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PERFORMANCE OF GROWING RAHMANY LAMBS FED ON RATIONS CONTAINING JOJOBA MEAL

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ABSTRACT

Two experiments were conducted to study the effect of using jojoba meal in ration on growing lambs performance. The first experiment was carried out to determine the *in vitro* disappearance of dry and organic matter (IVDMD and IVOMD) of the different experimental concentrates containing different levels of jojoba meal from 0 to 24% instead of undecorticated cottonseed meal.Depending on the results of first experiment 20 growing Rahmany lambs (about 6 mouths old and 21kg body weight) were used to evaluate the effect of feeding jojoba rations on the growth performance. Animals were randomly assigned into 4 similar feeding groups (5 animals each) to fed one of the experimental rations, all rations consisted of 50% roughage (25% clover hay + 25% rice straw) and 50% concentrate feed mixture (CFM) without jojoba meal (R1, control), 3% jojoba meal (R2), 6% jojoba meal (R3) or 9% jojoba meal (R4).

Rations were formulated to cover maintenance and growth requirements of the growing lambs according to NRC, 1994. At the end of feeding trial nutrients digestibility, blood, rumen and carcass treats were be carried out.

Results of second experiment indicated that the digestibility of DM, OM, CP, EE, NFE and nutritive value expressed as TDN decreased ($P<0.05$) with increasing the level of jojoba meal in the rations, except CF digestibility and nutritive value expressed as DCP of lambs fed R4 recorded higher values ($P<0.05$) than the other rations. Also, animals fed R4 recorded higher ($P<0.05$) values of blood serum albumin and globulin, feed efficiency expressed as kg DM, TDN and DCP /kg gain among the other groups. On the other hand total protein, GPT and GOT concentration, ruminal pH values and DCP intake were not significantly ($P<0.05$) affected by the jojoba meal levels.

Lambs received R1 and R2 showed higher ($P<0.05$) albumin/ globulin ratio, NH_3-N, weight gain, feed intake expressed as DM or TDN, hot carcass weight, dressing percentage, rumen full and empty, pelt, tail weight separable fat, meat and fat in carcass compared with those in other rations . Carcass characteristics of lambs were significantly less ($P<0.05$) affected by addition of jojoba meal to rations.

Conclusively, it could be recommended that replacing undecorticated cottonseed meal with jojoba meal (till 9%) in growing lambs rations seems to be the best for good performance and economic efficiency.

Keywords: Jojoba meal, lamb, digestibility, blood, growth performance and economical efficiency

INTRODCATION

Jojoba (*Simmondsia chinensis*) is one of some untradional sources of feed proteins which contains high protein, approximately 30 % or more. Jojoba could be used as feed ingredient to formulate balanced rations. It is a dioeciously desert shrub that grow on arid or semi arid regions. Is cultivated

to provide renewable source of unique high quality oil (Sabien *et al*., 1997). The meal remaining after the oil has been extracted contains high protein and therefore should be interest for livestock producers as a feed supplement (Motawe 2005). The major problem of using jojoba meal is the high level of anti-nutrition compounds as simmondsia and simmondsia-2-ferulate (Boven *et al*., 2000 and Khalel *et al*., 2008), which can be mitigated by various treatments. The major jojoba proteins were albumins 79% and globulins 21%, which have similar amino acid compositions and also showed a labile thrombin-inhibitory activity (Shrestha *et al*., 2002). The lambs were given rations containing 5% or 10% jojoba meal, residues of simmondsin and simmoudsia-2-ferulate were not detected in kidney, liver , muscle or blood Manos *et al*. (1986). Swingle *et al*. (1985) reported that the digestibility of dry matter, organic matter, gross energy, nitrogen retention and daily gain were lower ($P<0.05$) for the concentrate rations containing 10% treated jojoba meal (TJM) compared with the concentrate rations containing 10% undecorticated cottonseed meal (CSM). Carcass characteristics of lambs were not significantly affected by addition of jojoba meal to rations, but slaughter weight of jojoba meal was significantly less with both (5% or 10%) levels of jojoba meal (Charles *et al*., 1986).

The aim of this study was to evaluate the effect of replacing cotton seed meal by different levels of jojoba meal in the ration for lambs on digestibility, nutritive value, rumen activity, some blood parameters, productive performance and carcass characteristics.

MATERIALS AND METHODS

Two experiments were conducted in this study; the first one was carried out at the laboratory of Animal Production Research Institute, Ministry of Agriculture, in order to determine the *in vitro* disappearance of dry and organic matter (IVDMD and IVOMD) of the different experimental concentrate mixtures containing different levels of jojoba meal as replacement with cottonseed meal.

