

## EFFECT OF EWE'S MILK COMPOSITION AT BOTH EARLY AND LATE LACTATION PERIODS ON DOMIATI CHEESE PROPERTIES DURING PICKLING

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**ABSTRACT:** *The effects of lactation period on the chemical composition of ewe's milk and the quality of Domiati cheese made from it were studied. 18 individual samples were collected at the 4<sup>th</sup> week of lambing and combined and another 18 individual samples were collected at the 12<sup>th</sup> week and combined to represent the early and late lactation periods. Protein and fat contents of ewe's milk increased as lactation period proceeded, respectively while lactose content decreased. On the other hand, total solids and titratable acidity of ewe's milk did not change significantly ( $P > 0.05$ ) during lactation period. Lactation period did not affect significantly ( $P > 0.05$ ) the moisture content, total volatile fatty acids, titratable acidity, score of organoleptic properties and total free amino acids of the resultant cheese, while cheese yield, fat, total nitrogen and soluble nitrogen of cheese were increased ( $P \leq 0.05$ ) as lactation period advanced. On the other hand, soluble nitrogen, total volatile fatty acids, scores of organoleptic properties were increased as pickling period progressed, while cheese yield, moisture and total nitrogen contents were decreased.*

**Key words:** *Ewe's milk, lactation period, Domiati cheese.*

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### INTRODUCTION

Ewe's milk has high nutritional value and makes a cheese with special and important features. The protein in cheese made from ewe's milk is easily digested, especially by infants and elderly. Recently, sheep are gaining much interest in many parts of the world for their ability to live on poor grazing lands or mountainous regions that are not available to cattle. So, it is of interest to increase the population of sheep to overcome the problems of limited cultivated areas and milk production that does not cover the national demand. Although milk provides a good nutritional supply to inhabitants, a better understanding of the properties of ewe's milk is required.

Milk composition is affected by several factors, which may be either genetical or environmental. Among the latter group of factors, certain feeds consumed by the animal are known to have a noticeable effect on milk composition. Moreover, during the last three decades animal feeding

conditions and even kinds of feeds given to animals have somewhat been modified.

Domiat cheese is the most popular soft cheese in Egypt which can be consumed fresh or after pickling in salted whey for several months in soldered tins (Salama, 2004). It is well known in the Arabic world and variants are made in Europe and in many other countries. It is closely resembles Greek Feta cheese (Ismail, 2004). On the other hand, because of their well-balanced composition, milk proteins are excellent source of essential amino acids (isoleucine, leucine, lysine, methionine, threonine, tryptophan, phenylalanine and valine) (Amoit, 1985). Domiat cheese contains higher amounts of each essential amino acid than the reference protein which suggested by FAO and WHO, except for methionine and cystine (Renner, 1987). Moreover, food allergy to cheese protein has never been reported (Dillon, 1987).

The objective of this study was to investigate the effect of lactation period on milk composition and quality of Domiat cheese made from ewe's milk and monitor the changes of cheese quality during pickling period.

## **MATERIALS AND METHODS**

### **Materials**

#### **Milk samples:**

Ewe's milk samples were obtained from the Animal Breeding Research Station at Sakha. Animal Production Research Institute. Two batches of ewe's milk: 18 individually ewe's milk samples of each were collected during 4<sup>th</sup> and 12<sup>th</sup> weeks after lambing to represent two periods of the lactation seasons (Early and late lactation periods). Every batch was mixed well alone and the samples were analyzed for chemical composition. The two bulk ewe's milk batches were samples used to make Domiat cheese.

#### **Cheese making:**

Domiat cheese was manufactured from ewe's milk according to the method adapted by Fahmy and Sharara (1950) from heated milk (72°C / 15 Sec.) and salted with 8% NaCl. Powder rennet (HA-LA, Chr. Hansen Laboratory, Denmark), was used for coagulation. The resultant cheeses were pickled in heated salted whey (10% NaCl) in polyethylene bags according to Degheidi *et al.* (1998), then stored at room temperature (22-25°C) for 60 days. The cheese yield was recorded as kg of cheese / kg of milk x 100. The resultant cheeses were analysed for chemical and sensory evaluation when fresh and after 15, 30, 45 and 60 days of pickling. The experiment was triplicated.

