Egyptian Journal of Sheep & Goat Sciences, Vol. 11, No. 2, P: 15- 29 , August 2016

REPRODUCTIVE AND PRODUCTIVE PERFORMANCE OF LACTATING GOATS QUAFFED LINSEED OIL AND SUNFLOWER OIL

Khalifa, E. I.[1], A. M. Abdel-Gawad[1], H. R, Behery[1], G. I. El-Emam[2] and T. H. El-Sawah[3]

[1]Sheep and Goats Research Department, Animal Production Research Institute, Dokki, Giza, Egypt.
[2]By – products Utilization Research Department, Animal Production Research Institute, Dokki, Giza, Egypt.
[3]Milk Technology Research Department, Animal Production Research Institute, Dokki, Giza, Egypt.

ABSTRACT

Alteration of lipid and fatty acids (FA's) composition in ration could improve reproductive and productive performance of livestock. The present study aimed to define the effect of quaffing dairy goats with linseed oil or sunflower oil on reproductive and productive performance. Fifteen lactating Zaraibi goats were divided into three groups (5 each) namely T1, T2 and T3 groups. T1 used as control that nourished a basal ration (offered two times at 8 am and 3 pm daily) contained 50% concentrate feed mixture (CFM) + 50% roughage (offered at rate 3:1) included 750 gm berseem hay (BH) plus 250 gm rice straws RS. Whilst, T2 (quaffed linseed oil) and T3 (quaffed sunflower oil) were received previous basal ration plus the two oil types that orally given at 3% of dry matter intake which nearly equal 53gm oil type/head/ day. The amounts of oils were offered to T2 and T3 groups two times daily at 8:00 am (27 gm oil type /head/ day) and at 3:00 pm (26 gm oil type/head/day). These treatments were offered to goats of T1, T2 and T3 21 days pre-mating season (as flushing period) and continued up to seventeen weeks of lactation season. Then, three experiments were carried out on T1, T2 and T3 groups. The first experiment was to investigate the effect of linseed and sunflower oils on body weight (BW) of goats pre-mating season, post- mating season, pre-trimester of pregnancy (at 100 days), at 145 days pre-parturition, post- parturition, litter size and total weight of kids at postnatal. Second experiment, was carried out to investigate the effect of linseed and sunflower oils on amount of suckling milk, commercial milk and milk composition and body weight of kids. Third experiment was to evaluate blood metabolism through measuring glucose, total protein, albumin, globulin, triglycerides and cholesterol levels as results of linseed oil and sunflower oil. Quaff of linseed oil in T2 and sunflower oil in T3 improved ($P<0.05$) BW of goats during gestation, fertility rate and litter size than goats in T1 (first experiment). Goats in T1 recorded lower ($P<0.05$) suckling and commercial milk amounts within ($P<0.05$) lesser values of fat (%) and protein (%) during suckling and lactation periods than T2 and T3 groups. In addition, body weight of kids was ($P<0.05$) heavier with T2 and T3 groups compared to kids nursed in T1 group (second experiment). Quaffing oils to T2 and T3 goats caused a higher serum glucose, total protein, albumin, globulin concentrations ($P>0.05$) and reduced triglycerides and cholesterol concentrations ($P>0.05$) compared to all blood serum parameters in T1 (third experiment). Data indicated that, quaff of linseed or sunflower oils to lactating goats had beneficial effects on reproductive and productive parameters. Oils could enhance reproductive and productive performance, but sunflower oil is cheaper thus get better economical efficiency than linseed oil.

Key words: Goats, reproduction, production, linseed and sunflower oil.

INTRODUCTION

Providing sources of polyunsaturated fatty acids (PUFAs) to small ruminants has shown to be a good alternative enrich reproductive and productive performance. Cieslak *et al.* (2010) demonstrated that reduction of dry matter intake (DMI) accompanied feeding PUFAs may be a result of; 1) increase in ruminating time due to negative effects on rumen digestion 2) slowdown of rumen emptying due to a metabolic effect of long chain fatty acids and 3) in both situations a satiety effect due to rumen replenishment could occur. Additionally, dietary fat used for dairy animals in order to diminish the gap between net energy intake and

requirements to produce high milk yield and maintaining physiological status (Weisbjerg *et al.,* 2013). The oil seeds resulted in reduction of DMI that might have effect on the palatability of diet or the hypophagic effects of unsaturated fatty acids in diet, altering energy, ruminal fermentation and release of gut hormones (Byrne *et al.,* 2015). Moreover, milk production and its profile improved with linseed oil. This phenomenon reflects better utilization of feeds and increased volatile fatty acids (VFA's) concentration in rumen (Kholif *et al.,* 2015). From a physiological point of view, it is suggested that saturated or trans fatty acids altering prostaglandin (PG) concentration (Rodriguez-Sallaberry *et al.,* 2007) and linoleic acids could improve uterine health and increase fertility (Juchem *et al.,* 2008). Moreover, PUFAs such as omega-3 increased PG (in particular $PGF_{2\alpha}$ and $PGF_{3\alpha}$) which plays an important role in several aspects of reproduction, including ovulation, oestrus, embryo survival and parturition (Gulliver *et al*., 2012). Furthermore, linseed oil or seeds are rapidly hydrolyzed and biohyderogenated in rumen resulting in better meat and milk characteristics, altering the fatty acid composition of ruminants which reduce the risk of diseases (Gawad *et al.,* 2015). Some investigators showed that intake of PUFAs were positively associated with ruminal function. Hence, Morsy *et al*. (2015) indicated that feeding sunflower whole seeds or oil could decrease both ruminal pH and ruminal ammonia-N concentrations and increased concentrations of ruminal volatile fatty acids (VFA's).

Therefore, the current study investigated the influence of quaffing linseed oil (rich in ω-3) or sunflower oil (rich in ω-6) to dairy Zaraibi goats in order to develop practical feeding able to improve reproduction and production systems.

MATERIALS AND METHODS

This experiment was carried out at El-Serw Experimental Research Station, belonging to Animal Production Research Institute (APRI), Agriculture Research Center, Egypt, during the period from September, 2014 to October, 2015.

Experimental animals and feeding

Fifteen fertile Zaraibi goats with average 44.00± 0.88 kg body weight in 3rd lactating season were used in the present study. Goats were randomly divided into three equal groups (5 goats each) to perform T1, T2 and T3 groups. The goats in T1, T2 and T3 groups were placed in different pens under the same environmental condition and fed the basic ration. The basic ration formed of 50% concentrate feed mixture (CFM) + 50% roughage included berseem hay (BH) and rice straws (RS) at rate 3:1. It was offered twice daily, in equal quantities, at 8:00 am and 3:00 pm. The goats in T1 group (control) was nourished 1000 gm CFM + 750 gm BH + 250gm RS without any type of oil. Whereas, goats in T2 and T3 groups were fed the basic ration (control) plus 3% linseed oil or 3% sunflower oil of total dry matter intake (nearly 53 gm oil type /head/day). The oils were divided into two parts and quaffed twice daily at 8 am (27 gm oil type / head/day) and 3 pm (26 gm oil type /head/day) at feeding times. The amounts of basic ration were calculated according to NRC (2007). All experimental rations offered to goats in T1, T2 and T3 groups at day 21th pre-mating season (as flushing period) and continued up to seventeen weeks of lactation season. Clean and fresh water and mineral blocks offered freely throughout the experiment. The chemical compositions of basic rations were analyzed according to AOAC (2007) methods and illustrated in (Table1). Moreover, the saturated and unsaturated fatty acids profile for linseed oil and sunflower oil are shown in (Tables 2 and 3), respectively according to Zambiazi *et al.* (2007).

Experimental design

Three experiments were carried out to define the effects of quaffing linseed oil (T2) or sunflower oil (T3) on reproductive and productive performance compared to control (T1) in dairy Zaraibi goats. The first experiment carried out to study the effect of oil types on reproductive parameters from flushing to parturition. The second experiment carried out to evaluate the effect of oil types on suckling milk amount; weight of kids up to weaning and

Table 1: Chemical analysis of basic rations (% on DM basis).

