Egyptian J. Nutrition and Feeds (2008) 11 (1):55-71
ISSN 1110 - 6360

EFFECT OF USING CORN GLUTEN FEED IN GROWING LAMBS' RATION

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(Received, 18/9/2007, accepted 22/1/2008)

SUMMARY

A feeding trial evaluated the hypothesis that dry corn gluten feed (CGF) would improve growth performance of ewes fed concentrate feed mixture containing it.

Twenty-four growing ewes with an average of 3.8 months old were randomly and divided into three equal groups. Animals of each group were kept in separate shaded pen and fed one of the three tested rations as follows:

The basal ration composed of rice straw which was offered ad libitum as roughage along with concentrate feed mixture which consisted of 30% dried beet pulp, 30.6% yellow corn, 20% cotton seed meal, 6.8% soybean meal, 10% wheat bran, 1% salts, 0.5% mineral mixture, 1% dicalcium phosphate and 0.1%AD_3E as the control ration (R1). The treated groups, R2 and R3 received 90% and 80% of concentrate feed mixture with 10% and 20% CGF, respectively.

Lambs were weighed at the beginning of the experimental period then at two weeks intervals. At the end of the experimental period, four animals from each group were used to evaluate the nutrients digestibility and nutritive value of the experimental rations. Blood samples were taken each four-week before feeding animals.

The present study showed that the experimental rations do not affect on dry matter, organic matter, crude protein, crude fiber and ether extract digestibility values. Nitrogen balance was currently higher for R2 and R3 than R1. Total protein, globulin, urea-N and AST values were significantly ($P<0.05$) affected due to CGF inclusion in rations. Average daily weight gain and feed efficiency were better for R2 followed with R3 than R1.

It could be concluded that incorporation CGF (as replacement with concentrate feed mixture) in ration of growing ewes was successfully and safety in improving the performance of lambs.

***Keywords:** lambs, corn gluten feed, growth, digestion*

INTRODUCTION

There are a wide variety of available byproducts for using in ruminant feed, but usually those with a high level of local production will be the best values. Corn gluten feed (CGF) is a by-product of the wet milling process; wet milling separates the corn kernel into starch, oil, protein, and bran (Rausch *et al.*, 2003).

CGF whether wet or dry is an excellent feed that is reasonably good source of protein for ruminant. The protein of CGF is mostly degraded in the rumen. The level of protein degradability appears to be slightly lower for dry corn gluten feed (about 70%) than for wet (about 75%) and is an important factor when considering protein levels in the ration. Fiber in wet corn gluten feed is somewhat more digestible than in the dry form, permitting greater intakes of wet versus dry corn gluten feed. The total digestible nutrients (TDN) level in both is about 80%, which contains almost the same level TDN as barley (Ham *et al.* 1995, NRC. 1996). Wet corn gluten feed has some nutritional advantages over dry corn gluten feed but the later is easier to handle. Wet corn gluten feed has a bunk life of a few days in summer and one to two weeks in winter. Because of bunk life and transportation costs, wet corn gluten feed is only an option to producers that are in relative close proximity of the milling plant.

Block *et al.*, (2005) reported that CGF should not be confused with corn gluten meal. Corn gluten meal has 2 times the protein content of CGF. Also the protein in CGF is degraded relatively rapidly in the rumen versus the opposite trend with protein of corn gluten meal.

Rausch *et al.*, (2003) recorded that CGF having higher crude protein value ranged from 17 to 26 percent and fat content ranged from 1 to 7 percent, low in starch (about 20%) and high in digestible fiber. Because of these characteristics, ruminant can be fed relatively large amount of CGF. Therefore, regular feed testing is recommended or buys CGF that has a guaranteed analysis. Supplementing CGF rations with bypass protein, especially for lightweight growing lambs, provides some benefits.

Stock *et al.*, (2000) reported that the concentration of crude protein is about as twice as high in CGF as it is in corn grain. The amino acid content of CGF is about two times higher than in corn, but relative concentrations of the amino acid are similar. Corn grain has higher energy content than CGF. However, CGF may be equal to corn as an energy supplement in forage-based diets.

Dolores *et al.*, (2004) founds that corn grain can depress forage (fiber) digestibility while corn gluten feed does not appear to depress fiber digestibility.

