EFFECT OF ROCKET OIL ADDITION ON PRODUCTIVE AND REPRODUCTIVE PERFORMANCES AND SOME BLOOD PARAMETERS OF CROSSBRED EWES

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SUMMARY

Thirty-six crossbred ewes (½ finish Landrace x ½ Rahmani) aged 3-6 years and averaged live body weight (47.3 ± 1.73 kg) were randomly divided into three groups (12 ewes in each) according to their live body weight and reproductive history. All ewes were fed the same basal ration contained (CFM 50% and fresh berseem 50% on DM basis. Rocket oil (watercress oil) was received daily at levels 0.0,1.00 and 2 mg / 10 kg LBW for G1, G2 and G3, respectively. The experimental period was lasted for 150 days consisted of 3 periods, (late pregnancy 45 days), suckling (60 days) and rest or flushing (45 days). Income ewes in mating season was also studied. The results showed that the body weight changes of ewes during the different physiological stages as affected by rocket oil treatment were significantly gradually increased. The changes were higher ($P < 0.05$) in G3 by about 9.8% and in G2 by about 9.2% than control (8.2%). Average 6% FCM yield was higher ($P < 0.05$) in G2 and G3 than G1 being 564.7 and 626.5 vs 499.5 g, respectively. Percentage and yield of milk constituents were higher ($P < 0.05$) in G3 and G2 than G1 expect lactose% and solid not fat%. Ewes in G3 and G2 treated with rocket oil attained the best utilization efficiency as DM, TDN and DCP compared with those in G1. Concentrations of serum total protein and albumin were increased ($P < 0.05$) with rocket oil additive as compared with G1. While, creatinine, AST cholesterol and triglyceride concentration in blood serum were the highest ($P < 0.05$) in G1 compared with G2 and G3. Meantime the other serum blood parameters (globulin, urea and ALT concentration) were insignificantly differed among the experimental groups. Ewes treated with rocket oil (G2 and G3) showed significantly ($P < 0.05$) higher LBW at mating fertility rate%, pregnancy rate% lambing rate%, little size and twining rate% than those of control. Meantime the other tested characteristics showed higher values in G2 and G3 than G1 but without significant differences. Weaning weight, total gain and average daily gain of born lambs along with feed conversion were higher ($P < 0.05$) in G3 and G2 than G1. Semen quality (ejaculate volume, initial motility, live sperm, abnormal sperm, sperm cell concentration and total sperm) of lambs were better ($P < 0.05$) in G3 and G2 than in control. Adding rocket oil at level 1.0 and 2.0 mg / 10 kg / L.B.W during feeding crossbred ewes lead to significant ($P < 0.05$) improvement in their productive and reproductive performances along with higher feed efficiency. Also growth and reproductive performance of lambs from their dams were improved.

Keywords: *Crossbred ewes, rocket oil, milk production, feed and economic efficiency, offspring performance, puberty and semen quality.*

INTRODUCTION

Rocket seed oil showed a good effect as hypolipidemic agent, and contains high amount of omega-3 and omega-6 fatty acids (Abozid and Ayimba. 2014). It contains carotenoids, vitamin C, flavonoids such as appiin and luteolin and glucosinolates the precurosors of isothiocyanats and sulfaraphene (Talalay and Fahey, 2001). Also it has volatile oils like myristicn, apiole B-phellandren (Bradley, 1992, Leung and Foster.1996). It also contains Zn, Cu, Fe, Mg, Mn and other elements (Abdo. 2003) which increase immune response. Extracted oil of seed rocket has good physiochemical properties for their high unsaturated fatty acids (82.1%) and alpha linolenic acid (19.34%) (Hafez *et al*., 2016). Hafez *et al*., (2016) concluded that adding rocket oil (watercress oil) at level of 2 mg/ kg live body weight to Zaraibi goats led to significant ($P < 0.05$) improvement in semen physical characteristics of buks and increased fertility rate, milk yield, milk composition and economic feed efficiency of does. Also, kids produced from their dams during suckling period were improved. Also, adding rocket oil daily at level 2 mg/ kg

live body weight to ram lambs could lead to earlier age at puberty, improvement in growth performance at puberty higher reproductive ability and better economic feed efficiency of ram lambs (El-Badawy *et al*., (2018). However, the present study aimed to evaluate the effect of rocket oil (watercress oil) addition on productive and reproductive performances, some blood parameters, nutritional and economical milk efficiency of crossbred ewes. Some productive and reproductive performances of their lambs were also studied.

MATERIALS AND METHODS

This study was carried out at Sakha Experimental Station (Kafer El-Sheikh Governorate), belonging to Animal Production Research Institute (APRI), Agricultural Research Center, Ministry of Agriculture, Egypt.

