

EFFECT OF ADDING SOME HERBS TO GOAT FEED ON THE CHEMICAL, MICROBIOLOGICAL AND ORAGNOLEPTIC PROPERTIES OF DOMIATI CHEESE

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ABSTRACT

The effect of adding chamomile, thyme, fennel or peppermint to goat feed on some properties of Domiati cheese was studied. Results showed that effect of the feeding rations on the yield, titratable acidity %, pH values, fat/dry matter % and total nitrogen/dry matter % of Domiati cheese was insignificant. Water soluble nitrogen/total nitrogen % and amino acid nitrogen contents were significantly higher in herbs cheese while total volatile fatty acids content was significantly lower than that in control cheese. During ripening period, significant increase were noticed in pH value; titratable acidity %; total solids, fat/dry matter, water soluble nitrogen/dry matter, amino acids nitrogen and total volatile fatty acids contents. Chamomile, thyme, fennel and peppermint significantly decreased mould and yeast of Domiati cheese. Thyme and fennel significantly decreased total viable bacterial count; proteolytic, lipolytic, coliform and sporeforming bacteria in the cheese. Peppermint significantly decreased total viable bacterial count and lactic acid bacteria while it significantly increased proteolytic bacteria in the cheese. Oragnoleptic properties of Domiati cheese made from goat's milk highly improved as a result of feeding rations. Peppermint cheese gained the highest scores for oragnoleptic evaluation as compared with other treatments.

Thus, the obtained results indicated that the addition of herbs to goat feed can improve different properties of goat cheese and overcome the goaty flavour of goat's milk which is considered undesirable by most Egyptian consumers.

Keywords: Goat's milk - Herbs - Domiati cheese

INTRODUCTION

The amount of goat's milk in Egypt has recently increased. As of annals 2002, total goat's milk amount was 15000 Mt compared to 13000 Mt in 1994 (FAO, 2002). Also, goat's milk had received little attention in Egypt. This may be due to the goaty flavour found in goat's milk products, which is very rarely accepted by Egyptian consumers. Therefore, many trials were done to improve the flavour of goat's milk in dairy products e.g., blending it with buffalo's milk or cow's milk (Ismail, 2001) or using some cultures to produce special flavours (El-Zawahry, 2003).

The use of medicinal herbs and plants is well known since the old civilization times of ancient Egyptian and Greek. The selected plants for this study (chamomile, thyme, fennel and peppermint) are commonly used in

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different parts of the world and considered to have particular health benefits as carminatives, antispasmodics, antifatulent in dyspepsia and anorexia, antiseptics for respiratory and gastrointestinal tracts infections and flavour improving in foods (Blumenthal *et al.*, 2000). On the other hand, using medicinal herbs and seeds as feed additives to ruminants seems to be a recent trend globally (Singh *et al.*, 1993). Therefore, the aim of the present study was to study the effect of feeding goats using rations containing certain herbs on some chemical, microbiological and organoleptic properties of Domiati cheese.

MATERIALS AND METHODS

Materials:

Fresh goat's milk (zaraibi) was obtained from the herds of El- Sew Animal Production Research Station, Agriculture Research Center, Ministry of Agriculture.

Local commercial liquid calf rennet obtained from local market was added to the milk at a rate of 1 mL kg⁻¹ milk. Dry coarse commercial food grade salt was obtained from El-Nasr Company of Alexandria. Chamomile flowers; fennel fruits; leaves, aerial parts of thyme; leaves and flowering tops of peppermint were purchased from Royal Co., Cairo, Egypt.

Experimental animals:

Fifty zaraibi goats were chosen randomly from the herd of El- Sew Station. Goats were divided into five groups, ten goats/ group. The average body weight of each goat was 45 – 50 kg.

Rations and feeding:

Rations were offered in-group feeding to goats of each group, twice daily at 8 am and 4 pm. Drinking water and mineral blocks were available for free choice. Animals were fed for two months before delivery and nine months post it according to allowances of N.R.C of goats (1981). Feed additives (herbs) were added at a rate of 100 mg/ kg live body weights as recommended by Chevallier (1996). Goats in the five groups were fed on:

Group A: ration composed of 25% concentrate feed mixture + 35% yellow corn + 17% rice straw + 23% berseem (*Trifolium alexandrinum L.*) hay, on dry matter basis. This group served as a control ration (CR).

Group B: CR + 5 gram chamomile flowers.

Group C: CR + 5 gram thyme leaves and aerial parts.

Group D: CR + 5 gram fennel fruits.

Group E: CR + 5 gram peppermint leaves and flowering tops.

