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USING NEW PROTEIN SOURCES IN FEEDING RUMINANTS. 2- USING GUAR KORMA MEAL IN RATIONS OF LACTATING BUFFALO COWS.

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ABSTRACT

This study was carried out to evaluate using different levels of guar korma meal as a source of protein in rations of lactating buffalo cows. Thirty animals were chosen and divided into six similar groups (5 in each). Animals were at the 2nd season of lactation and assigned to receive guar korma meal at the rate of 0, 3.3, 6.7, 10.0, 13.3 and 16.7% to cover 0,10,20,30,40 and 50% from protein content of concentrate feed mixture (CFM) of rations A,B,C,D,E and F, respectively. Experimental rations consisted of CFM, berseem hay (RH) and wheat straw (WS) with rate 60:25:10, respectively.

Feeding trial lasted 240 days, during which six digestibility trials were carried out to determine digestibility coefficients and nutritive values. Samples of blood and rumen liquor were taken to measure some parameters. In addition , feed cost and economical efficiency were conducted.

The results obtained can be summarize as follows:

- Increasing guar korma meal level in the experimental rations tended to slightly increase total DM intake (Kg/h) with little increase in DM, CP and EE but somewhat decrease of OM contents of calculated composition of experimental rations.
- Experimental rations containing guar korma meal (rations E and F) significantly ($P < 0.05$) increased DM, OM, CP, EE and CF digestibility coefficients. The highest digestibility coefficients were recorded with ration F (containing 16.7% guar korma), recording 85.20, 93.15, 74.25, 70.82 and 65.16% for DM, OM, CP, EE and CF, respectively. Feeding values as TDN (%), DCP (%) and DE (Mcal/Kg DM) were significantly ($P < 0.05$) higher with increasing guar korma meal in experimental rations. Ration F (containg 16.7% guar korma) had the highest feeding values, being 71.03%, 10.15% and 3.13Mcal/Kg DM for TDN, DCP and DE, respectively.
- Average milk production as actual milk yields were 8.15, 8.24, 8.28, 8.75, 9.03 and 9.80 kg/h/d versus 8.07, 8.10, 8.12, 8.47, 8.63 and 9.26 Kg 7% FCM with animals fed rations A,B,C,D,E and F, respectively. The significant ($P < 0.05$) differences in milk production were not found in rations containing guar korma up to 10%, but increasing level of guar korma in experimental rations (rations E and F) tended to significantly increase milk production. Average milk composition such as fat, protein, TS and SNF percentages significantly ($P < 0.05$) decreased with increasing guar korma level in rations, but lactose percentage showed significant($P < 0.05$) increase. Also, the yields of the previous items showed significant higher or lower owing to different amounts of milk yields and their percentages.
- Average daily feed unit intake increased with increasing guar korma level in experimental rations. Animals fed ration F (containing 16.7% guar korma) had the highest feed unit intake expressed as DM, TDN and DCP, being 10.768, 7.649 and 1.093 kg, respectively. Animals fed ration (F) showed the best feed utilization efficiency expressed as kg DM, TDN or DCP/kg milk yield, being 1.099, 0.781 and

0.112 kg, respectively. The same previous trend was observed with feed efficiency expressed as Kg DM and TDN/Kg 7% FCM for ration (F) being 1.163 and 0.826 Kg, respectively.

- Averages of daily feed cost/Kg milk yield were 2.609, 2.534, 2.522, 2.416, 2.316 and 2.106 LE for rations A,B,C,D,E and F,respectively. Corresponding values expressed as feed cost/Kg 7% FCM were 2.635, 2.578, 2.572, 2.496, 2.423 and 2.229 LE showing the lowest cost was recorded with ration (F) which contained 16.7% guar korma meal. In the same trend, the highest net revenue was recorded with animals fed ration (F). Moreover, net revenue per kg actual milk or 7% FCM yield was also the highest with ration (F), being 3.894 and 4.121 LE, respectively. In addition, animals fed ration (F) had the highest economical efficiency (2.85) with improvement reach into 23.91%.
- Averages of some blood parameters such as protein concentration and its components, liver and kidney function values were at the normal range. Moreover, some rumen parameters were also at the same normal range.

From these results, it could be concluded that, guar korma meal can be used as a source of protein in ration formulation of lactating buffalo-cows. Incorporation of guar korma at the rate of 16.7% in concentrate feed mixture to cover 50% of protein content of CFM gave the highest digestibility for all nutrients, feeding values and milk production. Moreover, animals fed ration (F) containing 16.7% guar korma showed the best feed utilization efficiency and the lowest feed cost per kg actual milk or 7% FCM yield with the highest net revenue and economical efficiency.

Keywords: Guar korma meal – buffalo cows – milk production.

INTRODUCTION

All farm animals need adequate amounts of feed nutrients to cover their maintenance and production requirements. The main feed nutrients are water, energy and protein beside some vitamins and minerals. So, a lot of works were carried out to safe a sources of energy and protein for farm animals such as dried distiller grains with soluble (Anderson *et al*., 2006; Chibisa*et al*., 2012; Etman*et al*., 2012 and 2014b).

Guar korma meal is one of the important source of energy and protein for animal feeding especially dairy animals. The guar korma meal produced during extraction of gum from guar bean. It contains about 50% CP, 7% EE, 5% CF and 1% silica (Srivastava *et al*., 2011). Also, guar korma meal is the main by-product of guar meal production. It is a mixture of germs and hulls at an approximate ratio of 25% germ to 75% bulb (Lee *et al*., 2004). They reported that, guar korma could be used as feed ingredient after making some processing to improve its palatability and remove its anti-nutritional factors.

In this respect, guar korma meal was successfully used as a source of protein in the concentrate feed mixture for growing and fattening buffaloes in the 1st part of this series of experiments (Etman*et al.*, 2014a). Guar korma meal was used as a source of protein in concentrate feed mixture of growing buffaloe calves rations. Guar korma meal was incorporated with different levels to cover up to 50% from protein of CFM instead of protein of soybean meal and cotton seed cake in ration formulation of buffaloe calves. Results showed an increase of nutrient digestibility, feeding values, daily gains as well as improved feed utilization efficiency and decreased feed cost per kg weight gain. In the present study, guar korma meal will be tested to partially replace CFM protein in rations formulation of lactating buffalo cows.