Animals and treatments:

A total number of thirty-six mature healthy (1/2 Finish Landrace x 1/2 Rahmani ewes 3-6 years of age) were randomly distributed into three groups (control, G2 and G3), each of 12 ewes according to their live body weight (47.3±1.73 kg) and reproductive history. Ewes in the control, 2nd (G2) and 3rd (G3) groups were orally administrated with rocket oil (watercress oil) at levels of 0, 1 and 2 mg/10kg LBW, respectively. The experimental period was lasted for 150 days beginning from December and consisted of 3 periods, late pregnancy (45 days), suckling (60 days) and rest or flushing (45 days) income ewes in mating season (May).

At mating season (in May) ewes were monitored for sign of estrus using well trained ram two times per day (at 8.0 and 15.0 h) for 40 days (mating season). Data of weight and number of ewes exhibited estrus were recorded. Moreover, nine sexually mature fertile rams with LBW of 55.18±1.27 kg and 24 months of age were divided into three groups received the same treatments of ewes and used for natural mating of ewes of the same treatment group. Rams treatment started two months before breeding season in May.

Feeding system:

Animals were fed to cover the requirements (DM, TDN and DCP) during the experimental periods for late pregnancy (45 days), suckling (60 days) and rest or flushing (45 days) and income ewes in mating season (May) according to NRC (1985). A basal ration consisting of 50% concentrate feed mixture (CFM) and 50% fresh berseem (FB). Ewes were weighed bi-weekly and feed offered was adjusted according to the changes of body weight and stage of physiological state and production of ewes.

Composite feedstuffs samples were taken and stored for laboratory proximate analysis purpose, according to the methods of the A.O.A.C. (1995). Chemical composition of ingredients and experimental diets is presented in Table (1). Digestible crude protein (DCP) and total digestible nutrients (TDN) were calculated according to equation of Wardch, (1981) as follows:

$$DCP = - 5.7640 + 1.1063 (CP \%).$$

$$TDN = 81.9327 – 0.2855 (CF \%).$$

All animals were kept under equal management conditions and were kept in a semi-open shaded yard during the experimental period. Fresh water was available all times.

The productive performances:

After parturition, the productive performance of ewes including two parts, milk production and its composition and suckling lamb performance were studied.

Daily milk yield was determined weekly using milk suckling technique. Milk intake plus milk removed by hand milking represented daily individual milk yield for that week and 6% fat corrected milk (FCM) for each ewe was calculated based on daily milk yield and percentage of milk fat using the equation that decided by Mavrogenis and Papachristoforou (1988).

Fat correct milk (FCM) calculated according to equation, as follow:

$$6 \% FCM for sheep = milk yield (0.453+0.0912*\% fat).$$

Milk samples were taken from three ewes from each group during suckling period (8 week) to determine milk composition by Milko-Scann (133BN.FOSS Electric, Denmark).

Table (1): Chemical composition of feed ingredients, calculated composition and nutritive values of experimental diets (% on DM basis).

Item	Chemical composition							Nutritive values	
	DM	OM	CP	CF	EE	Ash	NFE	DCP	TDN
Concentrate Feed Mixture (CFM)*	92.19	92.83	14.53	10.72	3.11	7.17	64.47		
Berseem	15.11	89.55	12.90	28.78	1.79	10.45	46.08	8.51	73.71
1st experimental diet (G1)	25.75	91.15	13.72	19.63	2.44	8.85	55.36	9.41	76.36
2nd experimental diet (G2)	26.64	91.36	13.77	19.51	2.47	8.64	55.61	9.47	76.36
3rd experimental diet (G3)	27.49	90.97	13.81	19.10	2.52	9.03	55.54	9.51	76.48

**CFM: consisted of: 40% wheat bran, 30% ground yellow corn, 24% undecorticated cottonseed meal, 3% can molasses, 2% limestone and 1% common salt.*

Feed conversion was calculated as the amount of DM, TDN and DCP required for producing one kg %FCM.

After parturition, new born lambs were directly weighed at birth and weaning. Average daily gain of lambs was calculated from birth to weaning. Lambs were isolated away from their mothers and were fed as a group feeding once daily on the same treatment group used before. Suckling milk is the main source of lamb feeding during the first 8 weeks (suckling period) of age. The isolation period was increased gradually from 1 hr at fifth week of age and reached to the whole day (from morning till afternoon) at eighth week of age.

Blood serum parameters:

Blood samples were taken at the end of the experimental period from three ewes from each group from the jugular vein at 8.0 a.m. after feeding into vacationer tubes then centrifuged at 3000 rpm for 20 minutes in order to separate blood serum using serological pipettes, serum was carefully decanted into labeled tubes and stored at -20oC until analysis. Blood serum was analyzed for total protein (Armstrong and Carr 1964), albumin (Doumas *et al*., 1971), globulin was calculated by the difference between total protein and albumin, creatinine (Folin, 1994), urea–N (Siest *et al*., 1981), cholesterol (Fassati and Prenciple, 1982) and triglycerides (Richmond, 1973) as well as activity of asprtate (AST) and alanine (ALT) aminotransaminases (Reitman and Frankel, 1957) using spectrophotometer and commercial kits.

