

IMPACT OF SUNFLOWER SEEDS AND/OR VITAMIN E AND SELENIUM SUPPLEMENTATION ON MILK COMPOSITION AND FATTY ACIDS PROFILE OF LACTATING BALADI GOATS

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SUMMARY

Twenty eight lactating Baladi goats (3-4 years old and the average weight ranged from 33.9 – 35.6 kg) after two weeks of parturition were assigned according to milk production into four groups (7 animals each). Each group was randomly assigned to feed one of the following experimental rations, control ration (R1) consists of 50% concentrate feed mixture and 50% Egyptian clover (*Trifolium alexandrinum*), control ration was supplemented with either whole sunflower seeds (SFS) to provide 3.5% oil from DM intake (R2), 250 IU vitamin E and 2 mg selenium/h/d (R3) or both of the previous supplementation (R4). There were no significant differences among tested groups in digestibility of DM, CP, CF and EE. The lowest nutrients digestibility was recorded with R2 while, the highest were with R4. Goats fed either R3 or R4 had the highest globulin and the lowest cholesterol concentrations in blood plasma. There were no differences among groups in DMI, milk yield and milk contents of protein, lactose, TS and SNF while, milk fat content was increased with SFS supplementation (R2 and R4) compared with R1. Feeding on rations supplemented with vitamin E plus selenium (R3 and R4) increased their concentrations in milk. Total saturated fatty acids were decreased and total unsaturated fatty acids (TUFA), mono- and poly- unsaturated fatty acids were increased in milk when goats fed on R2 and R4. It could be concluded that feeding lactating goats on ration supplemented with SFS and vitamin E plus selenium improved lactation performance and increased TUFA, vitamin E and selenium in milk, which may have good impact on consumer's health.

Keywords: *Sunflower seeds, vitamin E, selenium, goats, milk composition and fatty acids profile.*

INTRODUCTION

Recently, there is a growing interest among the consumers related to health considerations to consume high-quality, safe and nutritious foods which is known by functional food (Pizzoferrato *et al.*, 2007 and Kralik *et al.*, 2012). Doyon and Labrecque (2008) defined functional food as "the food that fortified, enriched or enhanced foods with a component having a health benefit beyond basic nutrition can be considered, or it is the food components that may have health benefits that reduce the risk of specific diseases or other health concerns".

Whole sunflower seeds (SFS) contains one of the most healthy vegetable oils because it is rich in polyunsaturated FA (PUFA) especially, linoleic acid (66% of total FA), which is an n-6 FA (Petit *et al.*, 2004 and Ebrahimi *et al.*, 2014). Also, Morsy *et al.* (2015) reported that SFS have no anti-nutritional factors compared with the other oilseeds such as rapeseeds, soybeans and cottonseeds. So, it can be used safely as a feed ingredient in animal rations. Ebrahimi *et al.* (2014) found that feeding on SFS resulted in an increase of conjugated linoleic acid, CLA, and omega-6 content in milk and meat of ruminant animals. Also, increases in milk production and milk composition as fat content, CLA and omega 3 were recorded when lactating goats fed on 50g SFS /h/d (Morsy *et al.*, 2015). Abd El-Nabi (2012) showed that the highest FCM and CLA contents were recorded with lactating goats fed SFS to provide ration by 3.5% oil compared with soybean seeds and linseeds. Zucali *et al.* (2007) observed a decrease in medium and short chain fatty acids (C8-C16) content and an increase in long chain fatty acids content when SFS was added to lactation Alpine goats' diet by 5-6%.

Vitamin E (Vit E) is considered as an antioxidant that reduces free radicals, mono-unsaturated fats and saturated fats which help in reducing cholesterol level (Zanetti *et al.*, 2015). Also, the essential trace mineral, selenium (Se), has high importance to human health due to its role in immune system activation and reduction the risk of cardiovascular disease and cancer (Margaret, 2000). Bayril *et al.* (2015) found that supplementation with Se and Vit E increased milk yield and decreased incidence of sub-clinical

mastitis. In the same trend, Zanetti *et al.* (2015) indicated that either steers fed ration supplemented with Se or people consumed the steers' meat had higher Se and lower cholesterol concentrations in serum.

