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EFFECT OF WHOLE SUNFLOWER SEEDS SUPPLEMENTATION ON PERFORMANCE OF ZARAIBI GOATS

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ABSTRACT

The work aimed to study the effect of whole sunflower seeds' supplementation on the digestibility, rumen activity, blood constituents and body weight change, milk yield, colostrum and milk composition and kids' growth of Zaraibi goats. Fifteen Zaraibi goats with average body weights of 41.04±1.19 kg and aged 4-5 years at the last two months of pregnancy were divided into three groups (5 in each). The goats in the first group (control) were fed the basal ration (R1), which consisted of 50 % concentrate feed mixture (CFM) plus 50 % fresh berseem (winter ration) or plus 50 % berseem hay (summer ration) on dry matter (DM) basis. In the other two groups, 5 and 10 % of CFM were replaced by whole sunflower seeds for R2 and R3, respectively. Also, six digestibility trials were conducted to determine nutrient digestibility coefficients and nutritive values of the experimental rations during suckling period (winter ration) and mid-lactation period (summer ration) using Zaraibi bucks (3 in each group).

Dry matter intake (DMI) and ether extract (EE) significantly ($P<0.05$) increased digestibility, however, CF and NFE significantly ($P<0.05$) decreased digestibility with increasing level of sunflower seeds supplementation for winter and summer rations. However, the digestibility of dry matter (DM), organic matter (OM) and crude protein (CP) and the total digestible nutrients (TDN) and digestible crude protein (DCP) values were slightly increased by sunflower seeds supplementation ($P>0.05$). The pH value and ammonia-nitrogen (NH_3-N) concentration decreased significantly ($P<0.05$), but total volatile fatty acids (TVFA´s) concentration increased significantly ($P<0.05$) with increasing level of sunflower seeds' supplementation for winter and summer rations. The concentrations of total lipids, triglyceride and glucose increased significantly ($P<0.05$), whereas, the activity of asparagine aminotransferase (AST) and alanine aminotransferase (ALT) decreased significantly ($P<0.05$) with increasing level of sunflower seeds' supplementation for winter and summer rations.

Goats fed 10 % sunflower seeds supplemented diet (R3) showed the highest yield of colostrum and milk (0.95 and 1.55 kg day^{-1}) followed by those fed 5 % sunflower supplemented diet (R2) (0.89 and 1.38 kg day^{-1}), while those fed control diet (R1) had the lowest yield (0.73 and 1.18 kg day^{-1}), respectively ($P<0.05$). Goats fed 10 % sunflower seeds supplemented diet (R3) showed the highest percentages of all constituents in colostrum and milk followed by those fed 5 % sunflower supplemented diet (R2), while those fed control diet (R1) had the lowest percentages ($P<0.05$). The total DMI, total feed cost, total milk yield, price of total milk yield and economic efficiency increased significantly ($P<0.05$) with increasing level of sunflower seeds supplementation. Body weight of kids increased gradually with the progress of suckling period. The 5 % sunflower seeds supplemented group (R2) showed the highest body weight of goats and their kids followed by 10 % sunflower seeds supplemented group (R3), while the control group (R1) had the lowest values.

Key words: sunflower seeds; goats; digestibility; rumen fermentation; colostrum; milk yield and composition; economic efficiency

INTRODUCTION

In Egypt, goat population was about 3.2 million heads, of which only some thousands were Nubian (Zaraibi) goats, which weighed from 25-50 kg, produced 150-300 kg milk per season and their twin rate was about 2.5 (Galal *et al.*, 2005). Whole high-oil sunflower seeds have several characteristics of a desirable supplement for range beef cows; these include a high lipid concentration, a moderate concentration of protein, and excellent storage

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and handling characteristics. For these reasons, high-oil sunflower seeds could be used to replace traditional protein supplements, which concomitantly provide supplemental lipid. Supplementation of beef cattle with sunflower seeds or feeding diets containing sunflower seeds has variable effects on BW and reproduction (Bellows *et al.*, 2001; Alexander *et al*., 2002; Funston *et al.*, 2002). Sunflower seed would be a good choice from a consumer's point of view, as it is rich in polyunsaturated fatty acids and a source of linoleic acid (66 % of total fatty acids) which is omega 6 fatty acid (Petit, 2003).