Cheese manufacture:

Domiati cheese was made from goat's milk of the five groups as described by Fahmi and Sharara (1950). Twenty kg of fresh goat's milk of each group was taken at mid lactation period. Milk of all groups was heated to 40°C, salted at 8% salt and then renneted. After complete coagulation, the

resultant curds were ladled in wooden frames, lined with muslin cloth. After 24 hours, the resultant cheese of all treatments were weighed and pickled into their own whey, and stored in plastic jars at 25 °C ± 3 for 3 months. Samples were analyzed when fresh and after 15, 30, 60 and 90 days of ripening period.

Methods of analysis:

Milk samples were analyzed for titratable acidity (TA), total solids (TS), fat and total protein contents according to Ling (1963). The pH values were estimated using a pH meter type CG 710. Cheese was analyzed for total solids (TS), titratable acidity (TA), pH, fat, total nitrogen (TN), water soluble nitrogen (WSN) and amino acids nitrogen contents according to Ling (1963). Total volatile fatty acids (TVFA) was determined as described by Kosikowski (1978), and expressed as volume of 0.1N NaOH, ml 100 g⁻¹ cheese. Cheese samples were analyzed for total viable bacterial (TVBC); lactic acid (LAB), proteolytic, lipolytic, coliform bacteria; sporeformers; staphylococci; moulds and yeast counts according to the methods described by the American Public Health Association (1992). The cheese samples were scored for flavour (50 points), body and texture (40 points) and appearance and colour (10 points) by ten panelists according to Saleem *et al.* (2003). The obtained results were statistically analyzed using a software package (SAS, 1991) based on analysis of variance. When F-test was significant, least significant difference (LSD) was calculated according to Duncan (1955) for the comparison between means. The data were presented, in the Tables, as the mean (± standard deviation) of 3 replicate experiments.

RESULTS AND DISCUSSION

Chemical composition of goat's milk used in Domiati cheese manufacture:

The data revealed no significant ($p > 0.05$) differences in the chemical composition (total solids %, fat % and total protein %) of goat's milk among studied treatments (Table 1). Also, slight increase in titratable acidity % of goat's milk was noticed in treatments B and C (chamomile and thyme) comparing with those of other treatments (control, fennel and peppermint).

Table (1): Chemical composition of goat's milk used in Domiati cheese manufacture

Treatments	Titratable acidity %	pH	Total solids %	Fat %	Total protein %
A (control)	0.16 ^b ± 0.006	6.6 ^a ± 0.023	13.49 ^a ± 0.577	4.4 ^a ± 0.115	3.59 ^a ± 0.173
B (chamomile)	0.18 ^a ± 0.006	6.4 ^b ± 0.023	13.80 ^a ± 0.577	4.4 ^a ± 0.115	3.65 ^a ± 0.173
C (thyme)	0.18 ^a ± 0.006	6.5 ^b ± 0.023	14.03 ^a ± 0.577	4.3 ^a ± 0.115	3.70 ^a ± 0.173
D (fennel)	0.17 ^{ab} ± 0.006	6.5 ^{ab} ± 0.023	13.60 ^a ± 0.577	4.2 ^a ± 0.115	3.75 ^a ± 0.203
E (peppermint)	0.17 ^{ab} ± 0.006	6.5 ^{ab} ± 0.023	14.10 ^a ± 0.577	4.4 ^a ± 0.115	3.63 ^a ± 0.173

For each effect the different letters in the means the multiple comparison are different from each. Letters a is the highest means followed by b, cetc.

Domiat cheese yield:

There were non-significant ($p > 0.05$) differences in the yield values of fresh goat's Domiat cheese prepared from studied treatments (Tables 2 and 6). Khalil *et al.* (1999) reported that no considerable differences in fresh Domiat cheese yield were found when garlic, black cumin, fenugreek and chamomile herbs were mixed with goat feed.

Chemical composition of goat's milk Domiat cheese:

There was significant ($p < 0.01$) increase in the TS contents in treatment C (thyme) comparing with other treatments (Tables 2 and 6). During ripening period, the TS contents of all cheese significantly ($p < 0.001$) increased, this may be attributed to curd contraction and expulsion of whey as the result of acid production. These results were in accordance to those reported by El-Shafei (1994).

Table (2): Effect of adding some herbs to goat feed on the yield and chemical composition of Domiat cheese made from goat's milk

