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NUTRITIVE VALUE OF TRADITIONAL AND ULTRAFILTRATION TECHNIQUE OF DOMIATI CHEESE

Abd-Rabou, N.S. and M.H. El-Senaity
Food Technology and Dairying Department, National Research Center, Dokki, Cairo, Egypt

ABSTRACT

Domiati cheese was manufactured using traditional method and UF-technique. All fresh samples of Domiati cheese were evaluated for the appearance, flavour, richness, spreadability and overall acceptance. The gross composition such as total solids, fat, total nitrogen, salt, ash, soluble nitrogen, acidity and ripening indeces of samples were determined. Amino acid and mineral content were assessed. The nutritional aspects such as protein efficiency ratio (PER), biological value (BV), and net protein utilization (NPU) of Domiati cheese made by the two methods were also calculated. Using UF technique produced an end product of Domiati cheese with much higher contents of protein, fat and ash compared to that Domiati cheese made traditionally. A slight difference was found between the two methods on their contribution for daily requirements of essential amino acids for children and juveniles, which the contribution of UF-Domiati cheese was higher than that of the traditional one. Also, the samples of UF-Domiati cheese showed higher findings of BER, BV and NPU than those calculated for the samples of traditional Domiati cheese.
Key words: Nutritive value, Ultrafiltration technique, Domiati cheese

INTRODUCTION

Milk and its products are one of the most important sources of nutrients for human, and their trace elements are important for nutrition.

Cheese manufacture depends on the conversion of milk to gel by rennet, and whey expullsion progressively by synersis, according to the cosistency and composition of cheese variety. Domiti cheese is the most popular white soft cheese in Egypt. This cheese is either consumed fresh or after pickling. Damiati cheese could be considered as an important, nutritive and beneficial food for the relief of human affliction, especially intestinal disorders. The use of ultrafitration technique in the manufacture of cheese especially soft cheese was introduced, by ultrafiltrating milk (Covacevich & Kosikowski 1978 and Abd El-Salam, et al. 1981) for continuous mechanized operation. However, the traditional process and UF technique are the two major methods used for the manufacture of Domiati cheese in the most of dairy plants. The effect of the manufacturing process on the nutritive value of Domiati cheese was not cited in the literature. The present paper evaluates the effect of the traditional process and UF technique for making Domiati cheese on some nutritional characteristics of this vital dairy product.

MATERIALS AND METHODS

Source of Milk

Fresh bulk buffaloe's milk (6.5% fat) was obtained from the herd of the experimental station, Faculty of Vetrinary Medicine, Cairo University, Egypt .

Preparation of UF

Fresh raw milk was standardized to 4% fat, heated to 50^{O}C and ultrafiltered using a (Carb Sep Ultrafiltration Unit) (Type 25151, France). Inlet and outlet pressures were 3 and 5 bars, respectively. The UF process was operated to yield retentate containing about 23% total solids. The retentate was heated for 2 min. at 90^{O}C, cooled to 45^{O}C.

Cheese Manufacutre

Domiati cheese was manufacutred according to the method adopted by Fahmi & Sharara (1950) from heated milk (72^{O}C/15 sec.) and salted with 5% NaCl. Rennet powder HA-LA, Chr. Hansen Laboratory, Denmark, was used for coagulation.

Analytical procedures:

Sensory evaluation:

The fresh samples of traditional and UF Domiati cheese were assessed organoleptically for appearance, flavour, richness, spreadability and overall acceptance (El-Samragy, et al., 1997) using a hedonic scale of 0-5 (e.g. 0- dislike very much, 1= dislike moderately, 2= dislike slightly, 3= like slightly, 4= like moderately and 5= like very much). The scoring panel consisted of 50 persons chosen at random to evaluate the desirability and acceptability of Domiati cheese manufactured using the traditional method and UF technique. The samples were held 2hr at 20^{O}C before sensory evaluation. Also, the panelists were asked to comment if any undesirable changes, i.e. off-flavours, wheying off etc.. were observed.

Chemical analysis:

The methods of AOAC (1984) were used to determine total solids, protein, fat, ash and salt contents. The pH values were measured using Kinck-Digital pH Meter Model 646; Total volatil fatty acids (TVFA) were determined as described by Kosikowski (1978). Determination of ripening indeces; the method of Tawab & Hofi (1966) was adopted.