Reproductive performance during breeding season:

Semen collection and its evaluation of rams:

Semen was collected by artificial vagina from rams orally treated with rocket oil (at levels of 0, 1 and 2 mg/10kg LBW, respectively) for 60 days. All rams were healthy and clinically free of external and internal parasites. Palpation of the external genital showed that they were typically normal. Semen was collected twice weekly for four weeks. Reaction time was estimated at the beginning of collection (time elapsed from seeing ram the doe until complete ejaculation). Semen was evaluated for semen ejaculate volume (ml), percentages of initial motility (Melrose and Laing, 1970), livability (Eosin and Nigrosin stain), and abnormality of spermatozoa. Sperm cell concentration ($x10^9$/ml) was estimated microscopically using Neubeuer hemocytometer, while total sperm output ($x10^9$/ejaculate) was calculated by multiplying sperm cell concentration by ejaculate volume.

Body weight and scrotal circumference measurements of rams were determined. Scrotal circumference was measured to indicate testicular size for each ram by a flexible plastic tape around the greatest diameter of the tested and scrotum according to Hahn *et al*. (1969).

Testosterone assay of rams were carried out weekly by taken blood samples (for testosterone concentration (ng/ml) determination) were carried out biweekly. Direct radio-immuno-assay technique method was conducted for serum testosterone level determination using immunotech kits (I125) immunotech, France. The standard curve of testosterone ranged between 0.1 and 25.6 ng/ml.

Estrus and mating of ewes:

A teaser ram was used two times daily at 6-8 am and 3-4 pm to identify ewes in heat. Ewes in heat in the morning were offered to fertile ram chosen from the same experimental group of ewes. One mating was served at evening (3-4 p.m.) of the same day and another mating was served at the morning of the next day at (6-8 a.m.). Ewes showed estrus in the evening were served two times; the first at the morning (6-8 a.m.) of the following day and the second at the evening (3-4 p.m.) of the same day. Ewes passing two estrous cycles without heating were considered pregnant state. Estrus rate (%) was calculated according to (number of ewes showed estrus relative to number of total ewes) × 100 in each group. Fertility rate (%) was calculated according to (number of pregnant ewes relative to number of mated ewes) × 100. Pregnancy rate (%) was calculated according to (number of pregnant ewes relative to total number of ewes) × 100. Lambing rate (%) was calculated according to (number of lambed ewes relative to number of mated ewes) × 100. Litter size (Prolificacy rate) (%) was calculated by divided (number of total lambs born on number of lambed ewes) × 100 in each group. Twining rate (%) was calculated according to (number of twins lambed ewes relative to number of lambed ewes) × 100.

Statistical analysis:

Data were subjected to statistical analysis using one-way-analysis of variance according to Snedecor and Cochran (1980). The general linear model of SAS (2009) program was used in processing measured parameters according to the following mathematical model:

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

Where: Y_{ij} is the parameter under analysis, μ is the overall mean, T_i is the effect due to treatment and e_{ij} is the experimental error. The significant differences between means was statistically measured for significance at ($P<0.05$) according to Duncan's test (Duncan, 1955).

RESULTS AND DISCUSSION

Body weight and its changes during the different physiological stages:

There were marked changes in goat's body weight during the experimental different physiological stages as affected by rocket oil treatment Table (2).

The effect of rocket oil addition on body weight and its changes of ewes were increased gradually with the progress of pregnancy from weight of 47.2, 47.6and 47.1 kg at 45 days (start of experiment) with control, G2 and G3, respectively to 52.5, 54.3and 55.5kg BW at 7 day before lambing, respectively (Table 2).

However, rate of increase in body weight and its changes were higher ($P<0.05$) in G3 by about 58% than control and (14.1%) than G2. (Table 2). This could be due to improving their ruminal fermentation as well as utilization of all nutrient of the basal ration as the result of rocket oil treatment.

The changes in live weight gain values were almost constant till the last period of pregnancy where it showed a sharp increase in its value (Table 2), this reflect the rapid growth of the fetus and its attachments during the last 4 weeks of pregnancy as well as the improvement of feed utilization in this period of pregnancy. The results obtained showed that rocket oil addition increased weight of fetus in (G3) compared with control group.

Table (2): Body weight (kg) and body weight change (g/day) of ewes during different physiological stages as affected by rocket oil treatment.

Physiological stages	Experimental groups			±SE
	G1	G2	G3	
Late-pregnancy				
Duration, day	30	30	30	---
Body weight, kg (-45 day)	47.2	47.6	47.1	1.73
Body weight, kg (-7 day)	52.5	54.3	55.5	1.18
Change, kg	5.3[b]	6.7[b]	8.4[a]	1.31
Total DMI, kg /day	1.587	1.516	1.424	---
TDN kg / day	1.21	1.16	1.09	
DCP kg / day	0.15	0.14	0.14	
After-parturition				
a- Suckling period				
Duration, day	60	60	60	---
Body weight at parturition, kg	48.3	51.2	52.6	2.12
Body weight at weaning, kg	44.5[b]	48.4[b]	50.4[a]	1.51
Change , kg	-3.8	-2.8	-2.2	1.83
Total DMI, kg /day	1.638	1.621	1.546	---
TDN kg / day	1.25	1.24	1.18	
DCP kg / day, kg /day	0.16	0.15	1.5	
b- Mating period				
Duration, day	45	45	45	---
Initial Body weight, kg	44.7[b]	49.8[ab]	50.2[a]	1.42
Final Body weight, kg	48.4[b]	54.4[ab]	55.1[a]	1.75
Change, kg	3.7[b]	4.6[a]	4.9[a]	0.54
Total DMI, kg /day	1.388	1.324	1.292	---
TDN kg / day	1.06	1.01	0.99	
DCP kg / day	0.13	0.13	0.12	