Treatments	Ripening period (days)	Yield %	TS %	Titrateable acidity %	pH	Fat/ DM %
A (control)	Fresh	26.11 ± 0.58	38.11 ± 0.15	0.32 ± 0.02	6.5 ± 0.05	38.05 ± 0.20
	15		41.03 ± 0.22	1.14 ± 0.02	5.5 ± 0.00	39.73 ± 0.65
	30		43.42 ± 0.21	2.21 ± 0.01	3.9 ± 0.05	45.61 ± 0.72
	60		44.29 ± 0.61	2.54 ± 0.03	3.9 ± 0.05	46.06 ± 0.27
	90		46.92 ± 0.92	2.72 ± 0.02	3.7 ± 0.10	46.68 ± 0.45
B (chamomile)	Fresh	26.26 ± 0.58	37.99 ± 0.54	0.38 ± 0.00	6.4 ± 0.00	36.59 ± 0.60
	15		41.68 ± 0.70	1.23 ± 0.02	5.1 ± 0.01	38.15 ± 0.47
	30		43.02 ± 0.07	2.18 ± 0.01	4.0 ± 0.00	45.33 ± 0.55
	60		44.20 ± 0.18	2.49 ± 0.03	3.9 ± 0.05	47.29 ± 0.43
	90		45.92 ± 0.26	2.66 ± 0.01	3.8 ± 0.10	47.66 ± 0.55
C (thyme)	Fresh	27.52 ± 0.58	36.32 ± 0.43	0.38 ± 0.01	6.4 ± 0.00	37.17 ± 0.29
	15		39.61 ± 0.60	1.21 ± 0.01	5.2 ± 0.10	37.62 ± 0.68
	30		41.11 ± 0.12	2.20 ± 0.03	3.9 ± 0.05	45.49 ± 0.49
	60		43.26 ± 0.30	2.51 ± 0.01	3.9 ± 0.00	48.32 ± 0.48
	90		46.68 ± 0.56	2.68 ± 0.03	3.8 ± 0.05	45.42 ± 0.66
D (fennel)	Fresh	27.36 ± 0.58	36.80 ± 0.79	0.36 ± 0.00	6.4 ± 0.00	38.32 ± 0.36
	15		40.78 ± 0.54	1.18 ± 0.02	5.2 ± 0.05	37.77 ± 0.66
	30		42.66 ± 0.68	2.13 ± 0.01	4.1 ± 0.05	43.36 ± 0.52
	60		43.30 ± 0.41	2.41 ± 0.02	4.0 ± 0.05	47.35 ± 0.46
	90		46.89 ± 0.59	2.65 ± 0.03	3.8 ± 0.10	45.64 ± 0.44
E (peppermint)	Fresh	26.31 ± 0.58	37.87 ± 0.45	0.35 ± 0.01	6.5 ± 0.05	37.76 ± 0.62
	15		41.38 ± 0.39	1.22 ± 0.52	5.1 ± 0.05	36.49 ± 0.71
	30		42.32 ± 0.45	2.16 ± 0.01	4.0 ± 0.05	43.96 ± 0.69
	60		43.82 ± 0.60	2.37 ± 0.02	3.9 ± 0.05	45.42 ± 0.45
	90		46.09 ± 0.31	2.70 ± 0.04	3.7 ± 0.05	46.56 ± 0.35

Titrateable acidity %, pH values and fat/ dry matter contents of cheese treatments were not significantly ($p > 0.05$) affected by adding different herbs to goat feed (Tables 2 and 6). During ripening period, there were significantly ($p < 0.001$) increase in the titrateable acidity % and decrease in the pH values in all treatments. However, the development rate of TA % during ripening in control cheese (treatment A) was higher than that in the other treatments.

This may be due to transferring some substances from added herbs to the milk, which affected lactic acid bacteria. Ayyad (2003) stated that pleasant flavour was found in goat's milk as a result of adding various herbs (chamomile, thyme, fennel or peppermint) to goat feed. This may be attributed to pass some substances (e.g. menthene, nerolidol, bisabolol, linalol, santen and selinol) from the added aromatic herbs to milk without change. Also, other alcohol's derived from metabolites of chemical constituents of the aromatic herbs, passed to the milk as esters of nonanoic, decanoic acids. Fat/DM contents of all cheese treatments significantly ($p < 0.001$) increased as ripening period progress reaching maximum values at the end of ripening period. This probably attributed to the decrease in solids-not fat content as a result of protein degradation and its partial loss in whey during ripening as advocated by Fayed (1982).

Using of different herbs in goat feed did not show significant ($p > 0.05$) effect on TN/DM contents between treatments of the resultant cheese and during ripening period (Tables 3 and 6). These results are in agreement with those reported by Marshall (1986) and Ayyad (1997).

Table (3): Effect of adding some herbs to goat feed on TN/DM %, WSN/TN %, amino acids nitrogen % and TVFA of Domiati cheese made from goat's milk