Chemical composition (%)	Basal experimental diets		
	CFM	BH	RS
Dry matter	89.95	86.19	90.80
Organic matter	87.77	89.21	84.55
Crude protein	14.40	12.67	3.36
Ether extract	2.41	3.41	1.24
Crude fiber	7.09	27.84	37.50
Nitrogen free extract	63.87	45.29	42.45
Ash	12.23	10.79	15.45

CFM: concentrate feed mixture **BH:** berseem hay **RS:** rice straws

Table 2. Saturated fatty acids profile for linseed oil and sunflower oil.

Oil types	*Saturated fatty acids						
	C14:0	C16:0	C17:0	C18:0	C20:0	C22:0	C24:0
Linseed	0.05	4.81	0.05	3.03	0.20	-	0.01
Sunflower	0.06	5.70	0.04	4.79	0.30	1.16	0.31

***C14:0 = myristic, C16:0 = palmitic, C17:0 = margaric, C18:0 = stearic, C20:0 = arachidic, C22:0 = behenic and C24:0 = lignoceric.**

Table 3. Unsaturated fatty acids profile for linseed oil and sunflower oil.

Oil types	*Unsaturated fatty acids						
	C17:1	C18:1	C18:2 (ω-6)	C18:3 (ω-3)	C20:1	C20:2	C24:1
Linseed	0.12	21.42	15.18	54.24	0.40	0.39	0.10
Sunflower	0.06	15.26	71.17	0.45	0.22	0.09	0.39

***C17:1 = miristoleic, C18:1 = oleic, C18:2 = linoleic, C18:3 = linolenic, C20:1 = gadoleic, C20:2 = eicosadienoic and C24:1 = nervonic.**

***The source of fatty acid profile in Tables 2 and 3**

commercial milk yield. The third experiment established to measure the effect of oil types on blood metabolism.

Experimental procedures

In the first experiment, body weight (BW) of goats in T1, T2 and T3 pre-mating, post-mating, pre-trimester of pregnancy (at 100 days), at 145 days pre-parturition, post-parturition, litter size and postnatal body weight of kids were measured using electronic scale before offering rations. At parturition, fertility of goats were evaluated as following; conception rate (number of nanny goats conceived / nanny goats mated); fertility rate (number of nanny goats kidded / nanny goats mated); the single parity rate (number of nanny goats kidded single/ number of nanny goats kidded); the twins parities rate (number of nanny goats kidded twins/ number of nanny goats kidded); the triplet parities rate (number of nanny goats kidded triplet/number of nanny goats kidded); the kids gender % (male: female) as the number of born kids in each sex per total number of born kids.

In the second experiment at postnatal, four does (n=4 / treatment) were used to estimate suckling milk amount at 7, 15, 30, 60 and 90 days using oxytocin methods according to technique of Khalifa *et al.* (2013). The suckling milk samples (100 ml / group) were taken at 15, 30, 60 and 90 days for analysis of fat (%) and protein (%) using Milko-Scan (133B N. Foss Electric, Denmark). Also, the suckling milk energy value (SMEV, kcal/kg) at 15, 30, 60 and 90 days was calculated as= 203.8 + (8.36 × fat %) + (6.29 × protein %) according to Baldi *et al*. (1992). Moreover, an electronic scale used to record monthly variation in weight of kids until weaning. In addition, the same last does were used after weaning to evaluate commercial milk production through seventeen weeks of lactation season. Hand milking carried out twice

a day at 6 am and 5 pm, total milk yield for a doe/group registered weekly up to seventeen weeks of lactation. Measurement of milk yield / week assayed as following: daily milk yield at evaluation day (by added morning cooled milk and the evening milk samples ones) × 7 days. At seventeen weeks of lactation pooling, milk sample (100 ml /group) from each treatment (T1, T2 and T3) was used for chemical analysis using Milko-Scan (133B N. Foss Electric, Denmark).

In the third experiment, at seventeen weeks of lactation, blood samples were taken from T1, T2 and T3 groups (3 does / treatment). The blood samples were collected through the jugular vein then centrifuged at 3500 *g*/min. for 20 minutes. The blood serum was separated into clean dried eppendrof tubes and frozen in a deep freezer at -20°C until analysis. The concentrations of glucose, total protein, albumin, globulin, triglycerides and cholesterol were determined using specific kits (Stanbio Laboratory, Boerne, TX, USA). Albumin/globulin ratio (A/G ratio) was also calculated.

Statistical analysis

Data were statistically analyzed using ANOVA and Duncan's test to detect differences among means using SPSS® Statistical Software (SPSS® Version 22.0 for Windows, 2013). The P value of < 0.05 considered as statistically significant.

RESULTS AND DISCUSSION

1. First experiment

1.1. Body weight of does from flushing to parturition

The effects of linseed oil (T2) and sunflower oil (T3) on body weight (BW) of Zaraibi goats pre-flushing season up to parturition are presented in (Figure 1). Also, total weights of birth kids and litter size of goat in T1, T2 and T3 groups are illustrated in (Figure 2). With advance of age, goats in T2 and T3 groups, increased insignificantly in BW until trimester period compared to goats in T1. Similar trend was reported by Morsy *et al*., (2015) who observed that adding plant oil (as sunflower) obtained non-significant increase in BW of goats. Inversely, BW of goats in T2 and T3 groups tended to be increased significantly ($P<0.05$) from trimester period (at 100 days) to 145 days of gestation compared to T1 group. Changes in BW between 100 and 145 days of pregnancy may be due to receiving oil treatment which resulted in amelioration of litter size (1.6, 2.0 and 2.2) and total weight of kids which carried in uterus (2.90, 3.60, and 4.70 kg) in T1, T2 and T3 groups, respectively. These findings strongly suggest that PUFA's diets can reduce pregnancy losses. Hence, Salehi *et al.* (2013) hypothesized that oil seeds could restrict feed intake during the prepartum period, which improve postpartum intake, reduce negative energy balance, have a differential influence on resumption of cyclicity and carryover beneficial effects on fertility. In addition, Pana *et al.* (2015) revealed that litter size exhibited a strong effect on BW; moreover, there was a higher chance of increasing BW of does with the larger litter sizes.

1.2. Fertility rate

Data presented in (Table 4) show the impact of feeding linseed oil (T2) and sunflower oil (T3) on reproductive performance of goats. There is evidence that feeding fatty acids could improve the energy status, ovary function and increase conception rate as reported by Moriel *et al.*, (2014). In addition, Rodney *et al.* (2015) concluded that feeding fats and/or oil during flushing period has beneficial effects on fertility rate. PUFA's such as linoleic acid, α-linolenic acid, eicosapentaenoic acid and docosahexaenoic acids have garnered much attention lately for their positive effects on reproductive function. Of these findings those of Salehi *et al.* (2016) who found that diets enriched in n-3 PUFA's have positive effects on the development of the early embryo, potentially through the differential activation of genes involved in embryonic cellular growth and proliferation. Generally, the improvement of fertility may due to; (a) improvement in

