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The Role of Oils Addition to Diets and its Effect on Ration Consumption and Production Profomance Recovery of Dairy Goats

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ABSTRACT

Fifteen Zaraibi nanny goats were divided into three groups (N=5/group) and randomly assigned to three experimental diets: (1) control diet group free of oil (G1) fed concentrate fed mixture (CFM) + berseem hay (BH), (2) trial diet group (G2) received CFM+ BH+ linseed oil and (3) trial diet group (G3) fed CFM+BH+ sunflower oil (oil bottles are not suitable for marketing). All goats in G2 and G3 group received oils at the rate of 3% of dry matter intake. The study included evaluation of rations' consumption from flushing to mating, from trimester to parturition, during suckling and lactation months. Also, productive performance recovery included changing body weight of maternal, offspring number, litter size, average birth body weight of kids (at four days post-received colostrum), suckling milk amount, body weight of weaning kids, trading milk, blood metabolites and economic efficiency. The results indicated that oils addition in G2 and G3 reduced feedstuffs consumption from flushing up to parturition, during suckling and lactation months compared to goats in G1 group. Subsequently, the total consumption of rations for G1, G2 and G3 were 1200, 1191, and 1189 g / h /d from flushing to mating; 1390, 1380, and 1380 g / h /d during trimester to parturition; 1497, 1427 and 1427 g / h /d during suckling and 1223, 1210 and 1202 g / h /d during milking months, respectively. Consequently, the productive performance recovery such as changing body weight of maternal in G1, G2 and G3 groups from flushing (36.80, 36.78 and 36.44 kg) to parturition (37.48, 38.00 and 38.12 kg), offspring numbers was 8, 10 and 11 kids, litter size recorded 2.00, 2.50 and 2.20% and average body weight of birth kids reached to 2.90, 3.60 and 4.70 kg, respectively. Furthermore, the nanny goats in diet of G1 showed a lower ($P < 0.05$) suckling milk amount (1.79, 2.05, 1.92, 1.43 and 1.25kg /h) than nanny goats in G2 (2.75, 2.70, 2.65, 2.03 and 1.55 kg/h) and G3 (2.88, 3.05, 2.70, 2.20 and 1.58 kg/h) through evaluation period at 7, 15, 30, 60 and 90 days post-partum, respectively. In addition, body weight of kids at weaning recorded significant ($P<0.05$) differences among G1, G2 and G3, being 9.40, 11.10 and 11.90 kg, respectively. When, G2 and G3 groups received oils they could show the highest ($P<0.05$) yield of milk (363 and 389 kg) than goats in G1 (262 kg) during lactating months, respectively. But, no variation ($P > 0.05$) was observed in blood parameters among G1, G2 and G3, except glucose (62.35, 68.88 and 69.86 mg/dl) and calcium (9.01, 10.11 and 10.45 mg/dl). The economic efficiency indicated the best estimate in G3 (72.53%) followed by G2 (65.98%) and the less within G1 (55.55%). The results showed that the addition of linseed and sunflower oils to goats' rations could lead to a lower consumption of diet during critical periods (from flushing to parturition) of production. In addition, it has been found a better production performance recovery and economic efficiency than those fed feedstuffs alone.

Keywords: Dairy goats, energy, stages of production, linseed oil, sunflower oil.

INTRODUCTION

Energy is allows body functions to occur which including fetal development, milk production, body maintenance and weight gain. Without sufficient energy intake, the nanny goat's body will break down both fat and muscle tissue to be used as sources of energy. In this context, Chanjula (2017) found that animal loss weight, if they deplete more energy than they digest from nutritional sources. The by-products of oils are often considered as alternative ruminant rations' additives to overcome feed problems. The utilization of these by-products can also reduce feed cost and environmental pollution (Abdelhamid *et al*., 1993). In simpler terms, Gawad *et al.*(2015) stated that linseed oil is rapidly hydrolyzed and biohyderogenated in rumen resulting in altering the fatty acid composition of ruminants which reduce the risk of diseases. Furthermore, Morsy *et al*. (2015) confirmed that feeding of either sunflower oil decreased both ruminal pH and ruminal ammonia-N concentrations and enhanced concentrations of ruminal volatile fatty acids (VFA's). The by-products of either linseed or sunflower oils has been used to dairy goats (Khalifa *et al.,* 2016) and thus can result in increased efficiency of production. Feedstuffs supplementation or addition with oil improved nutrient utilization and productivity of the lactation goats (Eknaes *et al.,* 2017), which could be due to the balanced nutrients for optimum feed digestibility. On the other hands, Muktiani *et al.* (2018) concluded that feed intake was decreased when goats were supplemented with grapes seed oil. Generally, oils are dietary alternatives that will meet the nutritional requirements of animals without increasing the heat produced by ruminal fermentation (Lima *et al.,* 2018), since the use of oil increases the energy density in the dairy goats' diet without the risk of nutritional disorders. Therefore, the present study is being undertaken to investigate effects of oils (i.e. linseed and sunflower) addition on feed consumption during critical production periods and its production performance recovery of dairy Zaraibi goats.

MATERIALS AND METHODS

This research was performed at El-Serw Experimental Research Station, belonging to Animal Production Research Institute (APRI), Agriculture Research Center, Egypt.