It could be noticed that the guar korma meal provide the following benefits to cattle:

- It enhances their rate of reproduction (milk and fat content).
- It is free from harmful microbes like salmonella, *E. coli* and harmful toxins like aflatoxin.
- It provides more energy and protein since it has higher digestibility, which is reflected on better body weight and feed conversion efficiency.
- In dairy cows, guar korma mealprovides sufficient protein which increases the levels of milk and fat percentages.
- It is entirely natural feed for cattle.
- It is quite affordable.
- In beef cattle, it provides required protein and carbohydrates which improve muscles properties and hence increase their body weight and keep them in healthy state for meat production purpose.

• These advantages of guar korma were observed by Tiwari *et al*., (1994),Farkhanda*et al*., (2005), Kshatriya *et al*., (2009), Turki,*et al.,*(2011), Salehpour*et al*.,(2012) andEtman*et al*., (2014b).

The objective of this work aimed to use different levels of guar korma as a source of protein in ration of lactating buffalo-cows on milk yield and its composition and some bloo`d and rumen liquor parameters. In addition, nutrient digestibility, feed utilization efficiency and economical efficiency were studied.

MATERIALS AND METHODS

Feeding trial:

Thirty buffalo-cows averaging 402 kg live body weight and at the 2nd season of lactation were used in this trial. The aim of this experiment was to study the effect of using different levels of guar korma as a new source of protein in rations of lactating buffalo-cows performance. The trial was conducted at Animal House belonging to Animal Production Research Institute and El-Manar Company Station at Masr-Alexandria desert road, Egypt. All animals were chosen and divided into six similar groups (5 in each) and randomly assigned to receive six experimental rations containing guar korma meal as a source of protein at the rate of 0,3.3, 6.7, 10.0, 13.3 and 16.7% to cover 0,10,20,30,40 and 50% of protein content of concentrate feed mixture for experimental rations A,B,C,D,E and F, respectively. Experimental rations contained concentrate feed mixture, berseem hay and wheat straw at the rate of 60, 25 and 15%, respectively, which were taken according to Abou-Raya (1967) as follows:

Maintenance requirements: every 100 kg body weight require 0.51 kg SE and 50 gm DCP.

Production requirement: every kg fat corrected milk (both cow and buffaloe) require 0.26 kg SE and 72 gm DCP.

After two months of parturition, feeding trial lasted 240 days , during which CFM was offered twice daily at 8.00 a.m. and 3.00 p.m. followed by berseem hay, while wheat straw and water were available during the whole day.

Digestibility trial:

At the middle of feeding trial, six digestibility trials (3 animals in each) were conducted to determine the digestibility coefficients and nutritive values of experimental rations using acid insoluble ash (AID) method as a natural marker according to Van Keulen and Young (1977). Feces were collected for each animal in six groups. Feces samples were obtained individually, then dried, ground and kept for chemical analysis. At the same time, samples from feed intake and refused were also analyzed.

Recording and sampling procedure:

Buffalo-cows were completely milked twice daily at 9.00 a.m. and 4.00 p.m. Milk yields were individually recorded and were converted into 7% FCM yield according to Raafat and Saleh (1962). Composite milk samples from consecutive morning and evening milkings were taken biweekly to be analyzed for fat, protein and total solid by milko-scan model 133B, while lactose was determined by differences. Representative samples of concentrate feed mixture, berseem hay, wheat straw and feces were chemically analyzed according to A.O.A.C. (2000).

At the middle of the feeding trial, rumen liquor samples were taken from three buffalo-cows of digestibility trials before morning feeding and at 3 and 6 hours post feeding during 3 successive days using stomic stomach tube. Samples of rumen liquor were filtered through four layers of cheese cloth and divided into two portions. The 1^{st} was immediately tested for pH using digital pH meter and the 2^{nd} portion was preserved for determing total nitrogen (TN), protein nitrogen (PN) and ammonia-nitrogen (NH_3-N) according to A.O.A.C. (2000), while total volatile fatty acids (VEA's) concentration were determined according to Eadie*et al*. (1976). Blood samples were taken from the jugular vein of the same three buffalo-cows of digestibility trials at 3hr after feeding. Blood serum was separated from the whole blood and was stored at -20°C for determing the total protein, albumin, transaminase activities and creatinine and urea-N using commercial kits of Bio-Merieus, lab, France.

Data were statistically analyzed using general linear model program (GLM) of the Statistical Analysis System (SAS, 1996). The significant differences among means were tested using Duncan Multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Feed ingredients and their chemical composition:

The percentages of guar korma incorporated in concentrate feed mixture of experimental rations are shown in Table (1). Percentages of guar korma were 0, 3.3, 6.7, 10.0, 13.3 and 16.7% which represented 0,10, 20,30,40 and 50% of protein contents of concentrate feed mixture of experimental rations A,B,C,D,E and F, respectively. All concentrate feed mixture for all experimental rations were almost equal in DM, OM and CP contents as shown in Table (2). It could be noticed that, increasing guar korma percentage in CFM tended to somewhat increase EE and Ash contents, but CF and NFE contentstended to slightly decrease (Table 2). In addition, chemical composition of berseem hay, wheat straw and guar korma showed nearly similar analysis as found by Etman*et al* (2014a).

Table (1): Ingredients of concentrate feed mixture containing different levels of guar korma for experimental rations.

Items	* CFM of experimental ration					
	A	B	C	D	E	F
Ingredients (%)						
Guar korma	-	3.3	6.7	10.0	13.3	16.7
Yellow corn	32	28	28	29	28	26
Rice bran	18	18.7	19.3	20	28.7	30.3
Cotton seed cake	17	15	14	13	5	-
Wheat bran	15	21	21	20	17	15
Soybean meal (44%)	10	6	3	-	-	-
Molasses	5	5	5	5	5	5
Lime stone	2	2	2	2	2	2
Salt	1	1	1	1	1	1

*** CFM: Concentrate feed mixtures containing different levels of guar korma**

Table (2): Chemical composition of concentrate feed mixture containing different levels of guar korma (GK), berseem hay and wheat straw.