[a, b and c]: Means within the same row with different superscripts are significantly different (P<0.05).
G1: Control.G2: 1 mg rocket oil/10kg LBW /daily. G3: 2 mg rocket oil /10kg LBW /daily.

After-lambing:

Suckling period:

Data in Table (2) show non significant effects (P<0.05) of treated group on live body weights of ewes at parturition, but the weight at weaning was significantly different between control group and G3. From lambing to weaning period, ewes did not receive rocket oil (control) lost more body weight (-3.8kg) than ewes given rocket oil orally, but the differences were not significant (Table 2).

Accordingly, in the present study, body weight and its changes were decreased by 7.9, 5.4 and 4.2% for control, G2 and G3, respectively after lambing then gradually decreased up to weaning and began to increase later on (Table 2).

Mating period:

Results of Table (2) clearly showed that G3 which orally rocket oil had higher (P<0.05) body weight, body weight changes and lower feed intake than those of control group (Table 2). This may be due to the reflection of the essential nutrients content in rocket oil.

Body weight of ewes and its changes were increased gradually from 44.7, 49.8 and 50.2 for control, G2 and G3, respectively onset mating season (Table 2) to reach 48.4, 54.4 and 55.1, respectively at the end of experiment. However, rate of increase in body weight and its changes were higher (P<0.05) in G3 by about 9.8% and in G2 by about 9.2% than control 8.2% as observed in Table (2). The improvement in body weigh gain may be attributed to the rich content of rocket oil of much essential nutrients (glucosinotates, omega-3, omega-6 fatty acids, Eicosapentaenoic (EPA), docosahexaenoic (DHA) ∞ -linoleic acids (ALA) etc which are essential for achieving growth, physiochemical properties and metabolism (Kris-Etherton *et al*., 2002 , Thatcher and Staples., 2007 and Abozid and Ayimba 2014).

Data of DMI, TDN and DCP intake during late-pregnancy period and after parturition (sucking period and mating period) (Table 2) showed insignificant differences were detected among all treatments. This

may be attributed that all experimental rations had nearly similar chemical composition, TDN and DCP as shown in Table (1).

Milk yield and its composition:

Milk yield and its composition of ewe's as affected by orally rocket oil are presented in Table (3).

Average daily milk and 6% FCM yields were significantly higher (P< 0.05) with orally administration of rocket oil (1.0 and 2 mg/ 10 kg LBW) being 533.5 and 578.4 g/ day for actual milk yield, respectively and 564.7 and 626.5 g/day for 6% FCM, respectively compared with control such results suggested that rocket oil has the potential to improve rumen fermentation, digestibility and utilization of all nutrients of the tested diets. It also might hold true that rocket oil could have some digestion promoting effects investigated from the significant increase of daily milk and 6% FCM yield. However, this assumption has not been realized without orally administration of rocket oil (G1). Similar trend was reported by Hafez *et al*; (2016) with lactating Zaraibi goats orally administration with rocket oil.

Table (3): Milk yield and its composition of ewes during the suckling period (60 days) as affected by rocket oil treatment.

Item	Experimental groups			±SE
	G1	G2	G3	
Actual milk yield as actual (g/d)	485.3^{c}	533.5^{a}	578.4^{a}	0.29
Fat (6%) corrected milk (g/d)	499.5^{c}	564.7^{a}	626.5^{a}	0.18
Milk composition:				
Fat (%)	6.32^{c}	6.64^{b}	6.91^{a}	0.22
Fat yield (g/d)	30.67^{c}	35.42^{b}	39.96^{a}	0.09
Protein (%)	5.92^{b}	6.05^{a}	6.11^{a}	0.18
Protein yield (g/d)	28.72^{c}	32.27^{b}	35.34^{a}	0.26
Lactose (%)	5.41	5.37	5.32	0.38
Lactose yield (g/d)	26.25^{c}	28.64^{b}	30.77^{a}	0.08
Total solids (%)	18.53^{b}	18.92^{a}	19.17^{a}	0.14
Total solids yield (g/d)	89.92^{c}	100.9^{b}	110.8^{a}	0.11
Solids not fat (%)	12.21	12.28	12.26	0.09
Solids not fat yield (g/d)	59.25^{c}	65.51^{b}	70.91^{a}	0.27
Milk energy (MJ/kg)	2.22^{c}	2.52^{b}	2.81^{a}	0.11

$^{a, b \text{ and } c}$: Means within the same row with different superscripts are significantly different (P<0.05).
G1: Control.G2: 1 mg rocket oil/10kg LBW /daily. G3: 2 mg rocket oil /10kg LBW /daily.
Milk energy (MJ) calculated according to equation = milk yield (0.37 x fat % + 0.21 x milk protein % +0.95) + 0.07 x milk yield.