Experimental animals and feeding of experimental groups

Fifteen lactating Zaraibi goats in the third parity of lactation with an average live body weight of 36.77 kg were used in this research. The nanny goats were divided into three trial groups randomly (N=5 in each). The 1st group (G1) was control (free of oil addition); while, the 2nd group (G2) was treated with linseed oil (contains 8.4 kcal/g) and the 3rd group (G3) was treated with sunflower oil (contains 9.7 kcal/g). Oils by-products which used in this study were collected from oil factories that oil bottles are not suitable for marketing and invalid oil bottles during packing. Goats in each group were housed individual (each house was provided with feeding place, mineral blocks and fresh water) under the same environmental conditions.

Feeding of experimental groups

All nanny goats in G1 received a basal ration included CFM+BH which offered according to NRC (2007) to cover feeding requirements during different physiological stats of goats. However, nanny goats formed G2 and G3 received the same basal ration (CFM+BH) plus addition either linseed or sunflower oils up to 3% from dry matter intake (DMI), respectively.

Experimental ration

Feedstuffs analysis (AOAC, 2007) is represented in Table 1. However, Table 2 illustrates the saturated fatty acids profile for linseed oil and sunflower oil, but Table 3 presents the unsaturated fatty acids profile for both oils according to Zambiazi *et al.* (2007).

Table 1. Chemical analysis of dietary ingredients (% on DM basis)

Chemical composition	Dietary ingredients	
	CFM	BH
Dry matter (DM)	89.95	86.19
Organic matter (OM)	87.77	89.21
Crude protein (CP)	14.40	12.67
Ether extract (EE)	2.41	3.41
Crude fiber (CF)	7.09	27.84
Nitrogen free extract (NFE)	63.87	45.29
Ash	12.23	10.79
*Metabolic energy (kcal /g DM)	3.30	3.20

CFM: concentrate feed mixture, BH: berseem hay, *Calculation of metabolic energy=3260+0.455×CP+3.517×EE-4.037×CF according to Canbolat and Karabulut (2010).

Table 2. Saturated fatty acids profile for both linseed and sunflower oils

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 either linseed oil or 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.**

Experimental designs

This research was carried out to evaluate energy consumption as daily feedstuffs offered (it was recorded biweekly by weighing the offered diets and refusals from the previous day) during different stages of production from flushing to parturition, suckling period and lactation period. Thus, production performance recovery such as changing body weight of maternal, offspring number, litter size, average body weight of kids at birth, suckling milk amount, body weight of weaning kids, trading milk, blood metabolites and economic efficiency were estimated.

Experimental procedures:

Changing of body weight from flushing to parturition

Weight changing in G1, G2 and G3 groups was investigated pre-mating, post- mating, pre-trimester of pregnancy (at 100 days), at 145 days pre-parturition, post-parturition using an electronic scale in the morning before feeding.

Recovery in offspring parameters

At parturition, fertility rates of goats in G1, G2 and G3 were recorded as following: conception rate as number of nanny goats conceived / nanny goats mated. The single parity rate (as number of nanny goats kidded single/ number of nanny goats kidded. The Twins parities rate (as number of nanny goats kidded twins/ number of nanny goats kidded). The Triplet parities rate (as number of nanny goats kidded triplet/number of nanny goats kidded). Litter size (as number of total born kids /number of nanny goats kidded). The total birth weight of kids at four days (post-received milk colostrum) was recorded.

Recovery on suckling and milk harvest

Suckling milk harvest in G1, G2 and G3 were recorded at 7, 15, 30, 60 and 90 days using oxytocin methods according to Khalifa *et al.* (2013).Commercial milk harvest was carried out up to seventeen weeks of lactation. The hand milking was done two times daily at 6 a.m and 5 p.m., and then total milk yield for a doe/group was registered weekly. The amount of milk yield / week was evaluated as following: Total daily milk yield (by added morning cooled milk and the evening milk samples ones) × 7 days.

The blood metabolites

At seventeen weeks of lactation, blood samples were taken from the jugular vein of G1, G2 and G3 groups (3 nanny goats / treatment) in the morning before feeding. The aliquots of serum from blood samples were obtained by centrifugation at 3500 *g* / min and stored in Eppendrof tubes at -20ºC until the analysis. The biochemical metabolites analyzed were: glucose, total cholesterol, triglycerides, proteins (albumin and total protein), enzymes (aspartate aminotransferase - AST and gamma-glutamyl transferase - GGT), substances related to kidney functions (urea and creatinine) and minerals (calcium and phosphorus). Doles® commercial kits were used for biochemical analysis.

Economic efficiency

The economic efficiency was calculated by determine market price of feedstuffs and milk amount up to 17 weeks of lactation as following: Money output (price of sale milk) ÷ input (total price of energy consumed) ×100. In addition, the economic efficiency (%) relative to control with either G2 or G3 was calculated as following: The economic efficiency amount of G2 or G3 – economic efficiency amount of G1÷ economic efficiency amount of G1×100+100 (conceder economic efficiency of G1 is attained 100%).

Statistical analysis

The data were subjected to statistical analysis using general linear models procedure adapted by statistical package for social sciences version 22.0 for Windows (SPSS®, 2013) for user's guide with one-way ANOVA. Duncan test within SPSS program was done to determine the degree of significance between the means.

