

## IMPROVING THE QUALITY OF EDAM-LIKE CHEESE MADE BY ULTRAFILTRATION TECHNIQUE

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*Accepted 13 / 3 / 2004*

**ABSTRACT** : An attempt has been made to enhance the quality and ripening of Edam like cheese made from cow's milk retentate. Freeze shocked or heat shocked cultures of *Lactobacillus helveticus* were added to the pre -cheese at levels of 1, 1.5 and 2%. Inoculation of pre cheese with freeze shocked or heat shocked starter cultures did not considerably affect moisture, Fat /DM and pH values of the resultant cheese. However these treatments accelerated the formation of soluble nitrogen (SN),non protein nitrogen (NPN)and amino acid nitrogen (AAN). Total volatile fatty acids (TVFA) was found to be almost the same in all treatments. The percentage of volatile fatty acids was increased in cheese containing freez shocked or heat shocked starters, meanwhile this treatment enhanced cheese flavor and body characteristics. Both freez shocked and heat shocked starters showed similar effect in this respect.

**Key wordes:** Edam cheese, Ultrafitration, heat shocked, freez shocked.

### INTRODUCTION

The principle of making cheese with ultrafiltration of milk is to include the whey proteins with consequent increase in cheese

yield. The basic problem in the use of UF concentrates is due to their increased buffering capacity which in turn inhibts starter activity delays or prevents the lowering of pH and results in a decreasing rate

of proteolysis and flavor development (Glover 1985).

El-Shabrawy (1985) compared proteolysis in Edam cheese made by the traditional method and ultrafiltration technique. He concluded that proteolysis was slower in UF cheese compared with traditional cheese. Several investigators have shown that the use of Freeze shocked starter cultures accelerated the rate of proteolysis and flavor development in several cheese varieties e.g. Gouda cheese (Bartels *et al.*, 1987 and kim *et al.*, 1986), Ras cheese (Aly 1990 and EL- Shafei *et al.*, 1992), Cheddar cheese (EL-abboudi *et al.*, 1992). The use of heat shocked starter cultures was also applied to accelerate cheese ripening process eg. in Cheddar cheese (Smokuti *et al.*, 1981), Ras cheese (Abdel Baky *et al.*, 1986), Gouda cheese (Bartels *et al.*, 1987), Feta cheese (Vafapoulou *et al.*, 1989).

The present work was carried out to evaluate the effect of using freeze shocked or heat shocked starter lactic cultures to enhance ripening and flavour development in Edam like cheese made by UF technique.

## MATERIALS AND METHODS

### Materials:

Fresh cow's milk was obtained from the herd of EL-Serw Station, Animal Production Research Institute Agriculture Research Center., Ministry of Agriculture, Egypt. Ultrafiltered whole cow milk retentate 35% total Solids was prepared using a UF-unit type 25151 (Surface area 6.8m<sup>2</sup>. Membran type mineral, Tubular Moduls type). A mixed cultures of *Lactococcus lactis* sub. sp.*lactis*, *Lactococcus lactis* sub sp. *cremoris*, *Lactococcus lactis* sup. sp.*diacetylatis* and *Lactobacillus helveticus* were obtained from TEXEL laboratarium, France. HALA rennet was obtained from Chr-Hansen's, Laboratory Denmark ., calcium chloride, sodium chloride pure grade were used in cheese manufacturing. A solution of mixture of white soft paraffin wax, pellet honey wax and vaseline was used as a coating material at ratio of (1: 1: 0.2). Low heat skim milk powder was obtained from France. Tryptone glucose yeast extract and nutrient agar media were obtained from Oxide Ltd. London.

**Preparation of freeze-shocked or heat shocked cultures:**

A culture of *L. helveticus* was freeze shocked or heat shocked as described by Frey *et al.*, (1986).

**Cheese manufacture:**

After the cultures of *L. helveticus* have been freeze shocked or heat shocked it was incorporated into the pre-cheese curd at rates of 0.1 , 1.5, and 2% during cheese making then Edam like cheese making was completed as the procedure suggested by Pahkala *et al.*, (1985).Control Edam like cheese was made using UF retentate without adding heat or freeze shocked cultures.

**Methods of analysis:**

Cheese samples were analysed for moisture, fat and total nitrogen (TN) and pH according to Ling (1963).Amin acid nitrogen (AAN) was Olsonassed according to Stadhouder (1959).Total volatile fatty acids (TVFA) was determined as described by Kosikowski (1978).

**Determination of Free Fatty acids:**

Analysis of free fatty acids was carried out at the laboratory of the Dairying Animal Production

Research Institute, sodium soaped free fatty acids was prepared according to Kuzdzal and Kuzdzal (1966)., Methylene esters of free fatty acids with C2: C18 chain length were prepared according to the method of Kuzdzal and Kuzdzal (1967).

