Hebron University Research Journal.
Vol.(4), No.(1), pp.(81 – 91), 2009

H.U.R.J. is available online at
http://www.hebron.edu/journal

Effect of Feeding Sesame Oil Cake on Performance, Milk and Cheese Quality of Anglo-Nubian Goats

*Ayman Hejazi – **Jamal M. Abo Omar

*Ministry of Agriculture, Tolkurm Office , Tolkurm, Palestine
**Faculty of Agriculture, An Najah National University, Nablus, Palestine

Abstract:

This experiment was conducted to investigate the effects of feeding sesame oil cake (SOC) on milk and cheese quality of Anglo-Nubian goats. Sixteen lactating (20 days-in-milk) Anglo- Nubian goats were used in the experiment that lasted for 60 days. Goats were divided into 4 dietary treatment groups of 4 goats in each and the goats were distributed between the groups in a way they represent age and lactation stage. Goats were housed in pens of suitable size and were managed as any other commercial goat flock. The animals had free access to water. Straw was fed at rate of 1% of live body weight. Four types of dietary treatment were prepared using SOC. The first diet was the control and the other three diets contained: 5, 10, and 15% SOC, respectively. Animals fed twice daily and were milked during the feeding time. Milk yield (MY) was recorded daily and samples were taken for chemical analysis. Cheese was made on a monthly basis and samples were taken for sensory evaluation for flavor and texture. Incorporation of SOC in goats' diets at levels of 10 and 15% caused an increase ($P<0.05$) in MY compared to control and 5% SOC. Feeding SOC at all levels tested had a positive effect ($P<0.05$) on goats milk fat (MF). However, the highest MF percentage was

Key words: Anglo Nubian goats, sesame oil cake, milk yield, milk quality, cheese, sensory test.

** Corresponding author: aboomar57@najah.edu

detected in milk of goats fed with 15% SOC. Sesame Oil Cake had variable effects on milk protein (MP) where the highest MP content was from milk of goats fed with 5% cake. Both total solids (TS) and solids non fat (SNF) were increased (P<0.05) due to feeding different levels of SOC compared to control. Similar trends were observed on cheese composition in regard to fat content where feeding SOC at different levels increased significantly (P<0.05) cheese fat content compared to control. Other cheese components such as protein and ash were not affected by SOC feeding. Sensory results showed that flavor of cheese from goats consuming 10 and 15% SOC (P<0.05) was better than cheese from the other groups. However, an opposite trend was observed regarding cheese texture. The cheese from goats fed the control diet had (P<0.05) a better texture. The results of this study indicate that SOC can be used in goats' diets during lactation season. Similarly using SOC in goats' diets proved to be economically feasible.

الملخص:

تم إجراء هذه التجربة للتعرف على اثر التغذية بنسب مختلفة من كسبة السمسم على كمية و نوعية الحليب والجبن المأخوذة من ماعز الانجلونوبي، استخدم في هذه التجربة 16 ماعز انجلونوبي دخلت في فترة الحلب منذ 20 يوم حيث أن التجربة استمرت لمدة 60 يوم. قسمت الماعز إلى 4 مجموعات غذائية في كل مجموعة 4 من الماعز وأسكنت في حظائر مقسمة ومناسبة من حيث الاتساع وكذلك تمت رعايتها كأي قطيع ماعز تجاري، حصلت الحيوانات على القش والماء طوال الوقت، اربعة علائق مركزة حضرت باستخدام كسبة السمسم بحيث ان الاولى كانت الشاهد و الثلاث معاملات الاخرى كانت تحتوي على نسب من كسبة السمسم كبديل لنفس النسب من فول الصويا و الذرة كالتالي: 5، 10 و 15% من كسبة السمسم وغذيت الماعز بالعلائق المحضرة للتجربة مرتين يوميا وتم حلبها بنفس الوقت . كميات الحليب سجلت يوميا بينما تم تصنيع الجبن مرة شهريا. أظهرت نتائج الدراسة أن كسبة السمسم الخام التي استخدمت في التجربة كانت تشبه من حيث التركيب ما هو مستخدم عالميا. احدث خلط كسبة السمسم في علائق الماعز بنسب 10 و 15% زيادة (P<0.05) في كمية الحليب مقارنة مع الشاهد والعليقة المخلوطة بنسبة 5% من كسبة السمسم، أعطت التغذية بكسبة السمسم على جميع المستويات نتيجة ايجابية (P<0.05) بالنسبة لدهن الحليب حيث كانت أعلى نسبة دهن من الماعز التي غذيت على عليقة مخلوطة بنسبة 15% كسبة السمسم. كسبة السمسم لها تأثيرات متفاوتة على بروتين الحليب حيث كانت أعلى نسبة بروتين حليب من الماعز التي غذيت على عليقة مخلوطة بنسبة 5% من كسبة السمسم، المواد الصلبة الكلية والمواد الصلبة اللادهنية زادت (P<0.05) مع المستويات المختلفة من كسبة السمسم مقارنة مع الشاهد. نفس الاتجاهات لوحظت على تركيب الجبن خاصة محتوى الدهن حيث أن التغذية بنسب مختلفة من كسبة السمسم زادت (P<0.05) محتوى الدهن في الجبن مقارنة بالشاهد، المحتويات الأخرى في الجبن مثل البروتين والرماد لم تتأثر بالتغذية على كسبة السمسم .النتائج الحسية أظهرت أن مذاق الجبن التي صنعت من حليب الماعز التي غذيت بنسب 10 و 15% من كسبة السمسم كانت (P<0.05) الأفضل مقارنة مع المجموعات الأخرى، بينما كان الاتجاه عكسيا بالنسبة للقوام حيث لوحظ أن الجبن الذي صنع من حليب الماعز الشاهد كان (P<0.05) أفضل قوام. نتائج هذه التجربة اشارت الى انه يمكن استخدام كسبة السمسم في تغذية الماعز الحلوب. يفضل من الناحية الاقتصادية استخدام كسبة السمسم بشكل عملي، هناك حاجة إلى أبحاث أخرى لتدعيم مثل هذه النتائج.

Introduction:

More than 380000 goats are available in Palestine (PCBS, 2007). However, feeding cost makes more than 70% of total production costs (Abo Omar, 2002). In order to reduce feeding costs, attempts were made to use agricultural and industrial by-products as feed ingredients especially for ruminants. Therefore, it is essential to incorporate local raw materials and by-products in rations of farm animals. Among these by-products is the sesame oil cake (SOC). It is a by-product of sesame seed pressing. Approximately 10000 tons of the SOC are produced each year (Palestinian Ministry of Agriculture (PMA), 1999). Sesame oil cake is a relatively good source of crude protein (CP) which can replace part of basic ingredients in diets such as soybean. The chemical composition of SOC varies according to the method of processing (mechanical or solvent extraction). It has been reported that the dry matter (DM) content ranges from 83 to 96%. Also it has been reported that the CP, ash, ether extract, nitrogen free extract (NFE) and crude fiber (CF) are 23–26%, 7.5–17.5%, 1.4–27%, 25–31% and 5–12% on DM basis, respectively (FAO, 1990; Abo Omar, 2002). Ryu et al. (1998a) reported that incorporation of SOC in calves' rations had positive effects on performance. Similarly, SOC tended to improve feeding quality of rice straw when fed to steers (Ryu et al., 1998b), and fattening lambs at levels which ranged from 5% to 20% (Abo Omar, 2002). Sesame oil cake, a relatively good source of CP, can replace dried poultry excreta in calves' rations without causing harmful effects (Khan et al., 1998). Also, SOC improved dry matter intake (DMI) and organic matter (OM), CP, CF and ether extract digestibility.

However, it is not well understood whether incorporation of SOC in dairy ruminants will have impact on composition of milk and cheese. The objectives of this study were to investigate the effect of feeding SOC on the performance of Anglo-Nubian goats, MY, quality and cheese characters.

Materials and Methods

Diet preparation

The experimental diets were formulated at the experimental site. Raw SOC was collected from a local sesame pressing factories (Nablus and Tulkarm, Palestine) during the summer of 2007. The fresh material was transported to the experimental site. It was spread on a large plastic sheet for sun-drying for 3 days. The material was covered during night to avoid moisture accumulation.

The experimental diets were formulated to meet NRC (1994) nutrient requirements.