Incorporation of extra fats in ruminant rations in the form of oil seeds may only have a minor effect on rumen fermentation and macronutrient digestibility, but dry matter intake may be influenced by the type of oil seed (Polviset *et al*., 2010). High fat levels in the ration of ruminants inhibit ruminal fermentation and thus diminish the utilization of dietary fibres (Vafa *et al*., 2009). Fatty acids that are released in the rumen disturb the function of microbial cell membranes (Calsamiglia *et al*., 2007). The milk of small ruminants such as goats and sheep is of particular economic interest in certain areas of the world. In developing countries, the production of this type of milk has come to be a useful strategy to tackle the problem of undernutrition, especially among the infant population (Haenlein, 2004).

The objective of this study was to investigate the effect of whole sunflower seeds supplementation on the digestibility, rumen activity, blood constituents and body weight change, milk yield, colostrum and milk composition, and growth of kids of Zaraibi goats.

MATERIALS AND METHODS

The current work was carried out at Sakha Experimental Farm, belonging to the Animal Production Research Institute (APRI), Agricultural Research Center in cooperation with Department of Animal Production, Faculty of Agriculture, Kafrelsheikh University.

Fifteen Zaraibi goats with average body weight of 41.04±1.19 kg and aged 4-5 years at the last two months of pregnancy were divided into three similar groups (5 in each). The goats in the first group (control) were fed the basal ration (R1) consisting of 50 % concentrate feed mixture (CFM) plus 50 % fresh berseem during suckling period (winter ration) or plus 50 % berseem hay during lactation period (summer ration) on DM basis. In the other two groups, 5 and 10 % of CFM replaced by whole sunflower seeds for R2 and R3, respectively. Chemical composition of used feedstuffs and experimental rations are presented in Table (1).

Six digestibility trials were conducted using Zaraibi bucks (3 in each group) to determine nutrient digestibility coefficients and nutritive values of the winter and summer rations. Animals were kept in separate metabolic cages for 14 days as a preliminary period followed by 7 days collection period. The *ad libitum* intake from tested diets was measured during the preliminary period and was restricted to 90 % of

Table 1: Chemical composition of tested feedstuffs and experimental rations

Item	DM %	Composition of DM %					
		OM	CP	CF	EE	NFE	Ash
Concentrate feed mixture*	89.91	87.73	14.42	12.11	3.51	57.69	12.27
Whole sunflower seeds	90.53	92.98	16.67	18.31	21.74	36.26	7.02
Fresh berseem	17.53	85.79	14.22	26.25	2.19	43.13	14.21
Berseem hay	90.43	89.16	12.84	27.92	3.07	45.33	10.84
Experimental rations							
Winter rations							
R1	53.72	86.76	14.32	19.18	2.85	50.41	13.24
R2	53.75	87.02	14.43	19.49	3.76	49.34	12.98
R3	53.78	87.29	14.55	19.8	4.67	48.27	12.71
Summer rations							
R1	90.17	88.45	13.63	20.02	3.29	51.51	11.55
R2	90.20	88.71	13.74	20.33	4.20	50.44	11.29
R3	90.23	88.98	13.86	20.64	5.11	49.37	11.02

* CFM consisted of 25 % undecorticated cotton seed cake, 24 % wheat bran, 26 % yellow corn, 15 % rice bran, 5 % linseed cake, 3 % molasses, 1 % limestone and 1 % common salt

voluntary intake during the collection period to avoid any feed refusal. Animals were fed twice daily in two equal meals at 9 a.m. and 4 p.m. Water was made freely available throughout the day. The daily faeces excreted were collected, weighed and 10 % of the faeces were taken and dried for 48 hours at 65°C to determine dry matter excreted and composite for each animal. Representative samples of feedstuffs and faeces were analyzed to determine CP, CF, EE and ash according to AOAC (1995).

Rumen liquor samples were taken using stomach tube three hours after the morning feeding. The rumen liquor was filtered through double layers of cheese cloth into plastic bottles. The pH value and ammonia–nitrogen (NH_3-N) concentration were determined by using magnesium oxide (MgO) as described by AOAC (1995) and total volatile fatty acids (TVFA´s) concentration was determined by steam distillation method as described by Warner (1964). The blood samples were taken from the jugular vein of all animals in clean tubes, left in a standing position for about 20-30 minutes, centrifuged at 1500 rpm for 10 minutes and then serum removed very quickly. Blood serum samples were analyzed calorimetrically using kits produced by El-Nasr Pharmaceutical Chemicals Company to determine the activity of asparagine aminotransferase (AST) and alanine aminotransferase (ALT) (Harold, 1957), triglyceride (Scheletter and Nussel, 1975), cholesterol (Rolschlau, 1974), total lipids (Henry, 1964) and glucose (Trinder, 1969).