Items	DM (%)	Chemical composition (% DM basis)					
		CP	EE	CF	NFE	Ash	OM (%)
Berseem hay (BH)	90.20	15.80	3.02	24.65	47.13	9.40	90.60
Wheat straw (WS)	91.38	3.17	1.86	43.26	40.89	10.82	89.18
Guar korma (GK)	89.82	48.01	3.10	14.08	27.61	7.20	92.80
CFM containing 0% GK	88.50	16.04	4.69	9.28	61.74	8.25	91.75
CFM containing 3.3% GK	88.54	16.02	4.88	9.65	60.95	8.50	91.50
CFM containing 6.7% GK	88.59	16.15	5.00	9.77	60.52	8.56	91.44
CFM containing 10% GK	88.63	16.17	5.14	9.80	60.31	8.58	91.42
CFM containing **13.3% GK**	88.68	16.25	6.15	9.03	59.34	9.23	90.77
CFM containing 16.7% GK	88.72	16.47	6.25	8.26	59.37	9.65	90.35

*** CFM concentrate feed mixture of different experimental rations.**
GK : Guar Korma.

Feed intake and chemical composition:

Data presented in Table (3) showed that the total DM intake increased with increasing guar korma levels in CFM, being 10.420, 10.445, 10.500, 10.680. 10.724 and 10.768 kg/h for rations A,B,C,D,E and F, respectively. Increasing of DM intake might be due to higher palatable guar korma and somewhat higher intake of berseem hay and wheat straw.

It could be noticed that the chemical composition of different experimental rations showed somewhat higher in DM and EE contents with increasing guar korma meal, however, all experimental rations were isonitrogenous and isocaloric, as shown in Table (3). Calculated chemical composition of experimental rations showed the same trend with increasing guar korma level as reported by Etmanet *al*., (2014a).

Table (3): Average daily feed intake, calculated composition, digestibility coefficients and nutritive values of different experimental rations.

Items	Experimental rations					
	A	B	C	D	E	F
Av.daily feed intake (KgDM/h)						
Concentrate feed mixture	6.252	6.267	6.300	6.408	6.434	6.461
Berseem hay	2.605	2.611	2.625	2.670	2.681	2.692
Wheat straw	1.563	1.567	1.575	1.602	1.609	1.615
Total DM intake	10.420	10.445	10.500	10.680	10.724	10.768
Calculated composition of experimental rations (%,DM basis):						
DM	89.42	89.44	89.47	89.50	89.53	89.55
OM	91.01	90.86	90.82	90.81	90.42	90.17
CP	13.41	13.40	13.48	13.49	13.54	13.67
EE	3.78	3.90	3.97	4.05	4.66	4.72
CF	19.15	19.37	19.44	19.46	19.00	18.54
NFE	54.67	54.19	53.93	53.81	53.22	54.24
Ash	8.99	9.14	9.18	9.19	9.58	8.83
Digestibility coefficients of experimental rations (%):						
DM	82.75^{b}	82.96^{b}	83.15^{b}	83.64^{ab}	84.35^{a}	85.20^{a}
OM	88.74^{b}	89.21^{b}	90.56^{b}	90.84^{ab}	92.23^{a}	93.15^{a}
CP	65.20^{b}	66.14^{b}	68.38^{b}	70.48^{a}	70.82^{a}	74.25^{a}
EE	68.03^{b}	68.26^{b}	69.12^{ab}	69.52^{a}	70.04^{a}	70.82^{a}
CF	56.92^{b}	58.61^{b}	61.15^{a}	62.32^{a}	64.28^{a}	65.16^{a}
NFE	75.64	75.72	72.87	76.06	76.14	76.10
Nutritive values:						
TDN (%)	66.77^{b}	67.23^{b}	68.96^{b}	69.68^{a}	70.42^{a}	71.03^{a}
DCP (%)	8.74^{b}	8.86^{b}	9.22^{a}	9.51^{a}	9.59^{a}	10.15^{a}
* DE (Mcal/Kg DM)	2.94^{b}	2.96^{b}	3.04^{a}	3.07^{a}	3.10^{a}	3.13^{a}

*** DE was calculated according to Church (1984)**
a and b: Means in the same row with different superscripts are significantly different (P < 0.05).

Digestibility coefficients and nutritive value of experimental rations:

Data presented in Table (3) showed significant ($P < 0.05$) differences in DM, OM, CP, EE and CE digestibility among different experimental rations, while differences in NFE digestibility were not significant. Increasing guar korma level tended to significantly ($P < 0.05$) improve digestibility of most of nutrients especially with ration F which contained 16.7% guar korma. The DM digestibility recorded the highest value (85.20%) with ration F versus the lowest value (82.75%) recorded with ration A.

Differences in DM digestibility among rations A,B,C and D were not significant. No significant differences were also found among D,E and F rations. The same previous trend was observed with OM digestibility. The highest OM digestibility (93.15%) was reported with ration F, while the lowest OM digestibility (88.74%) was recorded with ration A, as shown in Table (3).

Results revealed that CP digestibility coefficients were 65.20, 66.14, 68.38, 70.48, 70.82 and 74.25% for rations A,B,C,D,E and F, respectively, showing higher digestibility with increasing guar korma level in experimental rations. However, increasing guar korma from zero to 6.7% or from 10.0 to 16.7% showed no significant differences. Higher CP digestibility with rations containing guar korma might be due to higher CP contents of these rations and higher palatability of guar korma. The same trend was observed with EE digestibility, showing the highest EE digestibility with ration F (70.82%) containing the highest level of guar korma. Also, CF digestibility appeared to significantly ($P < 0.05$) higher with increasing guar korma level from 6.7% to 16.7%. It could be noticed that increasing guar korma level tended to significantly ($P < 0.05$) increase CF digestibility up to 6.7% in ration.Further increase of level of guar korma led to higher CF digestibility but with no significant differences.

