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EFFECT OF GUAR KORMA MEAL IN NEW ZEALAND WHITE DOE RABBITS DIETS ON PRODUCTIVE AND PHYSIOLOGICAL PERFORMANCE

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This study was conducted to investigate the effect of inclusion of guar korma (Gyamopsis tetragonloba L.) meal (GKM) in rabbit diet on performance of New Zealand White (NZW) does during gestation and lactation on growth performance of weanlings. Forty multi-parious does 8-12 month old were allocated to five GKM dietary treatments: 0.0 (control), 2.5, 5.0, 7.5 and 10.0%. Does were naturally inseminated and housed separately in individual wired-cages. All animals were kept under the same management and hygienic conditions. Parameters live body weight and feed intake for does after gestation and lactation period were recorded. Also milk yield, litter size and litter weight were recorded weekly. Feed cost and some blood parameters were studied. Results indicated that feeding 5.0 % GKM significantly increased feed intake during gestation and lactation, while feeding 7.5 and 10.0% GKM diets resulted in inferior feed intake. Does fed on 5.0 % GKM recorded significantly the highest milk yield during four weeks of lactation compared with other groups. Litter size at birth and weaning were significantly higher in the control and 5.0% GKM groups than 2.5, 7.5 and 10.0% GKM group. Litter weights at birth and corresponding litter weight gains and through 4-week lactation period were increased with dietary GKM 5.0% while it decreased in the rest of treatments. Also, GKM at 2.5 and 5.0 % recorded the higher kid weight, kid weight gain and kid daily gain compared with the other groups. Total protein, albumin, globulin and glucose concentrations were increased with feeding on 5.0% GKM diet compared with other treatments, while control showed the highest concentration of triglycerides, total cholesterol, high density lipoprotein (HDL), and low density lipoprotein (LDL) in plasma. Adding the GKM to doe rabbits diet did not alter transaminase (aspartate aminotransferase, AST and alanine aminotransferase, ALT) activity. The lowest feeding cost per

weaned recorded with 5.0% GKM group compared with other treatments.

Based on the overall obtained results it could be recommended to include guar korma meal in doe-rabbits diet up to 5.0% of the diet without negative effect on performance during gestation and lactation periods with saving cost of feeding with 5.0% GKM.

Key word: Guar Korma Meal, Doe Rabbits, Gestation, Lactation, Blood Parameters.

Providing alternative feeding materials could participate to decrease the extraordinary increase in conventional feed-stuffs used in formulating rabbit diets.

Guar, *Cyamopsis tetragonoloba* L. (syn. *C. psoraloides*) or cluster bean is a drought-tolerant summer annual legume native to India and Pakistan (Rahman and Shafivr, 1967). Guar meal is a relatively inexpensive high protein meal produced as a by-product of guar gum manufacture. It is a mixture of germs and hulls at an approximate ratio of 25 % germ to 75 % hull (Lee *et al*., 2004). The high amino acid content of the guar meal protein makes it a useful protein supplement for mono-gastrics. Since the germ fraction of guar meal contains energy, protein, methionine and phosphorus in higher levels than that in soybean meal (SBM), addition of guar meal as a partial replacement (< 10%) of SBM in poultry diets may be a useful economic strategy for decreasing feed cost without any negative effects on production (Kamran, *et al.* 2002). The germ contains most of the protein in seed, the protein content of guar meal ranges between 33 to 45% depending on fraction types (Conner 2002). The chemical composition of GKM versus SBM observed (Walaa *et a*l., 2014) in Table 1.

Some of the anti-nutritional agents (trypsin inhibitors, gum residue, saponins, haemagglutinins, hydrocyanic acid and polyphenols) present in guar meal limit its usage at high levels in poultry diets (Anderson and Warnick, 1964). Therefore, growth inhibition that follows the inclusion of guar meal in poultry diet may be attributed to the residual gum content of the meal (Lee *et al*., 2005). While, the large saponins content of guar seed (up to 13% DM) could have both antinutritionals effect and a positive antimicrobial activity (Hassan *et al*., 2010). Guar meal can also be used as a binding agent in feed formulation. It is characterized as free flowing, has light greenish color and coarse texture and more importantly, guar meal is free from salmonella, E. coli, and aflatoxin (Lee *et al*., 2009).

