA production.

The results presented in table (4) show the effect of DDGS on the ruminal environment. In the present study, ruminal pH ranged from 6.47 to 6.58. These levels are suitable for the normal function of cellulotic bacteria (Mould and Qrskov1983; Mould *et al*.1983and Hoover 1986) and are above the threshold of acidosis (pH≤5.8) (Beliveau 2008). Average ruminal pH levels found in the current study are similar to those found in other studies (McCollum and Gaylean 1985; Stokes *et al*.1988 and Beck *et al*.1992). The pH obtained here are within the range (6.2-7.2) reported by (Van Soest 1994) as being optimal for fiber digestion. In this study, the supplementation of 10, 20, and 30% of DDGS resulted in decrease in NH3-N concentration. DDGS have relatively less ruminally degraded protein (RDP) and relatively more

RUP (NRC, 2000), thus decreasing ammonia concentration may occur, when steers supplemented with DDGS (Archibeque *et al*., 2008). In light of the results obtained by Satter and Slyter, (1974) and McCarthy *et al*., (1989) who reported that 5 to 6 mg/dl of ammonia is adequate to stimulate microbial protein synthesis, the level of ammonia concentration recorded in this study showed that the level of ammonia was adequate enough to allow maximum microbial protein synthesis. Supplemented with 20% DDGS showed significant(P<0.05) increase in total VFA concentration than 10, 30% DDGS and control. . The VFA and total ammonia concentration were largely determined by pH and decreased as pH increased (Lana *et al* 1998). The concentration of volatile fatty acids (VFA) is influenced by several factors as the composition of the ration, the amount of easily fermentable carbohydrates, OM digestibility beside ruminal pH, ammonia concentration and metabolic activity of rumen microfloraa. All these factors have an impact on VFA content (Sutton 1980). Supplementation with 10, 20, and 30% DDGS also increased the molar proportion of acetate and acetate: propionate in ruminal fluid. These increases were most likely due to the increase in the availability of digestible NDF from DDGS with increasing DDGS inclusion rates. Elizalde *et al*. (1999) reported acetate increased and Propionate decreased as DDGS supplementation increased. The present results supported the idea that the ratio of ruminal acetate: propionate was highly influenced by the capacity of the dietary treatments to produce pH and NH_4. Sheep with higher acetate: propionate ratio also has higher ruminal pH values, and in vitro experiments emphasized the idea that pH had a major impact on acetate: propionate ratio (Lana *et al* 1998). Limin Kung (1999), reported that the fermentation of fiber (cellulose and hemicellulose) results in the production of acetic acid that is used by the cow for energy and is the primary precursor of fat in milk.

Table (4): Overall mean of rumen parameters of sheep fed the experimental Rations (means ± SE).

Items	Experimental rations			
	$Ration_1$	$Ration_2$	$Ration_3$	$Ration_4$
Ph	6.47^b ± 0.11	6.52^a ± 0.10	6.50^a ± 0.05	6.58^a ± 0.07
NH_3-N concentration (mg/100mlR.L)	14.44 ± 0.12^a	13.12 ± 010^b	12.22 ± 0.15^c	11.95 ± 0.09^c
VFA concentration (meq/100 mlR.L)	13.11 ± 0.21^a	12.67 ± 0.12^b	13.45 ± 0.11^a	11.32 ± 0.14^c
Acetic acid, %	51.66 ± 0.31^b	53.43 ± 0.25^a	54.37 ±0.16^a	54.70 ± 0.22^a
propionic acid, %	24.33 ± 0.19^a	24.12 ± 0.11^a	23.07 ± 0.08^{ab}	22.30 ± 0.23^b
Butyric acid, %	12.80 ± 0.13	11.30 ± 0.23	11.70 ± 0.17	11.90 ± 0.40
Acetic : propionic ratio	2.12 ± 0.02^b	2.22 ±0.04^b	2.36 ± 0.05^a	2.45 ± 0.03^a

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

Degradation of dry matter and crude protein.