RESULTS AND DISCUSSION

Both energy and feedstuffs consumption during critical production periods

Both energy and feedstuffs consumption for G1, G2 and G3 goats during sensitive stage of production, from flushing to post-partum are presented in Table 4 and during suckling and lactation period are shown in Table 5. The current results recorded that from flushing to mating, goats in G2 and G3 consumed lower CFM (435 and 433 g / head/

day) than those in G1 (444 g / head /day), respectively. Also, under the trimester condition the greatest CFM intake was observed in G1 (792 g / head /day) compared to G2 (782g / head /day) and G3 (782 g / head /day). Regarding to energy and diet during suckling period, G1 has consumed the highest total feedstuffs (1497 g / head /day) compared to G2 (1427g / head /day) and G3 (1427g / head /day). However, the total daily feedstuffs consumed was lower in G2 (1210 g / head /day) and G3 (1220 g / head /day) than in G1 (1223 g / head /day) during lactating periods. That can be explained by the findings of Morsy *et al*. (2015) who revealed that diets containing energy sources are rapidly fermented in the rumen yielding high concentrations of lactate and volatile fatty acids that lead to decrease ruminal pH and feed consumption. Hence, the later authors assume that no difference in dry matter intake among treatments have been reported in lactating goats fed control ration (1.36 kg / head /day) and those fed sunflower oil (1.39 kg /head/day), respectively. In this sense, the use of oil in diets for ruminants has been reduced DM intake (Silva *et al.,* 2015). Furthermore, Muktiani *et al.* (2018) found that goats received seed oil at 22ml / head /day consumed lower dry matter intake (859.62 g / head / day) than those free of oil (939.92 g / head / day). Lima *et al.* (2018) confirm that the lowest dry matter intake reached to 1627 g / head /day when lactating goats' rations supplemented with 30 ml of oil compared to 1682 g / head /day in control goats. On the other hand, Abdel-Gawad and El-Emam (2018) recorded that Zaraibi kids received either linseed or sunflower oils consumed CFM up to 417 and 420 g/ h /d and BH 289 and 292 g/ h /d compared to control kids which consumed CFM at 423 g/ h /d and BH 295 g/ h /d, respectively. Moreover, Abdel-Gawad *et al.* (2017) reported that supplementation of energy sources to rations could alleviate consumption of CFM; it was 525 g/h/d in control group and 473 g/h/d in trial group during suckling period, while it reached 691 g/h/d in control group and 622 g/h/d in trial group during lactation period of dairy goats.

Table 4. Daily energy consumption from flushing to parturition

Items	Trial groups		
	G1	G2	G3
	From flushing up to mating		
ME of CFM, kcal/g/h/d	1465.2 *(444 g/h/d)	1428.9 *(435g/h/d)	1435.5 *(433g/h/d)
ME of BH, kcal/ g/h/d	2419.2 *(756 g/h/d)	2419.2 *(756 g/h/d)	2419.2 *(756 g/h/d)
ME of linseed oil, kcal/g /h/d	0.00	302.4 *(36g/h/d)	0.0
ME of sunflower oil, kcal/ g/h/d	0.0	0.0	349.2 *(36g/h/d)
Total ME consumption kcal/g/h/d	3884.4	4150.5	4203.9
Total ration consumption g/h/d	1200.0	1191.0	1189.0
Concentration: roughage	37:63	36:64	36:64
	From trimester to parturition		
ME of CFM, kcal/g /h/d	2613.6 *(792 g/h/d)	2580.6 *(782 g/h/d)	2580.6 *(782 g/h/d)
ME of BH, kcal/g /h/d	1919.6 *(598 g/h/d)	1919.7 *(598 g/h/d)	1919.7 *(598 g/h/d)
ME of linseed oil, kcal/g/h/d	0.0	344.4 *(41.00g/h/d)	0.0
ME of sunflower oil, kcal/ g/h/d	0.0	0.0	397.7 *(41.00 g/h/d)
Total ME kcal/g/h/d	4533.2	5114.7	5168.0
Total ration consumption g/h/d	1390.0	1380.0	1380.0
Concentration: roughage	57:43	57:43	57:43

ME: metabolic energy, CFM: concrete feed mixture, BH: berseem hay, G1: free of oil addition, G2: received linseed oil, G3: received sunflower oil, * Consumption quantity of CFM, BH and oil.

Table 5. Daily energy consumption during suckling and lactation periods

Items	Trial groups		
	G1	G2	G3
	During suckling period		
ME of CFM, kcal/g/h/d	2913.9 *(883 g/h/d)	2682.9 *(813g/h/d)	2682.9 *(813g/h/d)
ME of BH, kcal/ g/h/d	1964.8 *(614 g/h/d)	1964.8 *(614 g/h/d)	1964.8 *(614 g/h/d)
ME of linseed oil, kcal/g /h/d	0.0	361.2 *(43g/h/d)	0.0
ME of sunflower oil, kcal/ g/h/d	0.0	0.0	417.1 *(43g/h/d)
Total ME consumption kcal/g/h/d	4878.7	5008.9	5064.8
Total ration consumption g/h/d	1497.0	1427.0	1427.0
Concentration: roughage	58:42	57:43	57:43
	During lactation period		
ME of CFM, kcal/g /h/d	1890.90 *(573 g/h/d)	1821.6 *(560 g/h/d)	1848.0 *(552 g/h/d)
ME of BH, kcal/g /h/d	2080.00 *(650 g/h/d)	2080.0 *(650 g/h/d)	2080.0 *(650 g/h/d)
ME of linseed oil, kcal/g/h/d	0.00	302.4 *(36.00 g/h/d)	0.0
ME of sunflower oil, kcal/ g/h/d	0.0	0.0	349.2 *(36.00 g/h/d)
Total ME kcal/g/h/d	3970.9	4204.0	4277.2
Total ration consumption g/h/d	1223.0	1210.0	1202.0
Concentration: roughage	47:53	47:53	46:54

ME: metabolic energy, CFM: concrete feed mixture, BH: berseem hay, G1: free of oil addition, G2: received linseed oil, G3: received sunflower oil, * Consumption quantity of CFM, BH and oil.