Treatments	Ripening period (days)	TN/DM %	WSN/TN %	Amino acids nitrogen %	TVFA*
A (control)	Fresh	5.88 ± 0.11	7.55 ± 0.03	0.033 ± 0.001	8.8 ± 0.25
	15	5.88 ± 0.02	9.58 ± 0.04	0.034 ± 0.000	12.2 ± 0.15
	30	6.22 ± 0.03	11.63 ± 0.01	0.040 ± 0.001	14.6 ± 0.45
	60	6.64 ± 0.04	14.58 ± 0.03	0.046 ± 0.001	19.3 ± 0.35
	90	6.49 ± 0.95	20.13 ± 0.03	0.049 ± 0.001	25.4 ± 0.55
B (chamomile)	Fresh	5.79 ± 0.03	8.55 ± 0.05	0.030 ± 0.000	7.3 ± 0.05
	15	5.74 ± 0.03	11.03 ± 0.02	0.036 ± 0.001	10.0 ± 0.45
	30	6.09 ± 0.03	12.67 ± 0.04	0.044 ± 0.003	12.9 ± 0.80
	60	6.41 ± 0.01	17.74 ± 0.45	0.051 ± 0.001	18.8 ± 0.50
	90	6.66 ± 0.02	23.52 ± 0.03	0.057 ± 0.001	23.8 ± 0.30
C (thyme)	Fresh	5.98 ± 0.04	8.11 ± 0.01	0.027 ± 0.001	6.4 ± 0.15
	15	6.26 ± 0.02	10.04 ± 0.05	0.035 ± 0.002	9.4 ± 0.30
	30	6.31 ± 0.02	12.56 ± 0.07	0.048 ± 0.002	11.0 ± 0.35
	60	6.48 ± 0.03	17.18 ± 0.07	0.057 ± 0.016	16.6 ± 0.50
	90	6.37 ± 0.02	21.58 ± 0.06	0.061 ± 0.001	22.4 ± 0.45
D (fennel)	Fresh	5.75 ± 0.03	7.90 ± 0.10	0.025 ± 0.001	5.7 ± 0.30
	15	6.05 ± 0.02	9.77 ± 0.06	0.036 ± 0.001	8.3 ± 0.30
	30	6.10 ± 0.04	12.26 ± 0.03	0.049 ± 0.003	10.2 ± 0.45
	60	6.43 ± 0.01	15.64 ± 0.04	0.061 ± 0.001	15.2 ± 0.05
	90	6.36 ± 0.04	21.02 ± 0.03	0.069 ± 0.004	21.9 ± 0.75
E (peppermint)	Fresh	5.77 ± 0.02	7.78 ± 0.03	0.029 ± 0.002	7.9 ± 0.05
	15	5.72 ± 0.02	10.66 ± 0.05	0.034 ± 0.001	9.8 ± 0.45
	30	6.31 ± 0.03	12.28 ± 0.04	0.050 ± 0.003	11.0 ± 0.35
	60	6.38 ± 0.03	17.79 ± 0.04	0.063 ± 0.003	16.8 ± 0.60
	90	6.69 ± 0.03	23.45 ± 0.06	0.074 ± 0.004	22.9 ± 0.90

*expressed as ml 0.1N NaOH 100g⁻¹ cheese.

Addition of different herbs to goat feed significantly ($p < 0.001$) increased the WSN/TN contents in treated cheese than control (Tables 3 and 6). During ripening period, significantly ($p < 0.001$) increases in WSN/TN

values were observed in all cheese. The rate of increase was more pronounced in treatments B and E (chamomile and peppermint). This may be due to higher proteolytic bacterial count in treatments B and E comparing with control and other treatments (Tables 5 and 6). Ayyad (2003) found similar results. AAN contents significantly ($p < 0.01$) increased in herb-treated cheeses (B, C, D & E) as compared to the control sample (Tables 3 and 6). During ripening period the AAN contents significantly ($p < 0.001$) increased as ripening period progressed reaching maximum values at the end of ripening period. The higher AAN contents were obtained in herb treatments and according to the following order: peppermint cheese (E) > fennel cheese (D) > thyme cheese (C) > chamomile cheese (B) > control cheese (A).

Addition of different herbs to goat feed significantly ($p < 0.001$) decreased the total volatile fatty acids (TVFA) contents in treated cheese and during ripening period comparing with control cheese (Tables 3 and 6). TVFA contents of treatments A, B, C, D and E at the end of ripening period were 25.4, 23.8, 22.4, 21.9 and 22.9 mL of 0.1 N NaOH 100 g⁻¹ cheese, respectively.

Microbiological examination of Domiati cheese:

There were significant ($p < 0.001$) differences on TVBC, LAB, PB, LB, coliform, sporeformes, moulds and yeast numbers between cheese treatments (Tables 4 and 5). During ripening period, the numbers of different microbial groups significantly ($p < 0.001$) decreased reaching its minimum at the end of ripening period. This decrease could be evidently attributed to the increase in titratable acidity (Table 2) which controlled the rate of bacterial growth or acted as bactericidal agent (El-Abd et al., 2003).

With regard to the total viable bacterial count (Tables 4 and 6), treatments C, D and E (thyme, fennel and peppermint) significantly ($p < 0.001$) decreased TVBC as compared with control and treatment B (chamomile).

Adding thyme and peppermint (treatments C and E) to goat feed significantly ($p < 0.001$) decreased the number of lactic acid bacteria while, chamomile and fennel (treatments B and D) significantly ($p < 0.001$) increased this number as compared with control. After 90 days of ripening, LAB was not detected in all treatments except treatment B (Table 4).