Total bacterial count was carried out as described by Marth (1978). Proteolytic bacterial count was determined according to Chalmers (1962). Lipolytic bacterial count was determined as given by Sharf (1970).

**Sensory evaluation:**

The cheese samples were organoleptically assessed by 10 panelists for appearance (10), for flavour (50) and for body & texture(40) as mentioned by *Abdel Fattah (1966)*.

**RESULTS AND DISCUSSION**

**Moisture, fat and pH :**

Table (1) shows the gross chemical composition of Edam like cheese made by UF technique as affected by freeze shocked or heat shocked lactic starter cultures.

Concerning the moisture content, it could be seen that UF fresh cheese made with added

**Table (1): Gross chemical composition of Edam like cheese made from modified lactic cheese cultures.**

Property	Ripening Periods (day)	UF cheese (Control)	UF Cheese made with modified starter					
			% Freeze shocked			% heat shocked		
			1	1.5	2	1	1.5	2
Moisture %	0	48.11	47.90	47.92	47.83	48.21	48.12	48.51
	30	46.22	45.21	45.31	45.33	46.37	46.37	46.28
	60	39.21	39.10	39.12	39.11	39.22	39.30	39.24
	90	37.21	36.51	36.50	36.11	37.41	36.81	35.71
% Fat/DM	0	45.51	45.61	45.72	45.80	45.65	45.77	45.83
	30	46.12	46.22	46.32	46.51	46.32	46.51	46.69
	60	46.87	46.90	46.97	47.71	46.95	47.31	47.85
	90	46.99	47.11	47.21	48.15	47.21	47.55	48.23
pH	0	5.17	5.22	5.30	5.35	5.30	5.43	5.50
	30	5.15	5.18	5.23	5.41	5.22	5.29	5.71
	60	5.31	5.60	5.50	5.85	5.71	5.78	5.95
	90	5.91	5.99	6.00	6.08	6.20	6.09	6.08
TN%	0	3.75	3.78	3.81	3.92	3.79	3.82	3.95
	30	3.93	3.95	4.11	4.16	3.97	4.16	4.20
	60	4.20	4.27	4.39	4.39	4.29	4.42	4.41
	90	4.40	4.49	4.90	4.98	4.51	4.55	4.61

modified starters (Freeze or heat shocked) was almost the same compared with control cheese. Moisture content in all cases were found to be decreased gradually during ripening probably due to the formation of lactic acid which in turn led to shrinkage of cheese curd with consequent explosion of some moisture.

Increasing the level of added modified starter did not affect the moisture content when fresh or at each stage of ripening. The general trend of the obtained results agreed with that obtained by EL-Shabrawy (1985), and Spangler *et al.* (1991).

With regard to the fat content, it could be noticed that addition of modified starter cultures at different levels had negligible effect on fat contents. The obtained results are in agreement with those obtained by Ezzat and EL-Shafie (1991) and Kim *et al.*, (1994)

The pH values of Edam Like cheese made with added modified lactic starter cultures were higher than that of control cheese at the fresh and during the ripening periods. Meanwhile these results may be due to proteolysis and formation of certain cheese ripening degradation products (Godinho and Fox 1982).

#### **Change in some ripening indices:**

Soluble nitrogenous compounds (SN), non protein nitrogen (NPN), amino acid nitrogen (AAN) and total volatile fatty acids (TVFA) were taken as indices to evaluate the development in cheese ripening.(Table 2 ).

Edam like cheese made with added modified starter cultures had higher level of SN, NPN and AAN.

These observations were more remarkable in the cheeses containing the higher level of modified starter cultures. These results could be attributed to the action of proteolytic enzymes produced by freeze shocked or heat shocked starters. Similar results were obtained by other investigators (Pahkala *et al.*, (1985) Ezzat and EL-Shafie *et al.*, (1992) EL Shafie (1995) and Kebary *et al.*, (1996)) for certain cheese varieties.