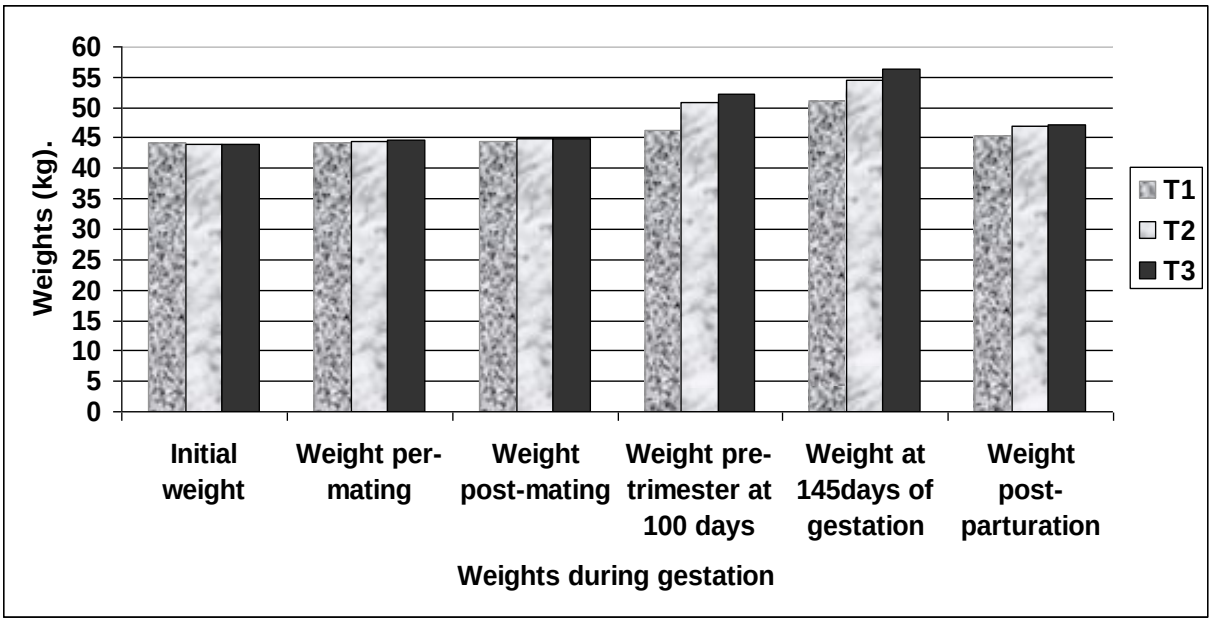

Figure 1: Changes in body weight of goats during gestation with control (T1), linseed oil (T2) and sunflower oil (T3).

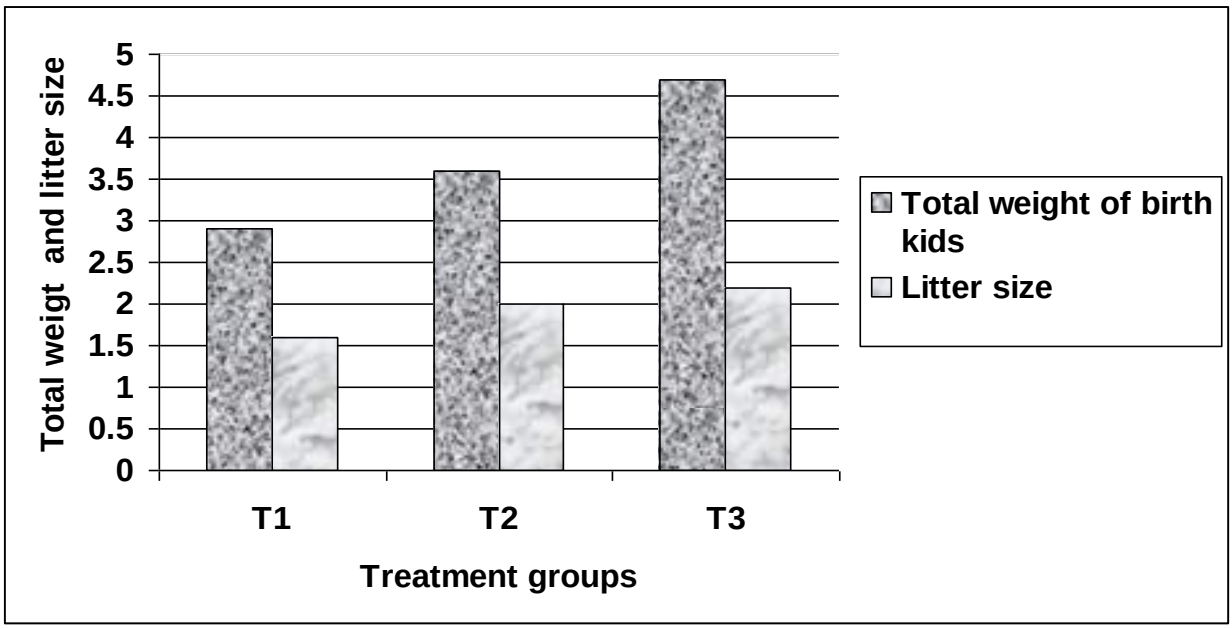

Figure 2: Total weight of birth kids and litter size with control (T1), linseed oil (T2) and sunflower oil (T3).
Litter size was defined as the total number of kids born ÷ number of does mating.

energy status, (b) increased production of steroid hormones (progesterone) which is essential for pregnancy maintenance, (c) alterations in serum insulin concentrations, which could improve ovarian follicular development, (d) reduced release of prostaglandin (PGF2α) from the uterus by specific long-chain fatty acids and (e) creating a conducive environment for early embryo survival and pregnancy establishment (Ambrose *et al.*, 2016).

2. Second experiment

2.1. Suckling milk yield and its composition

The results showed that the diets offered to goats in T2 and T3 groups achieved significantly ($P<0.05$) higher suckling milk amount than goats in T1 (Figure 3). Finding of Manso *et al.* (2011) stated that increasing of suckling milk in ewes fed fat might related in part to the genetic potential of the milk yield, supply of energy to the basal diet and the effects of the dietary fat on DMI and nutrient

Table 4: Fertility rate with control (T1) linseed oil (T2) and sunflower oil (T3).

Items	Treatment groups		
	T1	T2	T3
No. of mated does	5	5	5
No. of conceived does	4	5	5
Conception rate (%)	80.00	100.00	100.00
No. of does kidding	4.00	4.00	5.00
No. of does aborted	0.00	1.00	0.00
Fertility rate (%)	80.00	80.00	100.00
No. of does born a live kids	4.00	4.00	5.00
Total number of born kids	8.00	10.00	11.00
No. of live kids at birth day	8.00	10.00	11.00
No. of live kids after three days of birth	8.00	10.00	9.00
No. of kids mortality	0.00	0.00	2.00
Parity rate:-			
No. of does kidding single	1.00	0.00	0.00
Single rate (%)	25.00	0.00	0.00
No. of does kidding twins	2.00	2.00	4.00
Twinning rate (%)	50.00	50.00	80.00
No. of does kidding triplet	1.00	2.00	1.00
Triplet rate (%)	25.00	50.00	20.55
Sexing of kids:-			
No. of female kids	1	4.00	5.00
Sexing female ratio (%)	12.50	40.00	45.45
No. of male kids	7	6.00	6.00
Sexing male ratio (%)	87.50	60.00	54.56

partitioning. In addition, the highest suckling milk of goats in T2 and T3 groups may be due to improve regulation of gene expression in udder mammals.

Harini and James (2006) explained that a nuclear receptor capable of binding fatty acids that established a direct role for PUFA's in gene regulation, once fatty acids enter the cell they rapidly converted to fatty acyl coenzyme A (CoA) and produced secondary signaling intermediates such as cyclic AMP (cAMP), triphosphate (IP3) and calcium (Ca). Moreover, the most of suckling milk in T2 and T3 groups may attributed to increase volatile fatty acids (VFA's) concentration in rumen of goats given oil compared to T1 group. These results suggest that the anaerobic fermentation of oil (as linseed oil) was more efficient and faster in yielding more VFA's than control by indirect way (Kholif *et al.*, 2015).

Both fat (%), protein (%) and energy value (kcal/kg) in the suckling milk of goats increased significantly ($P<0.05$) in T2 and T3 groups compared to T1 group (Figures 4, 5 and 6, respectively). In general, it has been shown that quaffing oil seeds can favorably alter ruminal biohydrogenation and thereby the suckling milk amount and components compared to goats in T1. For instance, Abdelhamid *et al.* (2013) revealed that average daily milk yield (kg/doe), protein (%) and fat (%) contents at middle suckling period (45 days) were higher for Zaraibi does treated with 15 % whole sunflower (2.90, 2.53 and 5.53) than control does (2.50, 2.49 and 5.38), respectively. The presence of PUFA's (T2 and T3) in udder cell membranes could diminish susceptibility to free radical especially lipid peroxidation (which has structural damage to biological systems, produce damage of membrane function, enzymatic inactivation and toxic effects on cellular division and function) led to reduce milk production. Similarly, Repetto and Boveris (2012) found that PUFA's and their metabolites play physiological roles in selective permeability of cellular membranes,.