Table 1: Chemical composition (%) of guar korma meal (GKM) and soybean meal (SBM) according to (Walaa *et al*., 2014).

Items	GKM	SBM
Organic matter	94.37	93.60
Crud protein	49.22	44.00
Crude fiber	8.53	3.90
Ether extract	5.10	1.90
Ash	5.63	6.40
Nitrogen free extract	31.52	43.80
Digestible energy (kcal/kg)	3162.00	3202.00

Excessive concentrations of guar meal in poultry diets caused diarrhea, depressed growth rate and increased mortality of broilers (Rahman and Leighton, 1968). Heat treatments and fermentation have been proposed to improve the nutritive value of guar and most of the toxic and anti-nutrient effects could be removed by processing methods such as soaking, germination, boiling, autoclaving and fermentation (Srivastava *et al* 2011).

Guar meal can be used as a feed ingredient at level 2.5% of Inshas chicks diets without any adverse effect on growth performance (Nasrala *et al*., 2015). Also, Salma *et al*., (2015) reported that guar meal could replace 25 % of SBM (equal 6.75 and 6.25 % form diets for starter and grower respectively) in broilers diets without adverse effects on growth performance, blood lipids or economical efficiency, however inclusion high levels of guar meal in broiler diets caused deleterious effect growth performance. In growing-finishing pig, the inclusion of guar meal up to 6% had no negative effects on growth performance. Guar meal inclusion at 12% reduced growth without affecting pork meat quality (Heo *et al*., 2009). Unfortunately no available studies on evaluation of rabbit response to incorporation of guar korma meal in the diet.

Therefore, the objectives of the present study were to investigate the effect guar korma meal on performance of doe New Zealand White rabbits during gestation and lactation periods and some of physiological parameters.

MATERIALS AND METHODS

This study was carried out at Sakha Research Station, Animal Production Research Institute (APRI), Egypt.

***Experimental animals, design and management*:**

Forty multi-parious New Zealand White does 8-12 month old were equally allocated to five GKM dietary treatments: 0.0 (as control treatments),

2.5, 5.0, 7.5, 10.0% (8 does/treatment), does were naturally inseminated. Detection of conception was carried out by palpation at 10 days after mating and the non pregnant were remated immediately. Does were housed in individual wired-cages. All animals were kept under the same management and hygienic conditions and provided with fresh water and pelleted diets, *ad-libtum* over the experimental period.

Experimental diets and measurements:

Diets were formulated to meet the NRC'1977 requirements during gestation and lactation periods. Ingredients and calculated chemical analyses of experimental diets are presented in Table 2. Recording of does weight, Feed intake, litter size and weight at birth and weekly up to weaning were done. The change in live body weight during gestation period was calculated as the difference between the live body weight at mating and body weight after post partum, while the change in live body weight during suckling was calculated as the difference between the live body weight at the end of suckling period (at weaning) and the body weight post partum, in which the kids became four weeks of age. Milk yield was recorded twice a week for each doe as the increase in kids weight, resulted from weighting the kids before and after suckling, kids were subjected to 24 hours deprivation before measuring milk yield from suckling their mothers. Also, feeding cost during experimental period was calculated. Individual blood samples were collected from three does each treatment from the marginal ear vein in 5 ml. heparinized test tubes and centrifuged at 3000 r.p.m for 20 minutes then plasma were stored at -20ºC until the time of chemical analysis. Chemical analysis of the blood plasma included plasma total protein, albumin**,** globulin (determined by subtraction the value of albumin from total protein of the same plasma sample), transaminase (aspartate aminotransferase, AST and alanine aminotransferase, ALT**)**, glucose, total cholesterol, high density lipoprotein (HDL) and low density lipoprotein (LDL). All blood parameters determined with kits from Biosystems, S.A. Costa Brava, 30-Barcelona (Spain).

***Statistical analysis*:**

The collected data were subjected to analysis of variance using the general linear model (GLM) procedure of SAS User's guide (SAS , 2001). Duncan's Multiple Range test (Duncan's, 1955) was used to separate means when separation was relevant. Statistical significance was accepted at probability level of ($P<0.05$) using the following model:

$$Y_{ij} = \mu+T_i+e_{ij}.$$

Where: μ= Overall mean of Y_{ij}, T_i = Effect of treatment, I = (1,…5) e_{ij} =Random error .