This study aimed to investigate the effect of supplementing sunflower seeds and/or vitamin E and selenium to lactating goat rations on milk production, milk composition, vitamin E and selenium levels and fatty acids profile of milk.

MATERIALS AND METHODS

This work was carried out at Agricultural Experimental Station, Sheep and Goat Research Unit, Faculty of Agriculture, Cairo University, Giza, Egypt.

Experimental animals and rations:

Twenty eight lactating Baladi goats (3-4 years old and the average weight ranged from 33.9 – 35.6 kg) after two weeks of parturition were assigned into four groups of 7 animals each according to milk production. The experimental period was 36 days (30 days for adaptation and 6 days for samples collection). Each group was randomly assigned to feed one of the following experimental rations, control ration (R1) consists of 50% concentrate feed mixture and 50% Egyptian clover (*Trifolium alexandrinum*), control ration was supplemented with either whole sunflower seeds to provide 3.5% oil (R2), 250 IU vitamin E and 2 mg selenium/h/d (R3) or both of the previous supplementations (R4).

Rations were offered by 4% of body weight calculated to cover total nutrient requirements for lactating goats according to NRC (1981). The concentrate feed mixture was consisted of 60% yellow corn, 10% soybean meal, 10% sunflower meal, 15% wheat bran, , 1.2% premix, 0.8% common salt and 3% limestone. Vitamin E product (DSM rovemix E50) contained 500.000 IU tocopheryl acetate/kg was added to provide the ration with 250 IU vitamin E/h/d. Selenium (SEL-PLEXTM) is selenium (Se)-enriched yeast which contained 1000 ppm Se/kg was added to provide the ration with 2 mg Se/h/d.

Digestibility trial:

A grab sample method was applied at which acid insoluble ash (AIA) was used as an internal marker according to Van-Keulen and Young (1977) for determining nutrients digestibility. Fecal grab samples were collected for three successive days at the end of the lactation trial from each animal. Feed consumption and residues were recorded daily. Nutrients digestibility were calculated according to the following formula:

$$\text{Digestion coefficient} = 100 - \left[100 \times \frac{\% \text{ indicator in feed}}{\% \text{ indicator in feces}} \times \frac{\% \text{ nutrient in feces}}{\% \text{ nutrient in feed}} \right]$$

Milk sampling:

Kids were removed for 12 h (from 7 pm to 7 am) during three successive days at the end of adaptation period, then goats were hand-milked, the estimated milk yield was multiplied by two to estimate the daily milk production according to Smeti *et al.* (2014). One tenth of the milk yields for each animal as milk samples was immediately collected after milking, then samples were stored at (-18°C) for further analysis. After taking milk samples, kids were suckled the remaining milk.

Feces sampling:

Fecal samples were collected once daily at 7.00 am for three successive days from each goat. Subsample (10%) of the total collected feces was sprayed with 10% sulfuric acid and then dried at 60° C for 24 hour. Dried feces were kept individually in polyethylene bags for chemical analysis.

Blood sampling:

At the last day of the experimental period, blood samples were withdrawn individually from the jugular vein 4 hrs after the morning meal in tubes contained anticoagulant agent (EDTA). Collected blood samples were centrifuged at 4000 r.p.m for 20 minutes and blood plasma kept at deep freeze (-18°C) for further analysis.

Analytical procedures:

Feeds and feces analysis:

Chemical analyses of feedstuffs and feces samples were carried out according to the methods of AOAC (2012). The nitrogen free extract (NFE) was calculated by difference.

Blood plasma analysis:

Blood plasma total protein and creatinine were measured as described by Tietz (1990). Blood plasma albumin was determined according to Doumas *et al.* (1971). Alanin amino transferase (ALT) and aspartate amino transferase (AST) were determined according to Young (1990). Blood plasma cholesterol was determined according to Flegg (1973).