The second experiment was carried out at Mahallat Mousa Station, Animal Production Research Institute, Ministry of Agriculture in order to study the productive performance and carcass characteristics of lambs fed three experimental rations containing different levels of jojoba meal.

Experiment I:

An experiment was carried out to determine the *in vitro* DM and OM disappearance using the method of Tilley and Terry (1963). Nine concentrate feed mixtures were made as show in Table (1) to contain different levels of jojoba meal.

Table 1: Feed ingredients (%) of experimental concentrate feed mixtures containing jojoba meal.

Items	T1	T2	T3	T4	T5	T6	T7	T8	T9
Wheat bran	38	38	38	38	38	38	38	38	38
Yellow corn	31	31	31	31	31	31	31	31	31
Undecorticated Cottonseed meal	24	21	18	15	12	9	6	3	—
Jojoba meal	—	3	6	9	12	15	18	21	24
Molasses	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Limestone	2	2	2	2	2	2	2	2	2
Common salt	1	1	1	1	1	1	1	1	1
Vits&Mins mixture*	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

T1: control, T2: 12.5% of cotton seed meal was replaced by jojoba meal, T3: 25% of cotton seed meal was replaced by jojoba meal, T4: 37.5% of cotton seed meal was replaced by jojoba meal , T5: 50% of cotton seed meal was replaced by jojoba meal, T6: 62.5% of cotton seed meal was replaced by jojoba meal, T7: 75% of cotton seed meal was replaced by jojoba meal, T8: 87.5% of cotton seed meal was replaced by jojoba meal, T9: 100% of cotton seed meal was replaced by jojoba meal.

***Vits & Mins mixture per kg contained : vit.A 2,000,000 IU , D_3 150000 IU , E 8.33g , B_1 0.33g , B_6 1.7mg , B_2 1.0g , B_5 8.33g , K 0.33mg , Pantothanic acid 3.33g , Biotin 33mg , folic acid 0.83mg , Choline chloride 200mg , Mg 66.7g , Cu 0.5g , Se 16.6mg , Zn 117g and Fe 12.5g .**

Anti-nutritional compounds analysis:

Simmondsia was quantified by high performance liquid chromatography using au-parasail C_{18} column (Whatman, 300×4.6mm) eluting with methanol / water (25:75) at a flow rate of 1.5ml and detected at 217 nm as described by Verbiscar and Banigan (1978). Total phenolics were determined by the Folin-Deuis colorimetric method using tannic acid as a standerd Joslyn and Goldstein (1964). Phytic acid concentration was measured according to the method of Wheeler and Ferrel (1979).

Experiment Π:

Twenty growing Rahmany lambs (about 6 months old and 21 kg body weight) were assigned randomly into four similar groups to fed one of the following rations:

R1: 50% concentrate feed mixture (CFM) without jojoba meal+ 25% clover hay + 25% rice straw (control ration).

R2:50.0% CFM (3% jojoba meal) + 25% clover hay + 25% rice straw.

R3: 50% CFM (6% jojoba meal) + 25% clover hay + 25% rice straw R4: 50% CFM (9% jojoba meal) + 25% clover hay + 25% rice straw.

The lambs were fed according to NRC, 1994 for growing. All lambs were kept under semi-open sheds and restricted daily feeding was applied. Fresh water was available freely through the experimental period which lasted 135 days. The CFM was individually weighed for each animal and offered twice daily at 7 am. and 4 pm. , while roughage was offered at 8 am. and 5 pm.

Daily feed intake and weekly body weight of each lamb were recoded and then feed and economic efficiency were calculated. Feed allowance was adjusted weekly according to the change in body weight. Chemical analysis of different feedstuffs and calculated chemical composition of the experimental rations are presented in Table (2).

Blood samples were collected at 4 hours after morning feeding from jugular vein of each lamb at the last day of feeding period. The collected blood samples were centrifuged at 4000 r.p.m for 20 minutes. The obtained serum was stored at -8°C till analysis for total protein, albumin, urea-N, GOT and GPT which determined according to Henery (1964), Doumas (1971), Patton and Croch (1977) and Reitman and Frankel (1957), respectively. While globulin was calculated bt difference (Total protein-albumin). During the last month of the feeding experiment, three animals of each treatment were randomly chosen for digestion trials. Each trial lasted for four weeks, the first three weeks were as a preliminary period, followed by one week for feces collection, as described by Maynard, *et al*. (1979). Rumen fluid samples were taken individually from three lambs of each group before morning feeding , 3 and 6 hours of feeding for two periods throughout the experimental trial (at the mid and at the end of the feeding trial). Rumen fluid was obtained by using stomach tube with an aid of vacuum pump, the pH was measured immediately after rumen sample collection using a digital pH meter, Rumen fluid was strained through four layers of cheese cloth into plastic conditioners and kept for later analysis. The ammonia nitrogen concentration (NH_3-N) was determined using Con-way (1957) method and total VFA's concentration was determined by steam distillation as mentioned by Eadie *et al*. (1967).