Production performance recovery

Changing of maternal body weight (from flushing to parturition)

Figure 1 illustrates changes of maternal body weight in G1, G2 and G3 according to energy consumption. Changes of body weight from flushing to parturition did not significantly differ among trial groups. However, within advancement of gestation months, does in G2 and G3 indicated heavier body weight (P>0.05) than those in G1 trial. Hence, addition of oils may be affected positively on body weight of treated nanny goats. These findings strongly agree with those reported by Salehi *et al.* (2013) who suggest that oils by-products reduced feed intake, improved energy balance, have beneficial effects on fertility and kept body weight of maternal. In addition, Rodney *et al.* (2015) stated that feedstuffs containing fats /and or oil offered during flushing period has beneficial effects on body weight. Generally, Khalifa *et al.* (2016) concluded that when linseed or sunflower oils were added to basal ration, they had balanced effect on body weight from flushing (44.00 and 44.00 kg) to post-partum (46.92 and 47.18 kg) compared to does free of oil (44.20 and 45.35 kg), respectively.

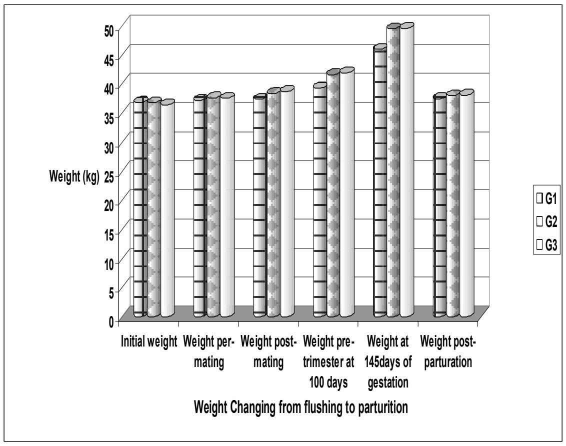

Figure 1. Changes of body weight from flushing to parturition within energy consumption in G1 (free of oil), G2 (additive with linseed oil) and G3 (additive with sunflower oil).

Offspring parameters

The addition of oils to diets for dairy goats in G2 and G3 has been related to higher conception rate (100.00 and 100.00%), offspring number (10 and 11), litter size (2.50 and 2.20 %) and total weight of birth kids (3.60 and 4.70 kg) than goats in G1 which has conception rate 80.00%, offspring number 8.00, litter size 2.00% and weight of birth kids 2.90kg (Table 6). Finding of Diaz (2009) cleared that greater amount of energy helps to reduce the negative energy balance (NEB) which translates into increased production of luteinizing (LH) and follicle-stimulating hormone (FSH), generating more growth and follicular development and promoting the ovulation. Moreover, fertility improvement may be attributed to (a) improvement in 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). On the other hand, Salehi *et al.* (2016) revealed that feedstuffs included PUFAs caused positive effects on the development of embryo, potentially through the differential activation of genes involved in embryonic cellular growth and proliferation.

Suckling milk amount

Figure 2 indicated that either G2 or G3 could be accomplished significantly ($P<0.05$) higher values of suckling milk than those goats in G1. Hence, goats in G2 had 2.75, 2.70, 2.65, 2.03 and 1.55 kg, but goats in G3 obtained 2.88, 3.05, 2.70, 2.20 and 1.58 kg compared to G1 goats which achieved 1.79, 2.05, 1.92, 1.43 and 1.25 kg during evaluation suckling milk periods at 7, 15, 30 60 and 90 days post-partum, respectively. In agreement with these results, the effects of oils have been well described in sheep by Go´mez-Cortes *et al.* (2008) who explained that milk production depends on the genetic potential to increase milk production. In addition, similar results have been obtained from supplementing dairy goats' rations with linseed or sunflower oils (Khalifa *et al.,* 2016). Surpassing milk production in G3 compared to G2 may be attributed to associate with an even greater increase in trans-*11 18:1* than linseed oil (Zhang *et al.,* 2006) also these differences are due to the biohydrogenation process of 18:2n-6 which is more abundant in sunflower oil than in linseed oil. Interestingly, milk yield increases when diets of dairy animals are supplemented with oils these changes might be due to the greater energy content of the supplemented diets. Research of Manso *et al.* (2011) have revealed that basal diet supply with 3% of palm oil, olive oil, soybean oil and linseed oil could be yielded the greatest values of suckling up to 1633, 1636, 1917 and 1403 ml, respectively. At the same time, the higher suckling milk of goats in G2 and G3 groups than G1 goats may be due to improve regulation of gene expression in udder mammals. Finding of Sampath and Ntambi (2006) suggested that a nuclear receptor capable of binding fatty acids could establish 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 G2 and G3 groups may be due to increased volatile fatty acids (VFA's) concentration in rumen of goats given oil compared to G1 group. These results are in agreement with Kholif *et al.* (2015) who explained that the anaerobic fermentation of oil (as linseed oil) was more efficient and faster in yielding more VFA's than control by indirect way. Enhancing milk amount with oil consumption in G2 and G3 attributed to high α-linolenic acid (ALA) in rations were able to upregulate the peroxisome proliferator-activated receptors (PPAR-α) gene and downregulate the stearoyl-CoA-desaturase gene compared to control diets with low ALA content (Trabalza-Marinucci *et al.,* 2016). According to Lerma-Reyes *et al.* (2018), they found that oil supplementation could prevent the negative energy balance which has amelioration changes in milk production, then changes in milk production have been observed with higher levels of lipids in diets.

