

## Improving the Quality of Domiati Cheese Made from Recombined Milk

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(Received: 28 October, 1985)

### ABSTRACT

*A trial has been carried out to improve the quality of Domiati cheese made from recombined milk. Addition of whey proteins/CMC complex recovered from whey, corresponding to 25% to 75% of cheese milk weight, increased cheese yield, reduced loss of weight during pickling and enhanced the body of cheese. Flavour intensity and the formation of soluble nitrogen compounds and Volatile Fatty Acids (VFA) were not affected.*

*Incorporating Piccantase B or Kapitalase K (commercial lipases) at 0.025% and 0.05% levels into the same cheese milk improved flavour intensity and the production of VFA. Flavour intensity of 4-weeks-old cheese made from lipase-treated milk (0.05%) was more pronounced than that of 8-weeks-old control cheese. Piccantase B was more effective in this respect. After 8 weeks of pickling, a rancid flavour was developed in cheese made from milk treated with the higher concentration of lipases (0.05%).*

## INTRODUCTION

Domiaty cheese is the most popular indigenous soft cheese in Egypt. Increasing demand for this type of cheese conflicts with a marked shortage in the fresh milk supply. Several studies have been carried out to solve this problem by the use of dried milk in cheese making (El Sadek *et al.*, 1974; Omar, 1977). The pickling of Domiaty cheese made from dried milk is complicated by technological problems such as marked loss in cheese weight, hard consistency (Rabie *et al.*, 1982) and slow flavour development (Omar *et al.*, 1983). Such characteristics lead to a cheese of inferior quality.

In the last three decades, attention has been drawn to the advantage of fortification of cheese milk with whey proteins. Many investigators have shown that this process improved cheese yield, body and nutritional value. Meanwhile, utilization of whey proteins in this way is of interest when considering the saving of natural resources and the solving of problems associated with pollution (Walker, 1970; El Shibiny *et al.*, 1973; Nebert *et al.*, 1974; Abdel Baky *et al.*, 1981).

Ohren & Tuckey (1969) and Liebich *et al.* (1970) suggested that Free Fatty Acids (FFA) are the basis of cheese flavour and that the characteristic aroma is related in particular to the ratio of FFA to other volatile components. Acceleration of milk fat hydrolysis by the incorporation of certain lipase preparations into either cheese milk or curd has been applied in cheese making as a useful controlled method to enhance the development of cheese flavour (Sood & Kosikowski, 1979; Abdel Salam *et al.*, 1979).

The aim of the present investigation was to evaluate the changes in yield, quality and ripening indices of Domiaty cheese made from recombined milk as they were affected by the incorporation in cheese milk of whey proteins and certain lipase preparations.

## MATERIALS AND METHODS

### Materials

Skimmed milk powder, produced in Holland, and standard calf liquid rennet were obtained from the Misr Milk and Food Company, Egypt. Butter oil produced in France was obtained from a local market.

Carboxymethyl cellulose with a substitution degree of 0.8 for the recovery of proteins from whey was supplied by the Hercules Company Ltd, London, Great Britain. Kapitalase K, an animal lipase preparation, was obtained from Dairy Land Food Laboratories, Waukesha, USA, and Piccantase B, a fungal esterase derived from *Mucor miehei*, was obtained from Rapidase, Seclin, France.

### **Preparation of whey proteins/CMC complex**

Salted whey was collected after the manufacture of Domiati cheese at the Laboratory of Dairying, Faculty of Agriculture, Zagazig University, Egypt. Whey was heated at 72 °C for 15 s to ensure good bacteriological quality, screened and cooled to about 25 °C. Equal volumes of whey and 0.25% CMC solution were mixed and the pH of the mixture was adjusted to 3.2. Mixtures were left for 1 h and the whey proteins/CMC complex was separated by centrifugation.

### **Domiati cheese making**

Two trials were carried out.

#### *Trial 1*

The first trial was undertaken to evaluate the effect of adding whey proteins/CMC complex to recombined milk on the yield, loss in weight and ripening changes of cheese.

