

Milk and Domiati Cheese Properties Affected by Feeding of Lactating Goats' on Strawberry Vines Hay

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ABSTRACT

This study was carried out to study the effect of replacing Berseem hay in feed of lactating goats by strawberry vines hay on milk properties and Domiati cheese properties made from this milk. Twenty eight Damascus goats were divided into four similar groups according to weight as follows: *Group1 were fed on concentrate mixtures + Berseem hay 1:1 as a control (treatment1). * Group 2 were fed on concentrate mixtures + (70 % Berseem hay and 30 % Strawberry vines hay) 1:1, (treatment 2). * Group 3 were fed on concentrate mixtures + mixtures of (30 % Berseem hay and 70 % Strawberry vines hay) 1:1, (treatment 3). * Group 4 were fed on concentrate mixture + Strawberry vines hay 1:1, (treatment 4). Domiati cheese was made from goats' milk, cheeses were stored at room temperature for 60 days and analyzed for total solids (TS), total nitrogen (TN), acidity, pH, fat, soluble nitrogen (SN), non protein nitrogen (NPN), total volatile fatty acids (TVFA) and organoleptic properties. Results showed that, no significant differences ($P < 0.05$) were found in curd tension and coagulation time in the curd of goats' milk from different treatments, syneresis significantly ($P \leq 0.05$) increased with replacing Berseem hay in feed of lactating goats by strawberry vines hay. Cheese yield slightly decreased particularly, at the high replacing rates of Berseem hay by Strawberry vines hay. The total solids and titratable acidity slightly increased and pH values slightly decreased by increasing the replacing rate. Significant differences ($P \leq 0.05$) were found in TN/DM% between treatments during the ripening period, while F/DM% and the ripening indices (SN/TN%, NPN/TN% and TVFA) decreased by increasing the replacing of Berseem hay by Strawberry vines hay in all treatments during storage period. The cheese made from T2 had the highest score points for organoleptic properties, followed by T1 (control), T3 and T4, respectively.

Keywords: Domiati cheese, Damascus goats, and strawberry vines hay

INTRODUCTION

World production of goat's milk increases steadily and the output reached about 12.8 MT in 2008 (FAO, 2011). Milk productivity depends mainly on the quantity and quality of feedstuffs (Aplocina and Spruzs, 2012). Milk composition is affected by several factors including the animals fed, local geographical, economical and climatic conditions (Voutzourakis *et al.*, 2014).

In Egypt, animals are suffering from shortage of feeds, especially during summer season which they almost depend on grains, concentrate feed mixtures and crop by products, mainly wheat and rice straw and little amounts of Berseem hay. The increasing costs of concentrates feeds (grains and protein supplements in particular) have led to significant increase in animal feed cost. The annual feed requirements for animal wealth in Egypt are about 14 million tons of total digestible nutrients (TDN). The shortage of animal feeds was calculated to be approximately 3.1 million tons of TDN (Fayed *et al.*, 2009). In Egypt, about 25 million tons of agricultural by products are annually produced (Ministry of Agriculture and Land Reclamation, 2008). According to this problem, growing attention is focused on the use of crop by- products, agricultural residues, wastes of fruits and vegetables for ruminant feeding, which could be considered as a significant trend to alleviate the acute shortage of feedstuffs in Egypt and most developing countries, as well as diminishing the environmental pollution (Abou-Selem and Bendary, 2005). Damascus goat is considered a dual-purpose animal (meat and milk) and also considered a seasonal breeder (Mavrogenis, *et al.*, 2006).

In Egypt, milk production depends mainly on buffaloes and cows. Goats received very little attention as an important livestock species. However, their importance as a potential source of meat and milk have

been recently realized, since they can play an important role in this respect, particularly, under the agricultural system prevailing in Egypt as subtropical country.

Goat milk has been described as having a higher digestibility and lower allergenic properties than cow's milk, (Martin *et al.*, 2003; Haenlein, 2004; Herrero & Requena, 2006; Park, *et al.*, 2007 and Minervini, *et al.* 2009).

Cheese properties are influenced by the animal species producing the milk, their health, agro-climatic situations, seasonality and feeding conditions (Elgersma *et al.* 2006; Hervás *et al.* 2008; Puga *et al.* 2009a). Also animal feeding appears to be the most important for milk composition and cheese quality (Sanz Sampelayo *et al.* 2007; Vasta *et al.* 2008),

So, the present work was done to study the effect of replacing Berseem hay in feed of lactating goats by strawberry vines hay on milk properties and Domiati cheese properties made from this milk.