Table 6. Offspring parameters within trial groups

Items	Trial groups		
	G1	G2	G3
No. of mating does	5	5	5
No. of conceived does	4	5	5
Conception rate (%)	80.00	100.00	100.00
No. of kidding does	4.00	4.00	5.00
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
Total number of born kids	8.00	10.00	11.00
Litter size, %	2.00	2.50	2.20
Total weight of birth kids (kg) at four days	2.90	3.60	4.70

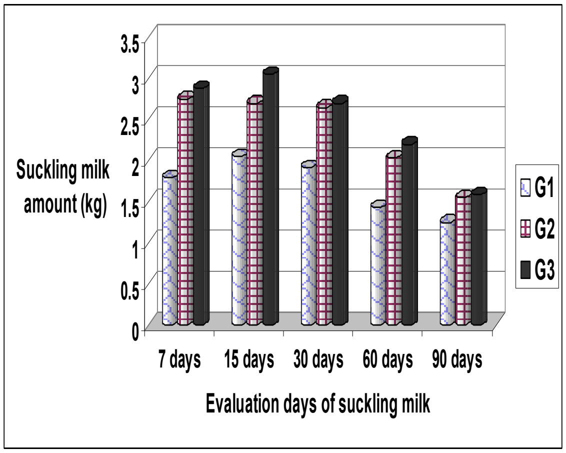

Figure 2. Suckling milk amount from beginning suckling to weaning in G1 (free of oil), G2 (additive with linseed oil) and G3 (additive with sunflower oil).

Changing of kids weight from birth to weaning

Changes (P<0.05) of kids body weight from birth to weaning (Figure 3) are shown between trial groups, the most kids body weight were recorded with G2 and G3 compared to G1. Differences in kids body weight may attributable to addition of oils to diets of goats which milked the greatest suckling milk caused improvement of kid's performance. Although, previous research suggested that suckling milk harvest increases when goat diets are supplemented with oils, these changes might only be due to the greatest viability of energy content of the diets (Manso *et al.,* 2011). Finding of Nudda *et al.* (2008) revealed that offspring are cared with their maternal thus supplementing dairy animal diets with different energy sources modifies suckling milk yield and increases the levels of healthy fatty acids (FAs) such as conjugated linoleic acid (CLA) and n-3 fatty acids (n-3 FA). In addition, it has been demonstrated that the modification of the kids' body size would be a proper response to changing factors such as availability of suckling milk amount (Gallardo *et al.*, 2015). In a sequence of animal studies, offspring and suckled lambs of maternal fed a diet high in calories before birth had heavier body weight throughout life (Trabalza-Marinucci *et al.,* 2016). In a study conducted with dairy Zaraibi goats received oils can able to alter body weight of kids as a result of suckling milk yield (Khalifa *et al.*, 2016). The same authors revealed that weaning body weight of kids recoded 9.44, 11.14 and 11.96 kg when kids suckled milk up to 8.44, 11.68 and 12.41 kg with control does, linseed and sunflower does groups, respectively. From an evolutionary point of view, Lerma-Reyes *et al.* (2018) indicated that changes in body weight in goat kids reflect the efficiency of converting suckled milk into body weight during the suckling period when experimental does treated with oils. In addition, it has been found that basal rations under oils feed condition can enhance energy in milk (Byrne *et al.,* 2015) which resulting in an improvement of metabolic processes in kids (Salehi *et al.*, 2016) by scavenge free radical from suckling milk (Xu *et al.*, 2014).

Milk harvest

The amount of milk harvest through 17th weeks of lactation indicated significantly (P<0.05) higher harvest of milk in either G2 or G3 groups than milk production in those goats in G1 group. However, nanny goats in G3 showed the highest milk yield (389 kg) followed by G2 (363 kg) compared to G1 (265kg) as shown from Figure 4. As a result, addition of oils to rations could improve milk harvest in dairy goats. This finding is confirmed with that of Kholif *et al*. (2015) who recorded more average milk yield with goat received linseed oil (1256 g / d) than control goat free of oil (1140 g / d). Also, this study showed higher milk harvest with goat fed sunflower oil which was in the line of Morsy *et al*. (2015) who found that sunflower oil could improved milk yield up to 1240 g /d compared to 1140 g / d for goat fed control diet. Also, the later authors cleared that increasing milk harvest which shown with sunflower oil may be due to the great of total volatile fatty acids (tVFA) concentration in rumen of goats fed diets added with sunflower oil, and consequent increased value of N-utilization efficiency, as well as an increased conversion and availability of nutrients for milk synthesis. Recently, these results are corresponding with the findings of other studies by Khalifa *et al.* (2016) and Leduc *et al.* (2017). They found more milk production with diet contained oils that may be due to efficient anaerobic fermentation, which increase organic matter and fibers digestibility and then improve milk yield. On the other hand, the highest milk harvest may be attributed to inhibit free radical, specially lipid peroxidation in udder cells (Xu *et al.*, 2014), availability of 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). In general, finding of Muktiani *et al.* (2018) discussed that milk yield was increased with minerals and oil; this increase may be due to the activity of digestibility of feedstuffs. Also, the same authors defined that minerals could increase the availability of glucose for lactose synthesisy increase, potential of insulin activists which caused uptake of glucose and amino acids to udder gland cells.