Recombined cream of 25% fat was prepared at El Mansoura Factory, Misr Milk and Food Company, Egypt. Skimmed milk powder was reconstituted in warm water (40 °C) at a ratio of 1:8. The fat content of cheese milk was standardized to 4%, using the prepared recombined cream. Recombined milk was then divided into five equal parts (10 kg each). The first four parts were mixed well with whey proteins/CMC complex recovered from whey amounts equal to 25%, 50%, 75% and 100% of cheese milk weight, respectively. The fifth part was left without additives as a control. The cheese making process was completed as described by Fahmi & Sharara (1950). Domiati cheese was also made from fresh cow's milk obtained from the herd of the Faculty of Agriculture, Zagazig University, Egypt. Cheeses were pickled in their own drained whey after adjusting its salt content to about 10% and were stored at room temperature (20–25 °C) for 12 weeks.

### *Trial 2*

The second trial was carried out to evaluate the quality and ripening of Domiati cheese made from recombined milk with added whey proteins/CMC complex (at the recommended level based on the results of trial 1) as affected by certain lipase preparations.

Recombined milk (RM) of 4% fat was prepared as in the first trial. RM was incorporated with whey proteins/CMC complex recovered from an amount of whey equal to 75% of cheese milk weight. Milk was then divided into five equal parts. The first four parts were inoculated with Piccantase B or Kapalase K at concentrations of 0.025% and 0.05% for each preparation. The fifth part was left as a control. Resultant cheeses were pickled in their own drained wheys and stored at room temperature (20–25°C) for 12 weeks.

### **Chemical analysis**

Cheese samples were analysed for moisture, fat, salt, total N, soluble N and non-protein N as described by Ling (1963). Cheese fat acidity was estimated as described by Abdel Kader (1971). Total volatile acidity was determined as described by Kosikowski (1970), while the method of Harper (1953), was adopted to determine free Volatile Fatty Acids with chain lengths of C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub> and higher.

### **Organoleptic evaluation**

The organoleptic properties of cheese samples were examined according to the score sheet given by El Koussy *et al.* (1970) with maximum score points of 60 for flavour and 40 body and texture.

## RESULTS AND DISCUSSION

### **Effect of whey proteins/CMC complex on some properties of recombined milk cheese**

#### *Yield and loss in weight*

Table 1 shows that the incorporation of whey proteins/CMC complex in recombined milk increased the yield of fresh cheese in proportion to the amount of added whey proteins/CMC complex and reduced loss of

**TABLE 1**  
Yield and Loss in Weight of Domiati Cheese Made from Recombined Milk (RM) as Affected by Whey proteins/CMC Complex

Property	Pickling period (weeks)	Without additives (control)	RM cheese			
			A <sup>a</sup>	B <sup>a</sup>	C <sup>a</sup>	D <sup>a</sup>
Yield (%)	Fresh	24.60	25.00	26.10	26.80	27.72
	4	19.70	21.55	22.50	23.70	25.00
	8	15.10	19.80	20.90	22.00	23.90
Loss in weight (%)	Fresh	—	—	—	—	—
	4	19.90	14.40	13.80	11.60	9.70
	8	38.60	20.80	19.90	17.90	13.70

<sup>a</sup> Whey proteins/CMC complex was recovered from whey amounts equal to 25%, 50%, 75% and 100% of cheese milk weight in A, B, C and D, respectively.

weight on pickling. The higher yield and weight of cheese during pickling could be attributed to the increase of water retained in the curd due to the high water-binding capacity of the whey proteins/CMC complex. The general trend of the results obtained is in agreement with that reported by several investigators. Walker (1970) showed that the addition of whey proteins to cheese milk increased yield by 12% to 15%. Meanwhile, El Shibiny *et al.* (1973) reported that this treatment increased the yield of Domiati cheese by 2.8% to 6.7%.

#### *Protein, fat, salt and titratable acidity*

As expected, the cheese made from milk with added whey proteins/CMC complex contained more proteins at the fresh stage than after pickling. The protein content of fresh cheese was found to be increased by 0.6% to 2.6% compared with recombined milk cheese without added whey proteins (Table 2).