Table 2: Compositions and calculated analysis of the experimental diets.

Ingredients	GKM (%)				
	0.0 (Control)	**2.5**	**5.0**	**7.5**	**10.0**
Yellow corn	19.55	18.55	19.10	21.10	22.60
Soy bean meal 44%	21.10	19.58	16.49	12.95	10.00
Alfalfa hay	25..85	25.85	25.85	24.35	23.35
Wheat bran	27.50	27.50	27.50	28.00	28.00
Guar korma meal (GKM)	0.00	2.50	5.00	7.50	10.00
Di calcium phosphate	1.50	1.50	1.50	1.50	1.50
Limestone	0.75	0.75	0.75	0.75	0.75
Molasses	3.00	3.00	3.00	3.00	3.00
NaCl	0.30	0.30	0.30	0.30	0.30
Premix*	0.30	0.30	0.30	0.30	0.30
DLMethionine	0.10	0.12	0.16	0.20	0.15
Anticoccidia (Diclazuril)	0.05	0.05	0.05	0.05	0.05
Total	**100**	**100**	**100**	**100**	**100**
Chemical composition (%)					
Crud protein	18.21	18.70	18.60	18.36	18.28
Digestible energy (kcal/kg)	2554	2552	2552	2570	2584
Crud fiber	12.77	12.85	12.85	12.46	12.19
Ether extract	2.70	2.77	2.87	3.01	3.13
Calcium	1.10	1.10	1.09	1.07	1.05
Total Phosphorus	0.79	0.77	0.76	0.74	0.72
Lysine	0.99	1.00	0.98	0.94	0.91
Methionine	0.39	0.47	0.57	0.66	0.67
Methionine +Cystene	0.70	0.70	0.70	0.70	0.71
Na	0.16	0.16	0.16	0.16	0.16
Cost / ton at Egyptian Local Price (LE)	2652	2613	2561	2543	2502

*Supplied per 1 kg diet: 6000 IU vit. A; 900 IU, vit. D_3; 40 mg, vit. E; 2.0 mg, vit. K_3; 2.0 mg vit., B_1; 4.0 mg , vit. B_2; 2.0 mg, vit. B_6; 0.010 mg, vit. B_{12}; 5.0 mg, vit. PP; 10.0 mg vit., B_5; 0.05 mg, B_8; 3.0 mg, B_9; 250 mg, choline; 50.0 mg, Fe;50.0 mg, Zn; 8.5 mg Mn; 5.0 mg Cu; 0.20 mg I, and 0.01 mg Se.

RESULTS AND DISCUSSION

1- Doe performance during pregnancy and lactation period

The effect of GKM on the performance of does during gestation and lactation periods is shown in Table 3. The gestation length and the does' weight after gestation haven't significantly affected by different treatments. Inclusion of GKM in does diet affected significantly both feed intake and change in weight of does during gestation period. The does fed on 0.0 or 5.0

% GKM diet recorded the highest feed intake value 4157.30 and 4042.50 g, respectively. The does fed up to 5% GKM during gestation period recorded the highest change in weight +132.50 g (4.36%), +124.38 g (3.43%) and +100.63 g (3.43%) for 5.0, 0.0 and 2.5 % GKM treatments, respectively. On contrary, increasing GKM more than 5.0 % in does diet decreased feed intake and change in live weight.

In this respect, Kamran *el al*., (2002) recorded that the broiler chicks significantly gained more weight when fed on 5.0 % guar meal. This gained weight may be due to the reflection of consumed more protein and amino acids and enhanced the digestion. This enhanced may come from the linearly increasing in count of *Lactobacillus* with decreasing count of cecal *Salmonilla spp.* and *E.Coli* by using guar meal. Mohamed (2014) found that, using GKM at levels 2.5, 5.0 and 10.0 % have increased the crypts depth of intestinal jejunum of broiler chicks and the linearly increasing in count of *Lactobacillus* in contrary with decreasing count of cecal *Salmonilla spp.* and *E.Coli* . While, using 5.0 % GKM diet increased body weight gain of chicks. In this respect, GKM had an inhibition action on colonization of pathogenic gastrointestinal bacteria (Bengmark, 1998), and enhanced macrophage activity (Duncan *et al*., 2002). Because rabbit is a small non-ruminant herbivore, rabbit feeding is more similar to ruminant feeding and digestive physiology shows some similarity particularly ceacal processes (Marounek *et al*., 2000). Fermentation pattern in rabbit cecum resembles that in the rumen; however it shows lower fibrolytic microbial activity and relatively higher amylolytic and proteolytic microbial activity (Gidenne, 1997).