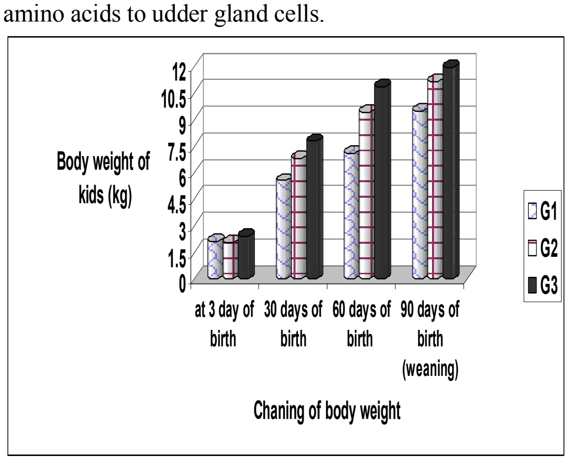

Figure 3. Changing of kids' weight from birth to weaning in G1 (free of oil), G2 (additive with linseed oil) and G3 (additive with sunflower oil).

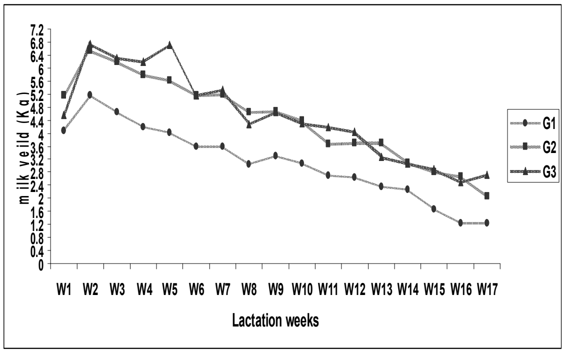

Figure 4. Milk harvest G1 (free of oil), G2 (additive with linseed oil) and G3 (additive with sunflower oil).

The blood metabolites

The concentrations of urea, creatinine, GGT, AST, albumin, total protein, triglycerides, total cholesterol were not altered by supplemented oils among goats in G1, G2 and G3 (Table 7). However, concentrations of glucose and calcium (Table 7) in goats fed a control diet (G1) were lower (P<0.05) than of those received different oils in G2 and G3 goats. The results of the present study showed that increased serum glucose concentration with linseed goat (G2) and sunflower goats (G3) may be due to increased total volatile fatty acid (tVFA) concentration in the rumen of goats (Khalifa *et al.,* 2016) revealed similar glucose concentration in goats fed ration with linseed, sunflower oil and free of oil. Also, the same authors found that blood serum glucose of linseed and sunflower goats confirmed a positive relationship between blood serum glucose and milk yield. Moreover, decreases in blood concentration of glucose should be associated with a high-energy deficit (Abdel-Gawad and El-Emam, 2018). On the other hand, rising of blood glycemia is occurred only during the anabolic phase of lactation period when energy intake is equal or superior to the energy release (Lima *et al.,* 2018). The results of our study showed decreased protein level with G1 goats compared to G2, and G3, which is in accordance with the results obtained in dairy goats (Khalifa *et al.,* 2016) and in growing kids (Abdel-Gawad and El-Emam, 2018) revealed that change in serum proteins among trial animals is an important consideration in the interpretation of serum proteins. Consequently, goats have lower protein may be due to greater N-recycling and thus greater efficiency in N-utilization (Babale *et al.,* 2018) and also stated that serum of total protein and albumin are indicated that dietary regimens have not compromised the liver functionalities in terms of biosynthesis. Changing levels of serum albumin is indicated to biosynthetic capabilities of liver and hepatocellular toxicity is often indicated by decline in albumin. Despite, serum albumin concentration was lower in G1 than G2 and G3 groups, but safety total serum albumin level in all experimental goats was slightly less than the normal reference range from 2.70 to 3.90 g/dl for goats (Kaneko *et al.,* 2008). In the present study, higher (P>0.05) value of total cholesterol is shown in G2 and G3 goats than G1 goats. However, triglyceride levels were the highest (P>0.01) for G1 group when compare to the other groups in G2 and G3 (Table 7). Inception, the majority of serum cholesterol and triglycerides levels were consistent with the general normal ranges reported for goats (Kaneko *et al.,* 2008). Conversely to what would be expected, that cholesterol is not affected by feeding system, it shows an increasing (P>0.05) trend in control groups compared to oils groups. This was discussed according several authors in crossbred lactating goats (Lima *et al.*, 2018) and in growing kids (Abdel-Gawad and El-Emam, 2018). Furthermore, Jóźwik *et al.* (2012) showed that cholesterol content was the lowest in early stage of lactation and then increased gradually during lactation also and they found a positive relationship between blood plasma cholesterol and milk yield cholesterol content. In fact, it is well know that, non-esterified fatty acid (NEFA) which are released at early lactation following intense fat mobilization are used hepatically for the synthesis of the triglycerides only if the balance between energy absorbed in the diet and that emitted due to production is not especially deficit (Eşki *et al.,* 2015). In the study carried out by Khalifa *et al.* (2016), there was a marked drop in serum triglycerides (181.00 and 180.25 mg/dl) and cholesterol (188.90 and 188.98 mg/dl) when dairy goats were treated with linseed and sunflower oils compared to goat free of oils (182.28 and 191.70 mg/dl), respectively.