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### Methods of analysis:

#### I- Chemical analysis of ewe's milk:

Titrate acidity, total solids, fat, protein and ash were determined according to the methods described by Ling (1963). pH values of ewe's milk samples was measured with an Orion pH meter (Orion Research Cambridge, M.A, U.S.A). Lactose content was determined as described in the method of Barnett and Abdel-Tawab (1957).

#### II- Chemical analysis of Domiati cheese made from ewe's milk:

Titrate acidity, moisture, fat, total and soluble nitrogen were determined according to Ling (1963). The method of Kosikowski (1982) was used to determine the total volatile fatty acids (TVFA). Total free amino acids were determined according to Weaver and Kroger (1978) using an amino acid analyzer (Beckman Amino Acid Analyzer 119 CL. Spinco Division of Beckman instruments,, Inc., Palo Alto, California).

### Sensory evaluation

Cheese samples were scored for flavour (50 points); body & texture (35 points); appearance and colour (15 points) according to El-Safty *et al.* (2004) by eight panelist from the staff members of the Dairy Department when fresh and during the pickling period.

### Statistical analysis

Factorial design 2 factors X 3 replicates and the completely randomized design were used to analyze the data, and student Newman Keuls test was followed to make the multiple comparisons (Steel and Torrie, 1980) using Costat program. Significant differences were determined at ( $P \leq 0.05$ ).

## RESULTS AND DISCUSSION

### Chemical Composition of ewe's milk:

Total solids (T.S) content of ewe's milk samples during early and late lactation periods are given in Table (1). The obtained results revealed that there were no significant differences ( $p > 0.05$ ) in TS content of ewe's milk samples. These values are in accordance with those reported by Soryal and El-Shaer (1999).

Fat content of ewe's milk during early and late lactation periods are shown in Table (1). The average fat content was 6.52% and 7.41% at early and late lactation periods, respectively. There were significant differences ( $p \leq 0.05$ ) between periods. The same trend was observed by Soryal and El-Shaer (1999), Odjakova *et al.* (2002), Lujerdean *et al.* (2003.), Csanadi *et al.* (2004) and Kanwal *et al.* (2004). These values were higher than the values of Ochoa *et al.* (2002) and Ahamefule *et al.* (2003), they were lower than those reported by Petters *et al.* (1992), Simos *et al.* (1996), Aganga *et al.* (2002) and Shahine (2007).

**Table (1): Chemical composition of ewe's milk during early and late lactation periods.**

Constituents	Lactation periods*	
	Early	Late
Total solids (%)	17.90 <sup>A</sup>	18.37 <sup>A</sup>
Fat (%)	6.52 <sup>B</sup>	7.41 <sup>A</sup>
Protein (%)	4.28 <sup>B</sup>	5.36 <sup>A</sup>
Lactose (%)	5.46 <sup>A</sup>	4.15 <sup>B</sup>
Ash (%)	0.79 <sup>B</sup>	0.86 <sup>A</sup>
Titrateable acidity (%)	0.19 <sup>A</sup>	0.18 <sup>A</sup>
pH value	6.59 <sup>A</sup>	6.62 <sup>A</sup>

\* Each value in the table is a mean of 3 replicates.

<sup>A, B</sup>: Means with different superscript letters in the same row are significantly different ( $P \geq 0.05$ ). Litter A is the highest mean followed by B.

