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Making Domiati Cheese from Mixtures of Cow's Milk and Milk Powder

Halima F. Abbas[1] ; A. A. Tammam[1]; Nanis H. Gomah[1-2]; Y. M. A. Elderwy[1] and Asmaa H. M. Moneeb[1*]

[1] Department of Dairy Science, Faculty of Agriculture, Assiut University, Assiut 71526, Egypt.
[2]College of Science, University of Hafr Al Batin, P.O. Box: 1803,Saudi Arabia.

ABSTRACT

Domiati cheese was made by mixing cow's full cream milk with five levels of milk powder. Fresh cow's Domiati cheese with no additive was taken as control. Other treatments: T1, T2, T3, and T4, were made with added 10, 20, 30 and 40%, respectively, of milk powder to the fresh cow's full cream milk before pasteurization. Examined cheese treatments were stored in pickle at 5°C., and analyzed after 15, 30, 45 and 60 days of storage. Highiest moisture content was detected in the control and lower yield, acidity, fat, total protein(TP), salt, soluble nitrogen(SN), total volatile fatty acids(TVFA), tyrosine and tryptophan were detected in the control ,compared with cheese treatments with added milk powder. An increase in the yield, acidity, fat, TP, salt, SN, TVFA, tyrosine and tryptophan was observed by increasing of milk powder in all of the examined treatments. Meanwhile, prolonging of the storage period resulted in decrease in yield and moisture cntent and increase of acidity, fat, TP, SN, TVFA,tyrosineand tryptophan. An increase in Total bacterial count, lactic acid bacteria, proteolytic bacteria and Yeast &moulds increased in all treatments by increasing the level of milk powder, and by increasing the storage period. no detection of All of the examed treatments were found completely free of coliform. Organolepticaly, Domiati cheese made from mixtures of cow milk and milk powder gained a higher score for appearance, body & texture,flavourand overall acceptability than control samples. Knowing that by the end of the storage period, T2 was the highest.

Keywords: Domiati cheese; Milk powder; Chemical composition; Microbiological analysis; Sensory quality.

INTRODUCTION

Cheese is a dairy product that has played a key rolein human nutrition for centuries. It is a popular food in almost all countries worldwide, because of its known health benefits and distinct flavor. Additionally, cheese contains high amounts of calcium, phosphorus, and valuable proteins,.The broad range ofdifferent cheeses available is based mainly on regionalconditions and production technology, which has beenrepeatedly adapted and optimized. The main objectivehas always been and still is to convert milk, which isperishable, into a product with a longer shelf-life whilstpreserving its nutrients (Hinrichs, 2001, Ross *et al*., 2011, USDA, 2011 and Kongo, 2013).

Rennet coagulation of milk in combination withfermentation is an effective means of dehydrating theresulting curd that forms at the expense of losingvaluable whey proteins. New technologies have enabledthe integration of the whey proteins and different milkconstituents into the cheese matrix to improveits nutrient value as well as the economic effectiveness ofproducedcheese.Cheese produced without whey separation had 100% yield, increased capacity on the production line, reduced milk usage up to 70%, reduced CO2 emission, and consistently high-quality products (Gomah *et al*., 2019 and Hinrichs, 2001).

Due to the huge gap between production and market demands of milk, cheese manufacturer in several countries relies, either partially or totally, on milk powders. Milk powder has specific functional properties that increase its participation in cheese making, including easier handling, transportation, processing and use in product formulations(Sharma *et al*., 2012).

Several studies have been carried out to increase the yield of cheese by reducing the loss of whey during cheese manufacturing. This is due to the lack of ability to reuse salted whey rendered after Domiati cheese making.Whey-less soft cheese contains around 64% moisture having a high whey protein: casein ratio; this also could contribute to increasing production profits Furthermore, reducing the whey loss from cheese can reduce the loss of huge amounts of lactose and milk protein existed in whey and reduce the environmental pollution, through reduction of gas emission .In a study of making Mozzarella cheese from recombined milk using modified milk powder, it helped in giving7.3% higher cheese yield, and cheese-making abilities similarto those of raw milk (Garem *et al*., 2000, Walzem *et al*., 2002 and Walzem *et al*., 2002).

Whey possesses a high nutritive value; it contains around 20% of proteins that existed in the original milk. Disposal and/or utilization of whey have a major worldwide interest among dairy specialists, due to its valuable components that should not be wasted, in addition to concerns on environmental pollution matters. It is hypothesized that the use of full cream milk powder in making the Domiati cheese is expected to reduce whey loss by modifying the total solids of milk (Smithers *et al*., 1996).