Table 2: Chemical composition (%) of feedstuffs and experimental rations (% on dry matter basis).

Items	DM	OM	CP	CF	EE	NFE	Ash	**	***	****
Feedstuffs:										
CFM	89.21	88.56	15.73	12.14	1.62	59.07	11.44			
Clover hay	88.19	89.02	12.01	28.56	2.41	46.04	10.98			
Rice straw	89.5	81.8	2.32	36.63	1.48	41.37	18.2			
Jojoba meal*	91.2	97.17	25.93	18.37	15.2	37.65	2.83	0.3	ND	ND
Jojoba meal	92.31	96.94	26.11	18.21	14.6	38.06	3.0	4.32	6.37	0.08
Rations:										
R1	98.03	86.98	11.45	22.37	1.78	51.38	13.02	0.02	ND	ND
R2	89.1	87.24	11.75	22.56	2.19	50.74	12.77	0.02	ND	ND
R3	89.15	87.51	12.06	22.74	2.59	50.12	12.49	0.03	ND	ND
R4	89.22	87.76	12.36	22.93	3.0	49.47	12.24	0.04	ND	ND

***Treated jojoba meal with heat at the manufacture **simmondsin ***poly phenolies ****phytic acid**

At the end of the feeding experiment, three lambs were slaughtered according to Islamic rites. After complete bleeding, head, feet and pelt, offals and thoracic and abdominal organs were removed and weighed. A 9-10-11th ribs sections were removed from the right side of each lamb. Ribs were dissected into lean (L), fat (F) and bone (B). The meat of the 9-10-11th ribs were chemically analyzed to determine moisture, protein, ether extract and ash percentage. Area of rib eye was measured as described by USDA (1968). Feed and fecal samples were chemically analyzed according to the methods of AOAC (1995). Data were statistically according to SAS (2000). Differences among means were determined by using Duncan's test (1955).

RESULTS AND DISCUSSION

1-The first experiment :

1. a. Effect of different levels of jojoba meal on chemical composition of experimental rations:

The effect of different levels of jojoba meal on chemical composition are presented in Table (2). There was increase in percentage of DM, OM, CP, CF and EE with increasing the level of jojoba meal in the ration. On the other hand, results showed decrease in percentage of NFE and ash with increasing the level of jojoba meal in the rations. Concerning the percentage of concentration of anti-nutritive compounds (simmondsin, poly phenolies and phytic acid), results indicated that heat treatment had positive affect on decreasing concentration of anti-nutrition compounds. These results are in agreement with Bellirou *et al*. (2005), El-Shennawy, 2005 and Khalel *et al*. (2008) who reported that heat treatment decreased the concentrate of simmondsin, poly phenolies and phytic acid by about 95, 93 and 92%, respectively. Also, Ahmed and Satti (2002) showed that moist heating of jojoba meal had an effect on decreasing levels of toxicolics.

1. b. Effect of different levels of jojoba meal on DM and OM disappearance:

Results pertaining to *in vitro* dry-and organic matter disappearance (IVDMD and IVOMD) of the different concentrates mixtures containing different levels of jojoba meal T3 are shown in Table (3). Values of IVDMD and IVOMD decreased with increasing the level of jojoba meal in the concentrate mixtures. The IVDMD and IVOMD of the treatments T2, T3 and T4 were almost similar 61.1, 60.7 and 60.2; 61.7, 60.5 and 60.3, respectively and decreased with increasing the level of jojoba meal replaced of the cottonseed meal in the concentrate mixtures. The percentage of cottonseed meal which substituted by 12.5, 25 and 37.5 % of jojoba meal, respectively were better compared with the other treatments. These results are in agreement with those obtained by Bargo *et al*. (2001) who reported that the *in vitro* dry-and organic matter disappearance were decreased with increasing the level of jojoba meal in the rations. This might be attributed to that increasing the level of jojoba meal in rations had a negative effect on microbial activity. Verbiscar *et al*. (1980) and Ahmed and Satti (2002) reported that most heating of jojoba meal had an effect on lowering levels of toxicants.