Milis *et al.*, (2005) suggested that wheat bran and CGF did not differ in exportation of energy in milk, assessed by fat corrected milk (FCM), which is consistent with similar growth rate of the lambs. While CGF group resulted higher fat, protein and solids non-fat (SNF) content in milk.

Driskill et al. (2007) detected that CGF has medium palatability; however, it is an excellent feed for all animals that can be shipped in a pellets or a loose form. It's widely used in feeds for dairy and beef cattle.

Generally optimal concentrations of CGF in rations offered for ad libitum consumption are well established, but research regarding optimal concentrations of CGF in limit-fed rations is lacking.

A feeding trial evaluated the hypothesis that CGF would improve growth performance of lambs fed growing rations and determination of optimal inclusion levels for CGF in growing lambs' ration.

MATERIALS AND METHODS

This study was carried out at the farm and laboratory of animals' nutrition unit, Biological Application Department, Nuclear Research Center, Atomic Energy Authority. Abou Zaabal.

Experimental animals:

Twenty-four local growing ewes (Ossimi x Barki) of 3.5 months old were divided randomly into three experimental groups (eight in each), each group housed separately in shaded pen. An average body weight for control and treated groups were 26.12, 26.12 and 26.00 Kg for 1st, 2nd and 3rd groups, respectively.

Growth experiment:

The basal ration composed of rice straw, which was offered ad libitum as roughage and concentrate feed mixture (CFM). The later consisted of 30% dried beet pulp, 30.6% yellow corn, 20% cotton seed meal, 6.8% soybean meal, 10% wheat bran, 1% salts, 0.5% mineral mixture, 1% dicalcium phosphate and 0.1% AD3E. Rice straw and CFM was considered as the control ration (R1). The treated groups (R2 and R3) received 90% and 80% of CFM with 10% and 20% CGF, respectively.

Chemical compositions of the ingredients were carried out according to A.O.A.C (1997), which is shown in Table (1). The rations were fed that cover the nutritional requirements of growing sheep according to NRC (1985).

The weighed daily rations were offered in two equal meals at 8.0 a.m. and 2.0 p.m. The rice straw was offered separately ad libitum at 130% of the previous day's intake (about 35% refusal rate). Fresh water was available at all the time and animals were healthy. Animals body weight were recorded before morning feeding at the beginning of the experimental than at twice weekly intervals till the end of the experiment, which lasted for 114 days to monitor their body weight change.

Digestibility trial:

At the end of experimental period, four ewes were randomly chosen from each group were used in digestibility trials to determine the feeding values and nitrogen balance for the rations. Four animals were assigned for each ration using metabolic cages. The 21 days were considered as a preliminary period

Table (1): Chemical analysis of feed ingredients (%on DM basis).

Ingredient	DM	CP	CF	EE	NFE	Ash
Yellow corn	90.12	10.35	3.51	2.89	81.31	1.94
Dried sugar beet pulp	90.52	9.01	18.59	2.20	66.1	4.1
Soya been meal	90.70	46.11	6.69	1.34	38.65	7.21
Cotton seed meal	90.07	24.05	22.65	4.77	42.44	6.09
Wheat bran	90.52	16.50	8.61	3.99	64.31	6.59
Corn gluten feed (CGF)	91.43	18.00	10.0	03.5	45.0	5.36

Ca*: calcium, P**: phosphorus, S***: sulfur for CGF were 0.36, 1.0 and 0.3%, respectively (Moore *et al.*, 2002).

Table (2): Chemical composition of experimental rations (% on DM basis).

Chemical composition (%)	R1, Control (100%CFM)	R2, (90%CFM +10%CGF)	R3, (80%CFM +20%CGF)
DM	90.46	90.76	91.06
OM	96.20	95.68	95.20
CP	16.10	16.29	16.32
CF	11.65	12.10	12.55
EE	02.24	02.34	02.53
NFE	66.21	64.95	63.80
Ash	03.80	04.32	04.80

followed by 6 days as collection period. Feed residues were removed at the next morning and individually weighed to determine the actual daily feed intake and recorded individually.