Milk analysis:

Milk samples were analyzed for total solids, fat, protein and lactose by infrared spectrophotometry (Foss matic 120 Milko- Scan, Foss Q3 183 Electric, Hillerød, Denmark) according to AOAC (1995) procedure. Solids not fat content of milk was calculated by the difference between total solids and fat content. Fatty acids profile of milk was determined via gas liquid chromatography (GLC) according to Farag *et al.* (1986). Vitamin E and selenium were analyzed at the regional center for food and feed (Giza, Egypt). Vitamin E was determined according to Danish official (1996). Selenium was determined in the form of selenium dioxide by atomic absorption spectrometry as described by Muniz-Naveiro *et al.* (2005).

Statistical analysis:

Data were analyzed by the least squares procedure of the General Linear Models Program of SAS (2009) according to procedures outlined by Snedecor and Cochran (1982). Data of milk yield, milk composition, nutrients digestibility's and blood plasma parameters were analyzed using one way analysis of variance. The model used was as following:

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

Where:

y_{ij} : The j^{th} animal of the i^{th} treatment.

μ : The overall mean.

T_i : The fixed effect of the i^{th} treatment.

e_{ij} : The random error assumed to be normally and independently distributed.

The Duncan's New Multiple range test (Duncan, 1955) and Least Square Means, LSM (Steel and Torrie, 1980) procedures were used to test the significance among means for all data ($p < 0.05$).

RESULTS AND DISCUSSION

Chemical composition of feed ingredients and experimental rations:

Data concerning chemical composition of feed ingredients and experimental rations are presented in Table (1). Results indicate that sunflower seeds (SFS) used in this study had lower EE content (39.52%) and higher CF content (25.37%) compared with data obtained by Abd El-Nabi (2012) being 44.00 and 22.50% or those obtained by Morsy *et al.* (2015) being 40.30 and 22.60%, respectively. While, CP content was almost the same with the other previous studies.

Data in the same Table showed that experimental rations were similar in its chemical composition except those supplemented with SFS (R2 and R4) were higher in CP, CF and EE and lower in NFE contents. These results may be due to high CP, CF and EE and low NFE contents in SFS. These results agreed with the finding of Abd El-Nabi (2012).

Table (1): Chemical composition of feed ingredients and experimental rations (DM basis).

Feed ingredients	Chemical composition, %						
	DM	OM	CP	CF	EE	NFE	Ash
CFM	93.77	90.03	13.25	8.10	3.81	64.87	9.97
FC	17.19	89.38	14.45	29.21	2.05	43.67	10.62
SFS	92.54	96.18	20.10	25.37	39.52	11.19	3.82
Experimental rations*							
R1	92.12	89.73	13.80	17.82	3.00	55.11	10.27
R2	92.15	90.23	14.36	19.20	5.90	50.77	9.77
R3	92.12	89.73	13.80	17.81	3.00	55.12	10.27
R4	92.15	90.23	14.36	19.20	5.90	50.77	9.77

CFM: Concentrate feed mixture. FC: Fresh clover (*Trifolium alexandrinum*). SFS: Sunflower seeds

R1: CFM+ FC (control). R2: control+SFS. R3: control + vitamin E and selenium. R4: control+ SFS+ vitamin E and selenium.

*Calculated

Digestion coefficients and nutritive values:

Data dealing with digestion coefficients of the experimental rations (Table 2) showed that there was no significant ($P<0.05$) difference in DM digestibility (DMD) among control ration (R1) and other rations (R2, R3 and R4). The same trend was mentioned by Abd El-Nabi (2012) and Petit *et al.* (2004) that there was no any significant effect on DMD when SFS supplemented ration fed to goats or dairy cows. While, Beauchemin *et al.* (2009) recorded a decrease in DMD with SFS supplementation in dairy cows ration. The lowest DMD recorded for R2 could be due to the high EE content as mentioned by Vargas *et al.* (2011) that rumen fermentation negatively affected by fat inclusion, while Narimani-Rad *et al.* (2012) reported the opposite with sunflower oil supplementation by *in vitro* study.