Protein content of ewe's milk during early and late lactation periods are presented in Table (1). The mean values of protein content were 4.28% and 5.36% at early and late lactation periods, respectively. There were significant differences ( $p \leq 0.05$ ) between the periods. Values were similar to Petters *et al.* (1992) and Ochoa *et al.* (2002). These results were lower than the results of Simos *et al.* (1996), Odjakova *et al.* (2002), Ahamefule *et al.* (2003), Csanadi *et al.* (2004), Kanwal *et al.* (2004) and Shahine (2007), while they were higher than those mentioned by Soryal and El-Shaer (1999) and Ahamefule *et al.* (2003).

Lactose content of ewe's milk during early and late lactation periods are given in Table (1). The average of protein content was 5.46% and 4.15% at early and late lactation periods, respectively. There were significant differences ( $p \leq 0.05$ ) between periods. These results are supported by Simos *et al.* (1996), Soryal and El-Shaer (1999) and Ochoa *et al.* (2002). The values was the same nearly the results of Lujerdean *et al.* (2003), Shahine (2007), they were higher than those reported by Kanwal *et al.* (2004).

Ash content in ewe's milk samples during early and late lactation periods are shown in Table (1). There were significant differences ( $p \leq 0.05$ ) between

the periods. These results are in accordance with those reported by Soryal and El-Shaer (1999), but they were lower than the values reported by Ochoa *et al.* (2002), Ahamefule *et al.* (2003), Kanwal *et al.* (2004) and Shahine (2007)..

The average values of titratable acidity (%) and pH value of ewe's milk samples during early and late lactation periods are given in Table (1). There were no significant differences ( $p > 0.05$ ) between the periods. These results are in agreement with those found by Simos *et al.* (1996), Celik and Ozdemir (2003) and Kanwal *et al.* (2004) and slightly lower than the results of Shahine (2007).

### **Chemical Composition of Domiati cheese made from ewe's milk at early (I) and late (II) lactation during pickling period:**

Cheese yield of Domiati cheese made from ewe's milk at early (I) and late (II) lactation during pickling periods are presented in Table (2). There were significant differences ( $p \leq 0.05$ ) between Cheeses (I) and (II), cheese (II) was the highest. On the other hand, cheese yield decreased as the pickling period advanced (Tables 2 and 6). This decrease in cheese yield may be due to the loss of moisture and some milk constituents (Degheidi *et al.*, 1998). These results agree with the results of El-Sissi (2002), Mehanna *et al.* (2002), Abd El-Kader (2003), Salama (2004) and Kebary *et al.* (2006).

The changes in moisture content of Domiati cheese made from ewe's milk at early (I) and late (II) lactation during pickling periods are shown in Tables (2 and 6). It could be noticed that there are no significant differences ( $P > 0.05$ ) between (I) and (II). The results obtained revealed that moisture content of Domiati cheese decreased significantly ( $p \leq 0.05$ ) as pickling period advanced (Tables 2 and 6). These results are in accordance with those reported by Degheidi *et al.* (1998), El-Sonbaty (2000), El-Sheikh *et al.* (2001), El-Sissi (2002), Abd El-Kader (2003), Salama (2004) and Kebary *et al.* (2006).

Fat content of Domiati cheese made from ewe's milk (I) and (II) during pickling periods are presented in Tables (2 and 6). Fat content / dry matter (DM) of cheese made from ewe's milk (I) and (II) during pickling periods are presented in Tables (2 and 6) and Fig. (1). Fat / DM was higher in cheese (II) than cheese (I) which might be due to the higher fat content in milk, while, Fat/DM content increased ( $p \leq 0.05$ ) gradually during pickling periods as progressed until the 45<sup>th</sup> day. Similar trends were obtained by Degheidi *et al.* (1998), El-Sonbaty (2000) and Kebary *et al.* (2006).