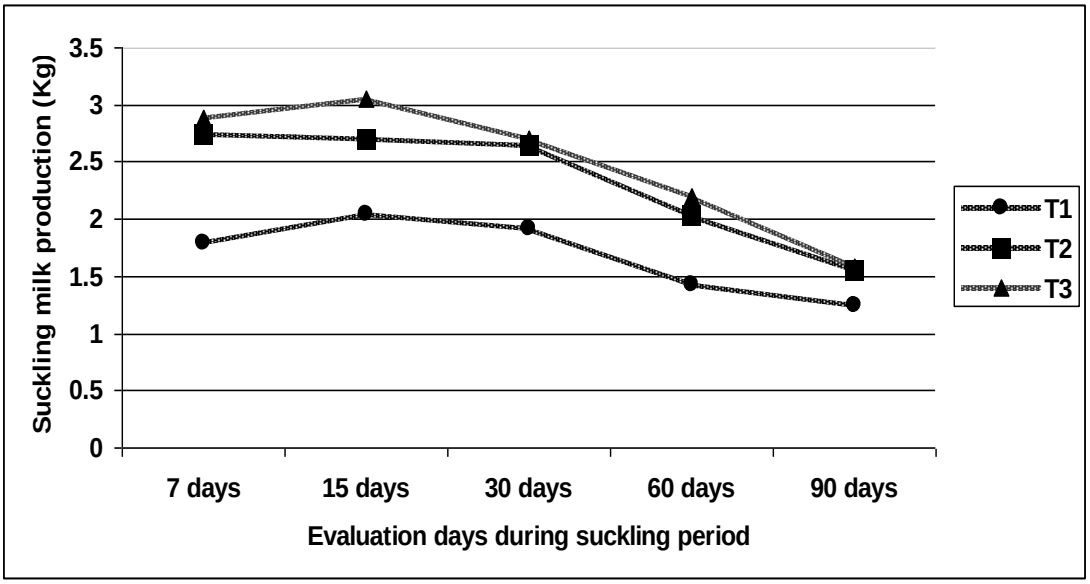

Figure 3: Suckling milk amount with control (T1), linseed oil (T2) and sunflower oil (T3).

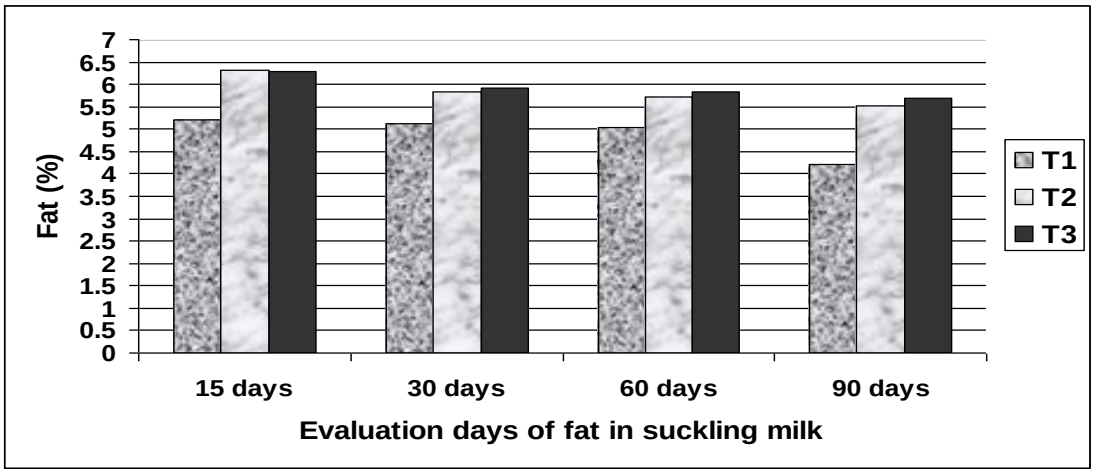

Figure 4: Suckling milk fat (%) with control (T1), linseed oil (T2) and sunflower oil (T3).

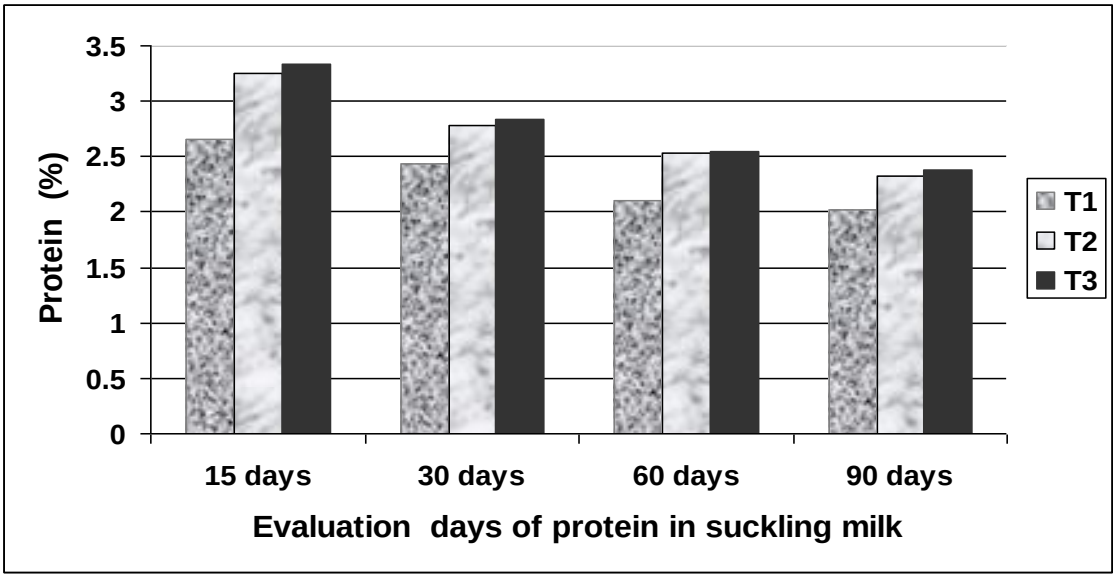

Figure 5: Suckling milk protein (%) with control (T1), linseed oil (T2) and sunflower oil (T3).

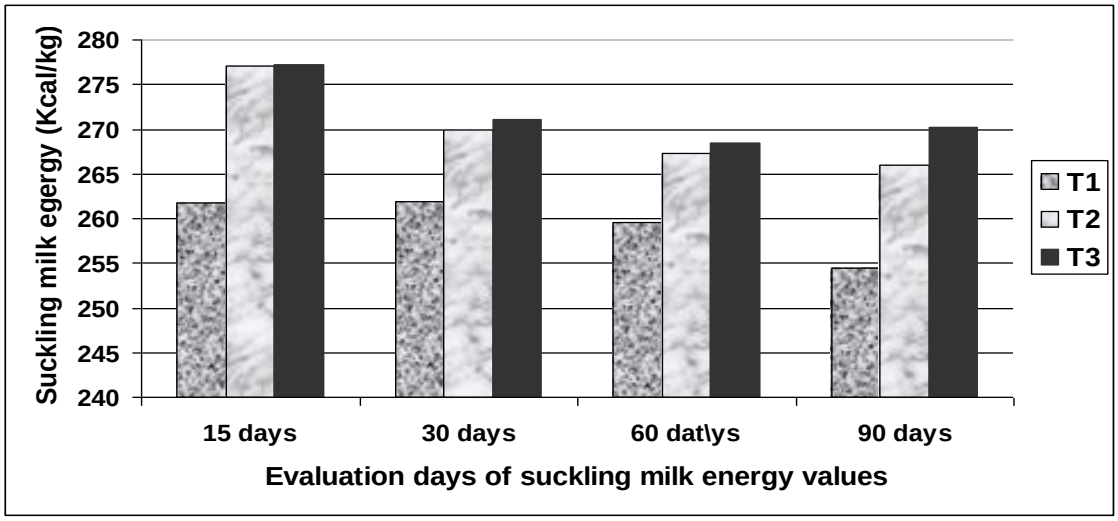

Figure 6: Suckling milk SMEV (kcal/kg) with control (T1), linseed oil (T2) and sunflower oil (T3).