2-The second expermint :

The preliminary results of the first experiment showed better *in vitro* dry and organic matter disappearance (IVDMD and IVOMD) when the percentage of cottonseed meal were replaced by12.5, 25 and 37.5 % of jojoba meal respectively.

Table 3: *In vitro* disappearance of dry and organic matter experimental CFM containing on different level of jojoba meal

Items	T1	T2	T3	T4	T5	T6	T7	T8	T9
IVDMD%	62.4	61.1	60.7	60.2	59.2	58.5	58.1	57.9	57.6
IVOMD%	61.9	61.7	60.5	60.3	59.6	59.1	58.8	58.6	58.4

1- Effect of different levels of jojoba on digestion coefficients and feeding values:

Data in Table (4) clearly indicated that lambs fed on control ration (R1) recorded higher digestibility value of DM, OM, CP, EE, and feeding value expressed as TDN than those fed R2 and R3, differences were not significant (P<0.05). However, the lambs fed (R4) recorded the lowest (P< 0.05) digestibility values. Concerning the feeding value expressed as DCP, data in Table (4) showed that animals fed 3% jojoba meal ration (R2) recorded lower values compared with the other treatments, however differences were not significant.

Generally, results showed that there was liner decrease in all digestibility nutrients of the tested rations with increasing jojoba level, except CF digestibility of lambs fed (R4) ration which recorded higher (P<0.05) values compared with the control ration (R1). The CF digestibility was improved with increasing the level of jojoba meal in the ration. The highest CF digestibility may be due to the increasing level of jojoba, which provide stimulatory factors to rumen microbial activity in particularly cellulolytic bacteria and so in rate of digestion. These results are in agreement with those reported by Swingel *et al*. (1985) who reported that the digestibility of DM, OM and gross energy were lower (P>0.05) when steers fed on rations containing 70% concentrate (10% treated jojoba meal) compared with 70% concentrate (10% cottonseed meal). Besides Ham *et al*.(2002) showed that the low level (2.77%) of jojoba meal in the rations did not influence the digestibility, but the higher level (8.1%) of jojoba meal reduced the digestibility of all nutrients.

Table 4: Nutrients digestibility and feeding value of lambs fed the different experimental rations (% on dry matter basis).

Items	Experimental groups			
	R1	R2	R3	R4
Nutrients digestibility,%				
DM	68.69	68.40	67.80	66.42
OM	70.02[a]	69.87[a b]	68.43 [a b]	65.27 [b]
CP	61.22 [a]	59.17 [a b]	58.92 [a b]	57.50 [b]
CF	55.65 [b]	56.43 [a b]	57.12 [a b]	58.84 [a]
EE	65.92	64.58	64.24	63.85
NFE	76.96 [a]	76.44 [a b]	75.69 [a b]	72.28 [b]
Feeding value,%				
TDN	63.23 [a]	62.49 [a b]	61.78 [a b]	57.55 [b]
DCP	7.01	6.95	7.11	7.12

a and b means of different letter in the same row are significant different. (P<0.05)

2- Blood parameters:

Data in Table (5) showed that blood serum constituents are within the normal range as determined by many researchers (Abd El-Rahman *et al*., 2003 and EL-Ashry *et al*., 2008). Results here in cleared that the highest (P<0.05) concentration of albumin and globulin were recorded for R4 followed by R3, while R1 (control ration) recorded the lowest values. This may be resulted from the higher percentage of CP level with increasing the level of jojoba meal in rations (Table 2). The highest (P<0.05) values of A/G ratio and urea-N were recorded of R1 and R2 followed by R4 and R3. On the other hand, the total protein, GPT and GOT were not affected by the level of jojoba meal in ration, showing no significant differences. These results indicated that no observable changes were detected in kidney and liver ultrastructure in any of the different groups. These results may be due to the low of simmoudsia (Table 2) in the tested rations. These results coincided with those obtained by Manos *et al.* (1986) and Charles *et al*. (1986) who noticed that lambs fed 10% jojoba meal rations had significantly lower (P< 0.05) blood urea-N than those of the other dietary treatment groups (10% treatment jojoba meal or 10% cottonseed meal).

Table 5: Blood serum constitutes of lambs fed the different experimental rations.