The objective of the present experiment was to study the influences of using full cream milk powder on the yield,

* **Corresponding author.**
E-mail address: asmaa_moneeb@yahoo.com
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composition, microbiological quality and sensory properties of Domiati cheese when fresh and during the storage period.

MATERIALS AND METHODS

Fresh whole cow's milk was obtained from the herd of Faculty of Agriculture, Assiut University with an average composition of (3.5% fat, 0.18% acidity, 2.84% protein and 4.83% lactose). Full cream milk powder(instant fortified product of New Zealand, (28.4% fat, 39% lactose and 24% protein) were used. Salt (El-salaam product of Egypt) was obtained from the local markets in Assiut city. Starter culture of lactic acid bacteria (*Lactococcus lactis* subsp *lactis* and *Lactococcus lactis* subsp. *cremoris)were* obtained from the National Research Center inGiza. Microbial Rennet Powder (Proquiga S.A, Spain) was used.

The present study was conducted at the laboratory of the Dairy Science Department, Faculty of Agriculture, Assiut University. Five treatments of Domiati cheese were carried out as follows: First treatment is a control in which fresh cow's full cream milk had no additive. In the other treatments T1, T2, T3, and T4, full cream milk powder was added at 10, 20, 30 and 40%, respectively, to the fresh cow's full cream milk before pasteurization..Domiati cheese was made as descriped by Ibrahim, (2003) with some modifications. Fresh and recombined milk were pasteurized at 72°C/15 sec. ٦% w/v salt was added to the milk, mixed and cooled to 42°C. Commercial starter culture of *Lactococcus lactis* subsp *lactis* and *Lactococcus lactis* subsp. *cremoris* in the ratio of 1:1% was added at the level of 1 % (w/v) of the milk. The milk was stirred gently and left for 30 minutes. Rennet was added to the milk at 40°C. Milk was then stirred for 10 minutes and left until coagulation occurred. The coagulum was then ladled into rectangular stainless steel moulds, left for 8 hours, lightly pressed overnight. Cubes of cheese were placed in plastic containers filled with whey and kept under refrigeration for 60 days.

Yield of Domiati cheese was determined by weighing the cheese and calculated using the following formula:

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

Cheese samples were also analyzed for moisture, titratable acidity, total protein, soluble nitrogen and salt according to AOAC(2012).Fat contents of samples were measured using the Gerber method (Ardö and Polychroniadou, 1999).Total volatile fatty acids (TVFA) were determined by the method of Kosikowski (1982).Tyrosine and Tryptophan were determined by the method of Vakaleris and Price (1959). Organoleptic scoring was done as described by ehaia (2006). Staff members of the Department of Dairy Science, Faculty of Agriculture, Assiut University participated in scoring. Evaluation using 15 points for the appearance, 40 points for body&texture,45 points for flavor and with overall acceptability of 100 points.

Total bacterial colony forming units (CFU) was determined by using the standard plate count technique as described by Marshall (2004).Lactic acid bacteria by Richter *et al.* (2001) using the MRS agar medium a.A 10% suspension of sterile skim milk in nutrient agar medium (Tammam, 2007)was used for counting the proteolytic bacteria. Dilutions of samples were incubated for 3 days at 30ºc.Duplicate tubes of MacConkey broth were used for the detection of the coliform numbers by the multiple tube technique, using Cohran(1950)method after incubation at 37°C for two days.Enumeration and counts of yeasts & molds were carried out in the samples using the media of potato dextrose agar as the method recommended by Awad *et al.* (2010).All the media were sterilized by autoclaving for 15 minutes at 121 °C.

Data were statistically analyzed using CoStat computer program (Steel, R.G.D., Torric,1980), significant differences were determined at $p \leq 0.05$

RESULT AND DISCUSSION

1. Cheese yield

Cheese yield is affected by many factors including milk composition, concentration and genetic variants of casein, milk quality, pasteurization treatment (Abd El-Gawad and Ahmed, 2011; Salem *et al*., 2007). Results presented in Table (1) show the yield of Domiati cheese made from full cream milk and milk powder when fresh and during the storage period. The yield increased by increasing the concentration of added full cream milk powder. Also, the yield of fresh cheese made from a mixture of cow milk and full cream milk powder was higher than the control. In addition, all cheese samples showed a gradual loss of yield during the storage period

Table 1. Yield of Domiati cheese made with milk powder during the storage period:-

Storage Period (day)	Control	T1	T2	T3	T4
Fresh	16%	29.21 %	55.5%	70%	87.41%
15 day	14.75%	27.31%	52.25%	69.38%	85.25%
30 day	13.33%	25.47%	49.10%	67.12%	81.75%
45 day	12.52%	23.60%	45.45%	61.11%	78.55%
60 day	11.66%	20.73%	40.30%	56.15%	73.40%
Means	13.65	25.26	48.53	64.75	81.27

control cheese: had no additive. T1, T2, T3, and T4: full cream milk powder was added with the percentages of 10, 20, 30 and 40%, respectively.