It could be shown that increasing guar korma level in experimental rations tended to increase NFE digestibility with no significant differences. Including guar korma meal to concentrate feed mixture of experimental rations up to 16.7% significantly ($P < 0.05$) increase most of nutrients digestibility coefficients.

Data were in agreement with those reported by Ahmed *et al*. (2000). They found that increased DM intake with increasing guar korma level up to 30% in sheep rations, Moreover, They recorded significant higher of OM and CP digestibilities with inclusion of guar korma at all levels studied.

The feeding values expressed as TDN, DCP and DE are shown in Table (3). Data revealed that ration F containing the highest level of guar korma (16.7%) had the highest feeding values, being 71.03% TDN, 10.15% DCP and 3.13 Mcal/kg as D.E. Increases in feeding values of experimental rations containing guar korma might be due to higher their nutrient digestibility with increasing DM intakes.

Generally, using guar korma in concentrate feed mixture with rate 16.7% to cover 50% of it's protein content tended to significantly ($P < 0.05$) enhance digestibility of most of all nutrients and feeding values. These results were agreement with those reported byAhmed *et al* (2000), Turki*et al.* (2011) andSalehpour*et al.* (2012). Morover,Etman*et al.* (2014a), concluded that higher nutrient digestibility and feeding values of rations containing guar korma might be due to its high palatability and high CP content. On the other hand, Walter *et al.* (2012) reported that using DDGS as a source of protein caused higher nutrient digestibility.

Milk yield and its composition:

Data presented in table (4) revealed that both actual and 7% FCM yields increased with increasing guar korma level. Differences in milk yield with increasing guar korma up to 10% were not significant, while incorporated guar korma with more percentage up to 16.7% tended to significantly ($P < 0.05$) increase milk production.

Average actual milk yield were 8.15, 8.24, 8.28, 8.75, 9.03 and 9.80 kg/head/day for animals fed rations A,B,C,D,E and F, respectively. The corresponding values of 7% FCM were 8.07, 8.10, 8.12, 8.47, 8.63 and 9.26 kg, respectively, as shown in Table (4).

Table (4): Average daily actual milk, fat corrected milk (FCM) yields and its composition for buffalo cows fed different experimental rations.

Items	Experimental rations					
	A	B	C	D	E	F
Av. milk production (kg/buffalo/day)						
Actual milk yield	8.15^{b}	8.24^{b}	8.28^{b}	8.75^{ab}	9.03^{a}	9.80^{a}
7% FCM yield	8.07^{b}	8.10^{b}	8.12^{b}	8.47^{ab}	8.63^{a}	9.26^{a}
Av. milk composition and its yield:						
Fat (%)	6.91^{a}	6.85^{a}	6.82^{a}	6.70^{ab}	6.58^{b}	6.47^{b}
Fat yield (gm/buffalo/day)	563^{b}	564^{b}	565^{b}	586^{b}	594^{b}	634^{a}
Protein (%)	3.96^{a}	3.90^{a}	3.84^{a}	3.80^{ab}	3.70^{b}	3.68^{b}
Protein yield (gm/buffalo/day)	322^{b}	321^{b}	318^{b}	333^{b}	334^{b}	361^{a}
Lactose (%)	4.80^{b}	4.82^{b}	4.83^{b}	4.85^{ab}	4.91^{a}	4.96^{a}
Lactose yield (gm/buffalo/day)	391^{c}	397^{bc}	400^{bc}	424^{b}	443^{a}	486^{a}
TS (%)	16.87^{a}	16.73^{a}	16.67^{a}	16.26^{b}	15.95^{b}	15.60^{c}
TS yield (gm/buffalo/day)	1375^{c}	1378^{c}	1380^{c}	1423^{b}	1440^{b}	1529^{a}
SNF (%)	9.96^{a}	9.88^{a}	9.85^{a}	9.56^{ab}	9.37^{b}	9.13^{b}
SNF yield (gm/buffalo/day)	812^{c}	814^{c}	815^{c}	837^{b}	846^{b}	895^{a}

a,b and c: Means in the same row with different superscripts are significantly different ($P < 0.05$).

These results were in agreement with those reported byKholif (1999), Also, Salehpour*et al.* (2012) reported that, diets of lactating goats containing guar korma tended to increase milk yield and quality. Moreover, Etman*et al.* (2012) showed that actual and 4% FCM yields increased with increasing dried distiller grain with soluble as a source of protein in ration formulation of lactating Friesian cows. The same previous trend was observed with Anderson *et al.* (2006), Janicek*et al.* (2008), Kelzer*et al.* (2009), Mullins *et al.* (2010) and Zhang *et al.* (2010). They reported that increasing DDGS as a source of protein in ration formulation of lactating cows tended to higher milk production.

The composition of milk presented in Table (4) such as fat, protein lactose, TS, SNF percentages and their yields showed significantly ($P < 0.05$) differences among different experimented rations. It could be noticed that increasing guar korma level in rations tended to decrease fat, protein, TS and SNF%, while lactose percentage appeared to somewhat increase with increasing guar korma level. At the same time, the yields of all previous items were significantly ($P < 0.05$) reflected according to different amounts of milk yield and different percentages of them. Data revealed that increasing guar korma from zero to 10% in ration formulation had no significant effect on composition of milk, while increasing guar korma up to 16.7% tended to significantly (P < 0.05) affect composition of milk and yields of its components, as shown in Table (4).

These data are in agreement with those reported by Chibisa*et al.* (2012), Etman*et al*. (2012), Benchaar*et al.* (2013)and Danes*et al.* (2013). They found that increasing protein level in experimental ration tended to increase milk yield and increase some milk components. Benchaar*et al*. (2013) reported significant increasesin milk yield and 4% FCM yield with increasing protein level in rations. Moreover, Chibisa and Mutsvangwa (2013) reported that feeding low CP diet lowered flows of microbial protein and metabolizable protein, which resulted in lower milk production compared with feeding high-CP diet.