Items	Experimental groups			
	R1	R2	R3	R4
Total protein (g/dl)	5.3± 0.3	5.22± 0.4	5.37± 0.1	5.43± 0.1
Albumin g/dl	3.82 b ±0.2	3.95 b ± 0.3	4.1 ab ± 0.2	4.28a± 0.2
Globulin g/dl	1.25 b ± 0.2	1.27 b ±0.1	1.55 a ±0.1	1.59 a ±1.0
A/G ratio	3.06 a ±0.1	3.11 a ±0.1	2.67 b ±0.2	2.7 b ±0.04
Urea-N (mg/dl)	42.51a ± 1.8	41.87 a±1.3	35.89 b ±1.6	33.4 c±1.9
GPT Iu/L	10.73± 1.2	10.92±1.0	11.09± 1.1	11.32±1.2
GOT Iu/L	8.13± 0.4	8.15± 0.4	8.21± 0.4	8.28± 0.3

a , b and c means of different letter in the same row are significant different.

3- Rumen parameters:

The data of rumen parameters are summarized in Table (6). Results showed no significant differences among the experimental groups regarding the ruminal pH values. In this connection Bargo *et al*. (2001) and Khalel *et al*. (2008) reported that ruminal pH was not affected by the level or the source of protein. It is obvious that the ruminal pH values were increased with increasing the level of jojoba meal in the rations. At 2 hrs post feeding, pH declined of all groups to reach the lowest values at 6 hrs.

Before feeding NH_3-N values were 25.60, 23.51, 22.64 and 21.9 mg/100ml rumen liquor for R1, R2, R3 and R4, respectively. Differences were significant (P<0.05), being lower of R4 than the other treatments. Ammonia-N increased after feeding then reached to the highest values for all dietary treatments at 4 hrs being 26.20, 25.35, 24.45 and 23.17 mg/100ml rumen liquor, respectively. Concentration of NH_3-N was significantly higher (P<0.05) for the control group than the other groups. Ammonia–N decreased there after. Generally, the concentration of NH_3-N was decreased as the level of jojoba meal increased in the rations. However, ruminal NH_3-N concentration values revealed that it was sufficient for microbial growth as described by Lu *et al*. (1990).

Table 6: Rumen parameters of lambs fed the different experimental rations:

Items	Experimental groups			
	R1	R2	R3	R4
pH				
0 hr	6.24±0.11	6.34±0.12	6.39±0.17	6.41±0.08
2 hrs	6.08±0.18	6.12±0.15	6.11±0.11	6.16±0.23
4 hrs	6.05±0.15	6.10±0.09	6.15±0.22	6.14±0.31
6 hrs	5.77±0.13	5.95±0.13	6.01±0.09	5.99±0.21
NH3-N				
0 hr	25.60a±1.11	23.51ab±0.59	22.64 b±0.47	21.91c±.069
2 hrs	24.84 a ±1.35	24.01ab±0.7	23.81 b±1.00	22.23c±0.82
4 hrs	26.20 a ±1.20	25.35 ab±1.1	24.45 b±0.74	23.17c±0.97
6 hrs	23.95 a ±0.85	21.78 ab±1.3	21.64 b±0.87	20.44c±0.81
TVFA's				
0 hr	9.86 a ±1.14	8.43 ab±0.59	7.14c±0.79	6.22d±0.64
2 hrs	13.73 a ±0.89	12.28 b±0.42	11.78c±0.47	10.84d±0.72
4 hrs	14.25 a ±0.77	13.41b±0.68	12.45c±0.59	11.72d±0.81
6 hrs	9.91 a ±0.81	8.75b±0.39	8.47 b±0.76	7.22c±0.46

a, b,c and d means of different letter in the same row are significant different. * (P<0.05)

Total VFA's was 9.86, 8.43, 7.14 and 6.22 mg/100m ruminal liquor before feeding for R1, R2, R3 and R4, respectively (Table, 6). In general, TVFA's decreased with increasing the level of jojoba meal in the rations. It increased in all treatment groups to reach its peak at 4-hr post feeding and decline there after. The lowest values were reported for R4 group, while the highest values were reported for the R1 group. The lower TVFA's values in R4 group may be due to the lowest microbial activity in the rumen. Jojoba meal supplemented rations decreased the concentration of total TVFA's compared with the control ration. This might be related to that energy and ammonia releases are nearly synchronized and enhance microbial production. Volatile fatty acids concentration, in the present study was good agreement with those obtained by Khalel *et al* . (2008).

4- Productive performance:

Results in Table (7) cleared that lambs fed high level of jojoba meal (R4) had lower (P>0.05) finial weight, total gain and daily gain compared with other treatments. This might be due to the generally decrease in nutrients digestibility and nutritive values for group (R4).The lambs fed 9% jojoba meal (R4) ration showed insignificant higher weight gain than the control ration. These results are in a good agreement with Swingle *et al*. (1985), Charles *et al*. (1986) and Ham *et al*. (2002) who concluded that weight gain was significantly lower for the lambs or steers fed 10% jojoba meal compared to 0 or 5% jojoba meal in the ration.