Amino acid profile:

Amino acids were analyzed using a modification of the Pico-TAG method (Millipore Cooperative, 1987). One gram of each sample was analyzed for the determination of total amino acids with 20ml 6N HCl for 24hr at 110^{O}C in capped tubes under nitrogen prepared samples in amounts of 20μl were running through Waters 600E Multisolvent HPLC (Waters Assoc., USA).

Mineral content:

Amounts of major minerals (i.e. Ca, K, Mg) and minor minerals (Zn, Fe, and Na) were determined according to the methods described in AOAC (1984) with an atomic absorption spectrophotometer (Perkin Ekmer Model 460). While phosphorus as a major element was determined using the method outlined by Troug *& Meyer* (1939).

Computation of nutritive value :

Protein efficiency ratio (PER) based on the amino acid contents of Labneh was calculated according to the recommendations of Alsmeyer *et al.* (1974) using the following equations:

PER1 = -0.684 + 0.456 (leucine) – 0.047 (proline)

PER2 = -0.468 + 0.454 (leucine) – 0.105 (tyrosine)

FER3 = -1.816 + 0.435 (methionine) + 0.78 (leucine) + 0.211 (histidine) – 0.944 (tyrosine)

Biological value (BV) and net protein utilization (NPU) were calculated using the equations suggested by Mitchell &Block (1946).

BV = 49.9 + 10.53 PER

NPU= BV X Digestibility (protein, 95%).

RESULTS AND DISCUSSION

Data presented in Table (1) summarize the response of the panelists of Domiati cheese manufactured using the two methods of processing. The scores of the panelists for both traditional and UF-cheese were in the positive side of sensory evaluation. Their responses ranged from like slightly to like very much. The scores given for Richness, spreadability, flavour and overall acceptance of UF-Domiati cheese were higher than those given for traditional Domiati cheese.

Table (1): Panelists score of sensory evaluation of traditional and UF-Domiati cheese.

Property	Process	Like very much		Like moderately		Like slightly	
		No.	%	No.	%	No.	%
Appearance	T	36	72	14	28	0	0
	UF	25	50	25	50	0	0
Flavour	T	27	54	23	46	0	0
	UF	41	82	7	14	2	4
Richness	T	26	52	20	40	4	8
	UF	46	92	4	8	2	4
Spreadability	T	19	38	14	28	17	24
	UF	48	96	0	0	2	4
Overall acceptance	T	40	80	8	16	2	4
	UF	50	100	0	0	0	0

The gross composition of the traditional and UF Domiati cheese is shown in table (2). It was found that the total solids of the traditional Domiati cheese prepared in the current work fell within previously reported data for

Domiati cheese in the literature (Abd El-Salam *et al.,* 1981; Abou-Donia, 1986 and Degheidi, *et al.,* 1998).

The protein content of both traditional and UF-Domiati cheese of samples was higher and fat was over than reported previosly (Abd El-Salam, *et al.,* 1981*;* Degheidi, *et al.,* 1998).

It was obvious that using UF-technique resulted an end product of Domiati cheese with protein and fat contents higher than the traditional Domiati cheese based on the dry weight. The UF-Domiati cheese had 2.257% total nitrogen and 15.60% fat, while the total nitrogen and fat contents of the traditional Domiati cheese were 1.73% and 14.2%, respectively. Soluble nitrogen and ash contents of traditional Domiati cheese were 0.27% and 1.3%, which were less than those determined for the UF-Domiati cheese (0.34% and 1.65%). It can be also seen that the salt is an equal serving weight of both UF and traditional cheese are different (Table 2).

Table (2) Gross composition of traditional and UF-Domiati cheese

Item	Milk	Traditional	UF-Domiati
Total Solids %	16.42	35.26	38.10
Fat %	6.5	14.2	15.6
Acidity %	0.16	0.43	0.23
Total Nitrogen %	0.655	1.73	2.257
S.N %	--	0.27	0.34
Salt %	--	4.34	4.2
Ash %	0.74	1.3	1.65
pH value	6.64	5.53	6.41
TVFA	--	1.85	2.42
F.R.I	--	14.5	9.8
S.R.I	--	21.7	26.7

The concentration of both essential and non-essential amino acids in samples of Domiati cheese made using the traditional and UF cheese is shown in (Table 3). The essential amino acids leucine, tyrosine and lysine were detected in concentrations much higher than those amounts of other essential amino acids in UF-Domiati cheese. While in the traditional cheese, the essential amino acids leucine, phenylalanine and valine were found in levels much higher than the concentrations of others. It is of interest that the observation of the lowest concentration of the essential amino acids were recorded for methionine in both UF and traditional Domiati cheese. In UF-Domiati cheese total non essential amino acids were found hihger than the traditional Domiati cheese.