cell signaling, regulation of gene expression and constringed propagation reaction of lipid peroxidation. On the other hand, Xu *et al.* (2014) successfully detected that PUFA's such as ω−6s and ω−3s could tightly collaborate to prevent free radical-mediated lipid peroxidation to produce a variety of free radical species

2.2. Weight of kids until weaning

Body weight (BW) of kids was varied (P<0.05) among goats in T1, T2 and T3 groups which reflected the effect of treating goats with linseed oil (T2) and sunflower oil (T3) on suckling milk production as shown in Figure (7). The average BW of kids after 3 days of parturition was 2.13, 2.08 and 2.37 kg, but with advanced age at 90 days the weaned kids reached 9.44, 11.14 and 11.95 kg in T1, T2 and T3 groups, respectively. This difference is certainly related to the respective milk production (quality and quantity) of either T2 or T3 compared to T1 (control) groups. Similarly, Helander (2014) demonstrated that changing growth rate of suckling lambs was mainly related to differences in milk yield, as well as, milk fat and protein levels. In the current study, fat (%), protein (%) and suckling milk energy were significantly (P<0.05) higher in does of T2 and T3 than does of T1 during different stages of suckling. This response is in agreement with those of Hafez *et al.* (2015) who confirmed that BW of weaned lambs (at 60 days) was 12.63 kg when suckling milk contains 6.7 % fat, 4.14 % protein and 285.83 kcal/kg energy , but BW was 16.00 kg when preceding components reached 8.4%, 5.47% and 308.41kcal/kg , respectively. These results because addition of PUFA's to basal rations of does could provide energy in milk (Byrne *et al.*, 2015) and maintain metabolic processes in kids (Salehi *et al.*, 2016). The previous finding that PUFA's have ability to scavenge free radical such as lipid peroxidation (Xu *et al.*, 2014) could reveal the goodness of suckling milk on consequent amelioration of growth rate of kids.

2.3. Milk production until seventeen weeks and its chemical composition

2. 3.1. Milk production until seventeen weeks

Milk yield was significantly (P<0.05) higher among goats in T1, T2 and T3 groups, but T3 obtained greater (P>0.05) milk amount than goats in T2 (Figure 8). The current study, found greater (P<0.05) milk yield in T2 (6.19, 5.80 and 5.26 kg) and T3 (6.30, 6.21 and 6.71 kg) than T1 (4.64, 4.20 and 4.01 kg) during 3rd, 4th and 5th weeks of lactation peak, respectively. This finding showed greater milk production with goats received either linseed oil (T2) or sunflower oil (T3) which compatible with Kholif *et al*. (2015) and Morsy *et al*. (2015). However, the lower milk yield with linseed oil (T2) consonance with findings of some other studies, that found a reduction in milk production by feeding extruded linseed (Lerch *et al*., 2012). Generally, the greatest milk yield of goats given treated rations (T2 and T3) may

be due to higher VFA's concentration in rumen than control ration (T1).

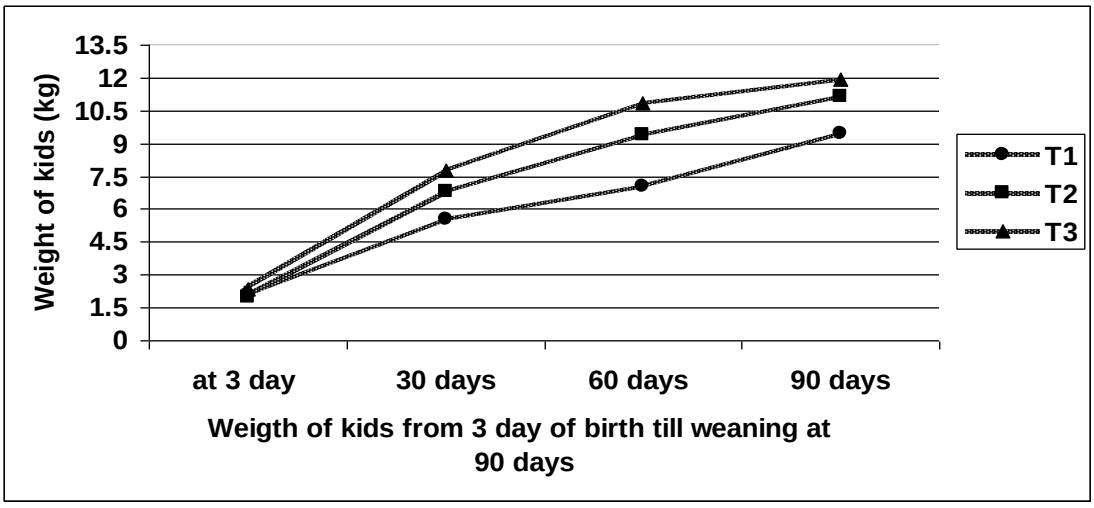

Figure 7: Weight of kids with control (T1), linseed oil (T2) and sunflower oil (T3).

Hence, total VFA's concentration in the rumen depends on nutrient digestibility, absorption rate, rumen pH, rate of digesta passage from rumen, as well as, the microbial population in the rumen and their activities. These results are in agreement with those obtained by Kholif *et al*. (2015) and Morsy *et al*. (2015). Moreover, Kholif *et al.* (2014) confirmed that the highest concentrations of VFA's indicated more efficient anaerobic fermentation, which might due to increase organic matter and fibers digestibility and led to improve milk yield of lactating goats. Meanwhile, these authors defined other visibility to increase milk yield, the reduction of ammonia-N concentrations as paralleled with increased ruminal VFA's thus considered as an indicator of higher fermentation rate and increased microbial protein synthesis, resulting in improvement of milk production. Otherwise, the greater milk yield in treated goats (T2 and T3) may attributed to prohibit free radical, specially lipid peroxidation in udder cells (Xu *et al.*, 2014), consume a goodness energy (Rodney *et al.*, 2015) or regulate mammary lipogenic gene expression and lipogenic enzyme activity that response of diets containing high proportions of concentrates and/or oil seeds (Salehi *et al.*, 2016).

2.3.2. Milk composition

Changes in milk composition affected by quaffed oil seeds to T2 and T3 goats compared

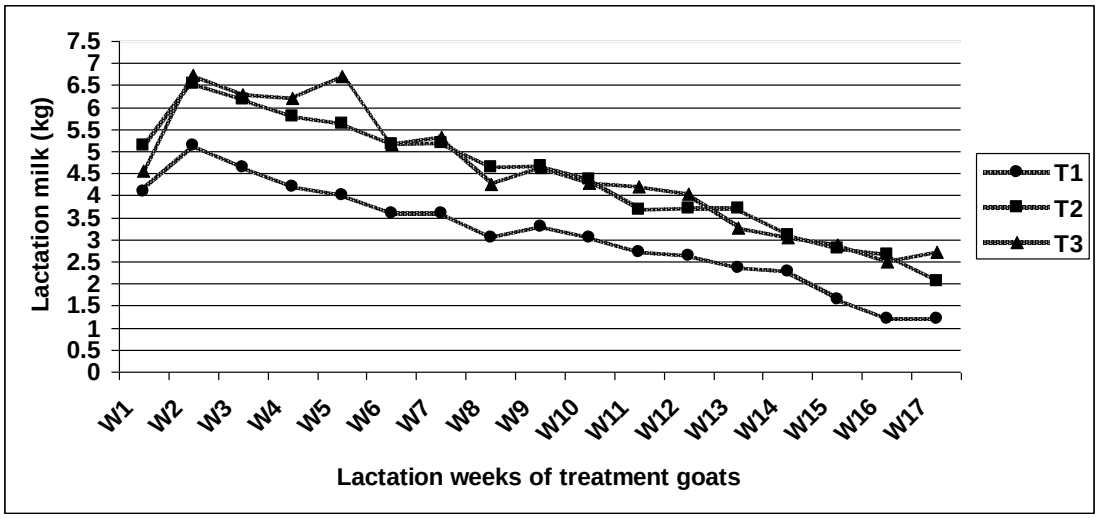

Figure 8: Milk production with control (T1), linseed oil (T2) and sunflower oil (T3).

to T1 are shown in (Table 5). The T1 diet had significant (P< 0.05) lower percentage of fat and protein (3.40 and 3.21%) compared to T2 (4.20, 3.44%) and T3 (4.10 and 3.54%), respectively. Similar trend was reported by Morsy *et al.* (2015) with fat in goats' milk. Solids not fat (SNF) and total solids (TS) showed significantly (P<0.05) higher values either with T2 or T3 than T1. Lactose and ash did not show significant differences among treatments.