Also, mean values of feed intake during suckling period showed significant increase for does fed diets containing 5.0 % GKM compared with the higher GKM levels. On the other hand, the same does lost more weight -118.13 g (-3.92%) compared with the other GKM treatment. Inclusion GKM at level 10.0% more than 5.0 % for does decreased feed intake compared with control group. In this respect, Salma *et al.,* (2015) obtained that, replaced GKM from SBM by 50 % (13.5 % from diet for starter and 12.5 % from diet for grower) and 75 % (20.25 % from diet for starter and 18.75 % from diet for grower) in broiler diet, recorded a decreased in feed intake and Walaa *et al.,* (2014) reported a depression in feed intake when substituted GKM from SBM by 25% (4% from diet) and 50 % (8 % from diets) in growing rabbit diets. On contrary with Thakur and Pradhan (1975); Sagar *et al*., (1978); Gharaei *et al*., (2012); Mishra *el al*., (2013) and Nasrala, *et al* (2015) reported that feed intake was significantly increased with increase GKM percent in poultry diets. Also, Salehpour

et al., (2012) recorded increasing DM intake with decreasing GKM level in cow diets. In dairy cows, palatability problems have been reported when more than 5.0% guar meal included in the diet. However, dairy cows and heifers fed rations containing 10-15% guar meal got acquainted to its odor and taste after a few days. Intake remained lower than with the control diet (cottonseed meal) but dairy performances were not affected. In growing dairy calves, flavored guar meal and toasted guar meal gave slightly better rates of intake and gain than raw guar meal (Rahman and Leighton 1968; Singh *et al.*, 2008 and Salehpour *et al.*, 2012).

2- Milk yield during suckling period:

Table (4) presents results of effect of GKM on milk yield. Does fed on 5.0 % GKM recorded significantly the highest milk yield during four weeks of lactation compared with others groups. However, the does fed on 7.5 and 10.0 % GKM recorded a depression in milk yield during the four weeks period. Does fed on 2.5 % GKM during four weeks had no negative effect on milk yield compared with control group. The mean value of milk yield during four weeks showed the same trend as weekly recorded values of milk yield.

Table 4: Effect of GKM level on milk yield of does (g/d):

Suckling period	GKM (%)					Pooled SE	Significance
	0.0	2.5	5.0	7.5	10.0		
Week 1	78.75^{b}	80.25^{b}	101.88^{a}	71.25^{b}	68.13^{b}	4.44	**
Week2	121.25^{b}	126.88^{b}	150.00^{a}	105.00^{c}	95.63^{c}	5.34	**
Week3	133.75^{bc}	144.38^{b}	190.63^{a}	117.50^{cd}	105.00^{d}	6.54	**
Week4	124.38^{b}	113.75^{bc}	153.13^{a}	100.63^{c}	73.13^{d}	5.27	**
Overall mean	114.53^{b}	116.32^{b}	148.91^{a}	98.60^{c}	85.47^{c}	4.61	**

$^{a, b\cdots}$ Means within each row have different letter(s) are significantly different.
**:(P<0.01). GKM= Guar Korma Meal.

In this respect, Salehpour *et al*, (2012) recorded increasing milk production for cow fed diet containing guar meal 25 % substitution for cotton seed more than control, 50 and 100% substitution. The increase in milk yield for doe feed on 2.5 and 5% GKM more than 7.5 and 10 % may be due to the does in those treatment consumed the highest feed intake during suckling period which reflected on milk yield. This result agreed with Salehpour *et al.*, (2012) who reported increasing in DM intake for lactating cows fed on 25 and 50 % GKM substituted for cotton seed. Also, they recorded improving of milk composition for lactated cow feed on guar meal (milk fat, protein and lactose) for all substitution levels. Results of cattle showed that the high content of the guar meal protein offers a good

source of essential amino acid (Turki *etal*. 2011). Furthermore the obtained results of milk yield explained the highest body weight loss of 5.0% GKM does, whereas does produced the biggest milk yield lost more weight.