The loss in cheese yield during the storage period could be attributed to the whey draining, which agrees with that reported byMohran and Fahmy (1989). Higher cheese yield was obtained in cheese made from a mixture of fresh and reconstituted milk. Gomah *et al.* (2019) stated the yield of cheese increased to 99.28% by using 40% dried milk, compared to 21.25, 33.33, 58.33, and 75.00% with the addition of 0, 10, 20, and 30% of dried milk, respectively.

Data shown inTable (2) illustrate the development of the chemical composition of the examined treatments of cheese, compared with the control during the cold storage for 60 days. The moisture content in all cheeses decreased as the storage period proceeded, which could be attributed to the contraction of curd as a result of developed acidity during the storage period. This decrease could also be related to an increase in the protein content, as mentioned by Abd-Rabou *et al.* (2016). An inverse relationship between moisture and total solids was also observed. It could also be seen that the total solids content was lower in control than alltreatments, which came in agreement with those reported byE. A. Ismail *et al.* (2010).

Data in Table (2) also reveale that the acidity of cheese samples was affected with the storage periods for 60 days. Lower acidity was detected in the control than that of the other treatments. The differences among cheese treatment in acidity might be attributed to the growth of the lactic acid bacteria and its ability to ferment lactose to lactic acid. These results came in harmony with the increase in the lactic acid bacteria count, which increased in all treated cheese samples compared with the control as indicated in Table (4). These results are in agreement with those obtained by Hamad(2015), who reported that fresh Domiatti cheese had the highest pH values (6.05 - 6.32) and the pH decrease sharply as the ripening continued because the microflora adapted to hydrolyze lactose into lactic acid gradually during the ripening and reach (3.05 - 3.52) at the end.

Results in Table (2) illustrate the changes of fat in Domiati cheese as affected by adding different concentrations of full cream milk powder during cold storage up to 60 days. The data indicated that treated cheese had the highest fat content, while the control cheese had the lowest.The results are in agreement with those obtained byHamad (2015), who found that recombined Feta-like cheese made from milk powder had higher fat content (24.59%) than that of the traditionalDomiati cheese (19.93%).

Gradual increases in the fat content of cheese was observed during the cold storage periods up to 60 days in all treatments. This might be attributed to the decrease in the moisture and the solids not fat contents.These results are in agreement with those obtained by Kebary and Youssef (2015). The vice versa was observed with fat content in cheese dry matter (FDM). This change in F/DM content, which might be attributed to the fat loss in whey as reported by Mohran and Fahmy (1989).

Table 2. Chemical analysis of Domiati cheese fortified with milk powder during the storage period:-

