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Production of White Soft Cheese without Whey Separation

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Abstract

A new protocol for the manufacturing of white soft cheese (Egyptian Domiati Cheese) by using a combination of cow's whole milk and dried whole milk to produce cheese without separation of whey as a secondary by-product was investigated.
In this study, different percentages of dried whole milk (0, 5, 10, 15, 20, 25, 30, 35, and 40% were added into cow milk. The results showed that the yield of cheese increased to 99.28% in cheese made by using 40% dried milk compared to 21.25, 33.33, 58.33, and 75.00% yield values with the addition of 0, 10, 20, and 30% of dried milk, respectively. The protein content of cheese was also increased gradually with increasing the added amounts of dried milk reaching to 11.71% compared to 6.74% for the control treatment (on wet weight bases). Also, the produced cheese scored higher values for taste, cheese cut, texture, and overall score compared to control and other treatments. This protocol can introduce the opportunity to coagulate the cheese curd with rennet in the package prepared for the marketing directly.

Key words: Domiati cheese, cheese without whey, coagulation in package, whey protein

Introduction

Dried powder milk has become a staple article of commerce as it contains all the nutritive values of the milk from which it was manufactured with a high reduction of volume and weight.

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The ordinary reconstituted milk further differs from natural milk in that it is not readily casein defied on the addition of rennet, it does not get the ordinary agglutinating curd necessary for cheese-making. Approximately, one million tons of milk powder is used over the world annually for making cheese. Fermented milk products such as yogurt and fresh cheeses can readily be manufactured from recombined milk, but it is more difficult to produce hard and semi-hard cheeses. The most critical factor in the manufacture of cheese from recombined milk is the quality of the milk powder used (Gilles and Lawrence, 1981).

Domiati cheese is the most important white pickled cheese made from fresh cow and buffalo milk. The unique step in its manufacturing is the addition of (10-14%) salt directly to cheese milk before rennet treatment. The yield is highly dependent on the quality and season of milk production. The cheese is consumed after three months (semi-ripened) or after 6 months (well ripened). Its production needs big capital because of the high prices of milk and the cost of ripening (Hamad, 2015).

Whey produced during cheese making as a by-product limits productivity and results in the loss of valuable proteins from the cheese produced. The production of whey can also create additional costs for waste treatment, even though whey contains food-grade ingredients that have been separated from milk. The inability of whey proteins to be retained in cheese is an important factor contributing to a lake of efficiency in the production of cheese, including a reduction in overall yield and increased costs (Fadaei. *et al.* 2012). In addition, cheese produced without whey separation had 100% yield, increased capacity on the production line, reduced milk usage up to 70%, reduced CO_2 emission, and consistently high-quality products.

This research was carried out to evaluate the benefit, in terms of the evaluation of physical and chemical characteristics of Egyptian Domiati cheese produced from a mixture of natural cow's whole milk with adding different amounts of whole milk powder until reaching a product of cheese without any separated whey as a secondary product. Where the output cheese contains a collection of components that present in both types of milk without any loss occur (especially whey proteins) leading to increased utilization of all milk components, which increase the nutritional value of cheese produced and minimize of the environmental pollution resulting from the whey cheese as an environmental contaminant. As well as developing the sensory quality of cheese. Different percentages of dried whole milk have been added to the fresh cow's whole milk to reach the degree of zero whey production during the coagulation

process by using an enzyme rennin. Estimation of the protein content of cheese product samples and sensory evaluation of resulted cheese compared to cheese manufactured by traditional methods from natural whole milk was carried out.

Materials and Methods

Fresh cow milk was obtained from the herd Faculty of Agric. Assiut Uni., Milk powder (MP) imported from the USA was obtained from the local market, whereas liquid animal rennet, sodium chloride, and calcium chloride were obtained from the local market.

Starter culture:

Mesophilic starter cultures containing *Lactococcus lactis subsp. cremoris* and *Lactococcus lactis subsp. lactis* were obtained from the Dairy Products Plant, Assiut University.