Table 7. Metabolic profile of serum blood of goats fed diets containing linseed (G2) and sunflower (G3) and free of oils (G1)

Items	* Range reference values	Trial groups		
		G1	G2	G3
Glucose (mg/dl)	50.00-75.00	62.35±0.76[b]	68.88±0.29[a]	69.86±1.71[a]
Total protein (g/dl)	6.20-7.90	5.44±0.14	6.57±0.19	6.66±0.15
Albumin (g/dl)	2.70-3.90	2.98±0.24	3.46±0.23	3.45±0.24
Cholesterol (mg/dl)	80.00-130.00	90.75±3.06	91.94±0.47	92.15±0.49
Triglycerides (mg/dl)	21.40- 42.80	38.95±0.42	38.09±0.83	38.19±0.65
GGT (UI)	20.00-56.00	52.04±1.77	50.64±1.66	50.55±1.72
AST (UI)	43.00-132.00	83.69±2.66	82.97±2.54	82.86±2.64
Urea (mg/dI)	21.40 - 42.80	31.97±2.22	32.45±2.11	32.38±2.15
Creatinine (mg/dI)	1.00-1.80	0.84±0.02	0.83±0.01	0.83±0.01
Calcium (mg/dl)	8.90-11.7	9.01±0.11[b]	10.11±0.14[a]	10.45±0.16[a]
Phosphorus (mg/dl)	4.20-9.10	8.42±0.47	8.79±0.29	8. 91±0.33

a and b: Means within the same row with different superscripts are significantly different at P<0.05. * Kaneko *et al.* (2008).

Serum AST and GGT levels were higher in G1 group than in the G2 and G3 groups (Table 7). According to Abdel-Gawad (2017), he confirmed that liver enzymes play important roles in intermediate metabolic processes to synthesis and degradation of amino acid in cells and the liver cell damage leads to an increases serum level of both ALT and AST enzymes. Hence, the activity of enzymes such as AST and GGT are used as indicators of physical stress and hepatocellular injury may be evaluated by measuring AST (Ganai *et al.,* 2017), because it has high activity in hepatocytes. At the same time, the later authors found that the cytoplasmatic enzyme as GGT is the first which increases the condition of hepatic sufferance. In general, Gupta *et al.* (2017) found that the level of these enzymes in serum reflects adverse effect of dietary protein or energy on liver, kidney and muscles mass. Also, a decreased concentration of urea was observed in the blood of G1 goats compared to G2 and G3 goats. According to Vahid *et al.* (2016), they reported that a high value of urea in the blood may be occurred when a low energy diet is provided which causes a contrary action in the concentration of rumen ammonia and this is caused by the reduction in microbial protein synthesis. The concentrations of creatinine in trial goats (G1, G2 and G3) is remained lower (Table 7) compared to reference values (Kaneko *et al.,* 2008). However, Ganai *et al.* (2017) concluded that the amount of formed creatinine is relatively constant for a determined subject and is barely affected by nourished with protein and energy intake. The results of the study indicated that the serum levels of the minerals as calcium (Ca) and phosphors (P) were altered by the supplemented oils to feedstuffs compared to goats free of oils.There was an increase ($P<0.05$) of Ca and P ($P>0.05$) among trial groups. However, the levels of Ca and P were maintained within the normal range described by Kaneko *et al.* (2008). The reduction in serum levels of P was related to an unbalance between Ca and P in the diet (Maged *et al.,* 2017) revealed that when energy sources as sesame seed supplemented to ration can attribute no significant changes of Ca and P in serum blood (10.10 and 4.95 mg/dl) compared to Ca and P in serum blood of control (10.08 and 4.90 mg/dl), respectively. Generally, Muktiani *et al.* (2018) discussed that minerals absorption in the intestine by the active transport system, the serum concentration of Ca and P could be interfered the amount of energy in the diet.

Economic efficiency

Data in Table 8 show a great cost in nanny goats' feedstuffs supplemented with linseed and sunflower oils in G2 and G3 compared to ration free of oils (G1). The differences in milk harvest during months of lactation may be due to that the addition of linseed oil (G2) and sunflower oil (G3) achieved more values of milk harvest. The total milk harvest was 265, 363 and 389 kg for G1, G2 and G3, respectively. Hence, increasing percentage in milk harvest with either G2 or G3 reached up to 36.98% and 46.79%, respectively. Accordingly, the experimental work realized improvement of economic efficiency when lactating goats in G2 and G3 received oils; it was advantaged up to 56.98 and 72.53%, respectively as compared to 55.55% in goats fed diet free of oil (G1). Thus, using oils can reduce the CFM consumption and resulted in lower cost per one kg of milk harvest. This reflects the greatest economic efficiency (EE) in G2 and G3 relative to control G1; where, it was 102.57 and 130.57% from milk production considering EE of G1 as 100%, respectively. At all events, the current results supported that addition of oils as a source of energy could improve basically balance of feedstuffs which achieved goodness in productive performance recovery in dairy goats. The observed consequences are in confirmed with findings obtained on dairy goats received different oils as sunflower oil (Morsy *et al.,* 2015), linseed and sunflower oil (Khalifa *et al.,* 2016), rapeseed oil (Eknaes *et al.,* 2017), grapes seed oil (Muktiani *et al.,* 2018), and soybean oil (Lerma-Reyes *et al.,* 2018).