Total nitrogen (T.N) and TN / DM contents of Domiati cheese made from ewe's milk at early (I) and late (II) lactation during pickling periods are shown in Tables (2 and 6 and Fig. 2). T.N / D.M content was higher in cheese (II) than cheese (I). However, T.N / D.M content significantly ( $p \leq 0.05$ ) decreased in both cheeses during pickling period (Fig. 2 and Table 6). These results may be due to the degradation of proteins into water soluble nitrogen (WSN) compounds and subsequently the loss of some (WSN) from the degraded proteins in pickling solution. These results are in agreement with those reported by El-Sonbaty (2000), El-Abd *et al.* (2003) and Kebary *et al.* (2006).

**Table (2): Changes in cheese yield, moisture, fat and total nitrogen (T.N) contents of Domiati cheese made from ewe's milk at early (I) and late (II) lactation periods during pickling at room temperature.**

Property	Pickling period (days)	Cheese*	
		I	II
Cheese yield %	Fresh	27.7	29.2
	15	24.3	27.0
	30	21.7	22.1
	45	21.0	21.9
	60	20.4	21.5
Moisture (%)	Fresh	60.82	61.36
	15	54.89	55.05
	30	52.56	51.12
	45	49.83	49.00
	60	47.12	45.50
Fat %	Fresh	13.8	14.5
	15	16.9	17.2
	30	20.7	21.9
	45	22.2	24.6
	60	22.3	25.0
T.N (%)	Fresh	2.20	2.27
	15	2.00	2.10
	30	1.77	2.00
	45	1.62	1.78
	60	1.50	1.62

\* Each value in the table is a mean of 3 replicates.

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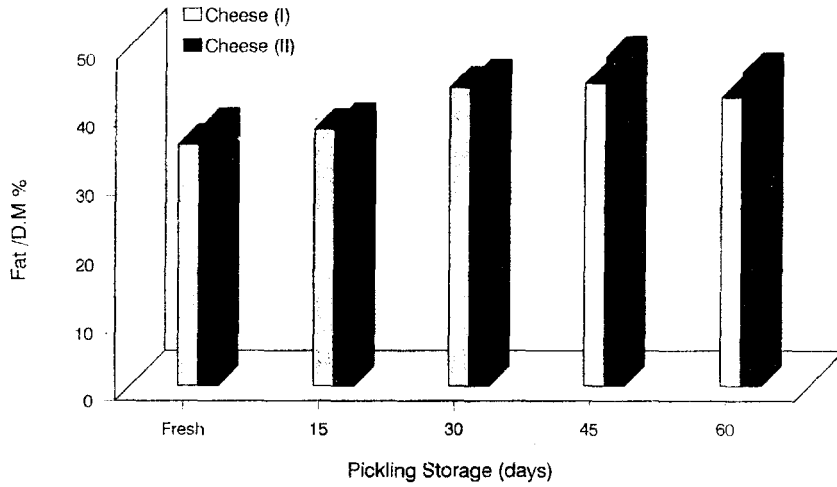


Fig. (1): Changes in fat on dry matter (DM) (%) of Domiati cheese made from ewe's milk at early (I) and late (II) lactation periods during pickling.

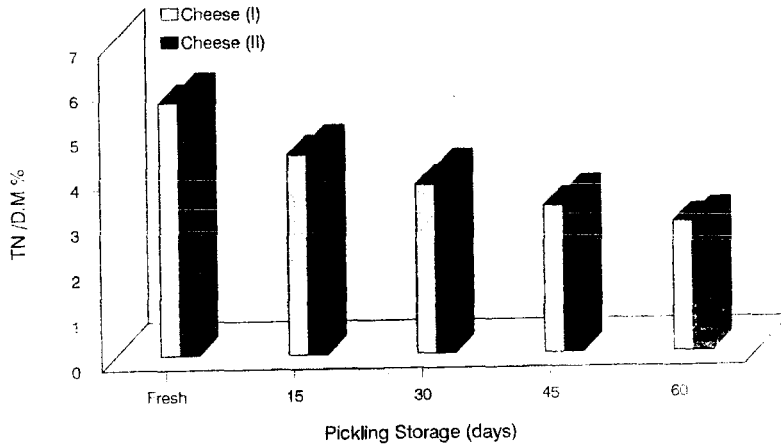


Fig. (2): Changes in total nitrogen on dry matter (TN / DM) % of Domiati cheese made from ewe's milk at early (I) and late (II) lactation periods during pickling.