Total feces were collected daily and weighed. Feces samples (10%) were sprayed with 10% sulphuric acid and dried at 60°c for 24 hrs then finely grounded and kept for chemical analyses. Total urine was individually collected in a glass bottle containing 20 ml of diluted sulphuric acid (10%). Urine volume was recorded and a sample of 5% was taken. At the end of the collection period, composite samples of feed offered and feces were mixed separately, finely ground and kept for chemical analysis. Feeds, feces and urine were analyzed by the conventional methods of A.O.A.C. (1997).

Blood parameters:

Blood samples were taken each four-week from the jugular vein using (10ml) glass tubes before morning feeding of each animal. Blood serum was separated through one hour by centrifuged at 4000 rpm for 15-min. to obtain serum, which stored at -20 °C until analyses. Commercial kits used to determine the concentrations of total proteins, albumin, Urea-N, Triglyceride and cholesterol and the activies of aspartate amino – transferase (AST), alanine amino – transferase (ALT) and alkaline phosphatase enzymes. Globulin was calculated by difference between total proteins and albumin.

Calcium was determined by using atomic absorption (Buck scientific 210 VGP). Phosphorus was determined by using spectrophotometer (carry – 3E-UV–visible).

Statistical analysis:

Data of feeding trial, digestibility trials, nitrogen balance and blood parameter were carried out as one-way classification and the difference among means were tested by using Duncan's multiple range test (Duncun. 1955). The statistical model was as follows:

$$X_{ij} = \mu + A_i + e_{ij}$$

Where: X_{ij} =represents observation, μ = Overall mean, A_i = effect of experimental rations, e_{ij} = experimental error.

RESULTS AND DISCUSSION

Chemical Composition of Rations:

Results of chemical analysis of feed ingredient and the experimental rations are presented in Tables (1, 2). CGF contains 18.00%crude protein (CP), 10.0% crude fiber (CF), 3.5% Ether extract (EE), 45.0% nitrogen free extract (NFE) and 5.36% ash. Moore *et al.* (2002) found that CGF contents of 23.2% CP, 33.2% NDF, 10.9% ADF, 0.19% Ca and 1.19% P (DM basis). Farran *et al.* (2006) reported that CGF is a high fiber, low starch feed by-product of the corn wet milling industry.

The results of the experimental rations analysis (Table 2) showed that the DM and OM content were almost similar. The lower CF, EE and ash contents were observed with control ration. While the slight increase in NFE% was found. Generally, the chemical composition of tested ration (R2 and R3) was nearly similar as show in Table (2).

Digestibility trial:

Data in Table (3) are shown dry matter intake (DMI). It's increased with increasing CGF inclusion into rations; this result may be due to greater intake of CFM and rice straw with these rations than control. Stock *et al.* (2000) reported that maximum gains and DMI resulted when CGF was included at 35% of dietary DM compared with the high levels of CGF or no CGF.

Kononoff *et al.* (2006) reported that cows consuming CGF (38% DM basis) during lactation period consumed more feed compared with the control.

Data indicated that the animals fed the experimental rations showed similar DM, OM, CP, CF, EE and NFE digestibility values.

Wickersham *et al.* (2004) studied the effects of CGF (20% of ration DM) on performance and digestion in lactating dairy cows. He found that the dry matter intake and total tract digestibility of DM, and CP were not different among rations; because rations did not affect ruminal liquid dilution rate, pH, or concentrations of total volatile fatty acids or ammonia. Therefore, the CGF products are serving as alternative feedstuffs in rations fed to ruminants.

The CP fraction of CGF consists of 75% degradable intake protein (DIP) and is degraded rapidly in the rumen (9.46%/h), having a rate of N disappearance similar to that of soybean meal. Thereby, CGF alone can meet the DIP requirements of ruminant consuming when included in either dry-rolled or cracked corn-based finishing rations (Montgomery *et al.*, 2003). It could be explaining our results; namely all the experimental rations containing soybean meal that may be reduced the effect of CGM on CP digestibility. Milis *et al* (2006) found that in situ degradability trials, soybean meal, corn gluten meal, cotton seed cake, wheat bran and CGF were weighed into Dacron bags and incubated in the rumen of three cannulated Chios ewes. Soybean meal, wheat bran and CGF were degraded significantly, while corn gluten meal and cotton seed cake were least degraded. Total tract digestibility was measured using five rams in an in vivo; soybean meal had higher CP digestibility, while CGF had higher organic matter and crude fiber digestibility compared to others.