Table (2): Digestion coefficients and nutritive values of the experimental rations.

Item	Experimental rations				±SE
	R1	R2	R3	R4	
Digestibility, %:					
DM	72.63 ^{ab}	70.06 ^b	72.23 ^{ab}	73.03 ^a	0.48
OM	74.33 ^a	72.26 ^b	74.33 ^a	74.71 ^a	0.30
CP	71.58	69.21	72.52	70.02	0.62
CF	62.35	60.68	61.13	60.67	0.38
EE	72.81	71.86	72.92	73.64	0.38
NFE	79.69 ^b	76.93 ^c	79.28 ^b	81.35 ^a	0.49
Nutritive values, %:					
TDN	69.82 ^b	70.18 ^b	69.52 ^b	72.78 ^a	0.40
DCP	9.88	9.94	10.01	10.05	0.03

^{a, b, c, ...} Means in the same row with different superscripts are significantly different ($P<0.05$).

R1: CFM+ FC (control). R2: control+SFS. R3: control + vitamin E and selenium. R4: control+ SFS+ vitamin E and selenium.

Organic matter digestibility did not significantly ($P<0.05$) differ among R1, R3 and R4. While, feeding goats on R2 significantly ($P<0.05$) decreased digestibility of OM and NFE by 3.6 and 3.5 %, respectively compared with R1. Also, a decrease in OM digestibility was recorded when SFS included in ration by Beauchemin *et al.* (2009).

There were no significant ($P<0.05$) differences among groups in the digestibility of CP, CF and EE being, (71.58, 62.35 and 72.81), (69.21, 60.68 and 71.86), (72.52, 61.13 and 72.92) and (70.02, 60.67 and 73.64), respectively for R1, R2, R3 and R4. These results may be due to the hard seed coat of SFS which protects the internal oil from rumen biohydrogenation and prevents the negative effect of oil on rumen microbes (Ekeren *et al.*, 1992). Jenkins and Palmquist (1982) found that high concentration of unsaturated fatty acids in feed ingredients had less toxic effect on rumen microbes. Feeding goats on R3 didn't significantly ($P<0.05$) affect digestibility of NFE while, with R4 it was significantly ($P<0.05$) increased

compared with R1 being, 79.28, 81.35 and 79.69, respectively. Abd El-Nabi (2012) reported that there were no any significant differences in digestibility of EE between control and SFS rations, while CP digestibility was increased with SFS supplementation.

The best nutritive value as TDN was recorded with SFS plus vitamin E and selenium supplementation (R4) was being 72.78%, while there was no significant difference among R2, R3 and control (R1) being 70.18, 69.52 and 69.82%, respectively. The increase in TDN value may be due to the highest digestibility of DM and NFE with R4 compared with the other treatments. However, no significant differences were observed among treatments in DCP value. These results were in agreement with those obtained by Abd El-Nabi (2012).

Blood plasma parameters:

Data in Table (3) shows that no significant differences were detected among different groups in blood plasma total protein, AST and ALT concentrations. These results are paralleled with Morsy *et al.* (2015) when goat ration was supplemented with 50 g SFS/head/d and with Juniper *et al.* (2006) when added selenized yeast to ration of lactating dairy cows.

Table (3): Effect of experimental rations on blood plasma parameters of lactating Baladi goats.

Parameters	Experimental rations				±SE
	R1	R2	R3	R4	
Total protein (g/dl)	6.27	6.00	6.47	6.53	0.10
Albumin (g/dl)	3.80 ^a	3.67 ^a	2.90 ^b	2.93 ^b	0.14
Globulin (g/dl)	2.47 ^b	2.33 ^b	3.57 ^a	3.60 ^a	0.18
AST (u/l)	79.75	81.58	80.67	83.00	0.65
ALT (u/l)	16.33	17.17	16.67	16.50	0.19
Cholesterol (mg/dl)	123.03 ^a	118.40 ^b	118.07 ^b	112.83 ^c	1.19

^{a, b, ...} Means in the same row with different superscripts are significantly different (P<0.05).