MATERIALS AND METHODS

The present study was carried out at El Gemmaiza Experimental Station, and Dairy Technology Department, Animal Production Research Institute, Ministry of Agriculture, Egypt.

Materials:

Animals:

Twenty eight Damascus healthy lactating goat's (aged 3 - 4 years and weighed 35- 40 kg were divided into four similar groups according to weight, (7 lactating goat's in each).

Animal shelters:

Lactating goat groups were housed in concrete pens, partially asbestos roofed in semi-open sheds during the experimental period. The surface area of each semi pen shed 8 x 28 meters each pen(8x7 meters) were surrounded by brick walls of two meters height, while the north, east and coast walls were 4.5m high.

Feeding system:

Animals were fed 181 days, (21 days end of the pregnant period, 70 days suckling period and 90 days lactation period) according to NRC, (1981) for goats as follows:

- Group1 (as a control) were fed on concentrate mixtures + Berseem hay 1:1 as a control (treatment1).
- Group 2 were fed on concentrate mixtures + mixtures (70 % Berseem hay and 30 % Strawberry vines hay) 1:1, (treatment 2).

- Group 3 were fed on concentrate mixtures + mixtures of (30 % Berseem hay and 70 % Strawberry vines hay) 1:1, (treatment 3).
- Group 4 were fed on concentrate mixture + Strawberry vines hay 1:1, (treatment 4)

Feed mixtures:

The concentrate feed mixture (CFM) was carried out according to A.O.A.C. (1996). The chemical composition of lactating goats' rations is presented in Table 1, (Galal, *et al.*, (2016).

Table 1. Chemical composition of lactating goats fed.

Items	Chemical composition %						
	DM	OM	CP	EE	CF	NFE	Ash
Treatment 1 (control)	89.15	88.31	13.98	2.36	21.31	50.66	11.69
Treatment 2	88.81	88.78	13.62	2.53	19.32	53.31	11.22
Treatment 3	88.32	88.60	12.65	2.68	16.85	56.42	11.40
Treatment 4	87.80	88.45	11.75	2.69	15.35	58.66	11.55

DM=Dry matter, OM=Organic matter, CP=Crude protein, EE=Ether extract, NFE=Nitrogen free extract, CF=crude fibers

Powder microbial rennet (France, 2200 TL, Food Specialties, France) was used as a coagulant. Salts (sodium chlorid and calcium chlorid) were obtained from El-Gomhoria Co., Cairo, Egypt. Yoghurt culture (*Streptococcus thermophilus* and *Lactobacillus delbruckii subsp. bulgaricus*) were obtained from Chr. Hansen's Laboratories, Copenhagen, Denmark.

Milk analysis:

Samples of milk at morning and evening (20 ml) were collected bi-weekly. Milk samples were analysed for total solids (TS), fat, solids not fat (SNF), total nitrogen (TN), lactose and salt by using digital Lactoscans, Milk analyzer, Wide LCD display-4 lines x 16 characters, 8900 Nova Zagora, Bulgaria. The chemical composition of produced milk is presented in Table 2, (Galal, *et al.*, (2016).

Table 2. chemical composition of produced milk

Items %	treatment			
	1	2	3	4
Total solids	13.12	12.64	12.97	13.29
Fat	4.00	3.76	3.95	4.19
Protein	3.38	3.24	3.28	3.34
Lactose	5.02	4.89	4.96	5.00

Cheese manufacture and analysis:

Domiat cheese was made from goats' milk as described by Fahmi and Sharara (1950). Cheeses were stored at room temperature for 60 days and analyzed for total solids (TS), total nitrogen (TN), acidity contents and pH values according to (A.O.A.C, 2000). The fat, soluble nitrogen (SN) and non protein nitrogen (NPN) contents

were determined as described by Ling (1963). The total volatile fatty acids (TVFA) were determined by the distillation method of Kosikowski (1986). Curd tension of the resultant curd was measured by the method of Chandrasekhara *et al.* (1957). Syneresis of the resultant curd was calculated as a percent of the volume of drained whey and calculated as a percent of the milk volume as described by Lawrence (1959). Cheese treatments were organoleptically examined freshly, 15, 30 and 60 days of ripening. 50 points were given for flavor, 40 points for body and texture, and 10 points for appearance.

Statistical analysis:

The statistical analysis was computed using analysis of variance procedures. Significant ($P \leq 0.05$) differences between means were separated by Duncan's Multiple Rang test procedures described in SAS (2003).