In other study, Ives *et al.* (2002) found that the protein in CGF appeared to be more readily degradable than that in soybean meal. Whereas, the ruminal pH and ammonia concentrations in steers fed soybean meal were lower than in those fed CGF. Steers fed soybean meal had higher ($P < 0.05$) ruminal concentrations of total VFA's and propionate, while steers fed CGF had higher counts of total

Table (3): Digestibility coefficients and nutritive values for the experimental rations.

Item	R1, Control (100%CFM)	R2, (90%CFM +10%CGF)	R3, (80%CFM +20%CGF)
Nutrients intake as DM			
CFM, g/head/day	738.5	907.6	905.1
Rice straw, g/head/day	96.2	125.2	114.2
Total DMI, g/head/day	834.7±2.01	1032.8±2.50	1019.3±3.11
CFM : Roughage ratio	7.7 : 1	7.2 : 1	7.9 :1
Digestibility coefficients%			
DM	75.5±0.58	75.4±0.34	76.5±0.53
OM	78.4±0.64	77.2±0.51	78.4±1.02
CP	70.2±0.46	71.7±0.41	72.6±0.57
CF	62.63±0.55	61.77±0.37	62.88±0.63
EE	88.9±0.61	88.5±0.55	88.0±0.71
NFE	82.9±0.43	83.1±0.36	82.9±0.68
Nutritive value%(DM basis)			
TDN	75.8±0.63	76.32±0.48	77.8±0.37
DCP	10.59±0.03	10.92±0.04	11.39±0.02
DE, M Cal/Kg DM*	3.34	3.36	3.43
ME, M Cal/Kg DM **	2.93	2.94	3.01
NE, M Cal/Kg DM***	1.74	1.75	1.79

The calorific values of the experimental rations estimated as follows: * DE (M cal/Kg DM) = 0.04409(TDN %).
** ME (M cal/Kg DM) =1.01(DE, M cal/Kg DM) -0.45,*** NE (M cal/Kg DM)=0.0245(TDN%) - 0.12(NRC.1998).

ciliated protozoa than steers fed soybean meal due to greater Entodinium sp., it's due to steers fed CGF had higher ruminal amino acid and peptide nitrogen concentrations than those fed soybean meal.

Montgomery *et al.* (2003) demonstrated that the value of CGF relative to corn might depend on the amount of roughage in the ration. This might be due to the inherent ability of CGF to provide energy without the reduction in fiber digestion often observed when high amounts of starch are fed. Due to its fibrous characteristics, CGF may be used to partially fulfill the roughage requirement in finishing rations. Compared to grain, CGF contains a greater proportion of dietary energy in the form of fermentable fiber rather than starch, and thus might decrease the negative effects of meal eating on ruminal fermentation.

TDN and DCP were higher in groups fed R2 and R3, which contained CGF than group fed R1, while differences between rations were not significant. It may be due to somewhat higher percentage of chemical analysis and digestibility of CGF ration. TDN intake was slightly greater for the CGF rations than for control, CGF is a medium protein feed, which contains almost the same total digestible nutrients level as CFM; and/or may be also the slight increase in CP disappearance from the total tract for these treatments. Stock *et al.* (2000) reported that the NE value of CGF is 93 to 115% of dry-rolled corn, depending on the source of CGF.

Sindt *et al.* (2003) observed that CGF (25 to 35% of dietary dry matter) could be used effectively as a source of energy in finishing rations based on steam-flaked corn.

In general, Greater amounts of CGF in rations may be cost effective but may restrict performance by decreasing dietary energy in case replaces CGF with corn. Feeding CGF likely decreases the potential for feedlot acidosis and may complement highly processed grain rations. Therefore, addition of CGF to dry-rolled corn rations replaces starch with fiber due to increasing pH and reducing the incidence of acidosis (Sindt *et al.*, 2002; Montgomery *et al.*, 2004).

Steep liquor in CGF contains lactate which improves lactic acid metabolism prevents lactate accumulation in the rumen (Krehbiel *et al.*, 1995), and reduces acidosis risk. Acidosis reduction may increase microbial efficiency, energy yield, and DIP requirement (NRC, 1996).