Four diets were formulated. Sesame oil cake (SOC) was added to replace similar amounts of soybean meal and corn. Diets used in the experiment are shown in table 1.

Table (1). Composition and chemical analysis of the 4 experimental diets used in the experiment

Diet	Control	Group 1	Group 2	Group 3
Corn	26	23	20	17
Soybean meal	14	12	10	8
SOC	0	5	10	15
Bran	27	27	27	27
Barely	18	18	18	18
Wheat	11	11	11	11
Salt	0.7	0.7	0.7	0.7
Oil	0.6	0.6	0.6	0.6
Limestone	1.8	1.8	1.8	1.8
Di-calcium Phosphate	0.4	0.4	0.4	0.4
Premix	0.5	0.5	0.5	0.5
Calculated Chemical Analysis%				
DM	90.1	90.7	91	90.6
CP	17.0	16.9	17.1	17.0
Crude Fat	2.00	2.91	4.24	5.7
CF	4.1	4.24	4.72	5.18
Cu (ppm)	8.3	9.2	10.1	11.1
Ash	6.1	6.22	6.5	6.4
Ca	1.03	1.05	1.07	1.09
Phosphorus	0.45	0.43	0.41	0.40

Feeding trial

A total 16 lactating Anglo-Nubian goats were used in the experiment. Goats were housed in the farm of the faculty of agriculture/ An- Najah National University, Tulkarm, Palestine. Goats were divided into four dietary treatment groups of four goats in each and the goats were distributed between the groups in a way they represent age and lactation stage. Goats were housed in pens of suitable size (4 square meters) and were managed as any commercial goats flock. The animals had free access to straw and water. Animals fed twice daily (4 kg of experimental diet for each group/ day) at 0700 and 1800 h and were milked during the feeding time. These goats had been 20 days-in-milk when the first batch of milk had been collected. Milk yield (MY) of each group was weighed daily throughout the experiment which lasted for 60 days. Milk samples were taken for chemical analysis twice per month and one time per month for cheese processing.

Processing of Nabulsi white cheese:

Goat milk was heated to 73°C and then cooled to 37°C and then the rennet (enzyme) was added (1drop/1kg of milk) to the milk and mixed well. The milk was set at the same temperature, (37°C) to coagulate for 45 minuets. Curd was scooped into cheese cloth and drained for 30 minuets and cheese was taken out of the cheese cloth and weighed. The cheese was cut into blocks (5 ´ 5 ´ 1 cm). Samples were taken for sensory evaluation and chemical analysis. The cheese blocks were maintained in salt solution (8 %) in separate plastic containers kept in the cooler at 4°C and sample was taken one time monthly for the two months. All cheese samples were frozen at (– 18°C) for later chemical analyses.

Chemical analysis of feed:
Feed samples were analyzed for DM, CP, CF, crude fat, ash, Cu, following procedures described in AOAC (1995) . The Ca and P contents were determined using the flame photometry instrument.

Chemical analysis of milk and cheese:
Fat content of milk and cheese was determined by ether extract procedure (Ether Extract, AOAC, 1995). Protein content was determined by the Kjeldahl procedure. Total solid content of milk and cheese was determined by the oven drying method. Lactose content of milk was determined by the milk analyzer instrument based on infrared measurement*.

Sensory evaluation:
Cheese samples were judged for sensory quality by a panel of three trained judges. The sensory quality was evaluated on a 15-point scale, with 10 points designated to flavor and five points to body and texture (Bodyfelt et al., 1988).

Data analysis:
All data were analyzed by ANOVA using the linear model procedure of SAS (SAS, 1988) to determine the effect of addition of sesame oil cake to goat's diets on M C, milk yield (MY), cheese yield (CY) and cheese quality. Least significant test (LSD) test was used to separate the significant means.

Results and Discussion
Composition of SOC
Table (2) shows the chemical composition of raw SOC. Composition values are in agreement with previous research (Abo Omar, 2002; Ryu et al., 1998b).

Table (2): Chemical composition analysis of SOC.