There was a small reduction in fat content; salt concentration was reduced at the lowest addition of whey protein but increased as the whey protein content was increased. The process did not affect the titratable acidity of the cheese in the fresh stage or during pickling. Similar results were reported by El-Shibiny *et al.* (1973) and Abdel Baky *et al.* (1981).

#### *Some ripening indices*

Soluble nitrogen (SN), non-protein nitrogen (NPN), Total Volatile Fatty

**TABLE 2**  
Gross Chemical Composition of Domiati Cheese Made from Recombined Milk (RM) as Affected by Whey Proteins/CMC Complex

Property	Pickling periods (weeks)	RM cheese				
		Without additives (control)	A <sup>a</sup>	B <sup>a</sup>	C <sup>a</sup>	D <sup>a</sup>
Moisture (%)	Fresh	62.12	61.10	62.20	63.70	64.42
	8	50.02	55.20	56.10	57.00	58.60
Fat (DM)	Fresh	43.7	43.6	43.1	43.0	43.0
	8	44.6	49.6	48.2	47.6	46.9
Salt (DM)	Fresh	17.5	17.1	17.1	17.3	17.6
	8	14.4	14.0	14.1	14.2	16.1
Acidity (Per cent of lactic acid)	Fresh	0.32	0.32	0.32	0.32	0.34
	8	1.30	1.32	1.32	1.34	1.34

<sup>a</sup> Whey proteins/CMC complex was recovered from whey amounts equal to 25%, 50%, 75% and 100% of cheese milk weight in A, B, C and D, respectively.

DM, Dry matter.

Acids (TVFA) and cheese fat acidity were taken as indices of cheese ripening (Table 3). These indicated that the ripening of Domiati cheese made from recombined milk was not affected by the addition of whey proteins/CMC complex to cheese milk, concentrations of SN, NPN and TVFA and cheese fat acidity being the same for control cheeses as for those with added whey proteins. These results agree with those of El-Shibiny *et al.* (1973) but differ from the conclusions of Abdel Baky *et al.* (1981) who reported that cheese made from fresh milk with added whey proteins showed higher levels of soluble nitrogen compounds and Total Volatile Fatty Acids compared with control cheese without additives.

#### *Organoleptic properties*

Table 4 indicates that recombined milk cheese with the addition of whey proteins/CMC complex had smooth body and firm consistency when fresh and during pickling. On the other hand, cheese without whey proteins showed weak body when fresh and acquired hard consistency during pickling. This may be because the extra whey proteins/CMC

**TABLE 3**

Some Ripening Indices of Domiati Cheese Made from Recombined Milk (RM) as Affected by Whey Proteins/CMC Complex

<i>Ripening index</i>	<i>Pickling period (weeks)</i>	<i>RM cheese</i>				
		<i>Without additives (control)</i>	<i>A<sup>a</sup></i>	<i>B<sup>a</sup></i>	<i>C<sup>a</sup></i>	<i>D<sup>a</sup></i>
Soluble N	Fresh	6.60	6.80	6.80	6.80	6.80
(Per cent of total N)	4	12.0	12.2	12.4	12.5	12.6
	8	18.8	19.2	19.9	19.3	19.6
Non-protein N	Fresh	2.76	2.70	2.72	2.70	2.81
(Per cent of total N)	4	3.70	3.90	3.96	3.98	4.00
	8	5.68	5.60	5.60	6.00	6.02
Total Volatile Fatty Acids	Fresh	3.32	3.30	3.36	3.36	3.40
(ml 0.1N NaOH/100 g)	4	8.00	8.40	8.42	8.40	8.62
	8	17.4	17.5	17.7	17.7	17.9
Cheese fat acidity	Fresh	0.30	0.32	0.32	0.32	0.32
(ml 0.1N NaOH/10 g cheese)	4	0.40	0.42	0.42	0.44	0.46
	8	0.68	0.70	0.72	0.74	0.74

<sup>a</sup> Whey proteins/CMC complex was recovered from whey amounts equal to 25%, 50%, 75% and 100% of cheese milk weight in A, B, C and D, respectively.