However, Montgomery *et al.* (2004) suggested that corn steep liquor protein is readily degraded in the rumen, and replacing steam-flaked corn with CGF most likely decreased the amount of readily available carbohydrate, which might have decreased the ability of ruminal bacteria to utilize free NH_3 for microbial protein synthesis.

Nitrogen Balance:

Data in Table (4) showed that nitrogen intake was higher for animals fed R2 and R3 than the R1. Significantly ($P<0.05$) differences were observed

Table (4): Nitrogen balance of lambs fed the experimental rations.

Item	R1, Control (100%CFM)	R2, (90%CFM +10%CGF)	R3, (80%CFM +20%CGF)
Nitrogen intake, g/head/day	20.14±1.23	25.18±1.52	25.60±1.34
Fecal nitrogen, g/head/day	6.65±0.53	7.62 ±0.62	7.01±0.46
Urinary nitrogen, g/head/day	8.27±0.71	10.79±0.54	11.88±0.67
Nitrogen excretion g/h/d	14.92± 1.02	18.41±1.13	18.89±1.21
As % of N intake	74.08±2.31	73.11±1.85	73.79±2.35
Nitrogen balance, g/day	5.22^{b}±0.61	6.77^{a}±0.55	6.71^{a} ±0.64

a, b Mean in the same row with different superscripts differ significantly ($P<0.05$).

Table (5): Some blood constituents of lambs fed the experimental rations.

Item	R1, Control (100%CFM)	R2, (90%CFM +10%CGF)	R3, (80%CFM +20%CGF)
Total protein, g/dl	6.36^{b} ±0.91	7.82^{a} ±0.93	7.86^{a} ±1.03
Albumin, g/dl	3.36 ±0.54	4.00 ±0.64	3.70 ±0.51
Globulin, g/dl	3.00^{b} ±0.70	3.82^{ab} ±0.51	4.16^{a} ±0.66
Urea-N, mg/dl	26.5^{b} ±2.00	29.6^{ab} ±1.82	31.5^{a} ±1.77
AST, IU /L	40.9^{b} ±3.21	48.3^{a} ±3.16	43.7^{ab} ±2.71
ALT, IU /L	23.3 ±2.35	23.5 ±2.71	23.7 ±1.65
Alkaline phosphatase, u/L	55.21 ±2.83	54.18±2.81	53.51 ±3.20
Triglyceride, mg/dl	71.5 ±2.32	72.6 ±1.91	73.2 ±1.18
Cholesterol, mg/dl	181 ±4.11	178 ±3.03	175 ±2.7

a, b Mean in the same row with different superscripts differ significantly ($P<0.05$).

Table (6): Mean daily gain, feed efficiency and feeding cost of lambs fed the experimental rations.

Item	R1, Control (100%CFM)	R2, (90%CFM +10%CGF)	R3, (80%CFM +20%CGF)
No. of animal	8	8	8
Days of trail	114	114	114
Average feed intake as DM, g/day	1010±8.12	1050±9.34	1050±8.11
Initial body weight, Kg	26.12±0.85	26.12±0.78	26.00±0.80
Final body weight, Kg	41.75±1.12	43.13±1.34	42.25±1.63
Total gain, Kg	15.63±1.33	17.01±1.02	16.25±1.06
Average daily body weight gain, g	137.1±11.35	149.2±13.50	142.5±10.67
Feed efficiency, Kg DM/Kg gain	7.367±0.74	7.037±1.23	7.368±1.42
Price of Kg DM of ration, P.T	119	113	108
Feed cost, Head/day, P.T	120.2	118.7	113.4
Feed cost for kg weight gain, P.T	877	796	796

among animals fed experimental rations in nitrogen balance.

Nitrogen balance was currently significantly higher for R2 and R3 than R1. This result may be attributed to N intake by growing ewes fed the R2 and R3 was greater available. Although nitrogen in runoff was higher from growing ewes were fed R2 and R3 as compared with those fed R1, however, expressed as a percentage of N excretion was nearly. Lukas *et al.* (2005) reported that dietary CP, EE concentration, and DMI had no effect on fecal CP content, whereas CF content, proportion of concentrate in the ration, and forage type significantly affected CP concentration in feces. Although, there is a curve linear relationship between fecal CP concentration and ration OM digestibility may be used to estimate ration OM digestibility, particularly for field trials.