Table 8. Economic efficiency of the trial groups

Particulars	Trial groups		
	G1	G2	G3
CFM consumption during 17^{th} weeks of milking, kg	379	370	365
BH consumption during 17^{th} weeks of milking, kg	449	449	449
Oils consumption during 17^{th} weeks of milking, kg	-	22	22
Total feedstuffs consumption, kg ^{A}	828	841	836
Cost of CFM , LE	1213	1184	1168
Cost of BH , LE	337	337	337
Cost of oils, LE	-	550	242
Total price of feedstuffs consumed , LE^{B}	1550	2071	1747
Total milk harvest, kg ^{C}	265	363	389
price of sell milk, LE^{D}	861	1180	1264
Economic efficiency			
Feed efficiency $^{C/B}$	0.32	0.43	0.47
Feed conversion $^{A/C}$	3.12	2.31	2.15
*Feeding cost of producing milk $^{B/C}$	5.85	5.71	4.49
Economic efficiency (EE) amount, $^{D/B}$	0.56	0.60	0.72
Economic efficiency (EE), %	55.55	56.98	72.53
EE (%) relative to control	100.00	102.57	130.57

Price of sell 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, **Economic efficiency (%) = money out put (price of sell milk) ÷ money input (total price of feed consumed) ×100, * EE (%) relative to control with G2 or G3= EE amount of G2 or G3 – EE amount of G1÷ EE amount of G1×100 +100 (conceder EE of G1 is 100%).**

CONCLUSION

It can be concluded that oil has been shown to be a good source for energy. Both linseed and sunflower oils addition to ration at 3% of dry matter intake diminished ration consumption during sensitive production stages of nanny goats, caused the best devolvement in production performance recovery and the less costs of feeding in dairy goats.

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دور إضافة الزيوت للعليقة و أثره على استهلاك العلائق واستعادة الأداء الإنتاجى للماعز الحلابة

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15 انثى زرايبى قسمت الى ثلاث مجاميع (5 اناث بكل مجموعه) كانت المجموعة الاولى مج1 تتغذى على مخلوط العلف المركز + دريس البرسيم والمجموعة الثانية (مج2) تتغذى على مخلوط العلف المركز + دريس البرسيم + 3% (من المادة الجافه) زيت الكتان والمجموعة الثالثة (مج3) تتغذى على مخلوط العلف المركز + دريس البرسيم + 3% (من المادة الجافه) زيت دوار الشمس (الزجاجات الزيت الغير مناسبة للتسويق) ولقد تم حساب العليقة المستهلكة من مرحلة الدفع الغذائي قبل وخلال موسم التلقيح ، الثلث الاخير من الحمل الى الولادة ، مرحلة الرضاعة الى اشهر الحليب وايضا تم دراسة الاداء الإنتاجي مشتملا التغير فى اوزان الامهات خلال الدراسة كذا المواليد حتى الفطام. ومن ثم تم حساب محصول اللبن خلال الموسم وتم اخذ بعض قياسات الدم وفى النهاية تم حساب الكفاءة الاقتصادية . وقد اوضحت النتائج ما يلى :- ان اضافة هذه الزيوت بنوعيها الى الى كلا من مج2 ,مج3 قد ادت الي نقص المستهلك من العليقة بدرجة معنوية فى مراحل الدفع الغذاء قبل وخلال موسم التلقيح ، الثلث الاخير من الحمل الى الولادة ، مرحلة الرضاعة الى موسم الحليب مقارنه ب مج1 وكان المستهلك من العليقة للمجموعات مج1,مج2,مج3 هو 1223, 1202, 1210 جم \ يوم/ رأس على التوالي. وكذلك كان التغير فى وزن الجسم للأمهات للمجموعات مج1,مج2,مج3 من مرحلة الدفع الغذائي هو38.12,38.00,37.48 الى الولادة واما عن اعداد المواليد بداية ب مج1 , مج2 ,مج3 هي 11,10,8 على التوالى وانه سجلت حجم البطن لأمهات المجاميع مج1,مج2,م3 2.20,2.50,2.00% على التوالي. وأيضا فان امهات مج1 اظهرت انخفاض معنوي فى كمية لبن الرضاعة 1.25,1.43,1.92,2.52,1.79 كجم \رأس عن امهات مج2 1.55,2.03,2.65,2.70,2.75 كجم / رأس عن امهات مج3 1.58,2.20,2.70,3.05,2.88 كجم /رأس وذلك خلال فترات التقييم 90,60,30,15,7 يوم بعد الولادة على التوالي. ومن ناحية اخرى فانة كانت هناك معنويه مسجله لأوزان الفطام بين مج1,مج2,مج3 11.90,11.10,9.40 كجم على التوالي فى حين انه كلا من مج2,مج3 قد حدث بها ارتفاع معنوي فى محصول اللبن الكلى 389,363كجم بالمقارنه بمج1 262 كجم . وبالنظر فى قياسات الدم للمجاميع الثلاثة فانه لا يوجد اى اختلاف معنوى واضح فيما عدا الجلوكوز والكالسيوم كانا 68.86,68,88,62.35 - 10.45,10.11,9.01 مللى جرام لكل مللى لتر للمجاميع مج1,مج2,مج3 على التوالى . واما عن الكفاءة الاقتصاد به فقد اظهرت مج3 افضل تحسن (72.53%) ثم مج2 (65.98%) واخيرا مج1 (55.55%). وعموما فان النتائج المستخلصة تشير الى انه بإضافة كلا من زيت دوار الشمس والكتان الى علائق الماعز الزرابي قد اعطت انخفاضا ملحوظا فى المستهلك من العليقة فى الفترات الحرجة (من التلقيح الى الولادة) بالإضافة الى المردود الإنتاجي الإيجابي وكذا ارتفاع الكفاءة الاقتصادية عن الماعز المغذاه على عليقه بدون هذه الزيوت