The yield of colostrum was determined during the first 3 days after kidding and samples were taken for chemical analysis. During the suckling period (90 days), goats were hand-milked every two weeks twice daily at 6 a.m. and 5 p.m. to determine average daily milk yield and the samples were subjected to further analysis. After the end of suckling period goats were mechanically milked twice daily up to the end of lactation (120 days) and average daily milk yield was recorded. Samples were taken from the connective evening and morning milkings and composite in proportion to milk yield for analysis. Milk samples were analyzed for fat, protein, lactose, solids not fat (SNF), and total solids (TS) by Milko-Scan, model 133B and ash by the difference.

The data were subjected to statistical analysis using general linear models procedure adapted by SPSS (2008) for user's guide with one-way ANOVA. Duncan test within SPSS was done to determine the degree of significance between the means.

RESULTS AND DISCUSSION

Average DM intake, digestibility coefficients and nutritive values of experimental rations by goats are shown in Table (2). Dry matter intake (DMI) increased significantly ($P<0.05$) with increasing level of sunflower seeds supplementation for winter and summer rations. These results agree with those obtained by Polviset *et al.* (2010) who found that DM intake is influenced by oil seed supplementation. Data also indicated that the digestibility of DM, OM and CP, and the TDN and DCP values were slightly increased by sunflower seeds supplementation.

Table 2: Average live body weight, DM intake, digestibility coefficients and nutritive values of winter and summer experimental rations

Item	Winter rations			Summer rations		
	R1	R2	R3	R1	R2	R3
LBW (kg)	44.60	45.3	45.40	46.30	47.40	46.60
DMI (g/day)	1541.80^{c}	1614.30^{b}	1663.70^{a}	1565.70^{c}	1631.50^{b}	1707.30^{a}
Digestibility coefficients %						
DM	70.12	71.22	72.15	68.61	68.89	69.68
OM	71.31	72.42	72.31	70.57	70.72	71.92
CP	70.11	72.65	73.27	67.32	68.95	69.42
CF	64.38^{a}	62.74^{ab}	59.81^{b}	65.71^{a}	63.21^{ab}	60.36^{b}
EE	68.72^{c}	74.92^{b}	78.14^{a}	69.69^{b}	71.55^{ab}	73.36^{a}
NFE	78.91^{a}	77.44^{ab}	76.37^{b}	77.05^{a}	76.38^{ab}	75.71^{b}
Nutritive values %						
TDN	66.57	67.26	67.58	67.18	67.61	68.89
DCP	10.04	10.48	10.66	9.18	9.47	9.62

a, b, c: Values in the same row with different superscripts differ significantly ($P<0.05$)

While EE digestibility increased significantly (P<0.05), CF and NFE digestibilities significantly decreased (P<0.05) with increasing level of sunflower seeds supplementation for winter and summer rations. These results agree with those obtained by Grummer and Carroll (1988) and Schauff and Clark (1989) in which ruminally inert fat supplements were fed to the cows. Arar and Harb (2006) observed no significant (P<0.05) differences for DM, OM, ADF and NDF digestibility. Digestibility of CP decreased and EE digestibility increased significantly by adding fat to the ration. High fat levels in the ration of ruminants inhibit ruminal fermentation and thus diminish the utilization of dietary fibre (Vafa *et al*., 2009).

Results in Table (3) revealed that the pH value and NH_3-N concentration decreased significantly (P<0.05), but TVFA´s concentration increased significantly (P<0.05) with increasing level of sunflower seeds supplementation for winter and summer rations. Moreover, pH value decreased, however the concentrations of TVFA´s and NH_3-N increased from before feeding to 3 hours after feeding and then showed opposite trend at 6 hours after feeding. The incorporation of extra fat in ruminant rations in the form of oil seed may only have a minor effect on rumen fermentation and macronutrient digestibility but dry matter intake may be influenced by the type of oil seed (Polviset *et al.*, 2010). Ivan *et al*. (2003) found that VFA concentration increased and ammonia-N decreased causing the decrease of pH in the rumen with sunflower seed supplementation.