The higher milk fat levels in T2 and T3 goats could related to more VFA's produced in rumen of goats than T1 goats. Actually, milk fat synthesis known to involve the coordinated activity of several lipogenic enzymes, but PUFA's nutrition may regulate mammary lipoprotein lipase, acetyl-CoA carboxylase, fatty acid synthase and stearoyl-CoA desaturase, which considered a key to produce greater milk fat (Bernard *et al.,* 2009). Abdelhamid *et al.* (2013) found that milk fat content was increased after parturition and then decreased during the major part of lactation; which related to a dilution effect due to increase milk volume until the lactation peak.

Increase of milk protein level with oil seed may be due to a great crude protein (CP) content, which came from high rumen fermentation, as a result of improvement of ruminal microbial protein synthesis and fiber fraction digestibility in T2 and T3 compared to T1 goats. In addition, protein content among T1, T2 and T3 groups was 3.21, 3.44 and 3.54%, respectively at 17 weeks of lactation. The obtained results assured with those noticed in milk of Zaraibi goats fed rations containing different types of oils (Hassan *et al.,* 2012). Furthermore, Kholif *et al.* (2015) confirmed a significant increase in protein content in lactating Damascus goats fed linseed oil (4.89%) compared to control (4.65%). By contrast, Morsy *et al.* (2015) defined no effects of sunflower oil addition to lactating Damascus goats' diets on milk protein (3.26%) compared to control group (3.16%).

Milk lactose concentration insignificantly differed among treatments; it reached 4.54, 4.62 and 4.59% for T1, T2 and T3, respectively. Indeed, increase in milk yield with oil seeds was associated with lactose in milk and consistent with the role of lactose in the regulation of milk osmolarity (Bernard *et al.,* 2009). These results are in agreement with those of Abdelhamid *et al.* (2013) who found that at 120 days during milking period lactose content was not affected significantly by feeding 15% sunflower seeds; being 3.56 and 3.63 % in control and treated goats, respectively. Contrary, Morsy *et al.* (2015) reported that linseed oil supplementation caused significant and positive correlation coefficient between lactose production and oil addition to goat diets.

Moreover, amount of ash content in T2 and T3 showed insignificant increase than T1. Morsy *et al.* (2015) reported also that ash content were similar, 0.88 and 0.89 %, in lactating Damascus goats received control and linseed oil ration, respectively. In general, the minimum and maximum milk ash content in different breeds of goats ranged between 0.56 and 0.99%, as reported by Mahmood and Usman (2010).

Total solids (TS) and solids not fat (SNF) in the present study appeared of higher values with T2 and T3, than control. The TS were 11.86, 13.01 and 12.92 %, while SNF were 8.46, 8.81 and 8.85 % within goats in T1, T2 and T3, respectively. The highest (P<0.05) TS values in T2 and T3 groups attributed to improvement of fat and protein (%) in treatment groups. On the contrary, Morsy *et al.* (2015) found that feeding linseed oil with diets not significantly affected TS, it was 12.80 and 13.60 % for control and treated group, respectively. Mahmood and Usman (2010) reported TS in goat milk ranged from 12.00 to 13.73% with mean value 12.84%. In general, any improvement in the nutritional management especially in the quality of energy during lactation resulted in increased milk production and composition, such as fat and protein concentrations (Marques *et al.,* 2016).

Table 5: Chemical composition of milk production with control (T1), linseed oil (T2) and sunflower oil (T3).

Items (%)	Treatments		
	T1	T2	T3
Fat	3.40±0.06[b]	4.20±0.05[a]	4.10±0.05[a]
Protein	3.21± 0.09[b]	3.44±1.00[a]	3.54±0.08[a]
Lactose	4.54±0.05	4.62±0.07	4.59±0.04
Ash	0.71±0.06	0.75±0.05	0.72±0.05
Solids not fat (SNF)	8.46±0.12[b]	8.81±0.06[a]	8.85±0.04[a]
Total solids (TS)	11.86±0.18[b]	13.01±0.11[a]	12.92±0.07[a]

a and b: Means within the same row with different superscripts are significantly different at P<0.05.

3. Third experiment

It is of interest to note that, goat rations treated with linseed oil (T2) and sunflower oil (T3) has attained changes in biochemical blood compared to control goats (T1) after seventeen weeks of lactation (Table 6). Blood biochemical contents as total protein, albumin (A), globulin (G), A / B ratio, triglycerides and cholesterol were insignificantly higher in T2 and T3 than T1. Only, glucose level was significantly (P<0.05) higher in T2 and T3 than T1 (66.83, 69.93 vs. 62.25%, respectively). Hence, higher glucose concentration in goats treated with oil seeds could indicate better energy status of goat bodies. Changes in glucose level may be due to the high dietary amount of long chain fatty acids that increase hepatic gluconeogenesis leading to increase propionate production in the rumen (Khalifa *et al.*, 2013). The increase of glucose concentration in goats fed oil seeds may also due to the increase of VFA's concentration in the rumen of goats (Morsy *et al.*, 2015). The previous authors defined also that triglycerides and cholesterol concentrations were insignificantly higher in control than goats treated with linseed oil (T2) or sunflower oil (T3). **Economical efficiency**

Economical estimation after seventeen weeks of lactation for control (T1), linseed oil (T2) or sunflower oil (T3) groups are shown in (Table 7). In the present study, the better milk yield, feed efficiency and feed conversion were obtained with goats in T2 and T3 groups, compared to control ration (T1). Whilst, goats in T3 group showed better economical efficiency than goats in T2 group. Thus sunflower oil may be used as the most cheap materials and practical oil added to ration for improvement of reproductive and productive performance in goat herds.

The lowest cost to produce kg of commercial milk was observed in T3 (1.72 L.E) compared to T2 (2.07 L.E) and T1 (2.17 L.E). Furthermore, goats received sunflower oil (T3) reflected higher economical efficiency of milk production 47. 37 % than linseed oil added in T2 group (39.34%) and T1 (37.43%). Meanwhile, relative improvements in efficiency compared to control were estimated by 127.07 % and 105.41%, for T3 and T2, respectively.

Table 6: Blood biochemical parameters with control (T1) linseed oil (T2) and sunflower oil (T3).

Item,%	Treatment groups		
	T1	T2	T3
Glucose (mg/dL)	62.25±0.66[b]	66.83±0.19[a]	69.93±0.74[a]
Total protein (g/dL)	6.40±0.04	6.47±0.09	6.56±0.05
Albumin (g/dL)	3.33±0.04	3.44±0.03	3.43±0.04
Globulin (g/dL)	2.92±0.01	2.99±0.05	3.00±0.02
A/G (%)	1.15±0.02	1.27±0.13	1.14±0.02
Triglycerides (mg/dL)	182.28±0.42	181.00±0.83	180.25±0.65
Cholesterol (mg/dL)	191.70±3.06	188.90±0.47	188.98±0.49

a and b: Means within the same row with different superscripts are significantly different at P<0.05.

Table 7: Economical efficiency of milk production in goats fed tested oils for seventeen weeks (of lactation).