3-Reproductive performance of does:

Litter size and mortality rate:

The effects of experimental treatments on litter size and mortality rate during four weeks are shown in Table 5. Litter size at birth and weaning were significantly higher in the control and 5% GKM groups compared to 2.5 or 7.5 or 10.0 % GKM groups at 28 day of age. The recorded values of litter size at birth showed no significant negative effect of inclusion 2.5 % GKM in dose diets, but after that this level of GKM decreased litter size significantly compared with control and 5 % GKM values. These results recorded the same trend for milk yield of does. Increasing the level of GKM to 7.5 or 10.0 % had increased the mortality rate numerically. However, the average of mortality rate was not significantly different between different treatments.

Table 5: Effect of GKM level on the litter size and mortality rate of does.

Age	GKM (%)					Pooled SE	Significance
	0.0	**2.5**	**5.0**	**7.5**	**10.0**		
Litter size							
At birth	8.00 ^{a}	7.13^{ab}	8.50 ^{a}	6.38 ^{b}	6.00 ^{b}	0.50	*
Week 1	7.13 ^{ab}	6.25 ^{bc}	7.50 ^{a}	5.50 ^{c}	5.25 ^{c}	0.34	**
Week 2	6.75 ^{a}	5.88 ^{b}	7.13 ^{a}	5.00 ^{c}	4.63 ^{c}	0.26	**
Week 3	6.75 ^{a}	5.75 ^{b}	6.88 ^{a}	4.88 ^{c}	4.50 ^{c}	0.26	**
Week 4	6.63 ^{a}	5.62 ^{b}	6.88 ^{a}	4.75 ^{c}	4.38 ^{c}	0.24	**
Mortality rate %							
1-28 days	17.13	21.18	19.06	25.55	27.00	5.06	NS

$^{a, b, \ldots}$ Means within each row have different letter(s) are significantly different.

NS: Not significant, *:(P<0.05), and **:(P<0.01) . GKM= Guar Korma Meal.

***Litter weight and litter weight gain*:**

Inclusion of GKM in doe diets significantly affected litter weight and their weight gain during four weeks (Table 6). Both values of litter weight and litter weight gain of experimental groups during the overall lactation period (1-4 wks) showed superior values of litters of 5.0 GKM group compared with other treatments followed by control and 2.5 % GKM groups. The total litter weight gain during the four weeks of lactation period increased by 16.0 % for does fed on 5.0 % GKM diet and decreased by 8.0 %, 30.6 % and 40.5 % for the does fed on 2.5 %, 7.5 % and 10.0 % GKM diets, respectively, compared with control group.

***Performance of kids overall suckling period*:**

Results in Table (7) shows mean values of kid weight at birth, kid weight at weaning, kid weight gain and average daily gain. These parameters showed significant differences between treatments. Feeding GKM at 2.5 % and 5.0 % improved kid weight at weaning by 8.4 and 10.6 % respectively, kids weight gain by 9.1 and 11.8 % and average daily gain 9.2 and 11.8 % respectively compared with control group. This increase is logic with the increasing in milk yield for both treatments. Using more than 5.0 % GKM didn't affect kid weight gain or kid daily gain compared with control group.

The obtained result of mortality rate agreement with Mishra *et al.*, (2013) who reported that mortality was not related to the dietary treatments of GKM to broiler diet (2 % in pre-starter, 5% in starter and finisher) and there was no significant variation observed between the groups. In this respect, GKM had an inhibition action on colonization of pathogenic gastrointestinal bacteria (Bengmark, 1998). However, the highest insignificant rate of mortality for the does fed on 7.5 and 10.0 % GKM are in agreement with Rahman and Leighton (1968) who found that excessive concentrations of guar meal in poultry diets caused diarrhea and increased mortality of broilers.

Table 7: Effect of GKM on the productive traits of kids over all suckling period.