Feed units intake and feed utilization efficiency:

The results illustrated in Table (5) showed that the feed unit intak expressed as DM, TDN and DCP increased with increasing guar korma level in ration formulation. Animals fed ration F (containing 16.7% guar korma) recorded 10.768, 7.649 and 1.093 Kg DM, TDN and DCP/head. respectively. Improvements of feed unit intakes with ration F were 3.34, 9.95 and 19.98% for DM, TDN and DCP, respectively, showing higher DCP intake owing to higher CP% of this ration.

Table (5): Average milk yield, feed unit intake and feed utilization efficiency of animals fed different experimental rations.

Items	Experimental rations					
	A	B	C	D	E	F
No. animals	5	5	5	5	5	5
Av. LBW (Kg)	402	405	398	400	401	406
Experimental period (day)	240	240	240	240	240	240
Av actual milk yield (kg/h)	8.15	8.24	8.28	8.75	9.03	9.80
Av. 7% FCM yield (kg/h)	8.07	8.10	8.12	8.47	8.63	9.26
Av. daily feed unit intake (Kg/h)						
DM	10.420	10.445	10.500	10.680	10.724	10.768
TDN	6.957	7.022	7.241	7.442	7.552	7.649
DCP	0.911	0.925	0.968	1.016	1.028	1.093
Feed utilization efficiency, as:						
KgDM/Kg milk yield	1.279	1.267	1.268	1.221	1.188	1.099
KgTDN/Kg milk yield	0.854	0.852	0.875	0.851	0.836	0.781
KgDCP/Kg milk yield	0.112	0.112	0.117	0.116	0.114	0.112
KgDM/Kg 7% FCM yield	1.291	1.289	1.293	1.261	1.243	1.163
KgTDN/Kg 7% FCM yield	0.862	0.867	0.892	0.879	0.875	0.826
KgDCP/Kg 7% FCM yield	0.113	0.114	0.119	0.120	0.119	0.118

Data in Table (5) shows feed utilization efficiency expressed as amounts of feed units intake to both actual milk and 7% FCM yields.

It could be noticed that, either Kg DM or Kg TDN per Kg milk yield were gradually decreased with increasing guar korma level in ration formulation, recording 1.099 and 0.781 Kg, respectively with ration F. But Kg DCP/Kg milk yield had fluctuated among different experimental rations. On the other hand, the feed utilization efficiency expressed as Kg DM, TDN or DCP/Kg 7% FCM yield were reflection of actual milk yield and milk fat percentage. However, ration F (containing 16.7% guar korma) appeared to record the best feed utilization efficiency, being 1.163 Kg DM/Kg 7% FCM versus 0.826 KgTDN/Kg 7% FCM.

These results were agreement with those recorded by Chibisa*et al.* (2012),Etman*et al.*(2012) and Benchaar*et al.* (2013). They found that, feed utilization efficiency improved with increasing level of DDGS in rations of lactating cows.

Feed cost and economical efficiency:

Data presented in Table (6) revealed that the cost of feeding of animals on different experimental rations depended on price of feed ingredients and amounts of feed intake. So, the costs of feeding were not fixed, showing that ration F (containing 16.7% guar korma) was the cheapest (20.643 LE/h) compared with the other rations. At the same time, feeding the last ration (ration F) recorded the highest cost of milk yield (58.800 LE/h). However, average daily feed cost per either Kg actual milk or kg 7% FCM yields tended to decrease with increasing guar korma level in experimental rations, while average net revenue (LE/h) appeared to increase with increasing guar korma level in ration formulation, being 27.639, 28.558, 28.797, 31.360, 33.267 and 38.157 LE with rations A,B,C,D,E and F, respectively. The same previous trend was observed when the net revenues were calculated as net revenue per both Kg milk yield and Kg 7% FCM yield.

Table (6): Average daily feed intake as fed, actual and 7% FCM yields, feed cost and economical efficiency.

Items	Experimental rations					
	A	B	C	D	E	F
Av. daily feed inake, as fed (kg/head):						
Concentrate feed mixture (CFM)	7.064	7.078	7.111	7.230	7.255	7.282
Berseem hay (BH)	2.888	2.895	2.910	2.960	2.972	2.984
Wheat straw (WS)	1.710	1.715	1.724	1.753	1.761	1.767
Av. daily milk yield (Kg/head):						
Actual milk yield	8.15	8.24	8.28	8.75	9.03	9.80
7% FCM yield	8.07	8.10	8.12	8.47	8.63	9.26
***Feed cost and economical efficiency:**						
Cost of feed intake (LE/head)	21.261	20.882	20.883	21.140	20.913	20.643
Cost of milk yield (LE/head)	48.900	49.440	49.680	52.500	54.180	58.800
Daily feed cost/kg milk yield	2.609	2.534	2.522	2.416	2.316	2.106
Daily feed cost/7% FCM yield	2.635	2.578	2.572	2.496	2.423	2.229
Net revenue (LE/head)	27.639	28.558	28.797	31.360	33.267	38.157
Net revenue/kg milk yield (LE)	3.391	3.526	3.478	3.584	3.684	3.894
Net revenue /7% FCM yield (LE)	3.425	3.530	3.546	3.702	3.855	4.121
Economical efficiency (%)	2.30	2.37	2.38	2.48	2.59	2.85
Improvement of economical efficiency (%)	-	3.04	3.48	7.83	12.61	23.91

*** Based on the assumption that the price of one ton of berseem hay, wheat straw and concentrate feed mixture containing guar korma with rate of 0, 3.3, 6.7, 10.7, 13.3 and 16.7% was 1600, 800, 2162, 2102, 2088, 2075, 2033 and 1985 LE, respectively, and the price of one kg milk was 6 LE.**

The results obtained in Table (6) showed that the economical efficiency expressed as cost of milk yield by cost of feed intake recorded 2.30, 2.37, 2.38 2.48. 2.59 and 2.85 with rations A,B,C,D,E and F respectively. The economical efficiency gradually increased with increasing guar korma level in experimental rations. The improvements of economical efficiency were 3.04, 3.48, 7.83, 12.61 and 23.91% with rations B,C,D,E and F, respectively. It could be noticed that the ration F (containing 16.7% guar korma meal) recorded the lowest feed cost and the highest net revenue, besides the highest economical efficiency.