Blood serum constituents as affected by feeding sunflower seeds are shown in Table (3). Blood is an index for several metabolic processes of the body. The concentrations of total lipids, triglyceride and glucose increased significantly (P<0.05), however the activity of

Table 3: Rumen activity of goats fed winter and summer experimental rations

Item	Winter rations			Summer rations		
	R1	R2	R3	R1	R2	R3
Rumen activity						
pH value						
Before morning feeding	7.18^{a}	7.11^{a}	6.81^{b}	7.25^{a}	6.95^{b}	6.91^{b}
After morning feeding						
3 hr	5.91^{a}	5.84^{a}	5.69^{b}	5.40	5.41	5.52
6 hr	7.13^{a}	6.84^{ab}	6.73^{b}	7.13^{a}	6.75^{b}	6.61^{b}
Mean	6.74^{a}	6.60^{ab}	6.41^{b}	6.59^{a}	6.37^{b}	6.35^{b}
TVFA´s (meq/100 ml)						
Before morning feeding	11.95^{b}	12.13^{b}	14.73^{a}	9.50^{b}	9.57^{b}	13.62^{a}
After morning feeding						
3 hr	17.25^{b}	18.41^{ab}	19.88^{a}	13.19^{b}	14.27^{b}	18.43^{a}
6 hr	12.44^{b}	13.51^{ab}	15.19^{a}	9.95^{b}	10.91^{b}	14.72^{a}
Mean	13.86^{b}	14.68^{b}	16.60^{a}	10.88^{b}	11.58^{b}	15.59^{a}
NH_3-N (mg/100 ml)						
Before morning feeding	23.61^{a}	22.71^{ab}	21.83^{b}	20.93^{a}	19.68^{b}	19.37^{b}
After morning feeding						
3 hr	26.84^{a}	25.64^{ab}	24.14^{b}	24.31^{a}	23.25^{ab}	22.26^{b}
6 hr	22.51^{a}	21.93^{ab}	20.97^{b}	21.27^{a}	19.57^{b}	19.15^{b}
Mean	24.32^{a}	23.42^{ab}	22.31^{b}	22.17^{a}	20.83^{b}	20.26^{b}
Blood serum constituents						
Total lipids (mg/dl)	156.76^{b}	317.41^{a}	357.72^{a}	224.25^{b}	469.85^{ab}	502.13^{a}
Triglyceride (mg/dl)	69.63^{b}	86.55^{ab}	100.18^{a}	46.50^{b}	71.10^{ab}	87.60^{a}
Cholesterol (mg/dl)	86.69^{a}	66.89^{b}	59.44^{b}	86.74	83.20	77.95
Glucose (mg/dl)	58.11	58.64	56.70	45.87	53.47	49.62
AST (u/ml)	36.00	28.89	29.30	46.00^{a}	27.38^{b}	31.85^{b}
ALT (u/ml)	26.61	20.16	22.55	34.72^{a}	25.55^{b}	28.72^{ab}

a, b: Values in the same row with different superscripts differ significantly (P<0.05)

AST and ALT decreased with increasing level of sunflower seeds supplementation for winter (P>0.05) and summer rations (P<0.05). The values of serum constituents obtained here are within the normal ranges. The decreased AST and ALT activity reflect normal liver function of goats fed the sunflower seeds supplemented rations. These results agree with those obtained by Gonthier *et al.* (2005) who reported that oil seeds supplementation increased the concentrations of cholesterol and/or non-esterifies fatty acids (NEFA) in bovine blood. In addition, the feeding of supplemental fat has given variable results when used to improve productivity in domestic ruminant management (Funston, 2004).

The yield and composition of colostrum of goats fed experimental rations is presented in Table (4). The yield of colostrum and the contents of fat, protein, lactose, solids not fat and total solids increased significantly (P<0.05) with sunflower seeds supplementation, as the 10 % sunflower seeds supplementation (R3) showed the highest contents followed by 5 % sunflower seeds supplementation (R2), while the control diet (R1) had the lowest contents (P<0.05). These results are in accordance with those obtained by Bee (2000) who found that addition of 2 % sunflower oil enriched in linoleic acid in food dose in the period of pregnancy and lactation affect on the fatty acids composition of colostrums.