Cheese making:

Manufacturing of Domiati cheese was carried out according to the method of Fahmi and Sharara (1950) with some modifications described by Baraka, *et al.* (2019). The control samples of soft cheese were made from fresh cow milk standardized to contain 3.5% fat, whereas the experimental samples were manufactured by adding different ratios of dried milk into the fresh standard cow's milk as follows: 50, 100, 150, 200, 250, 300, 350, and 400 g of dried milk/liter cow's milk to increase the total solids (TS). All milk batches were heated to 75°C for 15 sec. 10% (w/w) sodium chloride was added, after filtration through a tight muslin, 0.01% $CaCl_2$ solution was added, left 30 minutes before the addition of starter culture (1% w/w) and liquid rennet (60 ml/100 L.) to salted milk to achieve coagulation in 150 min. The obtained cheese batches were separately pickled in their whey and stored at 6±2°C for 3 months.

Chemical analysis:

Moisture content, solid not fat (SNF) and titratable acidity of milk powder used in this study were measured according to the method described in A.O.A.C. (2000). Fat percentage was determined by using Gerber method as described by Ling (1963). The total protein content was determined by Kjeldahl method according to A.O.A.C. (2000). The total Solids and ash content were measured according to A.O.A.C. (2000). Total sugars were measured by the Anthron method as described by Hedge and Hofreiter, (1962) by using Spectrophotometer (Uvi-line 9400, Germany). The pH values were measured using a pH meter (model ICM 14111), USA.

Yield calculation:

The actual yield of Domiati cheese was determined by weighing the cheese after removal from brine and expressed as a percentage of the milk weight in the respective vat (Shakeed *et al*., 2003).

$$\text{Cheese yield} = \frac{\text{Weight of cheese}}{\text{Weight of cheese milk}} \times 100$$

The yield of designed cast cheese was calculated as 96% of the total ingredients including water. All experiments were carried out in triplicate.

Organoleptic examination:

The cheese samples were organoleptically scored by 15 members at Dairy Technology Department, Assiut University using a scorecard for Taste (40 points), Cheese cut (20 points), Texture (20 points), and General acceptability (20 points). This was done according to Nelson and Trout (1981) and Hassan, *et al.* (1983).

Results and Discussion

Chemical characteristics of Fresh cow milk and dried whole milk.

The average values of chemical composition and some of the chemical properties of Fresh cow milk and dried milk used in the study are given in Table (1).

Table 1: Chemical characteristics of fresh and dried milk used in the study.

Milk type	Total solids (%)	Moisture (%)	SNF (%)	Lactose (%)	Ash (%)	Protein (%)	Fat (%)	Acidity (%)	pH
Dried	96.63	3.37	68.81	37.31	5.48	26.04	27.83	0.13	6.7
Fresh	12.8	87.2	9.3	4.6	0.72	3.05	3.5	0.19	6.6

The yield of cheese is one of the most important economic parameters for cheese manufacturers. Data in Table (2), illustrated in Fig. (1) showed that the addition of milk powder to liquid cow's milk significantly increased the yield values of soft cheese compared to those of the control samples.

The highest yield (99.28 %) was recorded for the cheese made from 400 g milk powder/L cow's milk compared to control (21.25%) and all other treatments. Also, the highest amount of whey released was recorded in the control treatment (3.15Kg) and treatment made from 50 g milk powder/L cow milk) (3.2Kg) and then reduced gradually to the minimum value in the treatment of 400 g milk powder/L cow milk (0.02Kg). These results were in agreement with those obtained by Hattem and Hassabo (2015).

The organoleptic evaluation as shown in Table (3) revealed that as milk powder increased, the taste, cheese cut, texture, and general acceptability of cheese were improved. Cheese from treatment

No.9 (400 g milk powder /1-liter cow milk) recorded the highest overall score as compared with other treatments.

Evaluation of protein contents in cheese and whey samples obtained from different treatments.