RESULTS AND DISCUSSION

Rheological properties of curd:

Table 3 shows the effect of replacing Berseem hay in feed of lactating goats' by strawberry vines hay on the curd tension (gm.), coagulation time (sec.) and syneresis (ml / 100 ml milk). No significant differences ($P < 0.05$) in curd tension and coagulation time between different treatments in of goats' milk. On the other hand, syneresis significantly ($P \leq 0.05$) increased with replacing Berseem hay in feed of lactating goats' by strawberry vines hay. The highest syneresis was detected in the treatment 4, comparing with other treatments.

Table 3. Rheological properties of goats' milk curd as affected by replacing Berseem hay in feed of lactating goats' by strawberry vines hay.

Items	treatment 1	treatment 2	treatment 3	treatment 4
Curd tension (gm.)	45 ^a	45 ^a	47 ^a	47 ^a
Syneresis (ml / 100 ml milk)	40 ^b	41 ^{ab}	43 ^{ab}	44 ^a
Coagulation time (sec.)	112 ^a	115 ^a	120 ^a	116 ^a

^{a, bc} Means in the same row with different superscripts differ significantly at $P < 0.05$

Chemical composition of Domiat cheese:

Data presented in Table 4 show the effect of replacing Berseem hay in feed of lactating goats' by strawberry vines hay on the yield and chemical

composition of the resultant Domiat cheese. Results showed that, cheese yield decreased at the high replacing rates, compared with that of T1 (control). The yield of all treatments decreased during storage period. Also, Domiat

cheese made from T1 (control) and T2 had the highest yield compared with the other treatments throughout the storage period, which may be due to the softer curd, which resulted in higher retention of moisture content. These results were in accordance with those reported by El-Gendy *et al.*, (1989 and Ismail & Osman (2004).

Significant differences ($P \leq 0.05$) were found in the total solids (TS %) in the cheese treatments. Cheese made from T4 and T3 had the highest total solids contents, followed by cheeses treatments T2 and T1 (control) at the end storage, respectively. In addition, the total solids contents of cheese in all treatments increased with advancing the storage period. This may be attributed to the development of acidity which induces shrinkage in the cheese matrix and exudation of

moisture from cheese curd. These results are in agreement with those reported by Hamed *et al.*, (1992); El-Abd *et al.*, (2003) and Hamad and Ismail, (2012).

No significant difference could be observed in the titratable acidity and pH values between treatments when fresh and at 15 days of storage. By increasing the replacing rate of Berseem hay in feed of lactating goats by strawberry vines hay and advanced the storage period, the titratable acidity content of cheese increased and pH values decreased. These results agree with those reported by Hamad and Ismail, (2012). This may be contributed to the microbial growth and peptidase activity of lactic acid bacteria and the liberation of amino acids and free fatty acids which stimulate the bacterial activity (Khosrowshahi, *et al.* 2006).

Table 4. Yield and chemical composition of Domiati cheese made from goats milk as affected by replacing Berseem hay in feed of lactating goats by strawberry vines hay.

Properties %	Storage period (days)	treatment 1 (control)	treatment 2	treatment 3	treatment 4
Yield	0	24.10 ^a	23.89 ^a	23.00 ^b	22.75 ^c
	15	18.15 ^a	17.93 ^{ab}	17.80 ^{bc}	17.60 ^c
	30	16.80 ^a	16.55 ^b	16.43 ^{bc}	16.25 ^c
	60	16.50 ^a	16.23 ^b	15.96 ^c	15.70 ^d
Total solids	0	38.70 ^b	38.75 ^{ab}	38.86 ^a	38.83 ^a
	15	46.60 ^a	46.63 ^a	46.74 ^a	46.70 ^a
	30	47.10 ^{ab}	47.05 ^b	47.25 ^a	47.12 ^{ab}
	60	47.30 ^b	47.34 ^b	47.40 ^b	47.84 ^a
Acidity	0	0.21 ^a	0.21 ^a	0.22 ^a	0.23 ^a
	15	1.15 ^a	1.16 ^a	1.16 ^a	1.17 ^a
	30	1.53 ^b	1.55 ^{ab}	1.56 ^{ab}	1.58 ^a
	60	2.31 ^b	2.31 ^b	2.33 ^{ab}	2.35 ^a
pH	0	6.30 ^a	6.31 ^a	6.30 ^a	6.28 ^a
	15	4.25 ^a	4.23 ^{ab}	4.23 ^{ab}	4.21 ^b
	30	4.01 ^a	4.00 ^{ab}	3.99 ^{ab}	3.98 ^b
	60	3.85 ^a	3.84 ^a	3.82 ^{ab}	3.80 ^b
Fat / DM	0	40.65 ^b	41.09 ^a	39.63 ^c	38.89 ^d
	15	40.75 ^b	41.31 ^a	40.12 ^c	39.51 ^d
	30	40.81 ^b	41.60 ^a	40.42 ^c	39.90 ^d
	60	41.19 ^b	41.86 ^a	40.82 ^c	40.26 ^d
T.N./D.M.	0	5.60 ^a	5.53 ^b	5.42 ^c	5.46 ^c
	15	5.19 ^a	5.15 ^{ab}	5.07 ^c	5.11 ^{bc}
	30	5.06 ^a	5.03 ^a	4.96 ^b	5.02 ^a
	60	4.75 ^a	4.69 ^{ab}	4.61 ^c	4.64 ^{bc}