**TABLE 4**

Organoleptic Properties of Domiati Cheese Made from Recombined Milk as Affected by Whey Proteins/CMC Complex

<i>Property</i>	<i>Pickling period (weeks)</i>	<i>RM cheese</i>				
		<i>Without additives (control)</i>	<i>A<sup>a</sup></i>	<i>B<sup>a</sup></i>	<i>C<sup>a</sup></i>	<i>D<sup>a</sup></i>
Flavour (60)	Fresh	35	37	37	37	37
	4	45	46	48	49	49
	8	46	48	50	50	50
Body and texture (60)	Fresh	29	31	32	32	30
	4	30	33	33	34	32
	8	32	34	35	36	28

<sup>a</sup> Whey proteins/CMC complex was recovered from whey amounts equal to 25%, 50%, 75% and 100% of cheese milk weight in A, B, C and D, respectively.

complex increased the capacity of the curd to retain moisture which, in turn, influenced cheese consistency (El Shibiny *et al.*, 1973). It was found that the fresh cheese generally had a flat flavour with a slightly more acidic taste than the control.

The addition of whey proteins/CMC complex to cheese milk did not improve cheese flavour, either when freshly made or after a pickling period of 8 weeks. It is concluded that proteins recovered from whey with CMC could be used successfully to improve yield, loss in weight and body characteristics of Domiati cheese made from recombined milk without adversely affecting its flavour.

### **Quality and ripening changes of recombined milk cheese as affected by whey proteins/CMC complex and certain lipase preparations**

Whey proteins recovered from an amount of whey equal to 75% of milk weight were used as an additive to recombined milk to enhance body characteristics (as recommended above). In addition, milk was treated with Kapitalase K or Piccantase B to increase the accumulation of Free Fatty Acids which are considered by several investigators to be the basis of cheese flavour (Ohren & Tuckey, 1969; Liebich *et al.*, 1970).

#### *Cheese fat acidity*

Both Piccantase B and Kapitalase K added to cheese milk stimulated the hydrolysis of cheese fat, as indicated by increased acidity (Table 5). This effect was more pronounced with Piccantase B. A further increase in cheese fat acidity was observed in cheese made from milk treated with the higher concentration (0.05%) of both lipase preparations. Several investigators have shown that lipolysis in cheese was accelerated by adding lipase preparations to cheese milk or curd (Peppler, 1975; Abdel Salam *et al.*, 1979).

#### *Soluble nitrogen compounds*

Concentrations of soluble nitrogen and non-protein nitrogen (Table 5) indicate that the degree of protein degradation in cheese made from lipase-treated milk was slightly higher than that of control cheese made from RM enriched with whey proteins/CMC complex only. This can be attributed to contamination of such lipase preparations with proteinases (Jolly & Kosikowski, 1978).



**TABLE 5**  
Effect of Certain Lipase Preparations on Some Ripening Indices of Domiati Cheese Made from Recombined Milk with Added Whey Proteins/CMC Complex<sup>a</sup>

Property	Pickling period (weeks)	Control cheese (without lipase)	Piccantase B		Kapalase K	
			0.025%	0.05%	0.025%	0.05%
Soluble N (Per cent of TN)	Fresh	6.51	6.70	6.70	6.72	6.76
	4	14.2	15.2	15.6	15.3	15.7
	8	20.0	20.0	21.0	21.0	21.2
NPN (Per cent of TN)	Fresh	3.00	3.02	3.10	3.10	3.12
	4	4.20	4.66	4.68	4.70	4.82
	8	5.00	5.50	5.48	5.56	5.60
Cheese fat acidity (ml 0.1N NaOH/10 g fat)	Fresh	0.46	0.60	0.66	0.48	0.52
	4	0.54	1.00	1.20	0.80	0.92
	8	0.90	1.90	2.30	1.28	1.42

<sup>a</sup> Whey proteins/CMC complex was recovered from whey amount equal to 75% of cheese milk weight.