These results were in agreement with those reported by Holt*et al.* (2010) ,Etman*et al.* (2012) and Etman*et al.* (2014a).They found that gradually increase source of protein such as DDGS in experimental rations tended to improve feed intake with improving net revenue and economical efficiency.

Some blood parameters:

The results summerized in Table (7) showed that the blood total protein and its fractions as albumin and globulin increased with increasing guar korma level in experimental rations. The serum total protein concentration ranged between 6.18 to 6.45, and albumin ranged between 3.80 to 3.94, while globulin ranged between 2.38 to 2.51 gm/100ml. However, the differences in serum total protein and its fractions were not significant. The ratios between albumin and globulin did not significantly differ among groups. Generally, the percentages of blood total protein, albumin and globulin concentrations were in normal range as reported by El-Shabrawy*et al.* (2012), Ojha*et al.* (2013) and Etman*et al.* (2014b).

Table (7): Blood parameters of animals fed experimental rations.

Items	Experimental rations					
	A	**B**	**C**	**D**	**E**	**F**
Serum protein (gm/100 ml)						
Total protein	6.18	6.21	6.25	6.29	6.38	6.45
Albumin (A)	3.80	3.82	3.84	3.88	3.91	3.94
Globulin (G)	2.38	2.39	2.41	2.41	2.47	2.51
A/G ratio	1.60	1.60	1.59	1.61	1.58	1.57
Liver function (IU/L):						
AST	39.15^{b}	40.16^{b}	41.28^{ab}	42.94^{a}	43.17^{a}	43.92^{a}
ALT	20.24^{b}	20.63^{b}	20.82^{ab}	22.87^{a}	23.75^{a}	23.88^{a}
Kidney function:						
Creatinine (mg/dL)	1.10	1.14	1.16	1.19	1.18	1.20
BUN (mg/dL)	15.42	16.87	16.91	16.98	17.08	17.15
BUN/creatinine	14.02	14.80	14.58	14.27	14.47	14.29

AST: Aspartate Amino Transfers
ALT: Alanin Amino Transfers
BUN: Blood Urea Nitrogen
A and b:Means in the same raw with different superscripts are significantly ($P < 0.05$) different.

Increasing guar korma level as a source of protein in concentrate feed mixture tended to increase of both AST and ALT concentrations, as shown in Table (7). With respect to liver function, it could be noticed that the

Asparatate Amino Transfers (AST) concentration (ranged between 39.15 to 43.92 IU/L) increased with increasing guar korma level, showing significantly ($P < 0.05$) higher concentration with animals fed rations D,E and F containing 10.0, 13.3 and 16.7% guar korma, respectively. The same previous trend was observed with Alanin Amino Transfers (ALT), which ranged between 20.24 to 23.88 IU/L, showing significantly ($P < 0.05$) higher concentration with the highest guar korma level in rations.

The concentrations of creatinine and blood urea nitrogen are indicators of kidney function. The concentrations of both gradually increased with increasing guar korma level in experimental ration, with no significant differences. The ratio between blood urea nitrogen (BUN) and creatinine were not significantly different among treatments. In general, the concentrations studied some serum blood parameters of animals fed rations containing guar korma were in the normal range indicating normal and healthy case of animals.The results were in agreement with those reported by Shwerab*et al.* (2010), Ojha*et al.* (2013) and Etman*et al.* (2014b).

So, the guar korma as a source of protein was good feed material for ruminants.

Some rumen liquor parameters:

The data presented in Table (8) revealed that average pH values graduall increase with increasing guar korma level in experimental rations during different sampling periods with no significantly different. However, pH values decreased at 3hrs post feeding and increased again at 6hrs after feeding. Ruminal pH value is affected by bacterial fermentation in the rumen. In addition, the small decrease in ruminal pH might be as a result of residual starch in guar korma which is degraded rapidly in the rumen as reported by Leupp*et al.* (2009). It could be noticed that, effect of sampling time on rumen pH values showed decreased at 3hrs , then returned to increase at 6hrs after feeding . This might be related to the fermentation processes of both non structural and structural carbohydrates to obtain the volatile fatty acids which increased with proceeding time and cause a reduction in ruminal pH. Data were in agreement with finding of Bargo*et al*. (2001) who reported that the ruminal pH value was not affected by level or source of protein. The concentration of NH_3-N was greater in ration containing guar korma than that of control ration during different sampling periods. It could be noticed that the NH_3 -N concentration with animals fed rations E and F were significantly ($p< 0.05$) higher than those fed other rations at 3 and 6hrs after feeding. This may be due to the greater portion of guar korma in ration E and F as a source of protein, which is more degradable in the rumen as reported by Chibisa*et al.* (2012) and Benchaar*et al.* (2013). Overall mean of NH_3 -N concentration appeared the same significant ($P<0.05$) trend during 3and 6 hrs after feeding , recording the highest concentration (20.27 mg/ 100 ml) with animals fed ration F (containing 16.7% guar korma).With respect to ruminal total VFA's concentration , the significant ($P<0.05$) differences were found with increasing guar korma level from 10 to 17.7% in tested rations, during different sampling times. Concentration of total VFAs gradually increased with increasing guar korma level in rations and at post feeding, as shown in Table

(8). Data also revealed that the total-N and protein-N concentrations showed significantly ($P<0.05$) higher with animals fed rations E and F, recording increased concentrations with increasing sampling times. Overall average of total-N ranged between 118.82 to 131.29 mg /100 ml versus 89.22 to 94.35 mg /100 ml for Protein-N concentration, showing the highest concentration was recorded with animals fed ration F (containing 16.7% guar korma). Results obtained in Table (8) showed that the decrease ruminal NH_3-N concentration with increasing sampling time (6hrs post feeding) might be due to improve the rumen microbes activity utilizing NH_3-N to produce microbial protein as reported byShakweer*et al.* (2010).

Table (8): Average some rumen liquor parameters of animals fed different experimental rations during different periods.