The numbers of proteolytic bacteria (PB) significantly ($p < 0.001$) higher in treatment E (peppermint). During ripening period there was significantly ($p < 0.001$) decrease in the PB numbers with significantly ($p < 0.001$) increase in the WSN/TN contents in all treatments. The increase of in WSN/TN contents of cheese during ripening period may be due to the release of the cell-bound proteinases into the surrounding cheese after lysis of the proteolytic bacterial cells (El-Sissi, 2002).

Adding thyme and fennel (treatments C and D) to goat feed significantly ($p < 0.001$) decreased the numbers of lipolytic bacteria in fresh and ripened Domiati cheese. Also, thyme and fennel treatments significantly ($p < 0.001$) decreased coliforms counts as compared to control, chamomile and peppermint cheese. During ripening, the coliforms counts significantly ($p < 0.001$) decreased rapidly in all samples reaching to nil after 90 days.

Table (4): Effect of adding some herbs to goat feed on some microorganisms of Domiati cheese made from goat's milk.

Treatments	Ripening period (days)	Microbial groups* (x10 ⁶)								Moulds & Yeast (x10 ⁷)
		TVBC (x10 ⁶)	Lactic acid bacteria (x10 ⁶)	Proteolytic bacteria (x10 ⁶)	Lipolytic bacteria (x10 ⁶)	Coliform bacteria (x10 ⁶)	Spore-forms bacteria (x10 ⁶)			
A (control)	Fresh	395 ± 11.00	12 ± 2.50	25 ± 3.20	12 ± 1.00	58 ± 3.50	112 ± 0.08	44 ± 0.03		
	15	100 ± 7.50	10 ± 2.50	5 ± 0.58	10 ± 1.00	36 ± 5.50	31 ± 0.17	31 ± 0.05		
	30	11 ± 1.50	7 ± 0.50	3 ± 0.59	7 ± 0.06	20 ± 0.08	11 ± 0.07	19 ± 0.19		
	60	0.03 ± 1.50	2 ± 1.00	1 ± 0.07	4 ± 0.11	5 ± 0.09	2 ± 0.24	9 ± 0.26		
B (chamomile)	90	0.01 ± 0.00	-	0.51 ± 0.03	2 ± 0.01	-	0.81 ± 0.08	3 ± 0.09		
	Fresh	406 ± 8.50	15 ± 2.00	27 ± 2.03	12 ± 0.01	59 ± 0.32	108 ± 0.31	40 ± 0.04		
	15	127 ± 4.50	12 ± 3.50	6 ± 0.89	11 ± 0.10	38 ± 0.03	39 ± 0.11	30 ± 0.11		
	30	13 ± 2.50	8 ± 1.00	3 ± 1.00	7 ± 0.04	19 ± 0.16	11 ± 0.14	20 ± 0.21		
C (thyme)	60	0.04 ± 1.00	3 ± 0.50	1 ± 0.05	3 ± 0.10	3 ± 0.10	1 ± 0.07	8 ± 0.29		
	90	0.005 ± 0.04	0.22 ± 0.03	0.54 ± 0.04	2 ± 0.08	-	-	3 ± 0.13		
	Fresh	331 ± 6.00	10 ± 3.50	26 ± 1.00	11 ± 0.18	54 ± 4.02	103 ± 0.08	34 ± 0.08		
	15	60 ± 6.50	6 ± 1.50	4 ± 0.58	8 ± 0.24	31 ± 0.07	25 ± 0.17	21 ± 0.18		
D (fennel)	30	8 ± 2.50	4 ± 0.50	2 ± 0.14	5 ± 0.10	14 ± 0.02	10 ± 0.09	15 ± 0.28		
	60	0.02 ± 0.50	2 ± 1.00	1 ± 0.07	4 ± 0.33	3 ± 0.08	1 ± 0.19	7 ± 0.16		
	90	0.0061 ± 0.02	-	0.49 ± 0.02	1 ± 0.02	-	-	2 ± 0.10		
	Fresh	320 ± 4.50	16 ± 1.50	23 ± 1.98	10 ± 0.11	51 ± 0.20	106 ± 0.21	32 ± 0.16		
E (peppermint)	15	35 ± 3.90	12 ± 2.50	2 ± 0.05	8 ± 0.06	27 ± 0.15	27 ± 0.07	23 ± 0.10		
	30	4 ± 0.50	8 ± 1.00	1 ± 0.07	6 ± 0.12	12 ± 0.04	6 ± 0.23	15 ± 0.32		
	60	0.02 ± 1.00	2 ± -	0.86 ± 0.02	3 ± 0.06	2 ± 0.14	1 ± 0.08	8 ± 0.08		
	90	0.0074 ± 0.05	-	0.46 ± 0.02	2 ± 0.08	-	0.50 ± 0.06	2 ± 0.21		
	Fresh	387 ± 4.35	9 ± 2.50	28 ± 1.00	13 ± 0.01	58 ± 0.09	122 ± 0.09	39 ± 0.11		
	15	40 ± 3.50	5 ± 2.00	7 ± 0.50	11 ± 0.04	32 ± 0.07	40 ± 0.01	26 ± 0.18		
	30	5 ± 0.050	2 ± 0.25	6 ± 0.09	6 ± 0.13	21 ± 0.19	13 ± 0.23	14 ± 0.22		
	60	0.01 ± 0.00	-	2 ± 0.07	4 ± 0.02	6 ± 0.32	1 ± 0.09	6 ± 0.07		
	90	0.0083 ± 0.04	-	1 ± 0.05	1 ± 0.07	-	0.94 ± 0.05	1.6 ± 0.14		