Regarding milk composition milk fat, milk protein, total solids percentages were significant higher (P< 0.05) with G2 and G3 groups than that of the control without orally administration of rocket oil. On the other hand, milk lactose and solid milk fat contents were not significant influenced with or without orally administrated of rocket oil. Meantime fat, protein, lactose, total solids and solids not fat yields tended to be significant higher in tested groups (G2 and G3) than control (G1). Such results are mainly a reflection of the actual milk and 6% FCM yields along with the beneficial effect of rocket oil. These results are in close agreement with those reported by Hafez *et al*., (2016), who recorded similar results in milk composition of lactating Zaraibi goats treated with rocket oil.

Feed conversion

Feed conversion expressed as production efficiency is presented in Table (4). Ewes in G3 and G2 treated with rocket oil attainal the best DM, TDN and DCP utilization efficiency compared with those in G1.

Table (4): Feed intake, milk yield and feed conversion of milk production of ewes during the suckling period (60 days).

Item	Experimental group			±SE
	G1	G2	G3	
Total number of ewes	12	12	12	---
Av. BW during suckling period, kg	46.4[b]	49.8[ab]	51.5[a]	0.63
Average daily DM intake, kg/h/d:				
CFM	0.830	0.830	0.830	---
Berseem	0.808	0.791	0.716	---
Rocket oil (ml)	---	5	10	---
Total DMI, kg / day	1.638	1.621	1.546	---
Total TDN, kg / day	1.25	1.24	1.18	---
Total DCP, kg / day	0.154	0.154	0.147	---
Milk yield (6% FCM), kg	0.499[c]	0.564[b]	0.626[a]	0.18
Feed conversion ratio:				
Av. DM, kg /kg (6% FCM) milk	3.28	2.87	2.46	---
Relative improve (%)	---	−12.5	−25	---
Av. TDN, kg /kg (6% FCM) milk	2.51	2.20	1.88	
Relative improve (%)		- 12.35	- 25.1	
Av. TDN, kg /kg (6% FCM) milk	0.309	0.273	0.23	---
Relative improve (%)		-11.65	-25.57	---

[a, b and c]: Means within the same row with different superscripts are significantly different (P<0.05).
G1: Control.G2: 1 mg rocket oil/10kg LBW /daily. G3: 2 mg rocket oil /10kg LBW /daily.

The results showed that, ewes in G3 and G2 required lower amount of DM, TDN and DCP per kg 6% than ewes without rocket oil treatment (G1). Results also indicated that rocket oil treatment in G2 and G3 significantly improved feed conversion efficiency DM, TDN and DCP kg / kg 6% FCM by 12.5 and 25.0, 12.35 and 25.1 and 11.65 and 25.57% respectively comparing with G1 without rocket oil treatment.

This finding indicate that addition of 2 mg / 10 kg LBW from rocket oil was more profitable than the other two treatments. However, such results mainly a reflection of the beneficial effects of essential nutrients in rocket oil. Similar results were reported by El-Badawy *et al*., (2018) with sheep and Hafez *et al*., (2016) in Zaraibi goats.

Reproductive performance:

Results presented in Table (5) revealed that ewes in G3 showed the best reproductive characteristics at may mating season followed by the G2 while the control recorded the lowest values with significant differences ($P < 0.05$) among the different groups.

Ewes treated with rocket oil (G2 and G3) showed significantly ($P < 0.05$) higher weights kg at mating and higher fertility rate%, pregnancy rate%, lambing rate%, litter size and twining rate% than those of control. Meantime the other tested characteristics showed higher values in G2 and G3 than in G1 but without significant differences. These results are in agreement with reported by Hafez *et al*., (2016) with Zaraibi goats and El-Badawy *et al*., (2018) with ram lambs. The observed improvement in reproductive performance in terms of the fertility rate, estrus rate, pregnancy rate, lambing rate, litter size and twining rate of ewes treated with rocket oil compared with control of fatty acids. Also this may be due to that rocket oil contain health promoting agents, including corticoids, vitamin C Barillari *et al*., (2005) the major constituent of rocket seed volatile oil is isothiocyanates which has antioxidants, antimicrobial and anticarcinogenic activities (Badee *et al*., 2003 , Barillari *et al*., 2005 and Haristory *et al*., 2005).

Table (5): Reproductive performance of ewes in May mating season as affected by rocket oil treatment.