Farran *et al.* (2006) reported that due to greater ADG and final weights, steers fed CGF had greater N retention based on modeled growth; however, the increase in N retention did not compensate for the increase in N intake.

In the contrast, Adams *et al.* (2004) observed that nitrogen in runoff was greater from pens where cattle were fed no CGF ($P < 0.01$) as compared with those pens fed 35% CGF with pond replicated across main effect of CGF treatment; N in runoff was averaging approximately 5 and 3% of N intake for 0 and 35% CGF pens, respectively.

Blood biochemical components and hormonal levels:

Data in Table (5) showed that the highest mean values of serum total protein recorded with R2 and R3 compared to R1. Mean values of serum albumin and globulin concentration appeared to the same toward of serum total protein with significantly differences with globulin of serum of R2, which may reflect the improvement in protein digestibility in the gut intestinal tract.

Mean values of serum urea- N were significantly affected by fed experiment rations, being the highest mean value observed with CGF rations. Schroeder (2003) reported that serum urea –N was greatest in cows fed rations containing 15 and 45% CGF.

Significant increases ($P<0.05$) were found with AST in blood serum of lambs fed R2 and R3 compared to R1, but serum ALT activity values were insignificantly. These results may be due to high body weight recorded for this group, Baranowski, *et al.* (2000) found that there is positively correlated between body weights and AST. The AST and ALT enzymes are most important indicator for liver cells activity. Serum alkaline phosphatase, triglyceride and serum cholesterol mean values did not affect by fed treatment rations. The values obtained herein were within the normal range for healthy sheep (Saleh and Saleh, 2003).

Daily gain and feed efficiency for lambs:

The means of feed intake, average daily body weight gain (ADG), and feed efficiency data of growing ewes fed different rations are shown in Table (6). Mean feed intake was greater with rations contain CGF than control. Loe *et al.* (2006) found that the addition of CGF to the barley or corn-based rations increased DMI and gain steers.

Data indicated that inclusion CGF in growing rations lead to the best ADG and feed efficiency. It might be due to higher both digestibility CP and feeding value as TDN for ration containing CGF than control ration. Mean total gain and average daily gain were higher with R2 and R3 than R1. However, feed intake, ADG and feed conversion data of growing ewes fed the experimental rations showed no significantly differences.

Scott *et al.* (2003) found that CGF inclusion into steam-flaked corn-based rations tended to increase DMI and ADG with no effect on feed efficiency. Farran *et al.* (2006) detected that replacing dry-rolled corn with 35% CGF increased DMI by 4.7%, and ADG by 3.4% compared with no CGF inclusion, efficiency of gain weight of steers fed 35% CGF were improved 4.4% compared with efficiency of steers fed 0% CGF.

Our data show that maximum ADG was observed at a lower inclusion rate of CGF than for higher level, which indicates that the energy value of CGF is dependent on inclusion rate. If CGF feed had the same energy value as CFM, ADG would be affected only by changes in DMI and the predicted maximum ADG would have occurred at the CGF feed inclusion rate that maximized DMI. Similarly, feed efficiency would have been affected only through alteration of the portion of intake available for gain, and feed efficiency would be increased as long as feed intake increased. However, ADG for R3 (20% CGF of DM) decreased relative to maximum ADG for R2 (10% CGF of DM), despite increased DMI. Therefore, the marginal energy value of CGF was less than CFM and declined with increasing inclusion. Predicted ADG was not expected to decrease when CGF levels increase to 20% below that expected for 10% CGF ration, suggesting increased DMI compensated for the decreasing dietary energy value. On other view, restricting feeding during growing may be strategy that improves the utilization of CGF at these levels. Montgomery *et al.* (2004) suggested that CGF increased percent apparent total-tract digestion of OM, NDF and starch, decreased ruminal total VFA's concentration, increased ruminal NH3 concentration, increased ruminal pH, and CGF also increased ruminal passage rate. Also suggested that limit feeding decreased percent apparent total-tract digestion of both OM and NDF, ruminal total VFA's concentration, and ruminal fill, but increased ruminal NH3 concentration.