*Staphylococcus aureus were not detected in 0.1 g cheese in all cheese treatments and throughout the ripening period.

Concerning to sporeformers numbers, it was significantly ($p < 0.001$) higher, reaching 122×10^2 cfu g^{-1} , in peppermint cheese while their numbers was lower in thyme cheese, 103×10^2 cfu g^{-1} . After 90 days of ripening, sporformes bacteria were not detected in treatment B and C (chamomile and thyme) whereas a few numbers were detected in other treatments.

The *Staphylococcus aureus* were not detected (nil in 0.1 g) in all cheese treatments and during the ripening period. Different feeding treatments significantly ($p < 0.001$) decreased the moulds and yeast of cheese either when fresh or during ripening period. The inhibition action on moulds and yeast was in descending order, fennel > thyme > peppermint > chamomile. These results are partly in agreement with Abdel-Kader (2001), who found that adding 0.1% thyme to the curd of Ras cheese decreased the numbers of total bacterial, coliforms and moulds & yeast counts.

Results of microbial examination of Domiati cheese show that some microbial groups were affected by the addition of some herbs to goat feed while the others did not. This indicated the transfer of some antibacterial agent from these herbs to milk, which affected on different microbial groups.

Organoleptic properties of Domiati cheese:

The organoleptic properties of Domiati cheese of all treatments significantly ($p < 0.001$) improved during ripening period (Tables 5 and 6).

Table (5): Effect of adding some herbs to goat feed on organoleptic properties of Domiati cheese made from goat's milk

Treatments	Ripening period (days)	Appearance & Colour (10)	Body & Texture (40)	Flavour (50)	Total score (100)
A (control)	0	8 ± 0.50	31 ± 2.00	27 ± 2.00	66 ± 4.50
	15	8 ± 0.50	33 ± 3.50	30 ± 2.50	71 ± 1.50
	30	8 ± 0.50	34 ± 0.50	32 ± 0.50	74 ± 1.50
	60	9 ± 0.50	37 ± 2.00	35 ± 3.50	81 ± 8.00
	90	9 ± 0.00	38 ± 2.00	37 ± 4.50	84 ± 6.50
B (chamomile)	0	8 ± 0.00	32 ± 1.50	32 ± 1.50	72 ± 2.98
	15	9 ± 0.50	35 ± 3.50	35 ± 3.00	79 ± 7.00
	30	9 ± 0.50	36 ± 1.50	39 ± 0.50	84 ± 2.50
	60	9 ± 0.00	36 ± 1.50	42 ± 2.00	89 ± 3.50
	90	9 ± 0.00	37 ± 2.50	44 ± 3.50	90 ± 6.00
C (thyme)	0	8 ± 0.00	30 ± 2.00	33 ± 2.50	71 ± 4.50
	15	9 ± 0.50	37 ± 1.00	37 ± 2.00	83 ± 3.50
	30	9 ± 0.50	37 ± 3.50	40 ± 0.00	88 ± 4.00
	60	9 ± 0.50	36 ± 2.50	43 ± 1.50	90 ± 4.50
	90	9 ± 0.00	38 ± 2.50	45 ± 2.50	92 ± 5.00
D (fennel)	0	7 ± 0.0	30 ± 2.50	35 ± 3.50	72 ± 6.00
	15	7 ± 0.50	32 ± 2.00	39 ± 2.50	78 ± 5.00
	30	8 ± 0.50	33 ± 0.50	43 ± 3.00	85 ± 4.00
	60	8 ± 0.50	37 ± 2.00	44 ± 1.50	89 ± 4.00
	90	8 ± 0.00	37 ± 1.50	45 ± 0.50	90 ± 2.00
E (peppermint)	0	8 ± 0.50	32 ± 1.50	35 ± 2.50	75 ± 4.50
	15	10 ± 0.00	38 ± 3.50	41 ± 1.00	89 ± 4.50
	30	10 ± 0.00	38 ± 1.50	44 ± 2.00	92 ± 3.50
	60	9 ± 0.00	38 ± 0.50	46 ± 0.50	93 ± 1.00
	90	10 ± 0.00	39 ± 0.50	47 ± 0.00	96 ± 0.50

Appearance and colour scores of treated cheese were significantly ($p < 0.001$) higher than those of control cheese. Peppermint cheese gained the higher scores of appearance and color at the beginning of ripening and after 90 days.