Items (g)	GKM%					Pooled SE	Sign.
	0.0	2.5	5.0	7.5	10.0		
Kid weight at birth	47.34	48.74	47.94	45.65	43.54	1.64	**NS**
kid weight at weaning	408.19^{b}	442.62^{a}	451.50^{a}	401.33^{bc}	375.57^{c}	10.48	**
Kid weight gain	360.85^{b}	393.88^{a}	403.56^{a}	355.68^{b}	332.03^{b}	10.18	**
Kid daily gain	12.89^{b}	14.08^{a}	14.41^{a}	12.70^{b}	11.86^{b}	0.36	**

$^{a, b\ldots}$ Means within each row have different letter(s) are significantly different.
NS: Not significant **:(P<0.01). GKM= Guar Korma Meal.

The enhancing of litter and kid weight gain of GKM treatment up to 5.0 % agree with Kamran *el al*., (2002) who recorded that the broiler chicks significantly gained more weight when fed on 5.0 % GKM. Turki *et al.* (2011) indicated an improvement in sheep body weight with 15% GKM feeding. On contrary Rajput *et al*., (1998) reported that increasing GKM level in diets decreased BWG and agree with Edward *et al*., (1988) who reported that GKM depressed the digestibility of starch and deprive the birds of the available energy. Increasing level of GKM than 5.0 % had a depression effect in litter gain which may be due to increase the anti-

nutritional agents as guar gum, tripsin inhibitor, saponins, poliphenols and hemagelotenins (Verma and Mc-Nab, 1982; Conner, 2002; and Lee *et al*., 2003). Also, high content of galactomannan gum in guar meal can increase intestinal viscosity, suppress growth (Burnett, 1966; Lee *et al*., 2003 and Gutierrez *et al*., 2007).

The presented results of litter size, mortality rate and litter weight in kids Tables (5, 6 and 7) are in good harmony with the results of milk yield, whereas inclusion 5.0 % of GKM in does diets increased milk yield significantly compared with other groups. That excess of milk yield saved more quantities of nutrients for kids to survive and growth compared with rates in other treatments. In addition the increased average daily of kid of 2.5 % and 5.0 % GKM treatments during suckling period might be improving the general microbial status of their colon due to beginning of feeding from their mothers feed (Bengmark, 1998; Duncan *et al*., 2002 and Mohamed, 2014).

4-Blood biochemical analysis:-

a-Plasma proteins and liver function:

As shown in Table 8, adding 5.0 % GKM to doe rabbit diets significantly increased concentrations of total protein and globulin compared to other groups, while decreased albumen/globulin ratio compared with 10.0 % GKM group. These results indicated that inclusion 5.0% GKM in does diet might be improved rabbit immunity and protein supply to milk production compared with other treatments. Adding the GKM to doe rabbits diet did not alter activities of AST and ALT enzymes compared to untreated control group and that mean, these treatment GKM haven't adverse effect on liver function. The obtained results showed increased level of total protein albumen by inclusion 2.5 % and 5.0 % of GKM in does diet, however the experimental diets of all treatments were formulated to be equal in protein and digestible energy. These results might be support the suggestion of improving performance through enhancing the microbial status of colon by using GKM as feed ingredient (Bengmark, 1998; Duncan *et al*., 2002 and Mohamed, 2014). The high content of the guar meal protein offers a good source of essential amino acids for cattle (Turki *et al.*, 2011) and enhancing the digestion. On contrary, Salma *et al.*, (2015) found that the concentrations of total protein, albumin and globulin in blood serum of broiler decreased significantly with replaced GKM at 25 % and 50 % and 75 % from SBM diets compared with control group.

Table 8: Biochemical parameters in blood of doe rabbits of the experimental groups.

Items	GKM (%)					Pooled SE	Sign.
	0.0	2.5	5.0	7.5	10.0		
Plasma protein and liver function							
Total protein (g/dl)	5.39 [b]	5.51 [b]	6.13 [a]	5.20 [bc]	4.85 [c]	±0.13	*
Albumin (g/dl)	2.75 [b]	2.82 [ab]	2.98 [a]	2.77 [b]	2.70 [b]	±0.06	*
Globulin (g/dl)	2.64 [b]	2.69 [b]	3.15 [a]	2.43 [bc]	2.15 [c]	±0.15	*
Albumin/ Globulin ratio	1.04 [ab]	1.05 [ab]	0.95 [b]	1.14 [ab]	1.26 [a]	±0.08	*
Activity of AST (U/ml)	32.03	31.41	31.34	31.77	31.87	±0.73	NS
Activity of ALT (U/ml)	24.07	24.69	25.86	23.94	25.35	±0.68	NS
Plasma lipids and glucose							
Triglycerides (mg/dl)	146.5[a]	136.93[b]	123.65 [c]	132.03[b]	135.71[b]	±12.75	*
Total cholesterol (mg/dl)	88.54 [a]	81.85 [b]	76.20 [b]	80.87 [b]	79.83 [b]	±9.93	*
HDL (mg/dl)	45.65 [a]	39.08 [b]	35.11 [b]	36.87 [b]	38.97 [b]	±5.63	*
LDL (mg/dl)	37.82 [a]	30.87[b]	27.65 [b]	27.98 [b]	33.17 [b]	±5.07	*
Glucose (mg/dl)	123.90 [ab]	122.31[b]	131.13 [a]	112.8[c]	121.4 [b]	±2.46	*