Concerning the feed intake, data in Table (7) showed that lambs group fed 9% jojoba meal (R4) recorded the lowest (P<0.05) DM and TDN intake. These results are supported by those reported by Cokelaere *et al.* (2000); Ham *et al*. (2002) and Shrestha *et al*. (2002) who found that feed intake as DM, TDN and DCP were decreased by increasing the level of jojoba meal in the rations. On the other hand, results of feed efficiency expressed as the

amount intake of DM, TDN and DCP (kg) to give one kg weight gain in Table (7) showed that the lambs fed 9% jojoba meal (R4) revealed worse feed efficiency. However, lambs fed 3% jojoba meal (R2) revealed better feed efficiency compared to other treatments. Improving feed efficiency of R2 group might be attributed mainly to the higher daily gain and nutrients digestibility. These results agreed with those reported by Cokelaere *et al*. (2000).

Table 7: Productive performance of lambs fed different experimental rations

Items	Experimental groups			
	R1	R2	R3	R4
Weight changes, kg:				
Initial weight (kg)	20.9±0.67	21±0.78	20.9±0.99	20.5±0.94
Final weight	44.4^{a}±1.10	45.2^{a}±1.06	42.9^{ab}±0.98	39.8^{c}±1.06
Total gain(kg)	23.5^{a}±0.52	24.2^{a}±0.90	22.0^{b}±1.0	19.3^{c} ±1.16
Daily gain	0.174^{a}±0.03	0.179^{a}±0.06	0.162^{b} ±0.08	0.142^{c}±0.08
Feed intake(kg):				
DM	1.60^{a}	1. 60^{a}	1.46^{b}	1.39^{c}
TDN	0.832^{a}	0.832^{a}	0.759^{b}	0.722^{c}
DCP	0.183	0.188	0.176	0.172
Feed efficiency:				
DM , kg/kg gain	9.19 ^{b}	8.94 ^{c}	9.01^{b}	9.79 ^{a}
TDN , kg/kg gain	4.78 ^{b}	4.65 ^{b}	4.69 ^{b}	5.08 ^{a}
DCP , kg/kg gain	1.05^{b}	1.05^{b}	1.09 ^{b}	1.21 ^{a}
Economic efficiency:				
Daily feed cost ,LE	1.88	1.68	1.36	1.127
Price of daily gain, LE	4.002	4.117	3.726	3.266
Feed cost LE/ kg	10.80	9.39	8.40	7.94
Relative economic efficiency	100	113.06	122.22	126.48

The price of feed stuffs and products; Feed Mixture / ton = 1800 (LE); Clover hay / ton = 950 (LE); Rice straw / ton=150(LE); Cottonseed meal / ton =1600(LE); Jojoba meal / ton = 800 (LE) and live body weight gain / kg =23(LE).

a , b and c means of different letter in the same row are significant different. (P<0.05)

The economic efficiency as shown in Table(7) revealed that the lambs fed 9% jojoba meal (R4) recorded the lowest daily feed cost and feed cost /kg gain (superior economical efficiency), followed by lambs in group (R3). Lambs groups fed control ration (R1) or (R2) had the most expensive daily feed cost and feed cost / kg gain.

5- Effect of dietary jojoba meal on carcass traits:

The effect of dietary jojoba meal on carcass traits of lambs is shown in Tables (8 and 9). Hot carcass followed the same pattern of the fasting body weight, being heavier (P>0.05) for control (R1) followed by R2 and R3 than for R4. Dressing percentage was higher (P>0.05) for the control group followed by R2 and R3 and lighter for R4. Differences were found to be significant for rumen full and empty and pelt fat. Weight and percentage of the organs were higher for R1 (control) followed by R2 and R3 and lastly for R4.Tail and separable fat weight and its percentage were also heavier in the same groups, however, differences were significant (P>0.05). No other differences were found regarding the other carcass traits (Table 8).

Table 8: Carcass traits of lambs fed different experimental rations.