#### *Free Volatile Fatty Acids*

Neither acetic nor propionic acids were remarkably affected by the addition of lipases. This may be because these acids are formed in cheese by fermentation of lactose, as well as by decarboxylation and deamination of amino acids through specific metabolic pathways (Nakae & Elliott, 1965). On the other hand, the concentrations of butyric acid and acids with chain lengths of C<sub>5</sub> and higher were found to be greater in cheese made from lipase-treated milk, probably due to the greater fat hydrolysis by such lipase preparations. Also, a greater accumulation of acids of C<sub>4</sub> chain length and higher was observed in cheese made from Piccantase B—treated milk. It is clear, also, that the addition of lipases to cheese milk reduced the time required for Free Fatty Acids formation. Thus, the level of Total Free Fatty Acids in 4-weeks-old cheese made from recombined milk with added 0.025% lipase preparation was similar to, or even greater than, that of control cheese pickled for 8 weeks (Table 6).

#### *Organoleptic properties*

It is evident from Table 7 that Domiati cheese made from recombined milk enriched with whey proteins/CMC complex combined with either

**TABLE 6**  
Effect of Certain Lipase Preparations on Free Volatile Fatty Acids of Domiati Cheese Made from Recombined Milk with Added Whey Proteins/CMC Complex<sup>a</sup>

Pickling periods (weeks)	FFA	Fresh milk cheese	Without additives (control)	Picantase B		Kapalase K	
				0.025%	0.05%	0.025%	0.05%
Fresh	C <sub>2</sub>	2.00	1.80	2.00	2.00	2.00	2.00
	C <sub>3</sub>	0.30	0.20	0.40	0.40	0.42	0.40
	C <sub>4</sub>	1.20	0.80	1.86	2.50	2.50	1.98
	C <sub>5</sub> and higher	4.20	2.60	6.20	6.60	3.50	5.60
	Total	7.70	5.40	10.5	11.5	1.42	9.98
4	C <sub>2</sub>	2.60	1.40	2.20	2.20	2.60	2.60
	C <sub>3</sub>	0.50	0.50	0.50	0.50	0.50	0.50
	C <sub>4</sub>	2.20	1.30	3.40	5.60	2.20	3.50
	C <sub>5</sub> and higher	6.70	3.80	9.80	11.20	7.20	9.80
	Total	12.0	7.00	15.4	19.5	12.5	16.4
8	C <sub>2</sub>	2.80	3.00	3.00	3.00	3.00	3.00
	C <sub>3</sub>	0.50	0.60	0.68	0.68	0.70	0.70
	C <sub>4</sub>	2.80	4.00	6.00	7.20	3.58	5.40
	C <sub>5</sub> and higher	10.2	6.20	14.1	20.2	10.2	15.9
	Total	16.3	13.8	23.8	31.1	17.5	20.0

<sup>a</sup> Whey proteins/CMC complex was recovered from whey amount equal to 75% of milk weight.

**TABLE 7**  
Effect of Certain Lipase Preparations on the Organoleptic Properties of Domiati Cheese Made from Recombined Milk with Added Whey Proteins/CMC Complex<sup>a</sup>

Property	Pickling periods (weeks)	Control	Picantase B		Kapalase K	
			0.025%	0.05%	0.025%	0.05%
Flavour (60)	Fresh	36	42	43	41	42
	4	43	51	53	50	52
	6	46	55	42	52	46
Body and texture (40)	Fresh	30	30	31	31	31
	4	32	32	32	32	32
	8	34	35	35	35	35

<sup>a</sup> Whey proteins/CMC complex was recovered from whey amount equal to 75% of milk weight.

Piccantase B or Kapalase K at concentrations of 0.025% and 0.05% showed, after 4 weeks of pickling, good flavour and acceptable consistency. Moreover, its flavour intensity was, in general, more pronounced at 4 weeks than in control cheese pickled for 8 weeks. Cheese consistency improved for the different treatments during the period of pickling. However, rancid flavour developed in cheese made from milk treated with both lipase preparations at a concentration of 0.05% after 8 weeks of pickling. Controlled lipolysis of milk fat has been applied in cheese making to enhance the development of cheese flavour (Sood & Kosikowski, 1979; El Neshawy, 1980).

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