The changes in titratable acidity (TA) of Domiati cheese made from ewe's milk (I) and (II) during pickling periods are presented in Tables (3 and 6). It could be observed that there were no significant differences ( $p > 0.05$ ) between cheeses. On the other hand, titratable acidity of Domiati cheese made from ewe's milk (I) and (II) increased gradually up to the end of pickling period ( $p \leq 0.05$ ). These results agree with those reported by El-Sonbaty (2000), El-Sissi (2002), El-Abd *et al.* (2003), Salama (2004) and Kebary *et al.* (2006).

Soluble nitrogen (S.N) content of Domiati cheese made from ewe's milk at early (I) and late (II) lactation during pickling periods are shown in Tables (3 & 6 and Fig. 3). S.N / T.N content was higher in cheese (I) than cheese (II). On the other hand, SN / TN content ( $p \leq 0.05$ ) increased significantly in cheeses throughout the pickling period (Fig. 3 and Table 6). These results are supported by the findings of El-Sonbaty (2000), Abd El-Kader (2003), Salama (2004) and Kebary *et al.* (2006).

Total volatile fatty acids (TVFA) content of Domiati cheese made from ewe's milk (I) and (II) during pickling periods are presented in Tables (3 and 7) and Fig. (4). No significant differences ( $P > 0.05$ ) between both cheeses (I) and (II) in TVFA. TVFA increased gradually up to the end of pickling period ( $p \leq 0.05$ ). This could be attributed to the lipase activity of lactic acid bacteria. These results are in accordance with those reported by Degheidi *et al.* (1998), El-Sonbaty (2000), Mehanna *et al.* (2002), El-Abd *et al.* (2003) and Kebary *et al.* (2006)

Changes in total free amino acids, essential and non essential amino acids content of ewe's milk at the early and late lactation periods are presented in Tables (4 & 7) and Fig. (5). A slight increase ( $P \leq 0.05$ ) in total, essential and non essential amino acids in cheese made from late lactation was found during pickling. It was observed also from Table (4) that concentrations of phenylalanine and leucine were predominant as essential amino acids. Concerning non essential amino acids glutamic acid and prolein were predominant.

Sensory evaluation of Domiati cheese made from ewe's milk (I) and (II) during pickling periods are presented in Tables (5 and 7). There were no significant differences ( $P > 0.05$ ) between both cheeses (I) and (II) in total scores (Table 7). It is obvious that the quality of cheeses gradually improved and the highest was at the end of pickling period. These results are in accordance with those reported by Degheidi *et al.* (1998).



**Effect of ewe's milk composition at both early and late lactation.....**

**Table (3): Changes in the titratable acidity, soluble nitrogen (S.N) and total volatile fatty acids (T.V.F.A) contents of Domiati cheese made from ewe's milk at early (I) and late (II) at lactation periods during pickling at room temperature.**

Property	Pickling period (days)	Cheese*	
		I	II
Titratable acidity (%)	Fresh	0.37	0.41
	15	0.90	1.00
	30	1.70	1.63
	45	1.82	1.81
	60	1.89	1.86
S.N (%)	Fresh	0.19	0.22
	15	0.24	0.27
	30	0.29	0.33
	45	0.38	0.43
	60	0.46	0.50
TVFA (ml 0.1N NaOH / 100 gm cheese)	Fresh	6.8	6.0
	15	9.3	10.4
	30	13.1	12.8
	45	16.8	17.2
	60	21.0	19.7

\* Each value in the table is a mean of 3 replicates.