Free volatile fatty acids (TVFA) were found to be higher in cheese with added modified starter cultures Table (2). This was more remarkable in cheese containing the higher level of added starter cultures. Meanwhile free volatile

**Table (2): Some ripening indices of Edam like cheese as affected by modified starter cultures.**

Property	Ripening Periods (days)	UF cheese (Control)	UF Cheese made with modified starter					
			% Freeze shocked			% heat shocked		
			1	1.5	2	1	1.5	2
SN/TN %	Fresh	6.20	6.34	6.82	7.14	6.59	7.32	7.59
	30	9.41	10.12	10.19	13.22	11.83	12.25	13.57
	60	12.14	14.29	14.80	16.40	13.98	15.61	18.82
	90	15.90	16.93	18.55	20.80	17.17	19.80	21.52
NPN/TN%	Fresh	4.26	4.49	4.98	5.10	5.01	5.23	5.31
	30	4.83	5.31	5.83	6.49	5.52	6.25	6.90
	60	5.47	6.32	7.06	8.20	6.56	7.23	8.61
	90	7.36	8.69	9.96	11.37	8.15	9.79	10.32
AAN/TN%	Fresh	1.30	1.50	1.60	1.83	1.60	1.70	2.05
	30	2.16	2.30	2.72	3.10	2.25	2.81	3.21
	60	4.70	5.10	5.12	5.62	5.12	5.18	6.30
	90	7.38	9.94	10.37	11.92	9.36	10.27	11.75
TVFA ml.0.1 NaOH/100g	Fresh	12.00	14.91	16.23	7.13	13.81	15.81	16.91
	30	19.27	23.95	28.78	31.92	22.22	27.11	30.11
	60	28.29	32.12	34.24	37.35	31.80	33.11	35.10
	90	33.99	35.21	38.92	41.29	35.00	37.91	39.08

TN: Total Nitrogen.

NPN: Non Protein Nitrogen .

SN: Soluble Nitrogen.

AAN: Amino Acid Nitrogen.

TVFA: Total Volatile Fatty Acids.

fatty acids increased gradually during the whole period of ripening. Similar results were obtained by Girgis *et al.*, (1983) Kime *et al.*, (1986), Aly (1990), El Shafie 1995 and El Soda *et al.*, (1999).

#### **Pattern of individual free fatty acids in ripened UF cheese.**

Table (3) shows the pattern of free fatty acids in UF Edam like cheese treated by the different levels of either freeze or heat shocked starter cultures. The pattern of free fatty acids in experimental and control cheeses was almost the same. The free volatile fatty acids in Edam Like cheese were found to be higher in cheese with added heat shocked starter culture. This was coupled with a decrease in the total non volatile fatty acids (C<sub>12</sub>-C<sub>18-3</sub>). Similar results were found by Aly (1990) and Kebary *et al.*, (1996).

#### **Bacteriological properties:**

Table (4) shows that cheese with added freeze shocked or heat shocked starter cultures had higher total bacterial count as well as higher proteolytic and lipolytic counts. These results could be due to the lysis of cells in freeze shocked or heat shocked starter and the liberation of intracellular enzymes which in turn enhanced

proteolysis and liberation of simple nitrogenous compounds. The latter compounds might stimulate the growth and activity of cheese flora in cheese with added modified starters.

#### **Organoleptic properties:**

Table (4) shows that cheese with added modified starter culture gained higher score points for flavour, body and texture and appearance.

At different stages of cheese ripening, this observation was more remarkable in cheese with added 2% heat shocked or freeze shocked starter culture. The higher score points given for experimental cheese during ripening could be attributed to the higher level of soluble nitrogenous compounds and total volatile fatty acids in cheese with added modified starter. These compounds are known to be good contributors to the better body and flavour observation in experimental cheese. No bitterness was developed in experimental cheese because modified starters provided a mixture of intracellular proteolytic enzymes i.e a proteinases, dipeptidases and amino peptidases. Similar results were obtained by Abdel Baky *et al.*, (1986), Kim *et al.*, 1986 and Abdeen 2000.

**Table (3): Free fatty acids contents of Edam cheese ripened for 90 days as affected by modified lactic culture .**

Carbon chain	UF cheese (Control.)	UF Cheese made with modified starter					
		% Freeze shocked			% heat shocked		
		1	1.5	2	1	1.5	2
C <sub>4</sub> + C <sub>6</sub>	2.232	1.285	1.488	1.273	3.105	2.553	4.569
C <sub>8</sub>	1.041	0.843	0.849	2.263	1.465	2.069	0.919
C <sub>10</sub>	1.655	1.864	1.867	1.899	2.327	2.246	1.578
Short	4.928	3.992	4.204	5.435	6.897	6.868	7.066
C <sub>12</sub>	1.683	2.396	1.969	1.041	2.514	2.226	1.135
Iso	0.316	0.443	0.085	-	-	0.211	0.119
C <sub>14</sub>	9.993	7.877	8.725	11.105	9.259	9.670	7.529
C <sub>14:1</sub>	-	0.922	1.681	-	-	-	2.559
C <sub>15</sub>	1.29	1.011	1.891	1.718	1.893	1.325	2.623
C <sub>15:1</sub>	0.373	-	-	-	2.713	-	-
Iso <sub>16</sub>	1.481	1.673	1.896	1.168	4.212	2.070	2.220
C <sub>16:1</sub>	19.371	26.363	24.80	24.891	32.433	30.707	24.349
C <sub>17</sub>	2.016	0.569	1.898	1.168	3.267	1.343	4.868
C <sub>17:1</sub>	3.131	-	1.228	0.568	-	-	2.543
C <sub>18</sub>	27.37	16.679	14.076	17.084	-	11.333	-
C <sub>18:1</sub>	19.272	36.982	-	-	19.690	32.254	18.336
C <sub>18:2</sub>	4.072	-	-	-	16.668	-	26.652