Table 4: Yield and composition of colostrum and milk of goats fed experimental rations

Item	Colostrum			Milk		
	R1	R2	R3	R1	R2	R3
Yield (kg/day)	0.73^{b}	0.89^{a}	0.95^{a}	1.18^{c}	1.38^{b}	1.55^{a}
Composition %						
Fat	4.91^{c}	5.15^{b}	5.48^{a}	3.07^{b}	3.49^{ab}	3.87^{a}
Protein	9.12^{c}	9.69^{b}	10.31^{a}	3.57^{b}	3.69^{b}	3.98^{a}
Lactose	4.43^{b}	4.53^{b}	4.76^{a}	2.71^{c}	3.06^{b}	3.31^{a}
SNF	14.34^{c}	15.02^{b}	15.88^{a}	7.00^{b}	7.51^{ab}	8.05^{a}
TS	19.25^{c}	20.17^{b}	21.36^{a}	10.07^{c}	11.00^{b}	11.92^{a}
Ash	0.79	0.80	0.80	0.72^{b}	0.76^{a}	0.76a

a, b, c: Values in the same row with different superscripts differ significantly (P<0.05)

The average daily milk yield of goats fed experimental rations are shown in Table (4). Average daily milk yield increased significantly (P<0.05) with sunflower seeds supplementation. The 10 % supplemented sunflower seeds diet (R3) revealed the highest mean of milk yield being 1.55 kg day^{-1} followed by 5 % supplemented sunflower seeds diet (R2) being 1.38 kg day^{-1}, while control diet (R1) had the lowest yield being 1.18 kg day^{-1} (P<0.05). Sunflower seeds supplementation increased the mean of daily milk yield by 16.95 and 31.36 % for R2 and R3 groups compared with R1, respectively. These results agree with those obtained by Schroeder *et al.* (2004) who found that milk and 4 % fat-corrected milk production of cows were increased by 0.97 and 1.05 kg/cow per day with fat supplementation. Mele *et al.* (2006) reported that the inclusion of soybean oil in the diet resulted in a significant increase of both daily milk yield and fat corrected milk of ewes (P<0.01). Strusinska *et al*. (2006) stated that the mean daily milk yield recorded increase in fat-protein supplemented cows by 10.3 % and FCM yield increased by 15.5 % than in the control group.

The milk composition of goats fed experimental rations during the lactation period is presented in Table (4). Goats fed 10 % sunflower seeds supplemented diet (R3) showed the highest percentages of all milk constituents followed by those fed 5 % sunflower supplemented diet (R2), while those fed control diet (R1) had the lowest percentages (P<0.05). These results agree with those obtained by Schroeder *et al*. (2004) who found that milk fat concentration was increased by 5.1 % with saturated fat supplementation when compared to control groups. Junior *et al.* (2010) reported that the utilization of fat sources in diets changes milk composition of lactating cows.

Feed intake presented in Table (5) revealed that the amount of concentrate feed intake was nearly the same for the different groups, while the amounts of fresh berseem and berseem hay intake increased with increasing level of sunflower seeds supplementation. Moreover, the total DM intake, total feed cost, total milk yield, price of total milk yield and economic efficiency increased

significantly (P<0.05) with increasing level of sunflower seeds supplementation. Economic efficiency expressed as the ratio between the price of total milk yield and the cost of total feed intake increased by 9.21 and 15.79 % for R2 and R3 compared to R1, respectively. These results agree with those obtained by Omer (1999) and El-Diahy (2004) who found that fat supplementation of Friesian calves and cows improved economic efficiency.

Table 5: Feed intake and economic efficiency of goats fed experimental rations

Item	Experimental rations		
	R1	R2	R3
Concentrate feed mixture			
Intake (kg/head)	183.07	181.71	178.60
Price (€)	43.08	42.76	42.02
Sunflower seeds			
Intake (kg/head)	-	9.50	19.71
Price (€)	-	3.35	6.96
Fresh berseem			
Intake (kg/head)	532.99	558.05	575.13
Price (€)	7.52	7.88	8.12
Berseem hay			
Intake (kg/head)	75.46	82.00	85.81
Price (€)	7.10	7.72	8.08
Total DM intake (kg/head)	326.27^{b}	343.95^{ab}	356.84^{a}
Total feed cost (€)	57.70^{b}	61.70^{ab}	65.18^{a}
Total milk yield (kg/head)	247.80^{c}	289.80^{b}	325.50^{a}
Price of milk yield (€)	87.46^{c}	102.28^{b}	114.88^{a}
Economic efficiency	1.52^{b}	1.66^{ab}	1.76^{a}

a, b, c: Values in the same row with different superscripts differ significantly (P<0.05).
Price of one kg in LE were 2 for concentrate feed mixture, 3 for sunflower seeds, 0.12 for fresh berseem, 0.80 for berseem hay and 3 for milk according to prices 2010