Item	Experimental group			±SE
	G1	G2	G3	
Total number of ewes	12	12	12	---
Body weight at mating (kg)	48.4[b]	54.4[ab]	55.1[a]	1.06
No. of ewes exhibited estrus (mated)	6	8	9	---
No. of pregnant ewes	5	8	9	---
No. of ewes lambing	5	7	8	---
No. of lambs born	6	9	11	---
No. of twins	1	2	3	---
Estrus rate (%)	50	66.66	75	4.22
Fertility rate (%)	83.3[b]	100[a]	100[a]	5.41
Pregnancy rate (%)	41.6[c]	66.6[b]	75[a]	6.44
Lambing rate (%)	83.3[b]	87.5[a]	88.8[a]	4.23
Litter size (Prolificacy)	1.2[b]	1.28[ab]	1.37[a]	0.06
Twining rate (%)	20[c]	28.6[b]	37.5[a]	7.42

[a, b and c]: Means within the same row with different superscripts are significantly different (P<0.05).
G1: Control.G2: 1 mg rocket oil/10kg LBW /daily. G3: 2 mg rocket oil /10kg LBW /daily.
G1: Control (12 ewes) wasn't treated pre-mating [and] mated by ram which not treated
G2: (12 ewes) treated by 1 mg rocket oil/10kg LBW /daily pre-mating and mated by ram receive the same treatment of ewes pre-mating period of 60 days.
G3: (12 ewes) treated by 2 mg rocket oil /10kg LBW /daily pre-mating and mated by ram receive the same treatment of ewes pre-mating period of 60 days.

Blood parameters:

Results of blood serum constituent of ewes illustrated in Table (6) showed that non significant differences were detected among the three tested groups in globulin, urea and ALT concentration. However, the mean values of blood serum globulin, urea and ALT are within the normal range of healthy goats obtained by Hafez *et al*., (2016).

As proved in our study Hafez *et al*., (2016) found insignificant effect of rocket oil on blood serum of ram lambs. Meantime, total protein and albumin concentrations in blood serum of ewes showed significant differences among the different ewe's treatments.

Table (6): Concentration of some biochemical and enzyme activity in blood serum of ewes in different experimental groups at the end of the experimental period.

Item	Experimental groups			±SE
	G1	G2	G3	
Total protein (g/dl)	6.28[c]	6.55[b]	6.86[a]	0.09
Albumin (g/dl)	3.43[b]	3.69[a]	3.79[a]	0.14
Globulin (g/dl) Creatinine	2.85	2.86	3.07	0.82
(mg/dl)	1.24[a]	1.08[b]	0.94[b]	0.07
Urea (mg/dl)	24.21	21.97	21.25	2.54
AST (U/ml)	41.43[a]	36.23[b]	35.51[b]	0.27
ALT (U/ml)	15.14	14.04	13.16	4.29
Cholesterol (mg/dl)	148.2[a]	124.8[b]	111.2[c]	1.25
Triglyceride (mg/dl)	105.8[a]	97.45[b]	90.25[c]	1.08

[a, b and c]: Means within the same row with different superscripts are significantly different (P<0.05).
G1: Control.G2: 1 mg rocket oil/10kg LBW /daily. G3: 2 mg rocket oil /10kg LBW /daily.

The higher values of total protein and albumin in blood serum of ewes in G2 and G3 indicated that rocket oil had a positive effect on the serum total protein and albumin concentration, however the lowest values found with the control group without rocket oil treatment may be attributed to the decrease in the absorbed and synthesized and increase in protein losses. The mean values of blood serum total protein and albumin are within the normal range of healthy goats obtained by Hafez *et al*., (2016). Mean values of creatinine, AST, cholesterol and triglyceride concentration in blood serum of ewes (Table 6) were the

highest with significant (P< 0.05) differences of untreated ewes (G1) compared with those of rocket oil. The tendency of reduction in cholesterol and triglycerides in serum of rabbit were indicated by Ibrahim (2005), who noticed that concentration of triglyceride was decreased in serum of rabbits fed 1 or 5% rocket seeds ration compared to control, this may be due to rocket seeds contain high content of unsaturated fatty acids (85%), the linoleic acids Thomas, (2002) and glucosinolates (Al-Doghachi *et al*., 2010), which play role in inhibiting absorption of fatty acids or inhibition of the enzyme H yroxyl-methyl-glutary- Co A which is important for cholesterol formation Bulbul *et al*., (2009). Rocket seeds also cause reduction of cholesterol value in blood Al-Doghachi *et al*., (2010) or may contain B-Sitosterol which reduce absorption of cholesterol from small intestine, so cholesterol value in blood will reduce El-Gengaihi *et al*., (2004).

Growth performance of lambs:

Data in Table (7) showed that lambs in G2 had significantly (P<0.05) the highest birth weight and the lowest (P<0.05) litter size. However, G3 recorded the significant highest weaning weight followed by G2 than control. The same bread was noticed for total weight gain average daily gain and ewe production (litter weight at birth, litter weight of weaning, total libber weight gain and libber average daily gain).

Table (7): Growth performance of lambs during suckling period (60 days).