It was indicated that rations supplemented with SFS or vitamin E plus selenium alone or together significantly (p<0.05) decreased plasma cholesterol level. Same trend was reported by Petit *et al.* (2004) that insignificant decrease in blood cholesterol level was recorded with SFS supplementation to dairy cows ration and showed that the effect on blood cholesterol could be altered by type of fatty acid. However, Garcia-Bojalil *et al.* (1998) noted an increase in blood cholesterol by fat supplementation. On the other hand, Morsy *et al.* (2015) found no change in blood cholesterol level of goats fed SFS supplemented ration.

Blood plasma globulin recorded higher values with R3 and R4 compared with R1 and R2. This result agreed with findings of Latorre *et al.* (2014) that rations enriched with vitamin E plus selenium and/or canola oil had an important role in increasing immunity and decreasing the susceptibility to infections of bulls. Liu *et al.* (2008) implied an improvement in antioxidant status due to a synergistic relationship between Vit E and Se which may be due to their effect in reducing the free radicals (Kim *et al.*, 1997). Latorre *et al.* (2014) mentioned that fatty acids supplementation could be a method to improve immunity, but depends on type of polyunsaturated F.A contained in ration. Morsy *et al.* (2015) observed insignificant increase in blood globulin concentration with SFS supplementation.

The present results concerning blood metabolites showed no adverse impact on goats health, since these values of blood parameters are within the normal physiological ranges which reported by Merck (2014).

Milk yield and composition:

It was observed from Table (4) that there was no difference in dry matter intake (DMI) among experimental groups. Also, Markus *et al.* (1996) and Petit *et al.* (2004) recorded the same result with dairy cows or lactating goats (Morsy *et al.*, 2015) fed SFS supplemented ration. While, Dayani *et al.* (2004) found a decrease in DMI with SFS ration fed to lactating dairy cows. Beauchemin *et al.* (2009) recorded an increase in DMI with SFS supplementation in lactating dairy cows ration. Pfister *et al.* (2013) concluded that feed consumption did not change either by sheep or cattle when fresh forages contained high Se concentration. They explained that adjusting the intake of animals should be done to prevent excessive Se intake.

Actual milk and FCM yields were not significantly (P<0.05) changed among different groups. However, the highest milk and FCM yields recorded with R4 and the lowest values were recorded with

R2. It could be attributed to with the highest TDN in R4. Zucali *et al.* (2007) observed a decrease in milk yield when goats fed SFS in semi-intensive production system and Mohammed *et al.* (2011) showed the same result with dairy cows. Markus *et al.* (1996) and Dayani *et al.* (2004) noted no significant differences in milk and FCM yields of dairy cows with SFS ration compared with soybean seeds ration. On the other hand, Abd El-Nabi (2012) and Morsy *et al.* (2015) found a significant ($P<0.05$) increase in milk yield of goats fed SFS ration. Regarding vitamin E and selenium supplementation, there were insignificant ($P<0.05$) increases in milk yield and FCM with R3 and R4 compared with R1. This result agreed with findings of Charmley *et al.* (1993) and Bayril *et al.* (2015) that a significant increase in milk yield was recorded with Vit E and Se supplementations in lactating dairy cows ration. They noted that might be due to the improvement in udder health by decreasing mastitis incidence or it could be attributed to the decrease in oxidative stress (Lacetera *et al.*, 1996).

Table (4): Effect of experimental rations on dry matter intake, milk yield and composition, concentrations of milk vitamin E and selenium and feed efficiency.