The effect of DDGS supplementation levels on the in-situ DM and CP disappearance are shown in Table (5).The effective degradability (ED) of DM calculated for k=5%h^{-1} (NRC, 1985). However, higher (P<0.05) ED was recorded for the control and group 10%DDGS, while the 20% and 30%DDGS had significantly lower (P<0.05) ED for the DM. Urdl *et al* (2006) reported that the DM degradation rates of the distillers DDGS are lower than that of soybean meal due to the increased rumen. The results of the in situ experiment are consistent with those of Batajoo and Shaver (1998), who report DM degradability for DDG was 44.2 % and a degradation rate of 4.9 % h-1. Other published values (Boila and Ingalls, 1994; Woods *et al*., 2003) for the potential degradability are also in the same range but with much lower rates of degradation (about 3.4 % h-1) and consequently lower effective degradabilities.

Supplementation with DDGS may have provided more readily available nutrients to the rumen microbes, potentially meeting nutritional requirements of rumen microflora without extensive degradation of the forage in the diet (Russell and Baldwin 1978). This may account for the reduced extent of forage degradation in the DDGS contaning diets with DDGS and only a numeric increase for total tract digestibility of DM.

The rumen undegradable protein (RUP) was highest (P<0.05) with Ration $_4$ supplement (30% DDGS). (Brouk 1994) found that RUP ranged from 53.5 to 67.2% of CP among various sources of DDG and Harty *et al*. (1998) found the range of RUP in DDG to be from 42.8 to 62.6%. The RUP values in this study had a range of (43.07-51.64%) of the CP. DDGS can provide an excellent source of rumen undegraded protein (RUP) of crude protein (CP) is 54.5% (Nuez 2010; Walter 2010). In this study the soluble CP values of DDGS ranged from 21.9 to 23.0% of the CP. These values are less than 28.5 % of CP value of DDGS suggested by NRC (2001), less than 25% reported by Islas and Navarro (2010) and greater than those found in DDGS (13.4 to 19.7%) of the CP by Kleinschmit *et al*. (2006). The CP slowly degradable fraction values ranged from 52.5 to 50.1% of CP, which are in close agreement with those by NRC 2001; (53.3% of CP). The rate of DDGS CP degradation observed in this study is relatively similar to values reported by Kleinschmit *et al*. (2007) in dairy cows fed a diet consisting of 18% wet distillers grain (DM basis). 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 (Clark *et al*., 1987). The variability of effective degradability of crude protein in the case of DDGS was not caused by grain species only. These results indicate that a various ethanol processing methods (presumably DDGS drying) may affect protein intestinal digestibility and absorbed protein. Previous studies have shown a negative effect of overheating on intestinal digestibility in other feed stuffs (Sommer *et al*. 1994; McKinnon et al., 1995 and Čerešňáková *et al*.1996).

Milk yield and composition

The result of this study indicate that the addition of DDGS 20% had a stimulating effect on the performance of dairy cows table (6). Similar results were obtained by Powers *et al*. (1995) who reported an increase in average milk yield by 0.75Kg with adding DDGS. Kleinshmit *et al*. (2006) showed that using DDGS in the diet of dairy cows increased milk yield by 4.8Kg as compared to the control. Grings *et al*. (1992) reported an increase in milk yield from 2.4 to 4.2 Kg depending on the level of DDGS in the ration.

Schingoethe (2007) recommended that DDGS constitutes a maximum of 20% of a dairy cow's diet. If DDGS is more than 20% of the dry diet, it may lead to a decrease in milk production and excess protein. The present result showed that FCM% yield increased with diet DDGS 20%. Also our experiment noted that a slight decrease in protein and lactose with increase the level of DDGS that may be due to a wrong balance of dose in terms of lysine demand as reprted by Kleinshmit *et al*.(2006). In contrary to the present study Kleinshmit *et al*. (2007) reported a tendency to increase the protein in milk with cows fed diets containing 25%DDGS on DM basis. Nichols (1998) reported that lysine was a first limiting amino acid in milk protein synthesis with diets containing 20% of DDGS. Tanaka *et al*. (2011) reported that diets containing 20 or 30% DDGS on DM basis feed to dairy cows in hot condition had significantly effect on DMI (dry matter intake) and milk yield. Howevre, milk protein decreased and fat increased on which in agreement whit our results that showed a linear increase in milk fat content with increase DDGS% in diets. Because the fat in DDGS, especially corn DDGS is quite unsaturated with typically more than 60% linoleic acid, it is logical to expect a modest increase in the concentration of unsaturated fatty acid in the milk produced as observed by Shingoethe *et al*.(1999) Leonardi *et al*.(2005) and Anderson *et al*. (2006) also reported modest increase in the healthful fatty acid conjugated linoleic acid while, Cyriac *et al*.(2005) observed that a linear decrease in milk fat concentration but milk production remained unchanged and milk protein content increased when cows were fed 0,7,14 and 21% of DDGS. Allen Trenkle (2007) assumed that the highest economic values of DDGS are obtained with the lower levels fed in the experiments (16 or 20% DDGS). Farlin (1981) demonstrated that including 40% DDGS reduced DMI 11 % and reduced milk yield and milk protein.