Item	Experimental groups			±SE
	G1	G2	G3	
No. of ewe lambed	12	12	12	---
Total number of lambs	15	14	16	---
Litter size / ewe	1.25	1.16	1.33	2.08
Birth weight, kg	3.45^{b}	3.89^{a}	3.43^{b}	0.05
Weaning weight, kg	12.13^{c}	13.36^{b}	13.85^{a}	0.80
Total weight gain, kg	8.68^{c}	9.47^{b}	10.42^{a}	0.59
Average daily gain, g/day	144.6^{c}	157.8^{b}	173.6^{a}	0.74
Relative improve (%)	100	110.9	120.1	---
Ewe production				
Litter weight at birth, kg	4.31	4.51	4.56	3.20
Litter weight at weaning, kg	15.16^{b}	15.49^{b}	18.42^{a}	0.78
Total litter weight gain, kg	10.85^{b}	10.98^{b}	13.86^{a}	1.68
Average daily gain, g/day	180.8^{b}	183.2^{b}	231.1^{a}	1.19
Relative improve (%)	100	101.3	127.8	---

$^{a, b \text{ and } c}$: Means within the same row with different superscripts are significantly different (P<0.05).

The results of the present study suggested that rocket oil could play as a natural growth promoter. The improvement in the body weight gain may be attributed to the rich content of the essential fatty acids as mentioned by Talalay and Fahey (2001) and Kim *et al*., (2004). The results of growth performance are in agreement with those achieved by El-Badawy *et al*., (2018), who found that treated ram lambs with rocket oil increased their average daily gain and feed utilization compared with lambs fed diet without rocket oil treatment.

Reproductive performance of rams:

Results in Table (8) showed significant (P< 0.05) differences among tested groups in all seminal characteristics. Rams in G2 and G3 treated with rocket oil produced better semen quality in terms of significant (P< 0.05) increase in final scrot circumference (cm), semen volume, initial motility, progressive motility, live sperm, sperm cell concentration and total sperm output and decreasing sperm abnormality percentage and reaction time than those in control group being the best in G3.

Table (8): Reproductive performance of rams as affected by rocket oil treatment.

Item	Experimental groups			±SE
	G1	G2	G3	
Initial body weight (kg)	54.85	55.48	55.21	2.37
Final body weight (kg)	59.19	62.82	64.12	1.83
Initial scrotal circumference(cm)	33.23	33.15	33.52	1.23
Final scrotal circumference(cm)	34.53^{c}	37.85^{b}	39.22^{a}	0.88
Testosterone concentration (ng/ml)	2.55^{c}	3.27^{b}	3.78^{a}	0.34
Reaction time (min. sec)	4.24^{a}	2.32^{b}	1.49^{c}	2.56
Semen volume (ml)	0.95^{c}	1.18^{b}	1.26^{a}	0.14
Initial motility (%)	71.17^{b}	74.28^{b}	78.36^{a}	0.58
Progressive motility (%)	58.55^{b}	65.36^{b}	72.87^{a}	1.85
Live sperm (%)	70.43^{b}	72.05^{a}	76.47^{a}	0.96
Abnormal sperm (%)	12.47^{a}	10.76^{b}	8.82^{c}	0.73
Sperm cell concentration (x 10^{9}/ ml)	3.07^{c}	3.22^{b}	3.45^{a}	2.74
Total sperm output (x 10^{9}/ejaculate)	2.92^{c}	3.80^{b}	4.35^{a}	3.24
Semen index*	12026^{c}	17893^{b}	24223^{a}	6.21
Relative improve (%)	100	148.8	201.4	---

$^{a, b \text{ and } c}$: Means within the same row with different superscripts are significantly different (P<0.05).

G1: Control.G2: 1 mg rocket oil/10kg LBW /daily. G3: 2 mg rocket oil /10kg LBW /daily.

* Semen index = Semen volume (ml) × Sperm cell concentration (x10^{9}/ ml) × Live sperm (%) × Progressive motility (%).

The present results of physical semen characteristics (Table 8) showed similar trend with those obtained by earlier studies Ahmed *et al*., (2005) with rabbits Hafez *et al*., (2016) with Zaraibi goats and El-Badawy *et al*., (2018) with ram lambs. The rocket seed contained some nutritional compounds like vitamins E and C, linoleic and arachidonic acids, which are essential fatty acids and having appositive effect on the activity of testosterone (Qussay and Essam 2015). Testosterone is considered as a precursor for biosynthesis of prostaglandin, that increase circulating of gonadotropin hormone, thus stimulates the steroid hormone production (testosterone) that is essential for normal reproduction function of male animals (Baiomy 1999) obtained results are in association with improving growth performance parameters of ram lambs in G2 and G3 treated with rocket oil. It is clear that scrota circumference (SC) and testicular size affected by rocket oil. SC value was lower for G1 and improved by orally administration of rocket oil in G2 and G3. This result give support to the hypothesis that testicular growth could positively affected when ram lambs received rocket oil. In that concern, Jibril *et al*., (2011) found that SC might play the important role on semen parameters of Yanakasa rams.