	Storage period	Control	T1	T2	T3	T4
	Fresh	72.71^{a}±0.51	72.03^{a}±0.89	62.7^{a}±1.45	56.64^{a}±1.01	49.36^{a}±0.38
	15 day	70.82^{b}±0.66	68.92^{b}±3.31	57.92^{b}±0.38	50.26^{b}±1.03	40.64^{b}±0.79
	30 day	68.25^{c}±0.75	65.12^{c}±0.80	54.56^{c}±0.70	46.04^{c}±0.77	40.27^{b}±0.90
Moisture	45 day	52.37^{d}±1.4	54.56^{d}±0.70	50.88^{d}±0.42	41.64^{d}±1.19	33.50^{c}±1.49
	60 day	40.63^{e}±0.63	50.87^{e}±0.79	49.36^{e}±0.38	30.91^{e}±0.86	29.49^{d}±1.18
	Means	60.96	62.3	55.08	45.1	38.65
	LSD	1.55	2.99	1.42	1.79	1.85
	Fresh	27.29^{e}±0.51	27.97^{e}±0.89	37.30^{e}±1.45	43.36^{e}±1.01	50.64^{d}±0.38
	15 day	29.18^{d}±0.66	31.08^{d}±3.31	42.08^{d}±0.38	49.74^{d}±1.03	59.36^{c}±0.8
	30 day	31.75^{c}±0.75	34.88c±0.80	45.44c±0.70	53.96c±0.77	59.73c±0.90
Total Solid	45 day	47.63^{b}±1.41	45.44^{b}±0.70	49.12^{b}±0.42	58.36^{b}±1.19	66.5^{b}±1.49
	60 day	59.37^{a}±0.63	49.13^{a}±0.79	50.64^{a}±0.38	69.09^{a}±0.86	70.51^{a}±1.18
	Mean	39.04	37.7	44.92	54.90	61.35
	LSD	1.55	2.99	1.43	1.79	1.85
	Fresh	0.34^{e}±0.01	0.41^{e}±0.02	0.44^{d}±0.02	0.53^{e}±0.02	0.72^{e}±0.01
	15 day	0.73^{d}±0.01	0.77^{d}±0.03	0.84^{c}±0.02	0.95^{d}±0.03	0.93^{d}±0.02
	30 day	0.95^{c}±0.01	1.06^{c}±0.05	1.31^{b}±0.14	1.45^{c}±0.05	1.65^{c}±0.04
Acidity	45 day	1.17^{b}±0.03	1.43^{b}±0.03	1.67^{a}±0.03	1.7^{b}±0.04	1.80^{b}±0.02
	60 day	1.26^{a}±0.07	1.57^{a}±0.07	1.76^{a}±0.04	1.85^{a}±0.03	1.91^{a}±0.07
	Means	0.89	1.05	1.2	1.3	1.4
	LSD	0.05	0.08	0.012	0.06	0.07
	Fresh	16.33^{e}±0.07	17.48^{e}±0.36	18.20^{e}±0.2	19.27^{d}±0.25	23.63^{e}±0.25
	15 day	19.27^{d}±0.25	19.23^{d}±0.35	20.47^{d}±0.91	22.0^{c}±0.5	25.77^{d}±0.31
	30 day	20.4^{c}±0.26	20.7^{c}±0.2	22.93^{c}±0.55	24.13^{b}±0.78	26.6^{c}±0.36
Fat	45 day	22.87^{b}±0.60	24.73^{b}±0.31	26.2^{b}±1.08	25.77^{a}±0.31	28.03^{b}±0.32
	60 day	24.73^{a}±0.31	26^{a}±0.27	28.03^{a}±0.32	26.60^{a}±0.36	30.63^{a}±0.25
	Means	20.72	21.63	23.17	23.55	26.93
	LSD	0.63	0.55	1.27	0.87	0.55
	Fresh	59.84^{c}±1.03	62.55^{a}±3.28	48.82^{b}±1.36	44.44^{a}±0.54	46.67^{a}±0.84
	15 day	66.03a±0.68	62.25^{a}±5.32	48.62^{b}±1.71	44.22^{a}±0.25	43.41^{bc}±1.1
	30 day	64.27^{b}±0.90	59.38^{ab}±1.94	50.46b±0.55	44.72a±1.47	44.53b±0.07
Fat/DM	45 day	48.08^{d}±0.53	54.43^{bc}±0.47	53.34^{a}±2.25	44.15^{a}±0.42	42.17^{c}±0.81
	60 day	41.66^{e}±0.85	52.93^{c}±1.34	55.36^{a}±1.02	38.5^{b}±0.95	43.44^{bc}±0.44
	Means	55.98	58.31	51.32	43.21	44.04
	LSD	1.48	5.44	2.72	1.54	1.35

Control cheese: had no additive. T1, T2, T3, and T4: full cream milk powder was added with the percentages of 10, 20, 30 and 40%, respectively. Different letters in the same column show significant difference at P≤ 0. 05.

Significant variations in the protein contents of different treatments of Domiati cheese was detected. Results in Table (2) indicated that increasing the T.S. of cheese milk yielded cheeses of higher total protein content. Adding milk powder in cheese making resulted in higher protein content, compared with the control (Table 2). Similar results were observed by Gomah *et al*. (2019). On the other hand, the protein content of cheese was increased significantly throughout the storage period Mohran and Fahmy (1989), who reported an increase in protein content of Domiati cheese through the storage period. The TP/DM content has been of the same trend as F/DM.