^{a, bc} Means in the same row with different superscripts differ significantly at $P < 0.05$

Data in the same Table showed that, the percentages of fat in dry matter (F/DM %) increased gradually but the total nitrogen in dry matter (TN/DM %) decreased in all treatments as the storage period progressed. Also, there was significant difference ($P \leq 0.05$) in both F/DM % and TN/DM % among cheese treatments throughout the storage period. The highest values of F/DM % was in cheese made from T2 followed by T1 (control), T3 and T4 respectively, but the highest values of TN/DM % was found in control cheese (T1), followed by T2, T4 and T3, respectively.

Ripening indices of cheese:

The changes in soluble nitrogen (SN/TN%), non protein nitrogen (NPN/TN%) and total volatile fatty acids (TVFA as ml NaOH 0.1 N/100 gm cheese) contents of Domiati cheese made from goats milk, as

affected by replacing Berseem hay in feed of lactating goats by strawberry vines hay are shown in Table 5. Significant differences ($P \leq 0.05$) were found in the ripening indices between treatments during storage period. From these results it could be noticed that the cheese treatment 2 attained the highest contents in SN/TN, NPN/TN and TVFA compared with other treatments during ripening period.

On the other hand SN/TN, NPN/TN and TVFA increased gradually in all treatments as storage period progressed, reaching the maximum values at the end of storage period. These increases may be attributed to the progressive breakdown of cheese proteins and lipids and formation of SN and TVFA. These findings agree with those reported by Fox (1993) and Ismail *et al.*, (2010).

Table 5. Ripening indices of Domiati cheese made from goats milk as affected by replacing Berseem hay in feed of lactating goats by strawberry vines hay.

Properties	Storage period (days)	Treatment 1 (control)	Treatment 2	Treatment 3	Treatment 4
S.N. / T.N. %	0	3.94 ^b	4.03 ^a	3.87 ^{bc}	3.81 ^c
	15	10.15 ^a	10.21 ^a	10.04 ^b	9.96 ^b
	30	17.63 ^{ab}	17.72 ^a	17.56 ^b	17.42 ^c
	60	21.30 ^{ab}	21.35 ^a	21.24 ^{bc}	21.18 ^c
N.P.N. / T.N. %	0	3.81 ^b	3.92 ^a	3.70 ^c	3.64 ^c
	15	9.86 ^b	10.00 ^a	9.75 ^{bc}	9.63 ^c
	30	12.86 ^b	12.98 ^a	12.72 ^c	12.30 ^d
	60	16.64 ^b	16.87 ^a	16.41 ^c	16.25 ^d
T.V.F.A. ml N/10 NaOH /100 gm. chesse	0	14.25 ^d	14.95 ^a	14.70 ^b	14.45 ^c
	15	21.38 ^d	22.15 ^a	21.90 ^b	21.73 ^c
	30	26.68 ^c	27.17 ^a	26.95 ^b	26.80 ^{bc}
	60	38.00 ^d	38.75 ^a	38.42 ^b	38.22 ^c

^{a, bc} Means in the same row with different superscripts differ significantly at P <0.05

Organoleptic properties of Domiati cheese:

The organoleptic properties of Domiati cheese treatments are presented in Table 6. The obtained results showed, an improvement of appearance, body & texture and flavour of all treatments by advancing of storage period (60 days). The cheese made from T2 had the

highest score for appearance, body & texture, flavour and total score followed by T1 (control), T3 and T4 respectively. This may be due to the high contents of soluble nitrogen and TVFA that serves as a precursor of certain flavour compounds.