Items	Treatment groups		
	T1	T2	T3
CFM consume during seventeen weeks, kg /4 does	476.00	476.00	476.00
BH consume during seventeen weeks, kg/ 4 does	357.00	357.00	357.00
RS consume during seventeen weeks, kg/4 does	119.00	119.00	119.00
Oil consume during seventeen weeks, kg / 4 does	-	25.23	25.23
Total nutriment intake, kg/4 does [A]	952.00	977.23	977.23
Cost of rations intake and sale milk, LE			
Cost of CFM /4 does	1523.20	1523.20	1523.20
Cost of BH / 4 does	267.75	267.75	267.75
Cost of RS/ 4 does	41.65	41.65	41.65
Cost of oil / 4 does	-	630.75	277.53
Total price of feed consumed / 4 does [B]	1832.10	2462.85	2109.63
Total milk yield / 4 does, kg [C]	211.05	298.15	307.55
price of sold milk, LE[D]	685.91	968.99	999.54
Economic efficiency			
Feed efficiency, [C/A]	0.22	0.31	0.32
Feed conversion, [A/C]	4.51	3.28	3.18
Feeding cost of producing milk / 4 does [B/C]	8.68	8.26	6.86
*Feeding cost of producing kg milk /doe	2.17	2.07	1.72
Economic efficiency (EE) amount, [D/B]	0.37	0.39	0.47
**Economic efficiency (EE), %	37.43	39.34	47.37
***EE (%) relative to control	100.00	105.41	127.03

Price of sale kg of goat milk is 3.25 (EGP).

Price in year 2016 for CFM, BH and RS were 3200, 750, 350 EGP /ton and linseed and sunflower 25 and 11 EGP / kg, respectively.

*** Feeding cost of producing kg milk /doe = Feeding cost of producing milk /4 does ÷ 4.**

****Economic efficiency (%) = money out put (price of sold milk) ÷ money input (total price of feed consumed) ×100.**

***** EE (%) relative to control with T2 or T3= EE amount of T2 or T3 – EE amount of T1÷ EE amount of T1×100 +100 (conceder EE of T1 is 100%).**

CONCLUSION

These results demonstrated a considerable scope in manipulating the energy of ration with oil seeds supplementation. The addition of linseed oil or sunflower oil to a diet at 3% of DMI improved body weight of goats during gestation, fertility rate, weight of weaning kids, milk production at suckling and lactation status and some blood metabolism when compared with basic ration. Sunflower oil (as cheap source) is more efficient economically than linseed oil.

REFERENCES

Abdelhamid, A. M, T. A. M. Ashmawy, Faten F. Abou Ammou and Heba A. El-Sanafawy, 2013. Effect of dietary inclusion of whole sunflower seeds on feeding lactating Zaraibi goats: Milk production and composition as well as mammary gland histology and economic efficiency. International Journal of Biotechnology Research, 1(1): 6 -19.

Ambrose, D. J., M. G. Colazo, R. Salehi, 2016. Can feeding fats improve reproductive performance in dairy cows? Advances in Dairy Technology, 28: 177-193.

AOAC, 2007. Association of Official Analytical Chemists. Official Methods of Analysis. 19th Edition. Washington, DC: USA.

Baldi, A., F. Cheli, C. Corino, V. Dell' Orto and F. Polidor, 1992. Effects of feeding calcium salts of long chain fatty acids on milk yield, milk composition and plasma parameters of lactating goats. Small Ruminal Research, 6: 303 - 310.

Bernard , L., M. Bonnet , C. Leroux , K. J. Shingfield and Y. Chilliard, 2009. Effect of sunflower-seed oil and linseed oil on tissue lipid metabolism, gene expression, and milk fatty acid secretion in Alpine goats fed maize silage–based diets. Journal Dairy Science, 92: 6083-6094.

Byrne, C. S., E. S. Chambers, D. J. Morrison, and G. Frost, 2015. The role of short chain fatty acids in appetite regulation and energy homeostasis. International Journal of Obesity, 39: 1331-1338.

Cieslak, A., J. Kowalczyk, M. Czauderna, A. Potkanski and M. Szumacher-Strabel, 2010. Enhancing unsaturated fatty acids in ewe's milk by feeding rapeseed or linseed oil. Czech Journal Animal Science, 55:496 -504.

Gawad, R. M. A., H. M. Kattab, M. Strabel, S. A. Abo-El-Nor, A. Cieslak, P. Zmore, M. Elnashar, H. El-Sayed and S. M. Kolif, 2015. Effect of different levels from linseed oil and linseed oil beads on rumen fermentation and microbial parameters using gas production system and rumen technique. Asian Journal of Animal and Veterinary Advances. 10 (3): 97-118.

Gulliver, C. E., M. A. Friend, B. J. King and E. H., Clayton, 2012. The role of omega-3 polyunsaturated fatty acids in reproduction of sheep and cattle. Animal Reproduction Science, 131: 9-22.

Hafez, Y. H., E. I., Khalifa, H. R., Behery, A. A., Mahrous, M. A. F. Amal, and A. M. H. Hanan, 2015. Productive and reproductive performance of ewes and growth rate of lambs as affected by non-conventional energy supplement to rations. Egyptian Journal of Sheep and Goat Sciences, 10 (2): 81-93.

Harini, S. and J. M. Ntambi, 2006. Regulation of gene expression by polyunsaturated fatty acids. Heart Metabolics, 32: 32-35.

Hassan, T. M., M. Ibrahim, K. Itman and I. Abdel-Hai, 2012. Productive and reproductive performance of Zaraibi goats fed different types of protected fat. The 13th Science Conformance for Animal Nutrition Sharm El-Sheikh, 14-17 February: 512-537.

Helander, C., 2014. Forage feeding in intensive lamb production. Intake and performance in ewes and lambs. Ph. D. Thesis Fac. of Agricultural Sciences, Swedish Univ. Skara.

Juchem, S., R. Cerri, M. Villaseñor, K. Galvão, R. Bruno, H. Rutigliano, E. DePeters, F. Silvestre, W. Thatcher and J. Santos, 2008. Supplementation with calcium salts of linoleic and trans-octadecenoic acids improves fertility of lactating dairy cows. Reproduction in Domestic Animals, 10: 1439 - 0531.

Khalifa, E. I., H. R., Behery, Y. H. , Hafez, A. A., Mahrous, Amal, A. Fayed and Hanan, A. M. Hassanien, 2013. Supplementing non-conventional energy sources to rations for improving production and reproduction performances of dairy Zaraibi nanny goats. Egyptian Journal of Sheep and Goat Sciences, 8 (2): 69 - 83.

Kholif, A. E., H. M. Khattab, A. A. El-Shewy, A. Z. M. Salem, A. M. Kholif, M. M. El-Sayed, H. M. Gado, and M. D. Mariezcurrena, 2014. Nutrient digestibility, ruminal fermentation activities, serum parameters and milk production and composition of lactating goats fed diets containing rice straw treated with *Pleurotusostreatus*. Asian Australasian Journal Animal Science, 27: 357-364.

Kholif, S. M., T. A. Morsy, O. H. Matloup, H. M. Ebeid, and A. M. Kholif, 2015. Effects of crushed linseed or linseed oil supplementation on performance of dairy goats and fatty acid profile in milk. Life Sciences Journal, 12: 94 -99.

Lerch S, K. J. Shingfield, A. Ferlay, A .Vanhatalo and Y.Chilliard, 2012. Rapeseed or linseed in grass-based diets: Effects on conjugated linoleic and conjugated linolenic acid isomers in milk fat from Holstein cows over 2 consecutive lactations. Journal Dairy Science, 95: 7269 -7287.

Mahmood, A. and S. Usman, 2010. A comparative study on the physicochemical parameters of milk samples collected from buffalo, cow, goat and sheep of gujrat, Pakistan. Pakistan Journal of Nutrition, 9 (12): 1192-1197.

Manso, T., R. Bodas, C. Vieira, A. R. Mantecon, T., Castro, 2011. Feeding vegetable oils to lactating ewes modifies the fatty acid profile of suckling lambs. Animal, 5: 1659-1667.

Marques, R. O., H. C. Gonçalves, P. R. L. Meirelles, G. I. L. Cañizares, G. M. Oliveira,

H. F. B. Gomes, S. Fernandes, A. A. Oliveira, É. P. Brito and R. F. Carmo, 2016. Effect of concentrate supplementation during pre-kidding on the productive and reproductive performance of goats raised on Guinea grass (*Panicum maximum* cv. Tobiatã) pasture. Ciências Agrárias Londrina, 37 (3): 1489 -1504.