Table (6): Statistical analysis of Domiati cheese made from goat's milk

Analysis	Effect of cheese treatments					Effect of ripening time (days)								
	Mean squares	F-value	A	B	C	D	E	Mean squares	F-value	0	15	30	60	90
Yield %	1.3508	1.35	26.11 ^a	26.26 ^a	27.52 ^a	27.36 ^a	26.31 ^a	-	-	-	-	-	-	-
TS %	2.759	5.66 ^{**}	42.75 ^a	42.50 ^a	41.394 ^a	42.082 ^a	42.296 ^a	113.96	233.9	37.41 ^a	40.894 ^a	42.504 ^c	47.77 ^b	46.49 ^b
Titratable acidity %	0.0168	0.75	1.786 ^a	1.788 ^a	1.794 ^a	1.745 ^a	1.859 ^a	9.231	413.9	0.357 ^a	1.296 ^b	2.175 ^c	2.463 ^b	2.681 ^a
pH	0.0095	1.59	4.670 ^{ab}	4.611 ^b	4.640 ^{ab}	4.690 ^a	4.67 ^{ab}	13.401	2232	6.440 ^a	5.221 ^b	3.96 ^c	3.90 ^c	3.76 ^c
Fa/DM %	2.1762	1.88	43.226 ^a	43.004 ^a	42.804 ^a	42.488 ^{ab}	42.632 ^a	210.27	374.9	37.57 ^a	37.952 ^c	44.748 ^b	46.806 ^a	46.39 ^a
TN/DM %	0.0730	0.280	6.323 ^a	6.139 ^a	6.278 ^a	6.136 ^a	6.174 ^a	0.4085	1.58	6.131 ^{ab}	5.927 ^a	6.21 ^{ab}	6.467 ^a	6.315 ^{ab}
SN/TN %	4.843	9.960 ^{**}	12.692 ^c	14.205 ^b	13.893 ^{bc}	13.318 ^{bc}	14.995 ^a	301.21	619.6	7.979 ^a	10.215 ^d	12.28 ^d	16.09 ^b	21.93 ^b
AA/N %	0.0001	4.940	0.406 ^c	0.0437 ^{bc}	0.047 ^{ab}	0.0481 ^{ab}	0.0506 ^a	0.0021	64.47	0.029 ^a	0.0351 ^c	0.0462 ^b	0.0581 ^a	0.062 ^a
TVFA mL0.1 N NaOH 100 g ⁻¹	21.044	52.30	16.090 ^a	14.58 ^b	13.16 ^c	12.29 ^c	13.70 ^c	412.21	1024	7.21 ^a	9.930 ^a	11.98 ^b	17.39 ^b	23.31 ^a
TVBC x 10 ⁶ cfu g ⁻¹	2810.21	15.24 ^{**}	102.3 ^a	110.40 ^a	80.819 ^b	72.248 ^b	77.067 ^b	236656	1283	358.5 ^a	72.7 ^b	8.30 ^c	2.600 ^c	0.739 ^c
LAB x 10 ⁶ cfu g ⁻¹	34.763	6.500 ^{***}	6.300 ^{ab}	7.644 ^a	4.70 ^b	7.400 ^a	3.250 ^c	225.36	47.78	12.40 ^a	9.00 ^b	5.95 ^c	1.900 ^c	0.044 ^c
PB x 10 ³ cfu g ⁻¹	14.809	7.910	6.963 ^b	7.514 ^b	6.999 ^a	6.002 ^b	5.800 ^b	1126.5	602.2	25.84 ^a	4.823 ^b	3.001 ^c	1.1732 ^d	0.601 ^a
LB x 10 ³ cfu g ⁻¹	3.6806	17.90 ^{***}	7.001 ^a	6.999 ^a	6.002 ^b	5.800 ^b	7.001 ^a	170.07	827.2	11.60 ^a	9.599 ^b	6.4014 ^c	3.6012 ^d	1.600 ^c
Coliforms x 10 ² cfu g ⁻¹	61.817	13.09	24.01 ^a	23.809 ^a	20.414 ^b	18.409 ^c	23.41 ^a	53.00.7	1122	56.10 ^a	32.914 ^b	17.226 ^c	3.807 ^d	0.00 ^c
Spoiformers x 10 ² cfu g ⁻¹	90.9917	2344	31.37 ^c	31.71 ^b	27.805 ^b	28.512 ^b	35.4 ^a	21240	99909	110.1 ^a	32.414 ^b	10.614 ^c	1.215 ^d	0.452 ^c
Moulds & yeast x 10 ² cfu g ⁻¹	60.978	1035	21.21 ^a	20.221 ^b	15.809 ^c	16.01 ^c	17.33 ^c	2038.4	34607	37.81 ^a	26.21 ^b	16.613 ^c	7.612 ^d	2.331 ^a
Flavour (50 points)	150.03	14.32	32.60 ^a	38.50 ^b	39.70 ^b	41.60 ^{ab}	42.40 ^a	219.68	20.96	32.2 ^d	36.6 ^c	39.8 ^b	42.2 ^{ab}	44.0 ^a
Body & texture (40 points)	17.00	1.87	35.00 ^{ab}	35.90 ^{ab}	36.30 ^{ab}	33.70 ^b	37.10 ^a	88.00	9.75	30.7 ^b	35.3 ^a	36.1 ^a	37.9 ^a	38.0 ^a
Appearance & colour (10 points)	3.430	13.19 ^{***}	8.2 ^b	9.000 ^a	8.00 ^a	7.9 ^b	9.30 ^a	3.98	15.31 ^{***}	7.60 ^c	8.60 ^b	9.20 ^a	8.900 ^{ab}	9.0 ^{ab}
Total (100 points)	222.62	6.05	75.80 ^a	83.40 ^a	84.90 ^a	83.20 ^a	88.80 ^a	666.6	18.11	70.50 ^a	80.50 ^c	85.10 ^{bc}	89.0 ^{ab}	91.00 ^a