Table (4) indicate the effect of the processing method of Domiati cheese on its contributions for daily requirements of essential amino acids for children and juveniles. The dialy requirements of essential amio acids were calculated using the following equation:

Daily requirements (%) = (total essential amino acids / Daily requirements) X 100.

The percentage refering to children and juveniles with 100 gram of cheese are 84.92 and 60.66 % for traditional product, while the UF-Domiati cheese covers 106.77 and 76.26% respectively.

It is clear that the contribution of UF-cheese for daily requirements of essential amino acids is 22.57 and 15.60% higher than that of traditional Domiati cheese for children and juveniles, respectively.

The findings of protein efficiency ratio (PER), biological value (BV) and net protein utilization (NPU) of UF-cheese computed using the first and third equation were higher than those calculated for traditional Domiati cheese. This result could be attributed to the higher concentration of leucine in the UF-cheese than in the traditional product, (Table 5).

Table (3): Amino acids content of traditional and UF-Domiati cheese

Amino acids	Milk	Traditional	UF-Domiati
Essential amino acids (EAA) %			
Histidine	0.06	0.22	0.51
Threonine	0.13	0.47	0.61
Valine	0.17	0.72	0.65
Methionine	0.06	0.23	0.38
Leucine	0.28	1.08	1.54
Isoleucine	0.15	0.56	0.74
Tyrosine	0.11	0.49	0.69
Phenylalanine	0.14	0.83	0.52
Lysine	0.23	0.46	0.96
Total (EAA)	1.33	5.06	6.60
Non-Essential amino acids (Non-EAA) %			
Arginine	0.08	0.52	0.67
Alanine	0.10	0.49	0.61
Serine	0.16	0.30	0.39
Glycine	0.06	0.45	0.58
Proline	0.33	1.04	1.36
Cystine	0.01	0.26	0.34
Aspartic acid	0.25	0.78	1.01
Glutamic acid	0.69	2.24	2.90
Total (Non-EAA)	1.68	6.08	7.86
Total amino acids	**3.01**	**11.14**	**14.46**

Table (4): Contribution of traditional and UF-Domiati cheese for daily requirements of essential amino acids

Amino acids	Traditional (g/100g)	UF-cheese (g/100g)	Recommended intake (g/day)*	
			Children (1-6 yr)	Juveniles (7-14 yr)
Histidine	0.22	0.51	0.10	0.20
Threonine	0.47	0.61	0.70	1.00
Valine	0.72	0.65	0.80	1.00
Methionine& Cystine	0.49	0.72	0.70	1.00
Leucine	1.08	1.54	1.20	1.70
Isoleucine	0.56	0.74	0.70	1.00
Phenylalanine& Tyrosine	1.32	1.21	1.10	1.60
Lysine	0.66	0.96	1.00	1.40
Tryptophane**	--	--	0.20	0.20
Total	5.52	6.94	6.50	9.10
Children	84.92 %	106.77 %		
Juveniles	60.66 %	76.26 %		

*** Jensen (1978) ** Not determined**

Table (5) Nutritive value of traditional and UF-Domiati cheese.

Item	Traditional	UF-Domiati
Protein efficiency ratio (PER)		
PER 1	3.34	3.75
PER 2	3.51	3.88
PER 3	2.92	3.60
Biological value (BV)		
BV 1	85.07	89.39
BV 2	86.86	90.76
BV 3	80.96	87.81
Net protein utilization (NPU)		
NPU 1	80.82	84.92
NPU 2	82.52	86.22
NPU 3	76.92	83.42

Also, a slight differences could be noticed in the concentration of the individual minerals in both UF and traditional Domiati cheese (Table 6). Ca, P and Mg were present in UF-Domiati cheese in much higher concentration than in traditional Domiati cheese. Slightly differences can be observed in levels of the trace elements between the both cheese. K is the same concentration in the traditional and UF-Domiati cheese (Table 6).