Moriel, P., B. I. Cappellozza, L. F. Ferraretto, A. C. Aboin, F. V. R. Vieira, R. O. Rodrigues, R. F. Cooke and J. L. M. Vasconcelos, 2014. Effects of supplementation of calcium salts of polyunsaturated fatty acids on serum concentrations of progesterone and insulin of pregnant dairy cows. Revista Brasileira de Zootecnia, 43 (1): 20-26.

Morsy, T. A., S. M. Kholif, O. H. Matloup, A. Z. M. Salem and A. Abu-Elella, 2015. Influence of sunflower whole seeds or oil on ruminal fermentation, milk production, composition and Fatty acids profile in lactating goats. Asian Australasian Journal Animal Science, 28 (8):1116 -1122.

NRC, 2007. Nutrient Requirements of Small Ruminants: sheep, goats, cervids, and New World camelids. National Research Council of the National Academies, National Academies Press, Washington, D.C., U.S.A.

Pana, S., C. Biswasb, D. Majumdarb, D. Senguptaa, A. Patrab, S. Ghoshc and A. Haldar, 2015. Influence of age, body weight, parity and morphometric traits on litter size in prolific Black Bengal goats. Journal of Applied Animal Research, 43 (1): 104 -111.

Repetto, M. G. and A. Boveris, 2012. Transition metals: bioinorganic and redox reactions in biological systems. In: Transition metals: uses and characteristics. Nova Science Publishers Inc (ed.): New York, USA: 349-370.

Rodney, R. M., P. Celi, W. Scott, K. Breinhild and I. J. Lean, 2015. Effects of dietary fat on fertility of dairy cattle: A meta-analysis and meta-regression. Journal Dairy Science, 98: 5601-5620.

Rodriguez-Sallaberry, C., C. Caldari-Torres, W. Collante, C. Staples and L. Badinga, 2007. Plasma prostaglandin and cytokine concentrations in periparturient Holstein cows fed diets enriched in saturated or trans fatty acids. Journal Dairy Science, 90: 5446-5452.

Salehi, R., M. G. Colazo, A. Behrouzi, A. Ruiz-Sanchez, M. Oba, M. K. Dyck and D. J. Ambrose, 2013. Superovulatory response and embryo production in Holstein cows fed diets enriched in oleic, linoleic, or α-linolenic acid. Reproductive Fertility Development, 26: 218-218.

Salehi, R., M. G. Colazo, M. Oba and D. J. Ambrose, 2016. Effects of prepartum diets supplemented with rolled oilseeds on calf birth weight, postpartum health, feed intake, milk yield and reproductive performance of dairy cows. Journal Dairy Science, 99 (5): 3584-3597.

SPSS, 2013. Statistical package for social sciences, IBM®SPSS Statistics Data Editor 22.0 License Authorization Wizard, Chicago, USA.

Weisbjerg, M. R., M. K. Larsen, L. Hymoller, M. Thorhauge, U. Kidmose, J. H. Nielson, J. B. Andersen, 2013. Milk production and composition in Danish Holstein, Danish red and Danish Jersey cows supplemented with saturated or unsaturated fat. Livestock Science, 155: 60-70.

Xu , Y., J. Qi, X. Yang , E. Wu and Steven Y. Qian, 2014. Free radical derivatives formed from cyclooxygenase-catalyzed dihomo-γ-linolenic acid peroxidation can attenuate colon cancer cell growth and enhance 5-fluorouracil's cytotoxicity. Redox Biology, 2 (2014): 610–618.

Zambiazi, R. C., R. Przybylski, M. W. Zambiazi and C. B. Mendonça, 2007. Fatty acid composition of vegetable oils and fats. Boletim do Centro de Pesquisa de Processamento de Alimentos, 25 (1): 111-120.

الملخص العربى

الأداء التناسلى والإنتاجى لتجريع الماعز الحلابة زيت الكتان وزيت دوار الشمس

[1]عزالدين ابراهيم خليفه- [1]عبد الجواد مجاهد عبد الجواد- [1]هشام رجب بحيرى- [2]جمال ابراهيم الإمام- [3]طلعت حسن السواح

1- قسم بحوث الأغنام والماعز- معهد بحوث الإنتاج الحيوانى- مركز البحوث الزراعية- الدقى –جيزة- مصر
2- قسم بحوث استخدام المخلفات - معهد بحوث الإنتاج الحيوانى- مركز البحوث الزراعية- الدقى –جيزة- مصر
3- قسم بحوث تكنولوجيا الألبان- معهد بحوث الإنتاج الحيوانى- مركز البحوث الزراعية- الدقى –جيزة- مصر

الغرض من هذه الدراسة قياس تأثير إضافة زيت الكتان ودوار الشمس على الأداء التناسلى والإنتاجى فى الماعز الزرايبى الحلابة. أستخدمت 15 عنزة حلابة قسمت إلى 3 معاملات (5/معاملة) ت1، ت2،ت3 .المعاملة ت1 كانت للمقارنة وغذيت على 50% علف مركز (1000جرام)+ 50 % مواد خشنة تشمل (750 جرام) دريس برسيم+ (250 جرام) قش الأرز بنسبة 1:3 . بالإضافة للعليقة السابقة (جرعت عنزات المعاملة ت2 بزيت الكتان وعنزات المعاملة ت3 بزيت دوار الشمس) والتجريع كان بمعدل 3% من كمية المادة الجافة المأكولة (53 جرام/ زيت/ رأس/يوم) قسمت على مرتين يوميا الأولى8 صباحا(27 جرام/ زيت/ رأس/يوم) ، والثانية 3 بعد الظهر (26 جرام/ زيت/ رأس/يوم). وقدمت المعاملات السابقة للعنزات فى ت1، ت2، ت3 قبل 21 يوم من بداية موسم التلقيح (كفترة دفع غدائى) وأستمرت حتى 17 أسبوع من موسم الحليب. وتم أجراء ثلاثة تجارب على عنزات ت1، ت2،ت3. التجربة الأولى لتقدير وزن العنزات قبل موسم التلقيح، بعد موسم التلقيح، عند الثلث الأخير من الحمل (100 يوم) ، وعند 145 يوم من الحمل، بعد الولادة، وحجم البطن، الوزن الكلى للمواليد بعد الولادة. التجربة الثانية لتقدير كمية وتركيب لبن الرضاعة والحليب ووزن الجداء المفطومة. التجربة الثالثة لتقييم أيض الدم مثل الجلوكوز- البروتين الكلى- الألبيومين- الجلوبيولين- الجلسريدات الثلاثية- الكوليسترول. وأظهرت النتائج فى التجربة الأولى ان إضافة الزيت لعنزات المعاملات ت2، ت3 حسن معنويا عند مستوى 5% من وزن العنزات اثناء الحمل، وحجم البطن، ومعدل الخصوبة مقارنة مع عنزات ت1(مجموعة المقارنة). وفى التجربة الثانية اظهرت عنزات ت1 انخفاض معنوى فى كمية لبن الرضاعة والحليب ونسب البروتين والدهن مقارنة مع عنزات ت2،ت3.وحققت عنزات ت2،ت3 اعلى معنوية فى وزن الجداء المفطومة مقارنة مع عنزات المعاملة ت1. والتجربة الثالثة اظهرت مع عنزات ت2،ت3 زيادة معنوية عالية عند مستوى 5% فى تركيز الجلوكوز وزيادة غير معنوية فى البروتين الكلى- الألبومين- الجلوبيولين وإنخفاض غير معنوى فى الجلسريدات الثلاثية والكوليسترول مقارنة مع عنزات ت1.وتوضح النتائج ان إضافة زيت الكتان ودوار الشمس لهم تأثير مفيد على الأداء التناسلى والإنتاجى للماعز الحلابة، لكن زيت دوار الشمس حقق كفاءة اقتصادية افضل من زيت الكتان.

REPRODUCTIVE AND PRODUCTIVE PERFORMANCE OF LACTATING GOATS QUAFFED LINSEED OIL AND SUNFLOWER OIL