[a, b....] Means within each row have different letter(s) are significantly different.
NS: Not significant, *:(P<0.05), GKM= Guar Korma Meal.

b-Plasma lipids and glucose:

According to results in Table (8), adding GKM at levels 2.5, 5.0, 7.5 or 10.0 % to doe rabbits diet enhance plasma lipid profile whereas concentrations of total cholesterol, HDL, LDL and triglycerides, while concentration of glucose was increased significantly by using 5.0 % GKM compared with 2.5, 7.5 and 10.0 % inclusion rate of GKM in does rabbit diet. Numerous investigations have shown some useful physiological functions of galactomannans, such as those found in guar meal. These functions include decrease in plasma cholesterol (Maisonnier *et al.*, 2001), plasma glucose (Ou *et al*., 2001). The obtained results of 5.0 % (GKM) may be due to lower lipid metabolism by lowers cholesterol and LDL in body pool. In this respect Salma *et al.,* (2015) recorded that serum triglycerides, cholesterol, HDL and LDL concentrations decreased significantly for group fed on control group followed by the group fed on (GKM-25 % substitution for SBM), while (GKM-75% substitution for SBM) had the highest concentrations. Cholesterol was significantly affected by experimental treatments; these probably were because of the eating of high levels of guar meal .In other studies authors reported that the high viscosity of guar gum may contribute to some beneficial physiological functions including decreasing plasma cholesterol (Fairchild *et al*., 1996; and Ou *et al*., 2001). On contrary with, (Shahbazi, 2012) who found that blood biochemical parameters were not affected by guar meal including

three levels of GKM (0.0, 25 and 50.0 g kg^{-1}) except for the serum level of cholesterol was increased.

On the other hand Mohamed and Kazem (2012) showed that intermediate and high GKM levels in diets (4 and 6 %) increased plasma triglycerides compared to the control group. Also there was a tendency for LDL to be affected by experimental groups. Plasma HDL was higher than the control group in the birds fed on the diet contained high levels of GKM (6 %). Triglycerides, cholesterol and HDL were significantly affected by experimental treatments.

According to the overall results of growth performance and physiological measurements, using GKM at level 5.0 % compared with other treatments showed the best performance. This may be due to increasing the *Lactobacillus* with decreasing count of cecal *Salmonilla spp.* and *E.Coli* (Mohamed 2014), or increasing blood protein or decreased triglyceride and LDL and that due to enhance blood circulation and metabolism and the useful of nutrients.

Feed cost:

Results of feeding cost for does fed GKM are summarized in Table 9. Using GKM decreased price of kg feed and total feed cost does compared with control group. However, the relative difference of feeding cost of each treatment to control showed that, the group feed on 5.0 % GKM (which recorded the best performance and the highest litter size) saved cost more than other groups when was taken the litter size in consideration. That's served our aimed to find cheaper protein source.

Table 9. Effect of guar korma meal on feeding cost of rabbit does.

Items	GKM (%)				
	0.0	**2.5**	**5.0**	**7.5**	**10.0**
Price/kg diet (LE)	2.65	2.61	2.56	2.51	2.5
Total feed intake/ doe/gestation and suckling period(kg)	10.05	9.61	10.36	9.34	9.35
Litter size at weaning	6.63	5.62	6.88	4.75	4.38
Total feed cost /doe (LE)	26.60	25.08	26.52	23.44	23.38
Total feed cost/ litter (Total feed coast/ litter size at weaning)	4.01	4.46	3.85	4.93	5.34
Relative difference of feeding cost from control*(%)	--	11.22 (increase cost)	3.40 (saving cost)	22.94 (increase cost)	33.17 (increase cost)

- **Relative difference of feeding cost from control** = 100 x (Feeding cost/doe each treatment - Feeding cost/doe of control group)/ Feeding cost/doe of control group).