This data congruent with Hussein and Berger (1995) suggested that CGF can substitute up to 25 or 50% of dietary DM without negative effects on feedlot performance, digestibility of nutrients, or carcass characteristics, heifers had better ADG and gain: feed when 25% CGF was fed.

Sindt *et al.*, (2002) found that feeding 30% CGF (DM basis) improved cattle performance compared with cattle fed 0 or 60% CGF, in finishing rations based on steam-flaked corn.

Sindt *et al*. (2003) reported that dry matter intake tended to increase as CGF increased in the ration. However, feeding increasing amounts of CGF resulted in a linear decrease ($P < 0.01$) in efficiency of gain. Heifers fed 45% CGF were 7.1% less efficient than heifers fed 25% CGF. Block *et al*. (2005) showed that the inclusion rate of CGF for maximizing ADG and feed efficiency in steam-flaked corn-based finishing rations for cattle are approximately 20% of DM. Whereas, the 20, 30, and 40% CGF treatments increased ADG by 7, 6, and 3% and increased DMI by 4, 5, and 5%, respectively; relative to the 0% CGF treatment. Feed efficiency was 102, 101, and 98% of the 0% CGF treatment for 20, 30, and 40% CGF, respectively.

These responses are in contrast with Macken *et al*. (2004) who observed that where no effect of CGF level in steam-flaked corn-based rations on ADG or feed efficiency, while dry matter intake was lower with 0% CGF than with concentrations of 20, 25, and 35% WCGF. Driskill *et al*. (2007) found that grazing cows in the high CGF supplementation treatment had greater body weight than cows grazing at the low CGF supplementation level.

In the other position, Milton (2001) and Loe *et al*. (2006) found that the optimum inclusion level of CGF in barley-based rations was greater than the optimum inclusion level of CGF in dry-rolled corn -based rations. Because grains that have fast rates of ruminal starch fermentation predispose ruminant to acidosis, categorized barley as having a faster rate of ruminal starch fermentation compared with corn, therefore, the rations containing dry-rolled barley needing increase levels of CGF to circumvent increase cases of sub-acute acidosis; these data suggest that CGF can be used without adversely affecting performance.

Additionally, Scott *et al*. (2003) reported that CGF has 25.3% more NE when fed with steam-flaked corn compared with being fed in dry-rolled corn -based rations, suggesting that CGF energy value may interact with corn processing.

This data indicates that the energy value of CGF is dependent on the ration, which it is included. The variable energy values might be attributed to a positive interaction between CGF and corn in reducing the deleterious impacts of acidosis. The resulting improvements in feed digestion, energy yield, and animal performance were independent of the impact of CGF on DMI.

Minerals of primary concern in co-product feeds are phosphorus and sulfur. CGF contains a high level of phosphorus, which need for healthy bones and teeth, energy metabolism, nervous system functioning and acid base balance in the body. Christopher and Baker (2002) indicated that P bioavailability in CGF is about twice as high as that in maize, when young chicks were used to determine phosphorus (P) bioavailability in CGF.

Although phosphorus is needed for proper bone and tissue formation, dietary excess has been associated with the formation of urinary calculi (water belly) and has a major impact on soil nutrient balance influencing manure management practices. Phosphorus requirement for growing and finishing sheep is at or below 0.35% of ration dry matter depending on gain, but phosphorus level in CGF (0.95%) far exceeds this requirement (NRC, 1985).

Sulfur dioxide is used to soften the kernel when corn is steeped in wet milling, which contributes to sulfur content of gluten feed. CGF contains a high in sulfur 0.45%; so total dietary sulfur content should be considered in areas where the water or other ration ingredients are high in sulfur. Because high dietary sulfur levels can produce toxic levels of hydrogen sulfide in the rumen causing reduced intakes and possibly death. Thiamin (B vitamin) normally produced in adequate quantities by rumen bacteria, is diminished in the rumen when pH is below normal in the presence of excess sulfur (Moore *et al.*, 2002).

To address phosphorus and sulfur issues, supplements must contain adequate amounts of calcium to balance the Ca: P ratio and thiamin and should not have any added phosphorus or sulfur, therefore specific co -product balancer supplements are available.