Item	Experimental rations				±SE
	R1	R2	R3	R4	
DMI (kg)	1.40	1.44	1.34	1.42	0.03
Milk yield (kg/h/d)	1.14	1.02	1.27	1.35	0.06
4% FCM (kg/h/d)	1.02	0.93	1.13	1.27	0.07
Milk composition, %					
Fat	3.21 ^c	3.46 ^b	3.28 ^c	3.63 ^a	0.05
Protein	3.41	3.40	3.42	3.55	0.09
Lactose	3.53	3.77	3.47	3.84	0.08
TS	10.87	11.35	10.90	11.73	0.25
SNF	7.66	7.89	7.63	8.10	0.14
Ash	0.72	0.72	0.73	0.71	0.01
Vitamin E (mg/100 g)	0.12 ^b	0.13 ^b	0.24 ^a	0.28 ^a	0.02
Selenium (mg/l)	1.96 ^b	2.05 ^b	2.57 ^a	2.59 ^a	0.09
Feed efficiency					
Milk yield/DMI, kg/kg	0.81 ^{ab}	0.71 ^b	0.95 ^a	0.95 ^a	0.04

^{a, b, ...} Means in the same row with different superscripts are significantly different ($P<0.05$).

Feeding on rations contained SFS (R2 and R4) significantly ($P < 0.05$) increased milk fat content than that with R1 and R3. The same result was mentioned by Zucali *et al.* (2007) and Morsy *et al.* (2015). However, Dayani *et al.* (2004) recorded a decrease in milk fat content. While, Petit *et al.* (2004) and Abd El-Nabi (2012) reported no change in milk fat content with SFS supplementation. Morsy *et al.* (2015) explained the increase in milk fat content with SFS as a result of increasing either carbon production in rumen or milk lactose content, whereas Sanz Sampelayo *et al.* (2002) found high correlation between milk lactose and fat contents ($r = 0.95$). In the same trend, our study showed an increase in milk lactose content with R2 and R4. The highest fat content was recorded when ration supplemented with SFS and Vit E plus Se (R4) being 3.63%. In this concern, Bell *et al.* (2006), Pottier *et al.* (2006) and Liu *et al.* (2008) found that supplementation with Vit E plus Se can alleviate the depression in milk fat especially when dairy cows fed high fat rations. There were no significant differences among groups in milk protein, lactose, TS and SNF contents. These results coincide with those obtained by Dayani *et al.* (2004), Abd El-Nabi (2012) and Morsy *et al.* (2015). The highest TS content was recorded for R2 and R4. This result may be related to the highest fat and lactose contents when goats fed either R2 or R4.

There was a significant ($P<0.05$) increase in milk contents of Vit. E and selenium by (100 and 31%) and (133 and 32%), respectively with R3 and R4 compared with R1, while, feeding on R2 wasn't significantly ($P<0.05$) different than that of R1. Charmley *et al.* (1993) showed that combination of Vit E (8000 IU/d) and Se (5 mg/d) increased milk concentrations of Vit E (from 0.92 to 1.75 $\mu\text{g/ml}$) and Se (from 14.3 to 34.6 $\mu\text{g/l}$). Also, Liu *et al.* (2008) found that milk Vit E and Se were increased by 45 and 142%, respectively when the two antioxidants added together (0.3 mg Se/kg DM and 10,000 IU/d vitamin E) to cows ration. Knowles *et al.* (1999) and Juniper *et al.* (2006) mentioned that supplementation of dairy cows ration with selenized yeast increased milk Se concentration. Focant *et al.* (1998) recorded an increase in milk Vit E (from 1.30 to 2.67 mg/kg milk) when lactating dairy cows ration was supplemented with oilseeds (rapeseed and linseed) plus Vit E.

Data in the same Table indicated that goats fed on R3 and R4 had the highest feed efficiency which may be related to the increase in milk production. The decrease in feed efficiency with R2 may be due to the decrease in milk yield. While, SFS supplementation had no significant effect on feed efficiency in other studies (Beauchemin *et al.*, 2009 and Morsy *et al.*, 2015).