Data presented in Table 2 reveal that the salt content of cheese samples was affected by the addition of milk powder and during the cold storage up to 60 days. Moreover, the control samples had lower salt than that of the other treatments and there wasan increasein salt content by increasing milk powder addition in treated cheese. The fresh samples had lower salt than that of cheese stored up to 60 days in all treatments. Similar results were round byMohran and Fahmy (1989)

Table (2 continued). Chemical analyses of Domiati cheese fortified with milk powder during the storage period:-

	Storage period	Control	T1	T2	T3	T4
	Fresh	15.21^{e}±0.2	15.31^{e}±0.97	16.24^{e}±0.35	16.28^{e}±1.23	18.64^{e}±0.85
	15 day	18.87^{d}±0.57	17.32^{d}±0.45	17.99^{d}±0.71	18.48^{d}±0.43	21.55^{d}±1.2
	30 day	20.53^{c}±0.37	20.36^{c}±0.81	21.32^{c}±1.38	21.9^{c}±0.82	24.16^{c}±0.76
TP	45 day	24.91^{b}±0.83	25.81^{b}±0.37	24.86^{b}±1.15	26.21^{b}±1.07	26.57^{b}±0.66
	60 day	26.33^{a}±0.32	27.7^{a}±0.27	27.7^{a}±0.27	29.8^{a}±1.22	30.23^{a}±1.61
	Means	21.17	21.3	21.62	22.53	24.23
	LSD	0.92	1.16	1.61	1.82	1.95
	Fresh	56.15^{bc}±4.56	58.33^{a}±6.27	43.6^{d}±2.61	35.1^{c}±1.26	36.83^{b}±1.94
	15 day	59.34^{b}±0.21	59.81^{a}±4.86	42.74^{cd}±1.31	37.92^{b}±0.36	36.32^{b}±2.43
	30 day	64.12^{a}±1.22	62.85^{a}±3.81	46.89^{c}±2.43	38.05^{b}±0.83	40.45^{a}±0.76
TP/DM	45 day	54.2^{c}±1.11	67.66^{a}±1.49	50.61^{b}±2.29	42.67^{a}±0.77	39.96^{a}±0.40
	60 day	46.66^{d}±0.81	60.69^{a}±3.28	54.71^{a}±0.93	38.12^{b}±0.95	42.87^{a}±1.99
	Means	56.09	59.87	47.71	38.37	39.29
	LSD	4.00	7.74	3.69	1.60	3.08
	Fresh	5.06^{d}±0.03	5.35^{e}±0.08	5.45^{e}±0.09	5.76^{c}±0.09	5.89^{c}±0.11
	15 day	5.16^{d}±0.05	5.65^{d}±0.09	5.7^{d}±0.05	6.12^{c}±0.13	6.21b^{c}±0.06
	30 day	5.89^{c}±0.11	5.88^{c}±0.10	6.02^{c}±0.21	7.24^{b}±0.38	6.63^{b}±0.39
Salt	45 day	7.1^{b}±0.05	7.39^{b}±0.13	7.71^{b}±0.07	8.24^{a}±0.14	8.55^{a}±0.05
	60 day	7.39^{a}±0.13	7.71^{a}±0.07	8.24^{a}±0.14	8.55^{a}±0.05	8.96^{a}±0.38
	Means	6.12	6.4	6.62	7.18	7.25
	LSD	0.15	0.17	0.23	0.36	0.59

Control cheese: had no additive. T1, T2, T3, and T4: full cream milk powder was added with the percentages of 10, 20, 30 and 40%, respectively. Different letters in the same column show significant difference at P≤ 0. 05.

Changes in ripening indices as indicated with the soluble nitrogen (SN) contents were shown in Table (3).

The proportion of total soluble nitrogen (SN) traditionally has been regarded as a ripening index for cheese as it reflects the extent of proteolysis, it is an indicator of casein hydrolysis brought by the action of the rennet and milk proteases present at the start of ripening (Visser, 1977).

The obtained data in Table (3) revealed that the SN increased in the same order during the storage period. This increase could be due to the activity of proteinases and peptidases released from the used starter culture, which resulted in higher proteolysis in cheese. Also, the control samples had lower values of SN than that of cheese manufactured by full cream milk powder. Meanwhile, the results of SN clarified that there were significant increases in SN by advancing the storage period. This increase could be due to the activity of proteinases and peptidases released from starter culture microorganisms, which resulted in higher proteolysis of The increase in SN could also be attributed to the enzyme activity, which agree with the results obtained by Moatsou *et al*.(2004), who found that the main proteolytic agent responsible for the primary proteolysis in cheese is the residual rennet because of the low pH, which is not favorable for plasmin action..