Nutrient	%
DM	95.7
CP	22.7
NDF	45.0
ADF	33.0
Crude Fat	26.9

Nutrient	%
NFE	31.0
Ash	7.50
Ca	0.60
Phosphorus	0.10
Cu (ppm)	33.0

Milk yield and composition

The results obtained from this experiment indicated that goats fed with high levels of SOC (Groups 2 and 3) produced higher ($P<0.05$) yield of milk compared with goats in the other two groups (Table 3).

Table (3). Milk yield and milk composition from goats fed different levels of SOC.

	Control	Group 1	Group 2	Group 3	LSD
M Y , kg	7.4b	7.3b	7.6a	7.7a	0.1559
Fat %	4.3c	4.8b	5.1a	5.1a	0.1455
Protein %	3.68b	3.74a	3.67b	3.69ab	0.0658
Lactose%	4.83	4.89	4.82	4.84	0.1095
TS %	13.59b	14.48a	14.39a	14.40a	0.2754
SNF %	9.26b	9.67a	9.24a	9.29a	0.1729
Ash%	0.73	0.74	0.73	0.74	0.0151

abc Rows of different superscripts are significantly different ($P<0.05$).

Milk fat percentage was higher ($P<0.05$) in milks of goats fed with 10 and 15 % SOC compared to the control goats. However, milk of goats fed the two high levels had more ($P<0.05$) fat compared to milk of goats fed the lowest level of SOC (Table 3).

These results are in agreement with previous research where feeding SOC increased milk fat for ewes (Zhang et al., 2006; Horton et al., 1992; Casals et al., 1999) and goats (Baldi et al., 1992; Mir et al., 1999) fed supplemental fats. However, these results were not consistent with results of Kitessa et al.(2003) where oil seeds had no or negative effects on ewes milk fat and of cows milk fat (Mustafa et al., 2003; Sarrazin et al., 2004). The NRC (2001) showed that factors affecting milk fat percentage are fat supplementation including level and type of fat, forage source, and other ingredients in the diet. Results of this study showed that feeding SOC to lactating goats up to 15% had a positive effect on milk fat percentage. As a result of higher milk fat percentage, milk from goats fed SOC contained more ($P<0.05$) TS and solids non fat compared to control group (Zhang et al., 2006; Casals et al., 1999).

Milk protein was not affected by dietary treatments (Table 3). This result is in agreement with previous studies (Mir et al., 1999; Kitessa et al., 2003; Zhang et al., 2006). Similar trends were observed in cow milk (Mustafa et al., 2003). However results of the current study are inconsistent with those of Casals et al. (1999) where a negative effect was found on milk protein percentages of ewes. Oilseed supplementation also caused significant reduction in milk protein percentage in dairy cows (Khorasani et al., 1991; Dhiman et al., 1995). This reduction might be attributed to a lack of increase in amino acids available to the mammary gland for protein syntheses as MY increases during fat supplementation (Wu and Huber, 1994; Zhang et al., 2006). The lack of response of milk protein to oilseed addition might be related to the short term supplementation.

Sesame oil cake increased ($P<0.05$) the content of TS and solids non fat (SNF) compared to control group but had no effects on other milk fractions as ash content. These results are in agreement with previous research (Khorasani et al., 1991).

Cheese yield and composition

Cheese yield and composition are shown in Table 4. Cheese making efficiency was not affected by dietary treatments. The yield of cheese was the same in all treatments.

Table (4). Cheese yield and Cheese composition from goats fed different levels of SOC.

	Control	Group 1	Group 2	Group 3	LSD
CY , kg	24.4	24.3	24.4	24.5	0.1222
DM %	48.1	47.2	49.5	51.2	4.0679
Fat %	16.2c	19.7b	20.9b	23.5a	2.7889
Protein %	11.9	12.0	11.9	12.1	1.3444
Ash%	1.56	1.52	1.53	1.60	0.1345

abc Rows of different superscripts are significantly different ($P<0.05$).

Cheese DM, protein and ash were not affected by dietary treatments and averaged 49.0, 11.9 and 1.55%, respectively. Our results are consistent with Dhiman et al. (1999) and Zhang et al. (2006) where no difference was found in the composition of cheese between oilseeds diets and control diet. However, feeding SOC increased cheese fat content compared to the control diet. The two highest levels of SOC had more ($P<0.05$) increase in cheese fat compared to the lowest level (Table 4). The high level of fat in milk may explain the significant increase in cheese fat. Our results in regard to cheese fat content are in contrast to other reports (Zhang et al., 2006).