Table (5): Degradation kinetics of DM and CP in the rumen of sheep fed the experimental Rations (mean ± SE).

Items	Experimental rations			
	Ration $_1$	Ration $_2$	Ration $_3$	Ration $_4$
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	47.96 ± 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	44.61 ± 0.24^b	43.67 ± 0.51^b
CP				
A	21.89 ± 0.51	21.96 ± 0.33	22.70 ± 0.31	23.08 ± 0.20
B	57.80 ± 0.13^a	52.46 ± 0.15^a	51.27 ± 0.63^a	50.11 ± 0.11^b
C	0.077 ± 0.001^a	0.060 ± 0.003^b	0.052 ± 0.001^c	0.050 ± 0.001^d
EDCP	56.93 ± 0.16^a	50.56 ± 0.26^b	48.83 ± 0.08^c	48.13 ± 0.17^c
RUP	43.07 ± 0.17^d	49.44 ± 0.30^c	51.16 ± 0.15^a	51.86 ± 0.13^a

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

Table (6): Milk production and chemical composition (%) of milk produced by cows fed the experimental Rations (Mean ± SE).

Items	Experimental rations			
	Ration 1	Ration 2	Ration 3	Ration 4
Milk yield (kg/d/h)	14.15±0.46[b]	13.91±0.33[b]	15.53±0.26[a]	14.19±0.22[b]
FCM4% (kg/d/h)	12.56±.05[b]	12.42±0.07[b]	14.15±0.03[a]	13.08±0.05[b]
Fat%	3.25 ± 0.06[b]	3.29 ± 0.04[b]	3.41 ± 0.05[a]	3.48±0.05[a]
Protein%	3.34 ± 0.08[a]	3.33 ± 0.12[a]	3.22± 0.10[b]	3.13 ± 0.06[b]
Lactose%	4.25± 0.11	4.20 ± 0.04	4.01 ± 0.02	3.91±0.02
Ash%	0.94 ± 0.01	0.93 ± 0.02	0.95 ± 0.01	0.97 ± 0.06
Total solid%	11.78 ± 0.1	11.75 ± 0.45	11.59 ± 0.03	11.49 ± 0.11
Solid not fat%	8. 53 ± 0.11[a]	8.46 ± 0.43[a]	8.18 ± 0.07[b]	8.01 ± 0.06[b]

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

Recommend:-

The present results demonstrated that besides being an excellent source of energy and proteins. DDGS is good source of RUP. Feeding DDGS in ruminant's rations at more than 20% lead to reduced protein metabolism, milk yield and milk protein production. Therefore, the balance of RDP and RUP needs special attention when DDGS replaces SBM as the main source of protein for lactating dairy cattle. Twenty percent DDGS in the ration was found to be suitable to give the best results compared with animals fed SBM or 10 and 20% DDGS. Animals fed this diet showed positive effect on digestibility coefficient, nutritive value, rumen fluids parameters and milk yield and milk composition. Further work is needed to examine the possibility of using higher of DDGS in beef ration and increasing DDGS in dairy cattle more than20%.