Generally, obtained results from the present study demonstrated that sperm production in male lambs is sensitive to increases in live body weight of lambs, testicular size, which may combine with an increase in the volume of seminiferous epithelium and the diameter of seminiferous tubules. Also, Bernardini *et al*., (2011) found that number of spermatozoa per ejaculate is related to testis volume and testis weight. Similar observations were reported by Hafez *et al*., (2016) and El-Badawy *et al*., (2018), who indicated beneficial effects of rocket oil on the accessory sex glands to produce seminal plasma in ram lambs.

CONCLUSION

It be concluded that adding rocket oil (watercress oil) at a level 1 and 2 mg / 10 kg live body weight to crossbred ewes lead to significant (P< 0.05) improvement in their productive and reproductive performances along with higher feed efficiency. Also, growth performance and reproductive performance of lambs produced from their dams were improved.

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تاثير إضافة زيت الجرجير على الآداء الإنتاجي والتناسلي وبعض مكونات الدم للنعاج الخليطة

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تم اجراء هذه الدراسة على 36 نعجة عشار خليط (2/1 فنلندى ×2/1 رحمانى) عمر 3-6 سنوات بمتوسط وزن جسم 1,73±47,3 كجم وزعت عشوائيا على ثلاثة مجموعات متماثلة (12 نعجه في كل مجموعة) حسب الوزن والحالة التناسلية للنعاج. غذيت كل النعاج على عليقة أساسية مكونة من 50% علف مركز + 50 % برسيم طازج على اساس المادة الجافة. اضيف زيت الجرجير يوميا على العلائق بمعدل صفر و 1 و2 مليجرام/ 10كجم وزن حى/ رأس للمجموعات الثلاثة. استمرت فترة التجربة 150 يوم وقسمت الى ثلاث فترات تجريبية (فترة الحمل المتأخر (45 يوم) وفترة رضاعة الحملان (60 يوم) وفترة الراحة أو الدفع الغذائى (45 يوم) بالاضافة الى دراسة إقتصاديات النعاج فى موسم التزاوج. أوضحت النتائج ما يلى :

أن التغير فى وزن النعاج أثناء المراحل الفسيولوجية المختلفة قد تأثر معنويا (5%) باضافة زيت الجرجير إلى العلائق حيث زاد بنسبة 9.8% للمجموعة الثالثة و 9.2% للمجموعة الثانية مقارنة بالمجموعة الاولى.

حقق الانتاج اليومى للبن المعدل 6% دهن زيادة معنوية لكل من المجموعة الثالثة والثانية مقارنة بالمجموعة الاولى حيث كانت 564.7 و 626.5 مقابل 499.5 جرام \ يوم على التوالى. زادت نسبة وكمية مكونات اللبن زيادة معنوية (5%) للمجموعة الثانية والثالثة مقارنة بالمجموعة الاولى فيما عدا نسبة اللاكتوز والجوامد اللادهنية.

حققت نعاج المجموعة الثالثة والثانية المعاملة بزيت الجرجير أفضل كفاءة غذائية للاستفادة من المادة الجافة والمركبات الغذائية المهضومة والبروتين المهضوم مقارنة بنعاج المجموعة الاولى الغير معاملة.

زادت نسبة البروتين والالبيومين زيادة معنوية فى سيرم دم النعاج المعاملة بزيت الجرجير مقارنة بنعاج المجموعة الاولى, بينما زاد معنويا (5%) تركيز الكرياتين و **AST** و الكلوسترول والتراى جلسيريد فى سيرم دم نعاج المجموعة الاولى مقارنة بالمجموعة الثانية والثالثة وفى نفس الوقت لم يكن هناك فروق معنوية فى تركيز بعض المكونات الاخرى (جلوبيولين واليوريا و **ALT**).

كانت النعاج المعاملة بزيت الجرجير الاثقل وزنا عند التزاوج والاعلى فى نسبة الخصوبة ونسبة الحمل و معدل lambing rate وقلة الحجم ونسبة التؤائم وفى نفس الوقت أظهرت باقى الصفات المميزة زيادة لكن بدون معنوية. كان وزن الفطام والنمو الكلى ومتوسط الزيادة اليومية بالاضافة الى الكفاءة الغذائية هو الافضل معنويا (5%) لحملان المجموعة الثالثة والثانية مقارنة بالمجموعة الاولى.

بالنسبة لجودة السائل المنوى (حجم القذفة و initial motility والحيوانات الحية والحيوانات المنوية الغير طبيعية وتركيز الحيوانات المنوية والعدد الكلى للحيوانات المنوية) كانت الافضل معنويا فى المجموعة الثالثة والثانية مقارنة بالكنترول.

ادت إضافة زيت الجرجير بنسبة 1, 2 مليجرام \ 10 كجم \ وزن حى أثناء تغذية النعاج الخليطة الى تحسن معنوى (5%) فى أدائها الانتاجى والتناسلى بالاضافة الى زيادة الكفاءة الغذائية وكذلك تحسن النمو والاداء التناسلى للحملان الناتجة من هذه النعاج.