Sensory analysis

The results of sensory analysis are shown in Table 5. These results were based on a scale of 10 for the flavor and a five point scale for texture.

Table (5). Results of sensory analysis

	Control	Group 1	Group 2	Group 3	LSD
Flavor	6.17b	6.33b	7.66a	8.5a	1.8976
Texture	4.16a	3.8b	3.66b	3.66b	1.5698

ab Rows of different superscripts are significantly different (P<0.05).

Feeding SOC at the levels of 10 and 15% in goats diets produced more (P<0.05) accepted flavor of cheese compared to the control and the low SOC level. Similar findings were observed by previous research (Eknaes and Skeie, 2006). Flavor of milk from goats fed with high roughage levels was superior compared to milk from goat fed with high concentrate levels as in the current experiment (Eknaes and Skeie, 2006). However, the texture of cheese was better (P<0.05) from goats fed the control diet compared to cheese from goats fed SOC at a different level.

The fresh cheese of goats fed 15% SOC was rated highly acceptable with a mean flavor score of 8.5 (out of 10). Cheese from goats fed 10% of SOC came in the second place. The main defect was found to be "acid" or "lack of flavor". A "goaty" flavor was identified in cheese as a characteristic sensory attribute of goat cheese in most of the cheeses. The main defect was identified as "pasty". Zeng and Escobar (1995) reported a similar total organoleptic score of 12.55 in a similar soft cheese using Alpine goat milk. The pasty texture was observed in our experiment as level of SOC increased in diets. A similar trend was observed as other research when feeding oil seeds (Zeng and Escobar, 1995).

Cost of feeding and milk yield

The cost per kg diet is shown in Table (6). The highest cost of diet was observed in goats fed the control diet. Cost of diet was reduced through groups from 1 to 3. This can be explained by the differences in prices of these diets. The reported figures from this experiment show the economic feasibility of feeding such type of ingredients and saving that can be achieved. A net of the 0.22 NIS/kg can be saved when using 15% SOC in group 3 compared to control. Numerically, about 220 NIS can be saved/ton diet. Increase in milk yield can be observed through groups from 1 to 3.and this means that the income from milk will be increased as shown in Table (6).

Table (6). Economic impacts of the feeding trial and milk yield

Parameter	Control	Group 1	Group 2	Group 3
Number of goats	4	4	4	4
Duration of the experiment, day	60	60	60	60
Daily feed intake, kg/ goat	1	1	1	1
Cost of kg diet, NIS.	1.8	1.78	1.65	1.58
Cost of total feed intake/ goat, NIS	108.0	106.8	99.0	94.8
Average daily milk yield, kg	1.85	1.83	1.90	1.92
Price of goat milk, kg, NIS	3.5	3.5	3.5	3.5
Price of daily milk yield/ goat, NIS	6.47	6.41	6.65	6.72
Price of total milk yield/ goat, NIS	388.8	384.6	399.0	403.2

References:

1. **Abo Omar, J**. (2002). Effects of feeding different levels of sesame oil cake on performance and digestibility of Awassi lambs. Small Rumin. Res. 46 ,187–190.
2. **AOAC.** (1995). Official Methods of Analysis. 16th ed. Association of Official Analytical Chemists. Arlington, VA.
3. **Baldi, A., Cheli, F., Corino, C., Dell'Orto, V., and Polidori, F.** (1992). Effects of feeding calcium salts of long chain fatty acids on milk yield, M C and plasma parameters of lactating goats. Small Rumin. Res. 6: 303–310.
4. **Bodyfelt, F. W., Tobias, J., and Trout, G. M.** (1988). The Sensory Evaluation of Dairy Products. Van Nostrand Reinhold, New York, NY.
5. **Casals, R., Caja, G., Such, X., Torre, C., and Calsamiglia, S**. (1999). Effects of calcium soaps and rumen undegradable protein on the milk pro¬duction and composition of dairy ewes. J. Dairy Sci. 66: 177–191.
6. **Dhiman, T. R., Anand, G. R., Satter, L. D., and Pariza, M. W**. (1999). Conju¬gated linoleic acid content of milk from cows fed different diets. J. Dairy Sci. 82: 2136–2156.
7. **Eknæs, M., and Skeie, S**. (2006). Effect of different level of roughage availability and contrast levels of concentrate supplementation on flavor of goat milk. Small Rumin. Res. 66: 32–43.
8. **FAO.** (1990). Production Yearbook. vol. 52. Food and Agriculture Organi-

zation of the United Nations, Rome, Italy, 253 pp.