Table 6. Organoleptic properties of Domiati cheese made from goats' milk as affected by replacing Berseem hay in feed of lactating goats by strawberry vines hay.

Storage period (days)	Cheese properties	Treatment 1 (control)	Treatment 2	Treatment 3	Treatment 4	
0	Appearance	10	7	7	7	
	Body and texture	40	30.50	30.60	30.20	30.10
	Flavour	50	38.00	37.90	37.60	37.40
	Total	100	75.50 ^a	75.50 ^a	74.80 ^a	74.50 ^a
15	Appearance	10	7.3	7.3	7.25	7.25
	Body and texture	40	31.2	31.25	31.15	31.00
	Flavour	50	40.00	40.60	38.50	38.10
	Total	100	78.50 ^b	79.15 ^a	76.90 ^c	76.35 ^d
30	Appearance	10	7.4	7.55	7.35	7.35
	Body and texture	40	33.60	33.75	32.70	32.50
	Flavour	50	39.90	40.45	40.30	39.75
	Total	100	80.90 ^b	81.75 ^a	80.35 ^c	79.60 ^d
60	Appearance	10	7.5	7.6	7.4	7.5
	Body and texture	40	35.00	35.00	34.60	34.50
	Flavour	50	40.00	40.10	39.70	39.60
	Total	100	82.50 ^a	82.70 ^a	81.70 ^b	81.60 ^b

^{a, bc} Means in the same row with different superscripts differ significantly at P <0.05

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تأثير تغذية الماعز الحلاب على دريس عروش الفراولة على خواص اللبن والجبن الدميائي أحمد الظواهرى

قسم تكنولوجيا الألبان – معهد بحوث الانتاج الحيوانى – مركز البحوث الزراعية – الدقى - جيزة

فى هذا البحث تم دراسة تأثير استبدال دريس البرسيم فى العلف التقليدى للماعز الحلاب بدريس عروش الفراولة على خواص اللبن الناتج والجبن الدميائي المصنع منه حيث تم الاستبدال بالنسب الآتية: * المعاملة الأولى: عليقة مركزة + دريس البرسيم بنسبة 1:1 (علف تقليدى) مقارنة * المعاملة الثانية: عليقة مركزة + 70% دريس البرسيم : 30% دريس عروش الفراولة * المعاملة الثالثة: عليقة مركزة + 30% دريس البرسيم : 70% دريس عروش الفراولة * المعاملة الرابعة: عليقة مركزة + 100% دريس عروش الفراولة وقد أظهرت النتائج الآتى: * عدم وجود فروق معنوية ($P \leq 0.05$) بين المعاملات فى قيم ال curd tension و coagulation time بينما وجد زيادة فى قيم ال Syneresis مع نسبة الاستبدال العالية * زيادة معنوية فى نسبة الجوامد الكلية والحموضة وانخفاض فى قيم ال pH بزيادة نسبة الناتج مع زيادة نسبة الاستبدال وخاصة مع نسب الاستبدال العالية * زيادة معنوية فى قيم الدهن بالنسبة للمادة الجافة (F/DM%) ونسبة النيتروجين الكلى الاستبدال * وجود فروق معنوية ($P \leq 0.05$) بين المعاملات طوال فترة التخزين فى قيم الدهن بالنسبة للمادة الجافة (TN/DM%) وكانت أعلى قيم الدهن بالنسبة للمادة الجافة فى المعاملة 2 ولية المعاملة 1 و 3 و 4 على الترتيب. بينما أعلى قيم منسوب للمادة الجافة الكلى بالنسبة للمادة الجافة كانت فى جبن المقارنة بليه المعاملات 2 و 4 و 3 على الترتيب. * وجود فروق معنوية ($P \leq 0.05$) فى قيم النيتروجين الذائب بالنسبة للنيتروجين الكلى (SN/TN%) والنيتروجين الغير بروتينى منسوب للنيتروجين الكلى (NPN/TN%) والأحماض الدهنية الكلية الطيارة (TVFA) بين كل المعاملات طوال فترة التسوية. كما لوحظ أن هذه القيم كانت أعلى فى المعاملة 2 مقارنة بباقي المعاملات. * عند اجراء التحكيم الحسى على الجبن الناتج حصلت المعاملة 2 على أعلى الدرجات مقارنة بجبن الكنترول وباقي المعاملات. وبذلك يمكن استبدال دريس البرسيم فى العلف التقليدى بدريس عروش الفراولة فى تغذية الماعز الحلاب دون تأثير معنوى على خواص اللبن الناتج والجبن الدميائي المصنع منه.