Items	Experimental groups			
	R1	R2	R3	R4
Fasting weight , kg	44.40[a]±1.1	45.2 [a]±0.76	42.9[ab]±1.95	39.8 [b]±0.83
Hot carcass without offals, kg	21.50 [a]±0.66	21.4 [a]±0.35	20.1[ab]±0.39	18.2[b]±0.34
Dressing percentage %	48.42 [a]±0.53	47.35 [a]±0.42	46.85[ab]±0.4	45.8 [b]±0.61
Head , kg	2.9±0.10	3.03±0.07	3.07±0.04	2.73±0.07
%of fasting weight	6.35±0.14	6.70±0.08	7.16±0.05	6.86±0.05
Legs , kg	1.03±0.01	0.97±0.02	0.89±0.01	0.83±0.01
%of fasting weight	2.32±0.01	2.15±0.03	2.07±0.01	2.09±0.01
Rumen full , kg	10.5 [a]±0.09	10.0 [a]±0.86	8.9[ab]±0.29	8.16 [b]±0.34
%of fasting weight	23.65[a]±0.10	22.12 [a]±0.63	20.75 [b]±0.3	20.5 [b]±0.21
Rumen empty , kg	4.10 [a]±0.11	3.50 [b]±0.13	3.33 [b]±0.07	3.22 [b]±0.13
%of fasting weight	9.23 [a]±0.09	7.74 [b]±0.17	7.76 [b]±0.10	8.1[ab]±0.14
Testes , kg	0.44±0.01	0.48±0.01	0.46±0.02	0.38±0.04
%of fasting weight	0.99±0.004	1.06±0.007	1.07±0.01	0.95±0.02
Spleen , kg	.065±0.001	0.07±0.002	0.06±0.002	0.05±0.001
%of fasting weight	0.15±0.002	0.14±0.001	0.14±0.001	0.14±0.001
Kidneys , kg	0.14±0.008	0.13±0.003	0.13±0.007	0.12±0.007
%of fasting weight	0.31±0.005	0.29±0.002	0.29±0.004	0.31±0.003
Pelt , kg	4.60 [a]±0.27	4.30 [a]±0.18	3.93[ab]±0.16	3.5 [b]±0.25
% of fasting weight	10.36 [a]±0.21	9.51[a b]±0.01	9.11[ab]±0.20	7.79 [b]±0.21
Heart , kg	0.167±0.01	0.165±0.01	0.166±0.04	0.153±0.03
%of fasting weight	0.38±0.007	0.37±0.005	0.39±0.006	0.38±0.004
Liver , kg	0.75±0.006	0.71±0.01	0.65±0.02	0.69±0.01
%of fasting weight	1.69±0.003	1.57±0.007	1.52±0.01	1.72±0.008
Lungs and trachea ,kg	0.68±0.02	0.63±0.007	0.57±0.02	0.59±0.013
%of fasting weight	1.53±0.03	1.39±0.004	1.33±0.02	1.48±0.01
Tail weight, kg	0.82 [b]±0.06	0.56 [c]±0.07	1.29 [a]±0.05	0.9[ab]±0.08
%of fasting weight	1.85 [b]±0.03	1.24 [c]±0.04	3.0 [a]±0.02	2.3[ab]±0.05
Separable fat*, kg	2.02 [a]±0.12	1.68 [b]±0.13	1.94[ab]±0.11	1.49 [c]±0.16
%of fasting weight	4.55 [a]±0.16	3.72 [b]±0.11	4.52 [a]±0.12	3.74 [b]±0.15

***Separable fat included : Omentum, Kidney fat , heart fat and fat tail**

a , b and c means of different letter in the same row are significant different. (P<0.05)

Table 9: Fat and physical characters of the 9-10-11th ribs of the lambs fed different experimental rations.

Items	Experimental groups			
	R1	R 2	R 3	R 4
Fat thickness over the rib (mm)	2.10±0.18	2.09±0.11	2.11±0.11	1.9 a±0.09
Fat thickness over the rib eye (mm)	1.0±0.06	1.28±0.03	1.20±0.13	1.16 0.04±
Rib eye area,(cm)	20.32±0.64	20.81±0.81	19.5±0.81	19.2 ±0.39
Lean (L)	55.35±1.45	54.40[ab]±0.92	53.9b±1.2	53.20 b±0.2
Fat (F)	28.21[a]±0.58	27.54[b]±0.31	27.59 b±0.7	26.2 c±0.6
Bone (B)	16.44[c]±0.30	18.06[b]±1.35	18.52 b±1.5	20.03 a±0.9
L / F ratio	1.96±0.23	1.98±0.21	1.95 ±0.17	2.03 ±0.2
L / B ratio	3.37 [a]±0.31	3.01ab±0.19	2.91ab±0.13	2.3b±0.027
Meat in carcass	11.9 [a]	11.65ab	10.83 b	9.7 c
Fat in carcass	6.07 [a]	5.89ab	5.55 b	4.78 c
Bone in carcass	3.53	3.86	3.75	3.75

a , b and c means of different letter in the same row are significant different. (P<0.05)

$$\text{L, F and B in carcass} = \frac{\text{L, F and B in eye muscle}}{\text{Eye muscle weight}} \times \frac{100}{100} \times \text{carcass weight}$$