CGF has been widely used and makes a very good option for developing ruminant-feeding programs. Lower costs of CGF compared with corn grain may provide incentive to increase substitution rates of CGF, in spite of reduced efficiencies or gain. Data in Table (6) show that feed cost per kg gain was lower with ration containing CGF compared with the control ration.

Sindt *et al.* (2002) observed that addition of CGF to the ration also increased ($P < 0.01$) the ruminal acetate: propionate ratio (2.1 and 1.6 for steers fed the ration containing CGF or corn, respectively).

This study conclusion that grain-based commercial supplements may not be economical for growing and finishing ewes, and feeding these traditionally high-starch supplements may lead to reduce ruminal pH and fiber digestibility. CGF as a by-product feed contains keep adequate levels of digestible fiber, which could potentially provide adequate gain without the management problems associated with high-starch rations.

Level of inclusion will vary depending on the ingredients fed, thereat; the variable energy availability of CGF is an important factor in selecting a dietary level. These results reflect the ability of CGF to meet the energy and nutrient needs of the growing ewes. Also, indicate that the addition of CGF to growing ewes' ration, which contains a high-fiber, improves average daily gain and increases dry matter intake. It is generally recommended that optimal inclusion, based on daily gain, was 10% CGF. Thereby, CGF could be used successfully and safety in rations to improve the performance of growing ewes.

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تأثير إستخدام جلوتين الذرة في علائق الحملان النامية

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قسم التطبيقات البيولوجية - مركز البحوث النووية- هيئة الطاقة الذرية- القاهرة- مصر

اجري هذا البحث بهدف دراسة تأثير اضافة جلوتين الذرة (18% بروتين) أحد نواتج تصنيع الذرة لعلائق أناث الحملان النامية علي النمو ومعدلات الهضم ومعدلات التحويل الغذائي وكذلك بعض قياسات الدم . أستخدم في هذه التجربة أربع وعشرون من أناث الحملان، تم تقسيمها إلى ثلاث مجموعات متساوية وتم تغذيتها علي إحدى العلائق التالية :

العليقة الأولى : تتكون من علف مركز ،والعليقة الثانية: تتكون من90% علف المركز و 10% من جلوتين الذرة، والعليقة الثالثة : تتكون من 80% علف المركز و 20% من جلوتين الذرة، كما قدم الي الحملان قش الأرز حتي الشبع.

أستمرت تجربة النمو من الفطام إلى عمر114 يوم حيث تضمنت تقدير كمية الغذاء المأكول ومعدلات النمو من خلال وزن الحيوانات مرة كل أسبوعين ، و أخذ عينات دم مرة كل أربع أسابيع لتقدير بعض قياسات الدم، في نهاية تجربة النمو تم إجراء تجربة هضم باستخدام أربع نعاج من كل مجموعة لتقدير معاملات الهضم لكل عليقه من العلائق المختبرة و الكفاءة الغذائية وميزان النيتروجين.

النتائج المتحصل عليها من هذه الدراسة:

1- أناث الحملان المغذاة على العلائق المختبرة لم تسجل أختلافات في معدل هضم لكل من البروتين الخام و الالياف الخام و المستخلص الخالى من الأزوت.

2- زيادة النيتروجين المحتجز فى مجموعة أناث الحملان المغذاة على العليقة الثانية و الثالثة بالمقارنة بأناث الحملان المغذاة على العليقة الاولى.

3- البروتين الكلي والجلوبيولين واليوريا و الإنزيمات الناقلة لمجموعة الأمين (AST) زاد تركيزها مع المجموعة الثالثة بالمقارنة بالمجموعتين الأخريين.

4- متوسط الزيادة اليومي و الكفاءة التحويلية للغذاء سجل أفضل النتائج مع المجموعة الثانية و الثالثة المحتوية على جلوتين الذرة، وكانت أعلاهما المجموعة الثانية.

من هذه الدراسة يمكن التوصية باستخدام جلوتين الذرة(18% بروتين) بصورة ناجحة بنسبة 10% من العلف المركز المستخدم كعلائق للحملان النامية، أيضا ممكن أن يكون بديلا ناجحا للاذرة غالية الثمن حيث انه يخفض من تكلفة التغذية ، حيث أنها حسنت من معاملات الهضم و القيم الغذائية ومعدل النمو للحملان النامية بدون أى تأثيرات سلبية علي الحملان.