Significant different at p < (0.05, 0.01, 0.001). For each effect the different letters in the means the multiple comparison are different from each. Letters a is the highest means followed by b, cetc.

Scores of body and texture of both control and different treatments were similar in fresh and ripened cheese. Flavour of goat's milk cheese which is not accepted by most Egyptian consumers was significantly ($p < 0.001$) improved by adding different herbs to goat feed. Treatment E (peppermint) obtained higher scores for flavour as well as total score points at different stage of cheese ripening. Ayyad (2003) found similar results.

From the above results, it could be concluded that adding chamomile, thyme, fennel and peppermint to goat feed improved different properties of Domiati cheese and overcome of goaty flavour of goat's milk which is considered undesirable by most Egyptian consumers.

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تأثير إضافة بعض الأعشاب لأعلاف الماعز على الخواص الكيماوية
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يهدف هذا البحث إلى دراسة تأثير تغذية الماعز على العلائق المضاف إليها بعض الأعشاب
الطبية (الكاموميل، الزعتر، الشمر والنعناع) على الخواص الكيماوية والميكروبيولوجية والحسية للجبن
اليميائي الناتج.

وتشير النتائج إلى عدم وجود فروق معنوية بين المعاملات المختلفة فى قيم التصافي و
الحموضة و الـ pH والدهن/المادة الجافة و النتروجين الكلى/المادة الجافة. فى حين زادت معنويا قيم
النتروجين الذائب فى الماء/النتروجين الكلى و نتروجين الأحماض الأمينية وانخفضت معنويا الأحماض
الدهنية الطيارة الكلية فى الجبن الناتج من لبن الماعز المضاف إلى علائقها الأعشاب السابقة. فى أثناء فترة
التسوية، حدثت زيادة معنوية فى قيم الـ pH والحموضة و المحتوى من المواد الصلبة الكلية والدهن/المادة
الجافة و النتروجين الذائب فى الماء/المادة الجافة و نتروجين الأحماض الأمينية و الأحماض الدهنية الطيارة
الكلية.

ولقد انخفض معنويا أعداد الفطريات والخمائر فى الجبن اليميائي الناتج من تغذية الماعز على
أعشاب الكاموميل، الزعتر، الشمر والنعناع. كما أدت التغذية على الزعتر والشمر إلى خفض معنوي فى
العدد الكلى للبكتريا الحية والبكتريا المحللة للبروتين والبكتريا المحللة للدهن وبكتريا القولون والبكتريا
المترجمة بالجبن الناتج من هذه المعاملات. كما أدت تغذية الماعز على النعناع إلى خفض معنوي فى العدد
الكلى للبكتريا الحية وبكتريا حامض اللاكتيك بينما زادت معنويا أعداد البكتريا المحللة للبروتين فى الجبن
الناتج من هذه المعاملة. كذلك انخفضت أعداد بكتريا حمض اللاكتيك فى جبن النعناع والزعتر. وقد أدت
إضافة هذه الأعشاب لعلائق الماعز إلى تحسن واضح فى الخواص الحسية للجبن اليميائي الناتج. وقد
حصل جبن النعناع على أعلى درجات التحكيم الحسي و أعلى جودة مقارنة بالمعاملات الأخرى. وأوضحت
النتائج أن إضافة هذه الأعشاب حسنت خواص الجبن الناتج واخفت طعم لبن الماعز الغير مقبول من قبل
معظم المستهلكين المصريين.