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تقييم نواتج تقطير الاذرة (DDGS) في علائق الحيوانات المجترة وتأثيرها على معدل إنتاج اللبن

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تم اجراء هذه الدراسة بهدف التحقق من مدى ملاءمة اضافة نواتج تقطير الأذرة (DDGS) الي علائق المجترات و تأثيرها على معدلات الهضم باستخدام أغنام البرقي وعلي إنتاج الحليب و مواصفاته في أبقار الفريزيان الهجين . وتم تكوين أربعة علائق العليقة الاولي (المقارنة) والعليقة الثانية والثالثة والرابعة تحتوي على 10 ، 20 و 30٪ من نواتج تقطير الأذرة (DDGS) علي التوالي وقد غذيت هذه العلائق علي صورة علائق مخلوط (Total Mixed Rations(TMR.وتم عمل التجارب الاتية:

1- تجربة معاملات الهضم : - باستخدام 3من ذكور الأغنام البرقي البالغة بمتوسط وزن 47 كجم لكل عليقة.
2- تجربة تخمرات سائل الكرش:- باستخدام 3من اناث الأغنام البرقي البالغة بمتوسط وزن 45 كجم لكل عليقة.
3- تجربة معدل انتاج اللبن :- باستخدام 16 بقرة حلوب من ابقار الفرزيان الخليط بمتوسط وزن 515

كجم ومعدل انتاج لبن 12كجم / يوم .

و قد أجريت التجارب بمحطة الانتاج الحيواني – مركز البحوث الزراعية بالنوبارية و المركز الاقليمي للاغذية و الاعلاف بالدخيلة.

- وأسفرت نتائج تجربة معاملات الهضم الظاهرية أن الحيوانات التي تغذت علي العليقة الثالثة و التي تحتوي علي 20 ٪ نواتج تقطيرالاذرة حققت زيادة كبيرة في معاملات هضم المادة الجافة (DM) والمادة العضوية (OM) و البروتين الخام (CP) (69.69 % ، 72.97٪ و 70.89 ٪ علي التوالي) بالمقارنة مع العلائق الأخرى. وقد أظهرت المجموعة التي تناولت العليقة الثالثة ايضا زيادة معنوية عند (p<0.05) في كل من القيمة الغذائية معبرا عنها بالمهضوم من البروتين (DCP) و مجموع المواد الغذائية المهضومة (TDN).

كما أوضحت نتائج تجربة تخمرات سائل الكرش زيادة في قيم الاس الهيدروجيني مع زيادة نسبة نواتج الاذرة المقطرة في العلائق ، ولكن مجموع تركيزالأحماض الدهنية المتطايرة ومعدل انتاج الأمونيا (NH3 -N) انخفضت بشكل ملحوظ (p<0.05) مع العليقة الثانية والرابعة . في حين أظهرت الحيوانات التي تغذت علي العليقة المقارنة والعليقة الثالثة أعلى نسبة معنوية عند (p<0.05) من مجموع تركيزالأحماض الدهنية المتطايرة. و قد بلغ معدل تحلل الماده الجافة في الكرش قيم تراوحت في المتوسط بين (46.45 للعليقة المقارنة حتي 43.67 ٪ للعليقة الربعة) ، و انخفضت العلائق المحتوية علي نواتج اذرة المقطرة انخفاضا معنويا عند (p<0.05) وزاد معدل الانخفاض خطيا مع زيادة نسبة نواتج الأذرة المقطرة في العلائق ولوحظ نفس الاتجاه مع معدل تحلل البروتين في الكرش والذي تراوحت قيمه بين (56.93% للعليقة المقارنة حتي 48.13 ٪ للعليقة الرابعة) بينما كانت قيم الجزء غير المتحلل في الكرش من البروتين (43.07 % للعليقة الرابعة حتي 51.86 ٪ للعليقة المقارنة). واظهرت تجربة انتاج اللبن زيادة كبيرة في إنتاج الحليب والحليب المعدل ب4% دهن مع الابقار التي تغذت علي العليقة الثالثة و كانت الزيادة معنوية عند مقارنتها بالعليقة المقارنة والعلائق الاخري. وكذلك حدث زيادة في نسبة الدهن باللبن زيادة خطية مع زيادة معدل تناول نواتج الاذرة المقطرة في العلائق عن عليقة المقارنة. بينما حدث العكس مع البروتين حيث اظهرت عليقة المقارنة اكبر نسبة عن العلائق الاخري التي انخفض بها نسبة البروتين في اللبن تدريجيا مع زيادة نسبة نواتج اذرة المقطرة في العلائق.

و خلصت الدراسة أنه يمكن استخدام نواتج تقطير الأذرة في انتاج علائق حيوانات اللبن و ان النسبة المثلي لاضافتها هي 20 % من التركيب الكلي للعليقة علي اساس الوزن الجاف.

قام بتحكيم البحث

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