**Table (4): Changes in total bacterial, count  $\times 10^6$  (cfu/gm), Proteolytic bacterial count  $\times 10^4$  (cfu/gm) and Lipolytic bacterial count  $\times 10^3$  (cfu/gm) of Edama like cheese from UF milk as effected by modified lactic culture.**

Property	Ripening Period (days)	UF cheese (Contol)	UF Cheese made with modified starter					
			% Freeze shocked			% heat shocked		
			1	1.5	2	1	1.5	2
Total bacterial count	0	165	172	175	180	176	180	187
	30	76	80	85	95	102	112	120
	60	55	61	70	81	72	89	92
	90	25	21	23	30	31	33	42
Total proteolytic bacterial count	0	130	120	122	135	134	140	146
	30	42	91	99	103	84	99	101
	60	26	29	46	60	32	45	55
	90	12	20	21	23	16	21	25
Total lipolytic bacterial count	0	100	110	107	111	103	107	116
	30	41	45	49	50	51	55	61
	60	21	26	31	40	42	46	53
	90	15	19	20	21	23	26	31

**Table (5): Organoleptic properties of Edam like cheese as affected by modified starter culture.**

Ripening period (days)	Cheese Properties		UF cheese (Control)	UF Cheese made with modified starter					
				% Freeze shocked			% heat shocked		
				1	1.5	2	1	1.5	2
30	Flavour	50	35.50	39.00	34.00	35.00	34.00	35.00	36.00
	Body & Texture	40	30.50	31.00	37.00	36.50	31.00	34.00	36.00
	Appearance	10	7.00	8.00	8.00	8.50	8.00	7.00	7.00
	Total	100	76.00	78.00	79.00	80.00	73.00	76.00	79.00
60	Flavour	50	37.00	38.00	41.00	42.50	41.00	43.00	45.00
	Body & Texture	40	33.00	32.00	34.00	34.50	36.00	35.00	36.00
	Appearance	10	8.00	8.50	8.00	8.00	8.00	8.00	8.00
	Total	100	78.00	78.50	83.00	85.00	85.00	86.00	89.00
90	Flavour	50	37.50	44.00	46.00	48.50	46.00	47.00	47.50
	Body & Texture	40	33.00	35.00	38.00	39.00	36.00	37.00	39.00
	Appearance	10	9.00	9.00	9.00	9.50	9.50	9.00	9.50
	Total	100	7.00	88.00	93.00	97.00	91.50	93.00	96.00

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تحسين جودة الجبن الشبيهة بالإيدام

باستخدام تقنية الترشيح الفائق

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أجريت محاولة لتصنيع وتحسين جودة و تسوية الجبن الشبيه بجبن الإيدام(الفلمنك) وذلك من المركز البروتنسي للبن السقري المعامل بالترشيح الفائق و لتحسين خواص الجبن الناتج ثم استخدام بادي *Lactobacillus helveticus* بجانب البادئات المستخدمة في صناعة الجبن وذلك بعد معاملته بكل من صدمة التجميد وكذا الصدمة الحرارية بنسب ١ و ١,٥ و ٢%. كما تم صناعة جبن المقارنة من نفس اللبن المعامل بالترشيح الفائق بدون إضافة بادي *L. helveticus* المعامل بالصدمة الحرارية أو صدمة التجميد

وقد وجد أن معاملة خثرة الجبن بالبادئات المعاملة بالصدمة الحرارية أو الصدمة التجميدية لم يكن لها تأثير ملحوظا علي محتوى الجبن من الرطوبة والدهن وكذلك درجة الـ pH مقارنة بجبن المقارنة . بينما أدى ذلك إلي اسراع عملية إنفراد المركبات النتروجينية الذائبة وكذلك المواد النتروجينية غير البروتينية والأحماض الأمينية الحرورايضا زادت نسبة الأحماض الدهنية الحرة المتطايرة وذلك مقارنة بجبن المقارنة .

بالاضافة لذلك فإن استخدام البادئات المعاملة بالصدمة الحرارية وكذلك صدمة التجميد أدت إلي تحسين خواص النكهة والقوام وظهرت كلنا المعاملتين تأثيراً متشابهاً علي الخواص الحسية.