Table 3. Ripening indexes of Domiati cheese fortified with milk powder during the storage period:-

	Storage period	Control	T1	T2	T3	T4
	Fresh	0.24^{d}±0.01	0.25^{e}±0.04	0.28^{d}±0.01	0.28^{d}±0.3	0.24^{e}±0.02
	15 day	0.29^{d}±0.05	0.31^{d}±0.07	0.36^{d}±0.6	0.34^{d}±0.3	0.58^{d}±0.07
	30 day	0.48^{c}±0.04	0.46 ^{c}±0.01	0.58^{c}±0.3	0.55^{c}±0.07	0.77^{c}±0.06
S.N	45 day	0.66^{b}±0.08	0.58^{b}±0.27	0.7^{b}±0.4	0.79^{b}±0.15	0.93^{b}±0.03
	60 day	0.93^{a}±0.13	1.09^{a}±0.09	0.99^{a}±0.1	1.08^{a}±0.05	1.02^{a}±0.03
	Means	0.52	0.53	0.58	0.61	0.71
	LSD	0.48	0.42	0.10	1.05	0.08
	Fresh	7.46^{e}±0.05	7.51^{e}±0.07	8.73^{e}±0.21	8.84^{e}±0.13	9.51^{d}±0.38
	15 day	11.31^{d}±0.13	12.75^{d}±0.07	9.80^{d}±0.17	12.84^{d}±0.05	9.30^{d}±0.06
	30 day	16.16^{c}±0.05	16.33^{c}±0.10	11.58^{c}±0.09	13.27^{c}±0.06	13.57^{c}±0.18
TVFA	45 day	18.86^{b}±0.10	19.78^{b}±0.18	18.96^{b}±0.08	20.24^{b}±0.23	22.46^{b}±0.52
	60 day	19.78^{a}±0.18	20.24^{a}±0.23	22.46^{a}±29	25.81^{a}±0.37	30.23^{a}±1.61
	Means	14.71	15.32	14.31	16.2	17.01
	LSD	0.20	0.26	0.48	0.37	1.42
	Fresh	14.51^{e}±0.14	17.95^{e}±0.07	21.6^{e}±0.25	28.47^{e}±0.10	32.45^{e}±0.21
	15 day	32.75^{d}±0.15	38.77^{d}±0.16	42.51^{d}±0.14	58.89^{d}±0.15	75.77^{d}±0.11
	30 day	120.08^{c}±0.09	139.28^{c}±0.26	148.54^{c}±0.50	175.33^{c}±0.30	197.19^{c}±0.23
Tyrosine	45 day	139.28^{b}±0.26	148.54^{b}±0.50	175.33^{b}±0.30	197.19^{b}±0.23	202.5^{b}±0.5
	60 day	202.5^{a}±0.5	291.2^{a}±0.18	312.47^{a}±0.43	338.6^{a}±3.83	460.47^{a}±1.75
	Means	101.82	127.15	140.09	159.7	193.68
	LSD	0.49	0.50	0.63	3.14	1.50
	Fresh	15.91^{c}±0.86	37.91^{e}±4.93	84.87^{c}±3.57	71.48^{b}±6.66	91.67^{e}±2.21
	15 day	61.04^{b}±17.4	71.98^{d}±7.13	208.83^{b}±8.96	79.38^{b}±3.01	115.03^{d}±1.12
	30 day	77.85^{a}±0.63	83.01^{c}±3.33	203.08^{ab}±0.76	124.12^{b}±64.45	233.15^{c}±2.53
Tryptophan	45 day	83.01^{a}±3.33	99.18^{b}±8.23	211.67^{a}±1.61	214.11^{a}±0.45	281.55^{b}±14.06
	60 day	90.94^{a}±3.44	126.18^{a}±0.36	214.75^{a}±0.65	233.15^{a}±2.53	298.17^{a}±3.09
	Means	65.75	83.65	184.64	144.45	203.91
	LSD	14.71	10.10	8.00	52.78	12.15

Control cheese: had no additive. T1, T2, T3, and T4: full cream milk powder was added with the percentages of 10, 20, 30 and 40%, respectively. Different letters in the same column show significant difference at P≤ 0. 05.