Milk fatty acids profile:

Data concerning milk fatty acids profile (Table 5) indicate that total saturated fatty acids (TSFA) decreased and total unsaturated fatty acids (TUFA), mono- (MUFA) and poly-unsaturated fatty acids (PUFA) increased with SFS supplementation (R2 and R4). The same results were obtained by Petit *et al.* (2004), Zucali *et al.* (2007) and Morsy *et al.* (2015) with rations supplemented with SFS. Ruminants cannot synthesis poly-unsaturated fatty acids, therefore this result could be related to the high content of unsaturated fatty acids in SFS. Abd El-Nabi (2012) explained the high TUFA and low TSFA concentrations with feeding SFS ration by the natural protection of oil seed hulls which facilitate oil intact by-passing from the rumen. Markus *et al.* (1996) found that supplementation of SFS decreased short chain fatty acids and increased long chain fatty acids.

In this study, data indicated that there were increase in long chain fatty acids especially C18:1, C18:2 and C18:3 and decrease in short chain fatty acids such as C12:0, C14:0 and C16:0. These results are in agreement with the findings of Parodi (2009) that saturated fatty acids such as C8:0, C10:0 and C18:0 might have no role in cardiovascular disease, while saturated fatty acids such as C12:0, C14:0 and C16:0 considered as cholesterol-raising factors. Concentrations of medium chain fatty acids (C14:0 – C17:0) were decreased with R2 and R4 being 38.00 and 32.77 compared to 44.42g in control (R1). Grummer (1991) and Dhiman *et al.* (2000) suggested that the increase in long chain fatty acids may inhibit the de novo synthesis of medium chain fatty acids in the mammary gland.

Table (5): Effect of experimental rations on milk fatty acids profile.

Item	Experimental rations				±SE
	R1	R2	R3	R4	
Fatty acids %:					
C8:0	1.65 ^d	2.24 ^b	1.97 ^c	3.65 ^a	0.23
C10:0	7.65 ^c	8.35 ^b	7.51 ^d	11.09 ^a	0.43
C12:0	3.93 ^a	3.32 ^c	3.47 ^b	2.95 ^d	0.11
C13:0	0.37 ^c	0.31 ^c	1.11 ^a	0.54 ^b	0.09
C14:0	9.21 ^a	8.31 ^b	9.16 ^a	7.93 ^c	0.17
C14:1	0.80 ^c	0.92 ^b	0.86 ^{bc}	1.06 ^a	0.03
C15:0	1.62 ^a	1.47 ^a	1.31 ^b	1.47 ^a	0.04
C16:0	31.57 ^a	25.72 ^b	31.30 ^a	21.52 ^c	1.31
C16:1	0.13 ^d	0.52 ^b	0.20 ^c	0.69 ^a	0.07
C17:0	1.09	1.06	1.07	0.10	0.02
C18:0	22.69 ^a	19.90 ^{ab}	22.18 ^{ab}	19.71 ^b	0.54
C18:1	17.98 ^b	24.29 ^a	18.16 ^b	24.81 ^a	1.04
C18:2	0.22 ^c	1.17 ^a	0.41 ^b	1.20 ^a	0.13
C18:3	1.11 ^b	2.29 ^a	1.29 ^b	2.52 ^a	0.19
TSFA	79.77 ^a	70.80 ^b	79.07 ^a	69.97 ^b	1.43
TUFA	20.23 ^b	29.19 ^a	20.93 ^b	30.03 ^a	1.40
MUFA	18.90 ^b	25.73 ^a	19.23 ^b	26.55 ^a	1.09
PUFA	1.33 ^c	3.46 ^a	1.70 ^b	3.48 ^a	0.30

^{a, b, c, d,} Means in the same row with different superscripts are significantly different (P<0.05).

TSFA: total saturated fatty acids, TUFA: total unsaturated fatty acids, MUFA: mono- unsaturated fatty acids, PUFA: poly- unsaturated fatty acids.