**Table (4): Amino acids content (mg / gm cheese) of Domiati cheese made from ewe's milk at early (I) and late (II) lactation period during pickling at room temperature.**

Amino acids	Cheese*			
	(I)		(II)	
	Pickling period (days)			
	Fresh	60 days	Fresh	60 days
Aspartic acid	8.8	9.1	8.4	9.0
Threonine	6.4	7.2	7.0	7.6
Serine	9.2	9.6	10.5	10.6
Glutamic	16.4	17.1	14.8	16.9
Proline	10.8	16.0	12.4	17.2
Glycine	1.9	2.3	2.1	2.7
Alanine	9.6	10.0	9.0	9.6
Cysteine	0.8	0.7	0.9	0.6
Valine	7.2	8.0	7.0	8.0
Methionine	1.9	2.8	2.3	3.2
Isoleucine	6.0	7.6	5.8	6.3
Leucine	14.7	15.0	13.9	16.2
Tyrosine	4.8	5.5	4.1	5.0
Phenylalanine	14.2	16.3	16.3	17.4
Histidine	3.0	3.9	3.7	3.8
Lysine	0.7	0.8	0.8	1.0
Tryptophan	0.9	3.2	1.0	3.7
Arginine	2.8	3.6	3.5	3.8
<b>Total Essential amino acids</b>	<b>52.0</b>	<b>60.9</b>	<b>54.1</b>	<b>63.4</b>
<b>Non essential amino acids</b>	<b>68.1</b>	<b>77.8</b>	<b>69.4</b>	<b>79.2</b>
<b>Total amino acids</b>	<b>120.1</b>	<b>140.7</b>	<b>123.5</b>	<b>142.6</b>

\* Each value in the table is a mean of 3 replicates.

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**Table (5): Sensory evaluation of Domiati cheese made from ewe's milk at early (I) and late (II) lactation periods during pickling at room temperature.**

Property	Pickling period (days)	Cheese*	
		I	II
Flavour (50)	Fresh	39.0	40.0
	15	41.5	41.0
	30	42.0	42.3
	45	42.4	42.3
	60	43.5	43.2
Body & texture (35)	Fresh	27.0	25.5
	15	28.2	27.4
	30	28.2	28.5
	45	29.1	29.0
	60	32.4	31.0
Appearance and Colour (15)	Fresh	10.5	11.0
	15	12.0	12.5
	30	11.2	13.0
	45	11.0	11.6
	60	12.0	12.1
Total score (100)	Fresh	76.5	76.5
	15	81.7	80.9
	30	81.4	83.8
	45	82.5	82.9
	60	87.9	86.3

\* Each value in the table is a mean of 3 replicates.

Table (6): Statistical analysis of Domiati cheese made from ewe's milk at early (I) and late (II) lactation periods during pickling.

Items	Effect of source of cheese			Effect of pickling period (days)					
	Mean squares	Multiple comparison <sup>◇</sup>		Mean squares	Multiple comparison <sup>◇</sup>				
		I	II		Fresh	15	30	45	60
Cheese yield%	13.0680*	B	A	63.342*	A	B	C	D	E
Moisture (%)	3.0528	A	A	191.857*	A	B	C	D	E
Fat (%)	15.9870*	B	A	104.186*	D	C	B	A	A
Fat / DM (%)	42.8407*	B	A	113.198*	D	C	B	AB	A
TN (%)	0.1387*	B	A	0.195*	A	B	C	D	E
TN/DM (%)	5.7029*	B	A	0.132*	A	B	C	D	E
Titratable acidity (%)	0.0452	A	A	2.491*	E	D	C	B	A
S.N (%)	0.0108*	B	A	0.075*	E	D	C	B	A
SN / TN (%)	2.5579*	B	A	276.694*	E	D	C	B	A

\* Significant at 0.05 level.

T.N= Total nitrogen.

S.N= Soluble nitrogen.

DM= Dry matter.

◇ For each effect the different letters in the means the multiple comparisons are different from each. Letter A is the highest mean followed by B, C .....etc.