Changes in fatty acid concentrations in Domiati cheese were investigated when fresh and after pickling at refrigeration during the cold storage. The results present in Table (3) indicate that the TVFA of Domiati cheese were higher in all treatments when fresh than the control cheese, which might be due to the addition of milk powder to the treatments, which also cotain low level of fat. This corresponds to the increase in the percentage of fat in treated cheese, compared to the control as shown in Table (1). In addition, the fatty acid levels in all treatments of Domiati cheese increased by extending the storage period, and the high levels of TVFA were detected at the end of storage. Similar results were found by Hattem and Hassabo (2015). Generally, the differences in fatty acid concentrations in cheese manufactures could be attributed to the added lactic acid starter cultures which responsible for producing lipolytic enzymes and increasing the levels of fatty acids (Shahab Lavasani *et al*., 2012)

The increase in free fatty acids levels, however are generally considered undesirable, they are important flavor compounds in many dairy products, especially cheese, and act as precursors to other flavour compounds and also have functional properties and could beneficial health, nutritional and bioactive properties (Mannion *et al*., 2016).

Changes in tyrosine & tryptophan contents of cheese are presented in Table (3). Results show that the soluble tyrosine and tryptophan concentrations increased gradually in all cheese treatments during the cold storage up to 60 days. Their contents in Domiati cheese made with full cream milk powder were also of higher contents of both tyrosine and tryptophan than those in the control.These results are in agreement with those obtained by El-Alfy *et al*. (2004).

Results of the sensory evaluation of Domiati cheese manufactured by full cream milk powder are presented in Fig 1. The samples of cheeses were evaluated for appearance, body and texture, flavour and overall acceptability. In regards to the appearance and the flavor attributes, there was a decrease in the score by the storage progress in all treatments and the control except for T2 which gained a higher score by the end of the storage period. For the body and texture, the treatments gained higher score than the control cheese at the end of storage. In general, the overall acceptability of Domiati cheese made with full cream milk powder was more accepted by the panelists than the control cheese when fresh and at the end of the storage period.

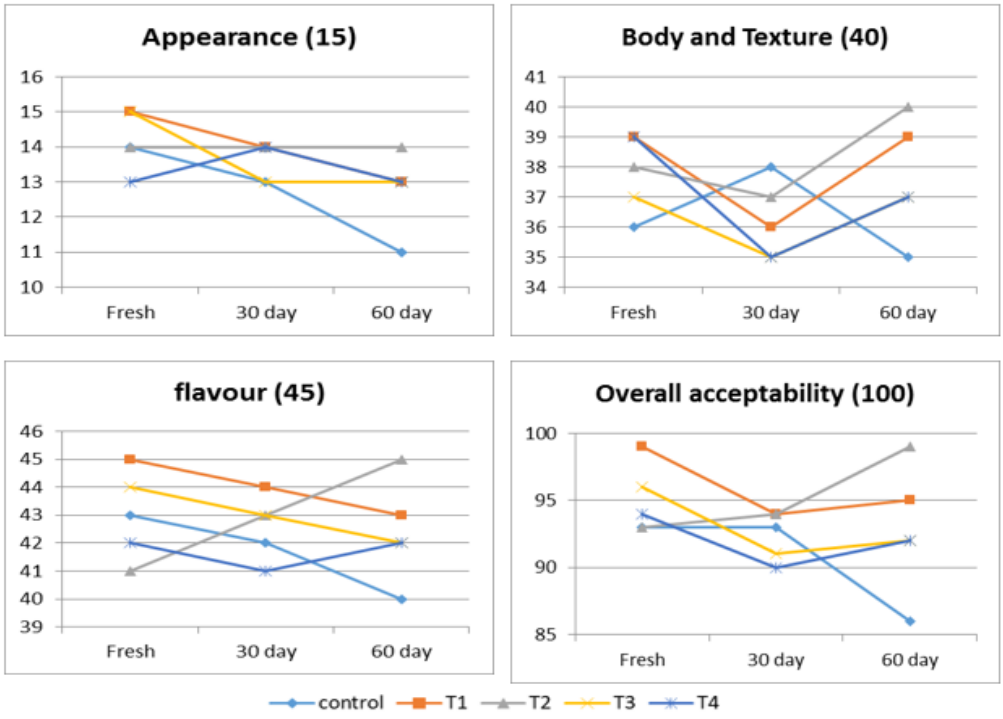

Fig. 1. The organoleptic scoring of Domiati cheese made with milk powder during the storage period.Control cheese: had no additive. T1, T2, T3, and T4: full cream milk powder was added with the percentages of 10, 20, 30 and 40%, respectively.