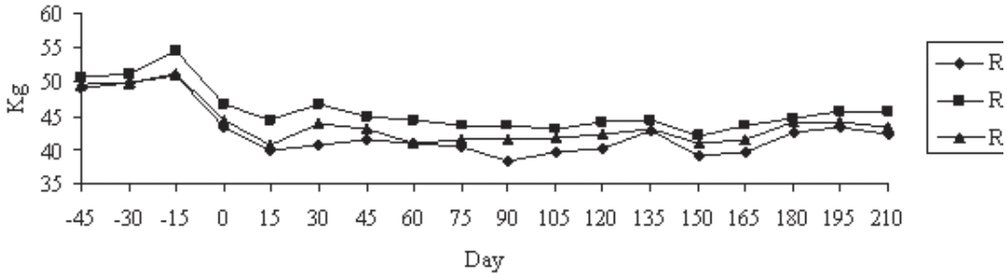

Fig. 1: Body weight change of goats fed experimental rations

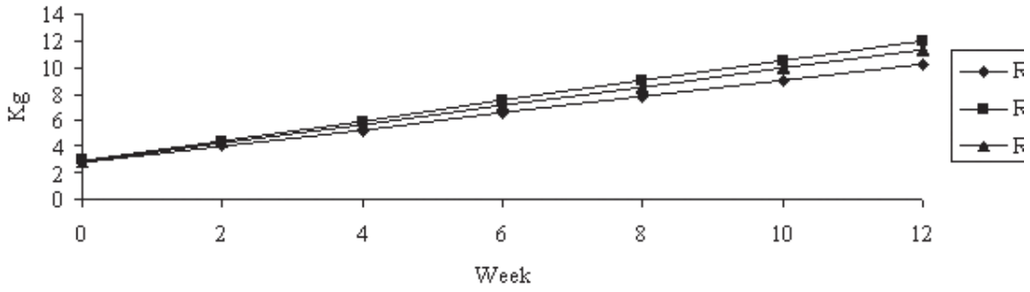

Fig. 2: Body weight of kids suckled goats fed experimental rations

Results of body weight change during the different physiological stages of goats as affected by sunflower seeds supplementation are presented in Fig. (1). Body weight increased gradually with the progress of pregnancy for the different groups. The group supplemented with 5 % sunflower seeds (R2) showed significantly ($P<0.05$) higher body weight at 15 days pre-kidding and kidding compared with both control (R1) and 10 % sunflower seeds (R3) groups. Moreover, there were inconstant changes in body weight during the suckling and lactation period. The 5 % sunflower seeds supplemented group (R2) revealed significantly ($P<0.05$) the highest body weight followed by 10 % sunflower seeds supplemented group (R3), while the control group (R1) had the lowest body weight. The reason for improvement of body weight may be due to increasing energy status and adequate time to recover body condition (Thomas and Williams, 1996). During the physiological stress of milk production particularly during the peak of lactation, goats tended to have no increase or may have loss of body weight (Dapoza *et al.*, 1999 and Olsson *et al.*, 1999). Zambom *et al.* (2003) revealed 15-20 % decrease in body weight of ewes after lambing.

Results in Fig. (2) showed that body weight of kids increased gradually with the progress of suckling period for the different groups. The 5 % sunflower seeds supplemented group (R2) showed the highest body weight followed by 10 % sunflower seeds supplemented group (R3), while the control group (R1) had the lowest values. The body weight at weaning increased by 17.07 and 10.54 % for R2 and R3 compared with R1, respectively. This could be related to the higher feeding values and energetic efficiency (Ruvuna *et al.*, 1992).