Items	Experimental rations					
	A	B	C	D	E	F
Rumen pH Values :						
Before feeding at 0 hrs	7.02	7.10	7.18	7.24	7.50	7.52
After feeding at 3 hrs	6.10	6.14	6.24	6.35	6.40	6.42
After feeding at 6 hrs	7.00	7.06	7.10	7.18	7.26	7.44
Overall average	6.71	6.77	6.84	6.92	7.05	7.13
Rumen NH3- N (mg/100ml):						
Before feeding at 0 hrs	16.14	16.28	17.08	17.12	17.26	18.37
After feeding at 3 hrs	20.32^{b}	21.08^{b}	21.27^{ab}	22.56^{ab}	23.16^{a}	24.18^{a}
After feeding at 6 hrs	16.28^{b}	16.35^{b}	17.29^{ab}	17.44^{ab}	18.03^{a}	18.25^{a}
Overall average	17.58^{b}	17.90^{b}	18.55^{ab}	19.04^{ab}	19.48^{a}	20.27^{a}
Rumen total VFA's (meq/ 100ml):						
Before feeding at 0 hrs	6.34^{b}	6.38^{b}	6.45^{b}	7.08^{a}	7.12^{a}	7.28^{a}
After feeding at 3 hrs	10.23^{b}	10.28^{b}	10.39^{b}	11.17^{a}	11.36^{a}	11.85^{a}
After feeding at 6 hrs	12.15^{b}	12.32^{b}	12.45^{b}	13.04^{a}	13.38^{a}	14.08^{a}
Overall average	9.57^{b}	9.66^{b}	9.76^{ab}	10.43^{a}	10.62^{a}	11.07^{a}
Rumen total – N (mg/ 100ml):						
Before feeding at 0 hrs	95.82^{b}	97.12^{b}	98.06^{b}	100.06^{a}	104.07^{a}	112.43^{a}
After feeding at 3 hrs	120.41^{b}	120.62^{b}	121.25^{ab}	121.48^{ab}	122.05^{a}	123.18^{a}
After feeding at 6 hrs	140.22^{b}	142.36^{b}	145.15^{b}	146.18^{b}	152.11^{a}	158.25^{a}
Overall average	118.82^{b}	120.03^{b}	121.49^{ab}	122.57^{a}	126.08^{a}	131.29^{a}
Rumen protein– N (mg/ 100ml):						
Before feeding at 0 hrs	75.82	76.14	76.32	78.35	78.72	78.84
After feeding at 3 hrs	81.64^{b}	81.77^{b}	82.35^{b}	82.54^{a}	83.05^{a}	84.03^{a}
After feeding at 3 hrs	110.20^{b}	110.86^{b}	112.11^{b}	112.48^{b}	118.63^{a}	120.18^{a}
Overall average	89.22^{b}	89.59^{b}	90.26^{ab}	91.12^{ab}	93.47^{a}	94.35^{a}
Rumen NPN (mg/ 100ml):						
Before feeding at 0 hrs	20.00^{b}	20.98^{b}	21.74^{b}	21.71^{b}	25.35^{a}	33.59^{a}
After feeding at 3 hrs	38.77^{b}	38.85^{b}	38.90^{a}	38.94^{a}	39.00^{a}	39.15^{a}
After feeding at 6 hrs	30.02^{c}	31.50^{c}	33.04^{b}	33.70^{b}	33.48^{b}	38.07^{a}
Overall average	29.60^{c}	30.44^{c}	31.23^{b}	31.45^{b}	32.61^{b}	36.94^{a}

a, b and c : Means in the same row with different superscripts are significant ($P < 0.05$) different.

On the other hand, rumen NPN concentration were reflected to both Total-N and Protein-N concentration. It could be noticed that the rumen NPN concentration showed significantly ($P<0.05$) greater with animals fed rations E and F during before feeding and at 3hrs after feeding , while the highest significant ($P<0.05$) value was recorded with animals fed ration F (containing 16.7% guar korma) during 6 hrs after feeding and with overall mean, as shown in Table (8). Also, data showed that animals fed ration F had the highest overall mean concentration with NH_3-N , total-N and protein-N, recording 20.27, 131.29 and 94.35 mg /100 ml, respectively, while total VFA's concentration recorded 11.07 meq /100 ml. Radev (2012) showed increase pH, VFA's and NH_3-N in rumen liquor of sheep with increased DDGS as a source of protein. Similar results were reported by Walter *et al.* (2012). They found that increases in NH_3-N and VFA's concentration were shown with increasing DDGS as a source of protein in experimental ration.

Generally, the concentration of some rumen liquor parameters increased with increasing guar korma level in experimental rations and their values were in the normal range as reported by Etman*et al.* (2012) and Salehpour*et al.* (2013). Moreover, Danes *et al* (2013) showed that higher level of protein of rations resulted in higher of NH_3-N in rumen liquor.

From these results, it could be noticed that all parameters of both serum blood and rumen liquor of animals fed rations containing guar korma were within the normal range, indicating that all animals were in a good health. Moreover, guar korma can be considered as a good source of protein for ruminants.

Generally, guar korma meal could be used as a source of protein feed mixture of ration formulation of lactating buffaloes. Increasing guar korma level up to 16.7% in experimental ration tended to significantly ($P < 0.05$) improve most of nutrient digestibilities, feeding values as TDN%, DCP% and DE (Mcal/KgDM). Moreover, actual milk and 7% FCM yields significantly ($P < 0.05$) increased with simultaneous improvement in milk composition. At the same time, feed utilization efficiency expressed as amounts of feed unit intake per kg actual milk or 7% FCM yields improved with using 16.7% guar korma level in experimental rations, giving the lowest feed cost with the highest net revenue and economical efficiency. In addition some blood and rumen liquor parameters concentrations were with the normal ranges without any side effects.