Results illustrated in Figures (2&3) showed that the protein content of cheese (on wet weight bases) increased gradually with the addition of dried milk. Protein contents in Domiati cheese were increased from 6.742% in treatment containing 500 g dried milk/2 L liquid cow's milk (25%) to 11.713% protein in treatment containing 800 g dried milk/2 L liquid cow's milk (40%). On the other hand, protein contents of whey samples increased with the addition of powdered milk from 1.232% in whey of treatment contained 300 g milk powder/2 L liquid cow's milk to 3.736% in whey of treatment contained 700 g milk powder/2L cow milk. Increasing the added amount of dried milk to 800 g/2 L of liquid cow's milk resulted in no whey production, which means that the total amounts of milk proteins and all of the milk components were incorporated into the produced cheese and no losses have occurred.

Conclusion

Production of soft cheese without whey formation by increasing the added amount of dried milk led to the employment of water content of the liquid milk as a solvent for rehydration of the added dried milk. This idea resulted in increasing the yield of cheese to 99.28% in cheese made using 400g powdered milk/ Liquid cow's milk compared to 21.25, 33.33, 58.33, and 75.00% yield values for the addition of 0, 100, 200, and 300g powdered milk/L liquid cow's milk, respectively. Besides, the prevention of whey formation increased the protein content and developed the organoleptic properties of the obtained cheese as well as, reduction of the environmental contamination.

Table 2: Different treatments for the manufacturing of Domiati cheese by adding different proportions of dried milk.

Type of treatment	Natural cow's Milk specifications	Milk weight prepared for industry (Kg)	Cheese Weight (Kg)	Whey weight (Kg)	Cheese yield (%)
1. Control	Fat :3.5% specific density:1,027 acidity: 0.19%	4.0	0.85	3.15	21.25
2. 50 g milk powder / 1 liter cow's milk	Fat :3.5% specific density:1.027 acidity: 0.19%	4.2	1.0	3.2	23.80
3. 100 g milk powder / 1 liter cow's milk	Fat :3.5% specific density:1,028 acidity: 0.17%	3.3	1.1	2.2	33.33
4. 150 g milk powder / 1 liter cow's milk	Fat :3.5% specific density:1,028 acidity: 0.17%	3.45	1.6	1.85	46.37
5. 200 g milk powder / 1 liter cow's milk	Fat :3.5% specific density:1,0285 acidity: 0.18%	2.4	1.4	1.0	58.33
6. 250 g milk powder / 1 liter cow's milk	Fat :3.5% specific density:1,029 acidity: 0.18%	2.5	1.6	0.9	64.00
7. 300 g milk powder / 1 liter cow's milk	Fat :3.5% specific density:1,029 acidity: 0.18%	2.6	1.95	0.65	75.00
8. 350 g milk powder / 1 liter cow's milk	Fat :3.5% specific density:1,029 acidity: 0.19%	2.7	2.39	0.315	88.50
9. 400 g milk powder / 1 liter cow's milk	Fat :3.5% specific density:1,029 acidity: 0.19%	2.8	2.78	0.02	99.28

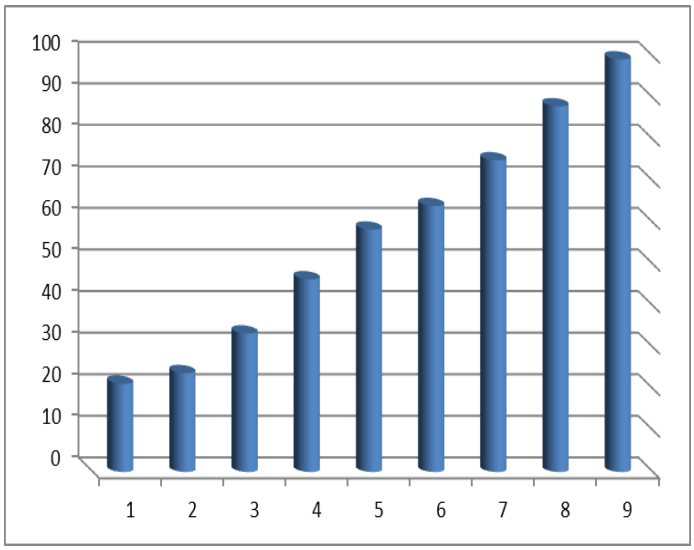

Figure 1: Effect of different treatments on the soft cheese yield (%).