9. **Horton, G. M. J., Wohlt, J. E., Palatini, D. D.,and Baldwin, J. A.** (1992). Rumen protected lipid for lactating ewes and their nursing lambs. Small Rumin. Res. 9: 27–36.

10. **Khan, M. J., Shahjalal, M. and Rashid, M. M.** (1998). Effect of replacing oil cake by poultry excreta on growth and nutrient utilization in growing bull calves. Asian–Australian J. Anim. Sci. 11: 385 – 390.

11. **Khorasani, G. R., Robinson, P. H., de Boer, G. and Kennelly, J. J**. (1991). Influence of canola fat on yield, fat percentage, fatty acid pro¬file and nitrogen fractions in Holstein milk. J. Dairy Sci. 74: 1904–1911.

12. **Kitessa, S. M., Peake, D., Bencini, R. and Williams, A. J.** (2003). Fish oil metabolism in ruminants. III. Transfer of n-3 polyunsaturated fatty acids (PUFA) from tuna oil into sheep's milk. Anim. Feed Sci. Technol. 108: 1–14.

13. **Mir, Z., Goonewardene, L. A., Okine, E., Jaegar, S. and Scheer, H. D.** (1999). Effect of feeding canola oil on constituents, conjugated linoleic acid (CLA) and long chain fatty acids in goats milk. Small Rumin. Res. 33: 137–143.

14. **Mustafa, A. F., Chouinard, P. Y. and Christensen, D. A.** (2003). Effects of feeding micronised flaxseed on yield and composi¬tion of milk from Holstein cows. J. Sci. Food Agric. 83: 920– 926.

15. **NRC.** (1994). Nutrition Requirements of Sheep. National Research Council, National Academy Press, Washington, DC, pp. 33–34.

16. **NRC.** (2001). Nutrient Requirements of Dairy Cattle, seventh revised edition, Natl. Acad. Sci. , Washington, DC, 381 pp.

17. **Palestinian Central Bureau of Statistics.** (2007). Agricultural Statistics, 2005/2006. Ramallah, Palestine.

18. **Palestinian Ministry of Agriculture**. (1999). Records on various branches of plants crops, Palestinian National Authority. Ramalla, Palestinian National Authority, pp. 30–43.

19. **Ryu, Y. W., Ko, Y. D. And Lee, S. M.** (1998a). Effect of feeding rice straw silage made with apple pomace. Korean J. Anim. Sci. 40 (3): 235–244.

20. **Ryu, Y. W., Ko, Y. D., and Lee, S. M.** (1998b). Effects of mixing ratio of apple pomace, sesame oil meal and cage layer excreta on feed quality of rice straw silage. Korean J. Anim. Sci. 40 (3): 245–254.

21. **Sarrazin, P., Mustafa, A. F., Chouinard, P Y., Raghavan, G., Sotocinal, S.** (2004). Performance of dairy cows fed roasted sunflower seed. J. Sci. Food Agric. 84: 1179–1185.

22. **SAS.** (1988). SAS user's guide. Statistics (version 5.18). SAS Inc. Cary, NC,USA.

23. **Wu, Z., and Huber, J. T.** (1994). Relationship between dietary fat supple¬mentation and protein concentration in lactating cows: A review. Livest. Prod. Sci. 39: 141–155.

24. **Zeng, S. S., and Escobar, E. N**. (1995). Influence of somatic cell count in goat milk on yield and quality of soft cheese. In: Proceedings of the IDF Production and Utilization of Ewe and Goat Milk Symposium in Crete, Greece, pp. 109–112.

25. **Zhang, R., Mustafa, A. F., and Zhao, X.** (2006). Effects of flaxseed supplementation to lactating ewes on milk composition, cheese yield, and fatty acid composition of milk and cheese. Small Rumin. Res. 63: 233–241.