Conclusively, from these results it could be recommended to include guar korma meal (GKM) in doe-rabbit diet up to 5.0% of the diet without negative effect on performance during gestation and lactation periods. In addition, using 5.0 % GKM saved some of feeding cost/ weaning litter more than other group compared with control group.

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تأثير كسب الجوار كورما فى علائق أمهات الأرانب النيوزيلاندى الأبيض على الأداء الإنتاجى والفسيولوجى

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تمت هذه الدراسه لتقيم تأثير إدخال معدلات من كسب الجوار (*Gyamopsis tetragonloba* L.) كورما (GKM) فى عليقة الأرانب على أداء أمهات الأرانب النيوزيلاندى الأبيض خلال فترتى الحمل والرضاعه وعلى نمو المواليد حتى الفطام. تم توزيع أربعون من أمهات اللأرانب النيوزيلاندى المتعددة الولادات عمر (٨-١٢) شهر الى خمس معاملات تغذى على علائق ٠ (كنترول) و ٢,٥ و ٥و ٧,٥ و ١٠ % كسب الجوار كورما. تم تلقيح الامهات طبيعيا وتم تسكينهم منفصلين فى اقفاص منفرده. كل الحيوانات خضعت لنفس برنامج الرعايه وتحت نفس الظروف الوقائيه. تم تسجيل وزن الامهات و الغذاء المأكول بعد الولاده وبعد الفطام و أيضا عدد الخلفات و وزنها أسبوعيا وتكلفة العليقه وتقدير بعض مكونات الدم. أظهرت النتائج ان التغذيه على مستوى ٥ % جوار أدى الى الزياده المعنويه فى الغذاء المأكول خلال فترتى الحمل والرضاعه ، بينما ادت التغذيه على نسبة ٧,٥ و ١٠ % من الجوار الى انخفاض معنوى فى الغذاء المأكول. سجلت الأمهات المغذاه على ٥ % جوار معنويا أعلى إنتاج للبن خلال الأربع اسابيع رضاعه بالمقارنه بباقى المعاملات. أدى إستخدام ٥ % من الجوار لعلائق الأمهات الى زيادة عدد الخلفات عند الولاده والفطام بالمقارنه بالكنترول و ٢,٥ و ٧,٥ و ١٠ % من الجوار. وكذلك أدى إستخدام مستوى ٥ % الى زيادة معنويه فى وزن الخلفات عند الولاده والزياده فى الوزن للفطام خلال الاربع اسابيع بينما قلت بباقى المعاملات. ادى إستخدام الجوار بنسبة ٢,٥ و ٥ % الى زيادة وزن الارنب المفطوم والزياده فى الوزن للأرنب الواحد والزياده اليوميه له بالمقارنه بباقى المعاملات. أظهرت نتائج تحاليل مكونات الدم زياده تركيز البروتين الكلى والالبيوميين والجلوبيولين والجلوكوز فى الدم عند مستوى ٥ % جوار، بينما سجلت الكنترول اعلى تركيز للجلسريدات الثلاثيه و الكوليسترول الكلى و الليبوبروتينات المنخفضة الكثافه والليبوبروتينات المرتفعه الكثافه فى الدم. ايضا لم يكن هناك اى تأثير لأستخدام الجوار فى العليقه على نشاط انزيمات الكبد ALT, AST . كما أوضحت النتائج أن العليقه المحتويه على ٥ % جوار هى الأقل تكلفه بالمقارنه بباقى المعاملات.

التوصية: من خلال النتائج المتحصل عليها يمكن التوصيه بإستخدام كسب الجوار كورما حتى مستوى ٥ % فى علائق أمهات الأرانب النيوزيلاندى الأبيض بدون أى تأثيرات سلبيه على الأداء الإنتاجى خلال فترتى الحمل والرضاعه بالإضافه إلى توفير جزء من تكاليف التغذيه عند مستوى ٥ %.