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إستخدام مصادر بروتينية جديدة في تغذية المجترات. ٢-إستخدام كسب جوار الكورما في علائق الجاموس الحلاب

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يهدف هذاالبحث إلىدراسة تأثير إستخدام نسب مختلفة من كسب جوارالكورما كمصدر بروتيني في علائق الجاموس الحلاب على أدائها الإنتاجى. إستخدم عدد٣٠ جاموسة في موسم حليبها الثاني وقسمت إلىستة مجموعات متماثلة وغذيت على علف مركز يحتوي على كسبجوار الكورما بنسب صفر ،٣,٣ ،٦,٧ ،١٠,٠ ، ١٣,٣ ،١٦,٧ % بحيث تغطي هذه النسب مايعادل صفر،١٠،٢٠،٣٠،٤٠،٥٠ %من بروتين العلف المركزالخاص بالعلائق التجريبية A,B,C,D,E,F على التوالي .وكانت العلائق التجريبية تتكون من علف

مركز ودريس برسيم وتبن قمح بنسب٦٠ :٢٥ :١٥ %على التوالي واستمرت التجربة٢٤٠ يوما ً، بجانب ذلك تم إجراء ستة تجار بهضم لتقدير القيمة الهضمية والغذائية لهذه العلائق ، كما تم أخذ عينات دم وسائل كرش لتقدير بعض المقاييس الخاصة بهما.

وكانت أهم النتائج المتحصل عليها مايلي:

- زادت نسب كل من المادة الجافة، البروتين الخام ، مستخلص الأثير وانخفاض طفيف للمادة العضوية مع زيادة نسبة جوارالكورما في العليقة وأد ذلك إلى زيادة كمية المادة الجافة المأكولة.
- أظهرت العلائق التجريبية المحتوية على جوار كورما (العلائقD,E) زيادة معنوية في معاملات هضم كل من المادة الجافة (DM) ،المادة العضوية (OM) ،البروتين الخام (CP) مستخلص الأثير(EE) ، الألياف الخام (CF) وكانت أعلى معاملات هضم للمركبات الغذائية مع العليقة (F) المحتوية على أعلى نسبة من جوارالكورما)١٦,٧ (% وسجلت٨٥,٢٠، ٩٣,١٥، ٧٤,٢٥، ٧٠,٨٢، ٦٥,١٦ % لكل من DM , OM, CP, EE,CF على التوالي ، كما تميزت العليقة (F) بأنها أعلى قيمة غذائية وسجلت TDN٧١,٠٣ % ،DCP٥ ١٠,١ % ، ٣,١٣.Mcal/kg/DM (DE)
- كان متوسط إنتاج اللبن اليومي٨,١٥، ٨,٢٤، ٨,٢٨، ٨,٧٥، ٩,٠٣، ٩,٨٠كجم/ رأس بينما كان متوسط إنتاج اللبن المعدل ٧ % دهن يساوي ٨,٠٧، ٨,١٠، ٨,١٢، ٨,٤٧، ٨,٦٣، ٩,٢٦كجم/ رأس للحيوانات التيتغذت على العلائقA,B,C,D,E,F على التوالي ، وقد كانت زيادة كمية إنتاج اللبن معنوية للمجموعتين E , F مع زيادة نسبة جوارالكورما ، هذا وقد أظهر تنسب كل من الدهن ، البروتين ، الجوامد الكلية ، الجوامد اللادهنيه انخفاضا ًمع زيادة نسبة جوارالكورما في العليقة ، بينما ارتفعت نسبة اللاكتوز ، هذا وقد تأثرت كميات كل من الدهن والبروتين والجوامد الكلية والجوامد اللادهنية واللاكتوز معنويا ًبالزيادة أو النقص تبعا ًلنسب هذه القيم وكميات اللبن الناتجة.
- زاد متوسط وحدات المأكول اليومي زيادة معنوية بزيادة نسبة جوارالكورما في العلائق وسجلت ١٠,٧٦٨، ٧,٦٤٩، ١,٠٩٣كجم لكل من الـ DM ،TDN، DCP على التوالي للمجموعة التيتغذت على العليقة (F) حيث أظهرت هذه المجموعة أيضا ًأفضل كفاءة غذائية معبرا ًعنها بكميات المادة الجافة أوالطاقة أوالبروتين المأكول لكل كجم لبن عادياً ولبن معدل الدهن ٧ %.
- كان متوسط تكلفة التغذية لكل كجم لبن يساوي ٢,٦٠٩، ٢,٥٣٤، ٢,٥٢٢، ٢,٤١٦، ٢,٣١٦، ٢,١٠٦جنيها ًمصريا ًللمجموعات التيتغذت على العلائق F,E,D,BC,A على التوالي .وقد كانت القيم المقابلة محسوبة على أساسا للبن المعدل الدهن تساوي ٢,٦٣٥، ٢,٣٧٨، ٢,٥٧٢، ٢,٤٩٦، ٢,٤٢٣، ٢,٢٢٩جنيها ًعلى التوالي .وقد أظهرت العليقة المحتوية على ١٦,٧ % جوار كورما (F) أقل تكلفة معاً على كفاءة غذائية.
- أظهرت بعض قياسات عينات الدم وتركيزالبروتين ومشتقات هو كذلك قيم وظائف الكبد والكليب الإضافة إلى تركيز بعض قياسات الكرش أنها داخل النطاق الطبيعي وكذلك على الفترات الزمنية المتعاقبة.

من هذه الدراسة يمكن الإستفادة من كسب جوار الكورما في علائق الجاموس الحلاب كمصدر للبروتين بنسبة تصل إلى١٦,٧ % حيث أن هذه النسبة تغطي٥٠ %من بروتين العلف المركز وقد أدى ذلك إلى زيادة معاملات هضم العلائق مع إرتفاع القيمة الغذائية ، كما أظهرت النتائج زيادة إنتاج اللبن وأعطت هذه النسبة أقل تكلفة غذائية مع أعلى كفاءة غذائية مع عدم ظهور أي تأثيرات سلبية على صحة الحيوانات حيث كانت تركيزات بعض مقاييس الدم والكرش في النطاق الطبيعي.

وعلى الرغم من ذلك هناك حاجة لزيادة الدراسات لمعرفة أفضل نسبة إستخدام من كسب الجوارفي علائق حيوانات اللبن والتسمين.