From these results it could be concluded that sunflower seeds supplementation improved ether extract digestibility and rumen fermentation and liver function and increased body weight of goats. Goats fed diet supplemented with 10 % sunflower seeds showed the highest milk yield, colostrum and milk constituents and economic efficiency, while goats fed diet supplemented with 5 % sunflower seeds revealed the highest body weight at weaning and daily gain for their kids.

REFERENCES

ALEXANDER, B. M. – HESS, B. W. – HIXON, D. L. – GARRETT, B. L. – RULE, D. C. – MCFARLAND, M. – BOTTGER, J. D. – SIMMS, D. D. – MOSS, G. E. 2002. Influence of prepartum fat supplementation on subsequent beef cow reproduction and calf performance. *Prof. Anim. Sci.,* 18, 351-357.

AOAC, 1995. Association of Official Analytical Chemists. Official Methods of Analysis, 15th Ed., Washington, DC.

ARAR, H. R. H. – HARB, M. 2006. The effect of adding protected fat in the ration of lactating awassi ewes and fattening lambs. *Jordan J. Agricultural Sci.*, 2, 35-44.

BEE, G. 2000. Dietary conjugated linoleic acids alter adipose tissue and milk lipids of pregnant and lactating sows. *J. Nutr.,* 130, 2292-2298.

BELLOWS, R. A. – GRINGS, E.E. – SIMMS, D. D. – GEARY, T. W. – BERGMAN, J. W. 2001. Effects of feeding supplemental fat during gestation to first-calf beef heifers. *Prof. Anim. Sci*., 17, 81-89.

CALSAMIGLIA, S. – BUSQUET, M. – CARDOZO, P. W. – CASTILLEJOS, L. – FERRET, A. 2007. Invited review: Essential oils as modifiers of rumen microbial fermentation. *J. Dairy Sci*., 90, 2580-2595.

DAPOZA, C. – CASTRILLO, C. – BALCELLS, J. – MARTIN-ORUE, S. – GUADA, J. A. 1999. On the variation of urinary excretion of creatinine and purine derivations in pregnant and lactating ewes given diets with different protein contents. *J. Anim. Sci.,* 68, 555.

EL-DIAHY, Y. M. M. 2004. Effect of fat supplementation on productive and reproductive performance in lactating Friesian cows. M. Sc. Thesis, Fac. of Agric.,

Kafr El-Sheikh, Tanta University.

FUNSTON, R. N. 2004. Fat supplementation and reproduction in beef females. *J. Anim. Sci.,* 82, E154-161.

FUNSTON, R. N. – GEARY, T. W. – ANSOTEGUI, R. P. – LIPSEY, R. J. – PATTERSON, J. A. 2002. Supplementation with whole sunflower seeds before artificial insemination in beef heifers. *Prof. Anim. Sci*., 18, 254-257.

GALAL, S. – ABDEL-RASOUL, F. – ANOUS, M. R. – SHAAT, I. M. 2005. Onstation Characterization of Small Ruminant Breeds in Egypt. In: *Characterization of Small Ruminant Breeds in West Asia and North Africa*, 2: 141-193 Luis Iniguez (Ed.) ICARDA, Aleppo, Syria.

GONTHIER, C. – MUSTAFA, A. F. – OUELLET, D. R. – CHOUINARD, P. Y. – BERTHIAUME, R. – PETIT, H. V. 2005. Feeding micronized and extruded flaxseed to dairy cows: Effects on blood parameters and milk fatty acid composition. *J. Dairy Sci.,* 88, 748-756.

GRUMMER, R. R. – CARROLL, D. J. 1988. A review of lipoprotein cholesterol metabolism. Importance to ovulation function. *J. Anim. Sci*., 66, 3166.

HAENLEIN, G. F. W. 2004. Goat milk in human nutrition. *Small Ruminant Res.,* 51, 155-163.

HAROLD, P. C. 1957. Determination method of GOT and GPT. *Laboratory Anim. Sci.*, 43, 244-246.

HENRY, E. J. 1964. Calorimetric determination of total lipids. Clin. Chem. Principples and Technics. Harper Row NY, pp. 181.

IVAN, M. – ENTZ, T. – MIR, P. S. – MIR, Z. – MCALLISTER, T.A. 2003. Effects of sunflower seed supplementation and different dietary protein concentrations on the ciliate protozoa population dynamics in the rumen of sheep. *Can. J. Anim. Sci.*, 83, 809-817.