Lean (L) and fat (F) percentage were significantly higher for R1 (control) group than the other rations. Bone percentage followed the opposite trend with significant differences (P>0.05). This led to a higher lean to bone ratio for R1 ration than the other treatments. On the other hand, L/F ratio

showed the reverse trend being higher for R4 compared with other treatments, differences were not significant. Carcass meat and fat decreased with increasing the level of jojoba meal in the rations. This indicates that animal fed R1 and R2 deposited more lean and fat which may be explained on the basis that animals were still active in depositing protein and needed more energy to do it. The results of eye muscle were less of R4 group than other treatments and differences were not significant. These results are in agreement with Charles *et al*. (1986) who reported that carcass characteristics of lambs were significant less ($P<0.05$) affected by addition 5 or 10% jojoba meal in ration. Measures of separable fat are closely related to live weight or carcass weight within groups of lambs of similar genetic background (Shahin 2000).

Finally, It could de concluded that feeding growing lambs on 9% jojoba meal in the ration had superior economical efficiency, but digestibility, daily gain and some carcass traits were improved with decreasing the levels of jojoba meal in the rations.

Further studies are needed for long run experiment in order to define the metabolic compounds could be found in the products (meat and milk) of different animals fed such jojoba meal.

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أداء الحملان الرحمانى النامية المغذاة على علائق تحتوى كسب الجوجوبا

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اجريت تجربتان لدراسة تأثير استخدام كسب الجوجوبا فى العليقة على اداء الحملان الرحمانى النامية ، حيث اجريت التجربة الاولى لتقدير معدل اختفاء المادة الجافة والعضوية معمليا لمخاليط المركزات التجريبية المحتوية على نسب مختلفة من كسب الجوجوبا كبديل لكسب القطن غير المقشور بمستويات من ٠ : ٢٤% .

اعتمادا على نتائج التجربة الاولى تم استخدام ٢٠ حمل رحمانى نامى (عمر ٦ اشهر ومتوسط وزن ٢١ كجم) لتقييم تأثير تغذية الحملان علائق تحتوى كسب الجوجوبا على كفاءة النمو. تم عشوائياً تقسيم الحيوانات الى اربع مجموعات متماثلة (٥/ مجموعة) لتغذى على إحدى العلائق التجريبية، جميع العلائق احتوت على ٥٠% علف خشن (٢٥% دريس برسيم+٢٥% قش أرز) و ٥٠ % مخلوط علف مركز بدون كسب الجوجوبا (مج١، كنترول)، ٣% كسب جوجوبا (مج٢)، ٦% كسب جوجوبا (مج٣) أو ٩% كسب جوجوبا (مج٤). وفى نهاية تجربة النمو تم تقدير معاملات هضم العناصر الغذائية المختلفةو قياسات الدم والكرش والذبيحة. .

اظهرت نتائج التجربة الثانية انخفاض معنوى فى معامل هضم المادة الجافة والعضوية والبروتين الخام والمستخلص الاثيرى والمستخلص خالى الازوت والقيمة الغذائية فى صورة مركبات غذائية مهضومة كلية (TDN) وذلك بزيادة مستوى كسب الجوجوبا فى العلائق التجريبية ، على الرغم من الحملان المغذاة على عليقة احتوت ٩% كسب جوجوبا حققت اعلى معامل هضم للالياف الخام وقيمة غذائية فى صورة بروتين خام مهضوم (DCP) مقارنة بباقى المجموعات الغذائية .ولوحظ ايضا ان مجموعة الحملان المغذاة على ٩% كسب جوجوبا سجلت اعلى قيم معنويا لكل من مستوى ألبيومين وجلوبيولين سيرم الدم وكفاءة التحويل الغذائى (كجم مادة جافة وTDN/ كجم زيادة فى وزن الجسم) مقارنة بالمجموعات الاخرى . ومن جهة اخرى لم يتأثر معنويا تركيز كل من البروتينات الكلية لسيرم الدم ووظائف الكبد وقيم درجة حموضه الكرش والمأكول من البروتين الخام المهضوم بالمستويات المختلفة لكسب الجوجوبا .

بناء على ذلك يمكن التوصية باحلال كسب الجوجوبا محل كسب القطن غير المقشور حتى مستوى ٩% فى علائق الاغنام النامية لتحقيق افضل اداء انتاجى وكفاءة اقتصادية .