From the foregoing results, it was concluded that application of the UF-technique improved the richness and spreadability of the end product of Domiati cheese. Protein and fat contents of the UF-Domiati cheese were higher than those of the traditional Domiati cheese.

Table (6): Percentage daily intake of minerals (mg/ 100g) of Domiati cheese

Category		Children		Males		Females		Pregnant	lactating
Age (year)		1-6	7-10	11-24	25-50+	11-24	25-50+		
Ca	RDA	800	800	1200	800	1200	800	1200	1200
	Trad	158	158	158	158	158	158	158	158
	UF	325	325	325	325	325	325	325	325
P	RDA	800	800	1200	800	1200	800	1200	1200
	Trad	155	155	155	155	155	155	155	155
	UF	174	174	174	174	174	174	174	174
Mg	RDA	80	170	270	350	280	280	320	355
	Trad	15	15	15	15	15	15	15	15
	UF	33	33	33	33	33	33	33	33
K	RDA	500-1650	1000-3000	1525-4575	1875-5625	1525-4575	1875-5625		
	Trad	159	159	159	159	159	159	159	159
	UF	158	158	158	158	158	158	158	158
Na	RDA	325-975	600-1800	900-2700	1100-3300	900-2300	1100-3300		
	Trad	53	53	53	53	53	53	53	53
	UF	68	68	68	68	68	68	68	68
Zn	RDA	10	10	15	15	12	12	15	19
	Trad	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
	UF	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Fe	RDA	10	10	12	10	15	15	30	25
	Trad	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
	UF	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06

RDA :Recommended dietary allowance (mg) as reported by McLaren and Meguid (1988).

No big differences were observed in the levels of the individual minerals between the traditional and UF-Domiati cheese. Also, UF-Domiati cheese showed a slight effect on the nutritive characteristic of the end product compared to that made traditionally.

The contribution of UF-Domiati cheese for daily requirements of essential amino acids for children and juveniles were higher when the same amount of traditional product was consumed. Moreover, the higher concentration of leucine in the UF-cheese increased its PER, BV and NPU compared to those calculated for traditional Domiati cheese.

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القيمة الغذائية للجبن الدمياطى باستخدام طريقة الترشيح الفوقى والطريقة التقليدية

نبيل سامى عبدربه و محمود حمزة السنيطى

قسم الصناعات الغذائية والالبـان – المركز القومى للبحوث- الدقى –مصر.

تم فى هذا البحث تصنيع الجبن الدمياطى من لبن مركز بالترشيح الفوقى وكذلك بالطريقة التقليدية. وقد تم تقييم الجبن الناتج حسيا (من حيث المظهر، النكهه ، الطعم الدسم ، القابلية للفرد والقبول العام) . كما تم تقدير التركيب الكيماوى للجبن والذى يشتمل على الجوامد الكلية – الدهن- النتروجين الكلى – الرماد- الملح – النتروجين الذائب –الحموضة ومعامل التسوية كما تم أيضا تقدير محتوى الجبن الناتج من الاحماض الامينية والعناصر المعدنية وتم حسلب القيمة الغذائية للعينات عن طريق تقدير كفاءة البروتين والقيمة البيولوجية ودرجة الاستفادة من البروتين الصافى والاملاح التى يحتاجها الجسم يوميا للجبن المصنع بالطريقتين.

وقد أظهرت النتائج المتحصل عليها ان استخدام لبن مركز بالترشيح الفوقى فى تصنيع الجبن الدمياطى أعطى جبن ذات محتوى عالى من البروتين والدهن والاملاح المعدنية والرماد مقارنة بالجبن الناتج بالطريقة التقليدية . كما لوحظ أيضا ارتفاع فى محتوى الاحماض الامينية الاساسية فى الجبن الناتج باستخدام لبن مركزبالترشيح الفوقىعنه فى الطريقة التقليدية. كما تميز الجبن الناتج من لبن مركز بالترشيح الفوقى بارتفاع نسبة معدل الاستفادة من البروتين والقيمة البيولوجية ونسبة كفاءة البروتين مما يدل على أرتفاع القيمة الحيوية الغذائية للجبن الدمياطى المصنع من لبن مركز بالترشيح الفوقى عنه بالطرية التقليدية.