Table (7): Statistical analysis of Domiati cheese made from ewe's milk at early (I) and late (II) lactation periods during pickling.

Items	Effect of source of cheese			Effect of pickling period (days)					
	Mean squares	Multiple comparison <sup>◊</sup>		Mean squares	Multiple comparison <sup>◊</sup>				
		I	II		Fresh	15	30	45	60
TVFA (ml 0.1N NaOH/100 g cheese)	0.4563	A	A	88.029*	E	D	C	B	A
Essential amino acids (mg / gm cheese)	19.7823*	B	A	248.429*	B	-	-	-	A
Non essential amino acids (mg / gm cheese)	14.6831	A	A	30.652*	B	-	-	-	A
Total amino acids (mg/gm cheese).	18.6875	A	A	1291.688*	B	-	-	-	A
<b><u>Sensory evaluation</u></b>									
Flavour	0.0480	A	A	2.582*	C	B	AB	AB	A
Body & texture	3.6748	A	A	4.049*	C	B	B	B	A
Appearance and colour	3.6750	A	A	2.471	A	A	A	A	A
Total score	0.0479	A	A	86.388*	C	B	B	B	A

\* Significant at 0.05 level.

◊ For each effect the different letters in the means the multiple comparisons are different from each. Letter A is the highest mean followed by B, C .....etc.

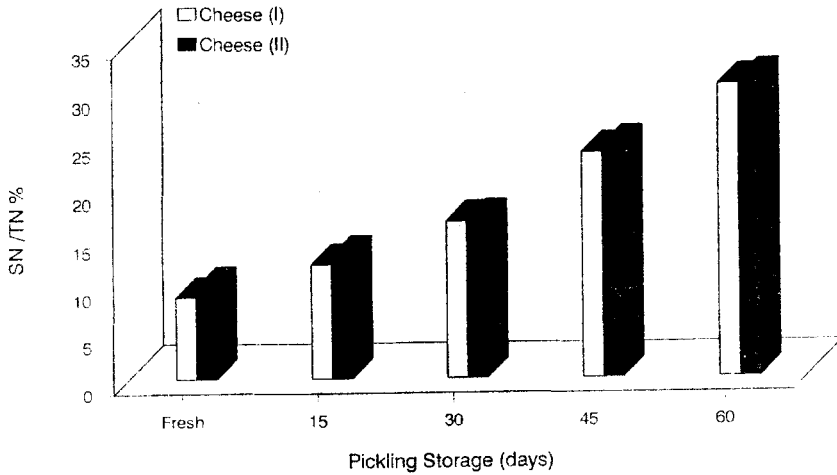


Fig. (3): Changes in SN/TN ratio of Domiati cheese made from ewe's milk at early (I) and late (II) lactation periods during pickling.

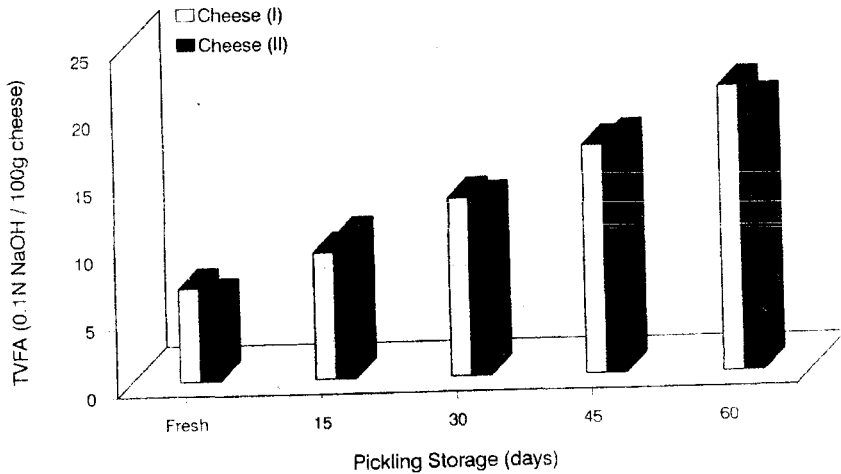


Fig. (4): Changes in Total volatile fatty acids (TVFA) contents of Domiati cheese made from ewe's milk at early (I) and late (II) lactation periods during pickling.