Regarding Vit E and Se supplementation, R3 had the same trend compared with R1 in most of FA concentrations. However, R3 showed a significant (P<0.05) increase in PUFA and insignificant improvement in MUFA compared with R1. Liu *et al.* (2008) found that supplementation with Vit E and Se increased TUFA and decreased TSFA in cow milk and explained these results by the ability of Vit E and Se as two antioxidants in inhibiting the oxidation of unsaturated FA more than saturated FA. It was observed that when Vit E added to ration supplemented either with oilseeds such as rapeseed and linseed (Focant *et al.*, 1998) or with safflower and flaxseed oils (Bell *et al.*, 2006) decreased saturated FA and increased unsaturated FA.

CONCLUSION

It could be summarized that combination of whole sunflower seeds to provide 3.5% oil and vitamin E (250 IU/h/d) plus selenium (2 mg/h/d) in lactating Baladi goats' ration increased nutrients digestibility, milk production and milk fat content. Moreover, total unsaturated fatty acids and poly-unsaturated fatty acids were increased, while total saturated fatty acids were decreased in milk which could positively affect consumer's health.

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تأثير اضافة بذور عباد الشمس مع أو فيتامين هـ والسليينيوم على تركيب اللبن والاحماض الدهنية للماعز البلدى الحلاب

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تم تقسيم 28 عنزة بلدى حلابية (3-4 سنوات ومتوسط وزن 33.9-35.6 كجم) بعد اسبوعين من الولادة لأربع مجاميع (7 حيوانات بالمجموعة) تبعاً للإنتاج وتم توزيع المجاميع عشوائياً للتغذية لمدة 36 يوم على كل من العلائق التالية: عليقة المقارنة (R1) تتكون من 50% مخلوط علف مركز و50% برسيم مصرى، والتي أضيف إليها كل من : بذور عباد الشمس ليمد العليقة بـ 3.5% زيت على أساس المادة الجافة المأكولة (المعاملة الثانية R2) أو مخلوط من فيتامين هـ (250 وحدة دوليه) وسليينيوم (2 ملليجرام) /رأس/يوم (المعاملة الثالثة R3) أو كلاهما (المعاملة الرابعة R4). لم يكن هناك اختلافات معنوية بين المجاميع المختبرة فى هضم المادة الجافة، البروتين الخام، الألياف الخام ومستخلص الاثير. سجلت المعاملة الثانية (R2) أقل قيم للهضم بينما سجلت المعاملة الرابعة (R4) القيم الأعلى. الماعز الذى تغذت على العليقة الثالثة والرابعة (R3 و R4) سجلت أعلى تركيز للجلوبولين وأقل تركيز للكوليسترول بالدم. بينما لم يكن هناك اختلافات معنوية بين المجاميع فى كمية المادة الجافة المأكولة، محصول اللبن ومحتواه من البروتين، اللاكتوز، الجوامد الكلية والمواد اللادهنية، ولكن كان هناك زيادة فى محتوى اللبن من الدهن للمجاميع التى تغذت على بذور عباد الشمس (R2 و R4). التغذية على العلائق المضاف لها فيتامين هـ والسليينيوم (R3 و R4) أدى الى زيادة تركيزهما فى اللبن. كان هناك انخفاض فى تركيز الاحماض الدهنية المشبعة الكلية وزيادة فى تركيز الاحماض الدهنية غير المشبعة الكلية والاحماض الدهنية أحادية وعديدة التشبع فى لبن الماعز المغذاه على كلاً من العليقة الثانية (R2) والرابعة (R4). وبهذا يمكن تلخيص النتائج فى أن إضافة كلاً من بذور عباد الشمس ومخلوط فيتامين هـ والسليينيوم لعلائق الماعز الحلاب يحسن من الأداء الإنتاجى كما يزيد من تركيز الاحماض الدهنية غير المشبعة الكلية، فيتامين هـ والسليينيوم فى اللبن مما قد يكون له تأثير جيد على صحة المستهلكين.