JUNIOR, J. E. F. – RENNO, F. P. – SANTOS, M. V. – GANDRA, J. R. – FILHO, M. M. – VENTURELLI, B. C. 2010. Productive performance and composition of milk protein fraction in dairy cows supplemented with fat sources. *Revista Brasileira de Zootecnia,* 39, 845-852.

MELE, M. – BUCCIONI, A. – PETACCHI, F. – SERRA, A. – BANNI, S. – ANTONGIOVANNI, M. –SECCHIAR, P. 2006. Effect of forage/concentrate ratio and soybean oil supplementation on milk yield, and composition from Sarda ewes. *Animal Res.,* 55, 273-285.

OLSSON, G. – BERGSTEN, C. – WIKTORSSON, H. 1999. The influence of diet bfore and after calving on the food intake, production and health of primiparous cows with special reference to sole haemorrhages. *Anim. Sci.,* 66, 75-86.

OMER, F. M. 1999. Using protected fat prepared from soap industry by-products in finishing ration of Friesian bulls. Ph. D. Thesis, Fac. of Agric., Cairo University.

PETIT, H. V. 2003. Digestion, milk production, milk composition, and blood composition of dairy cows fed formaldehyde treated flaxseed or sunflower seed. *J. Dairy Sci.,* 86, 2637-2646.

POLVISET, W. – WACHIRAPAKORN, C. – ALHAIDARY, A. – MOHAMED, H. E. – BEYNEN, A. C. – YUANGKLANG, C. 2010. Rumen fermentation and nutrient digestibility in beef steers fed rations containing either cotton seed or sunflower seed. *Research J. Biological Sci*., 5, 204-208.

ROLSCHLAU, P. 1974. *Klin. Biochem*., 12: 226

RUVUNA, F. – TAYLOR, J. F. – OKEYO, M. – WANYOIKE, M. – AHUYA, C. 1992. Effects of breed and castration on slaughter weight and carcass composition of goats. *Small Ruminant Res*., 7, 175-183.

SCHAUFF, D. J. – CLARK, J. H., 1989. Effects of prilled fatty acids and calcium on rumen fermentation, nutrient digestibilities, milk production and milk composition. *J. Dairy Sci.*, 72, 917-927.

SCHELETTER, G. – NUSSEL, E. 1975. Aebeitsned sozialnd pracentined 10, 25.

SCHROEDER, G. F. – GAGLIOSTRO, G. A. – Bargo, F. – Delahoy, J. E. – Muller, L. D. 2004. Effects of fat supplementation on milk production and composition by dairy cows on pasture: a review. *Livestock Prod. Sci.,* 86, 1-18.

SPSS 2008. Statistical package for the social science, Release 16, SPSS INC, Chicago, USA.

STRUSINSKA, D. – MINAKOWSKI, D. – PYSERA, B. – KALINIEWICZ, J. 2006. Effects of fat-protein supplementation of diets for cows in early lactation on milk yield and composition. *Czech J. Anim. Sci.,* 51, 196-204.

THOMAS, M. G. – WILLIAMS, G. L., 1996. Metabolic hormone secretion and FSH induced superovulatory responses of beef heifers fed dietary fat supplemented containing prodomintly saturated or polyunsaturated fatty acids. *Theriogenology* 45, 451.

TRINDER, A. 1969. Evaluation of trinder‘s glucose oxidase method for measuring glucose in serum. *Clinical Chemistry,* 21, 1754-1760.

VAFA, T. S. – NASERIAN, A. A. – HERAVI MOUSSAVI, A. R. 2009. Effect of different levels of fish oil and canola oil on in vitro and in vivo nutrient digestibility. *Res. J. Biol. Sci.,* 4, 1221-1226.

WARNER, A. C. I. 1964. Production of volatile fatty acids in the rumen, method of measurements. *Nutrition Abstract and Review,* 34, 339.

ZAMBOM, M. A. – ALCALDE, C. R. – MACEDO, F. A. F. – SILVA, K. T. – MARTINS, E. N. – SONTOS, G. T. 2003. Performance and quality of milk of Saanen goats feeding with different roughage concentrations, in the prepartum and lactation. From CD of IX world conference on animal production, Oct. 26-31, Porto Alegre, Rio Grande Do Sul, Brazil.