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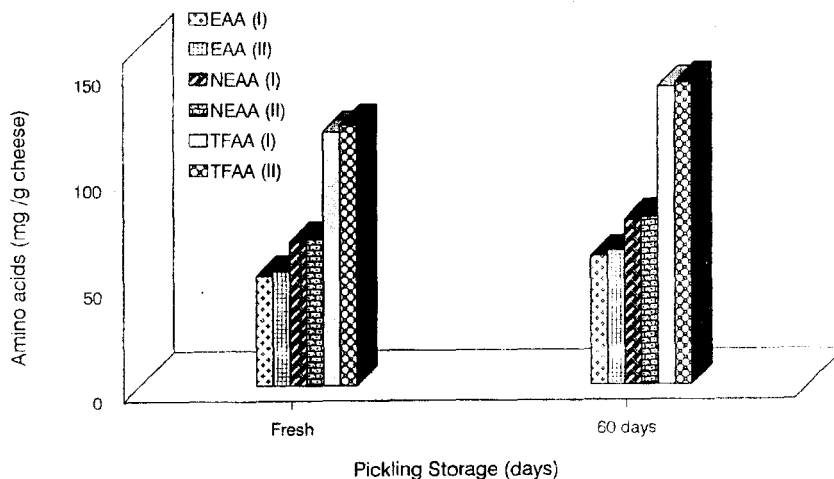


Fig. (5): Changes in essential amino acids (EAA), non essential amino acids (NEAA) and total free amino acids (TFAA) contents of Domiati cheese made from ewe's milk at early (I) and late (II) lactation periods during pickling.

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**Effect of ewe's milk composition at both early and late lactation.....**

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## تأثير تركيب لبن الأغنام عند كل من مرحلة الحليب المبكرة والمتأخرة على خواص الجبن الدمياطى أثناء التسوية

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### الملخص العربى:

يهدف هذا البحث لدراسة تأثير تركيب لبن الأغنام خلال مرحلة الحليب على صفات الجبن الدمياطى التى تصنع من هذا اللبن، لذلك فقد تم تجميع ١٨ عينة عند الأسبوع الرابع من بداية مرحلة الحليب وتمثل المرحلة المبكرة للحليب وتم خلطها (لتمثل دفعة أولى مركبة) وبالمثل تم تجميع ١٨ عينة عند الأسبوع الثانى عشر لتمثل مرحلة أخيرة من الحليب (لتمثل دفعة ثانية مركبة) وتم دراسة تركيب اللبن وكذلك تم صناعة الجبن الدمياطى من الدفعتين.

### ولقد أوضحت النتائج المتحصل عليها ماالى:

- ١- ازدادت نسب كل من الدهن والبروتين الكلى والرماد فى لبن الأغنام بتقدم مرحلة الحليب بينما انخفضت نسبة اللاكتوز فى حين لم تتأثر نسب كل من الجوامد الصلبة الكلية والحموضة والـ pH.
- ٢- ازدادت نسب التصافى والدهن والنيتروجين الكلى والنيتروجين الذائب فى الجبن المصنعة من لبن الأغنام فى المرحلة المتقدمة من الحليب فى حين لم تتأثر نسب كل من الرطوبة والحموضة والأحماض الدهنية الطيارة الكلية والأحماض الأمينية وكذلك درجات التحكيم.
- ٣- ازدادت نسب كل من الدهن والنيتروجين الذائب والأحماض الدهنية الطيارة الكلية والحموضة والأحماض الأمينية وكذلك درجات التحكيم للجبن أثناء التسوية فى حين انخفضت نسب كل من التصافى والرطوبة والنيتروجين الكلى.