Table 3: Organoleptic evaluation of cheese produced from different treatments.

Type of treatment	Taste (40)	Cheese cut (20)	Texture (20)	General acceptability(20)	Overall Scores (100)
Control	27.14	11.7	10.57	12.57	61.98
50 g milk powder / 1 liter cow's milk	27.6	15.2	13.1	14.8	70.7
100 g milk powder / 1 liter cow's milk	35.4	15.8	17.2	17.1	85.5
150 g milk powder / 1 liter cow's milk	35.8	15.85	17.7	17.5	86.85
200 g milk powder / 1 liter cow's milk	36.5	17.5	17.2	17.4	88.6
250 g milk powder / 1 liter cow's milk	36.7	17.7	18	18.2	90.6
300 g milk powder / 1 liter cow's milk	36.9	17.2	17.8	18.5	90.4
350 g milk powder / 1 liter cow's milk	36.6	17.16	17.66	17.9	89.32
400 g milk powder / 1 liter cow's milk	38	18.14	18	18.85	92.99

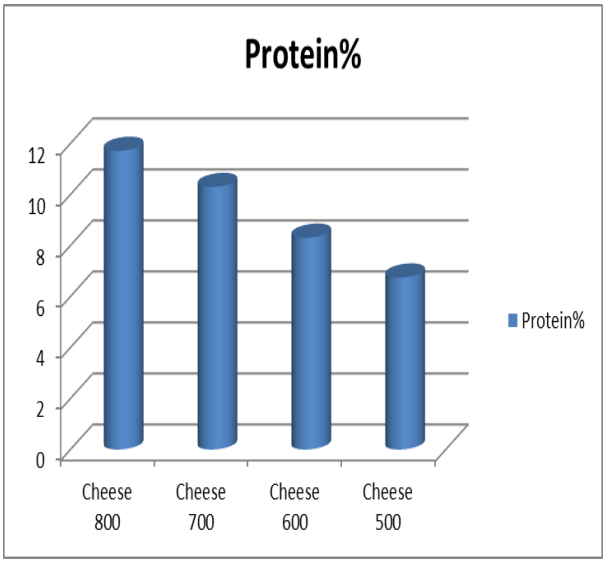

Figure 2: Protein content in cheese samples produced by adding different amounts of dried milk.

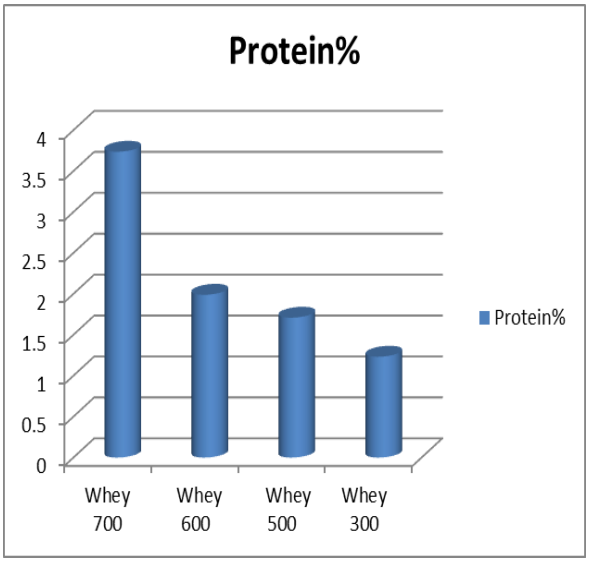

Figure 3: Protein content in whey samples released from different manufacturing treatments.

Acknowledgments

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