Similar results were found by Hattem and Hassabo 2015 and Gomah *et al*.2019), how found that cheese made using 50% protein concentrate and 50% skim milk powder achieved higher score in body and texture and flavour compared to the control cheese made without milk powder. Hamad (2015), on the other hand obtained rather different results.

Total bacterial count, lactic acid bacteria counts, photolytic bacteria and yeasts and molds in Domiati cheese during cold storage periods up to 60 days are illustrated in Table (4). Results indicated that the total bacterial counts of examined cheese increased during the storage period. The obtained results are also in agreement with those previously reported in this work about the increase occurred in the values of titratable acidity of cheese samples during storage. This increase of acidity was recorded in all samples and reached its maximum value at the end of the pickling process (Neamat Allah, 1997).

Table 4. Microbiological analysis of Domiati cheese fortified with milk powder during the storage period:-

Properties	Storage periods (days)	Treatments				
		Control	T1	T2	T3	T4
Total bacterial count ($CFU\times10^5$)	Fresh	33.00	41.5	45.00	48.5	50.5
	15 day	43.5	55.00	45.5	55.00	54.00
	30 day	53.00	58.5	55.5	57.5	58. 5
	45 day	59.5	61.00	60.00	59. 5	62.5
	60 day	68.5	66. 5	67.00	63.55	65.00
Lactic acidBacteria ($CFU\times10^4$)	Fresh	25.5	32.5	33.00	37.5	47. 5
	15 day	31.5	38.00	37.5	48.00	48.5
	30 day	39.00	43.00	45.00	51.00	53.5
	45 day	44.5	55.5	56.5	59.5	59.00
	60 day	59.5	62.00	69..00	67.00	58.46
Proteolytic bacteria count ($CFU\times10^3$)	Fresh	ND	ND	ND	ND	ND
	15 day	8.5	12.5	14.00	18.00	24.00
	30 day	14.00	18. 00	20.5	24. 5	29.5
	45 day	28.5	20. 5	28. 5	30.5	35.00
	60 day	36.00	27.00	34.00	35.00	44. 5
Yeast& Moulds ($CFU\times10^2$)	Fresh	ND	ND	ND	ND	ND
	15 day	10. 5	12.00	18.5	32.00	33.00
	30 day	14.00	19.5	33.5	38.00	44.5
	45 day	28. 5	23.5	53.5	43.50	53.00
	60 day	34.00	55.00	62.00	55.60	59.00

Control cheese: had no additive. T1, T2, T3, and T4: full cream milk powder was added with the percentages of 10, 20, 30 and 40%, respectively.

Lactic acid bacteria count increased in all cheese samples during the pickling period.Lactic acid bacteria are indigenous microflora in raw milk, yoghurt and cheese. They are Gram positive, non-spore forming, cocci or rods bacteria. They produce lactic acid as a major end product from lactose fermentation resulting in pH reduction and creating an unfavorable environment for growth of pathogens and spoilage organisms (Aslim *et al*., 2005).

proteolytic bacterial counts of Domiati cheese increased in all cheese samples during the pickling period as reported byHamid *et al*.(1992).

Following the obtained results of coliform bacteria in manufactured Domiati cheese, the results indicate that all treatment of Domiati cheese samples,while fresh or during storage, were found completely free of coliforms, which might be due to high hygienic condition during making of cheese. The obtained results came in harmony with those obtained by El-Alfy *et al*.2004 and Kebary and Youssef 2015).

On the other hand, yeasts &moulds were not detected in all fresh cheeses and control and in cheese made with full cream milk powder. However, these organisms were detected in fewer numbers after 15 days of storage period , followed by increase by extending the storage period as a result of acidity development. Generally, these microorganisms may be reached to the cheese samples from the manufacturing environment (Derar and El Zubeir, 2013; Sayed *et al*., 2013).The appearance of yeasts &moulds may be due to some post contamination during handling and storage of cheeses.

CONCLUSION

The results presented in this study confirm the ability to make Domiati cheese from the recombined milk with acceptable quality by using full cream milk powder. It also indicates that the use of recombined milk was advantageous compared to fresh milk, in terms of yields and milk component recovery.Domiati cheese made from full cream milk powder resulted in high organoleptic properties. Such improvements in the cheese yield and characteristics could increase both producer profits and consumer acceptability of this type of cheese.

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تصنيع الجبن الدمياطى بمخاليط اللبنالبقري ومسحوق اللبن المجفف

حليمة فاروق عباس[١] ، عادل على تمام[١] ، نانيس حسانين جمعة[١-٢] ، ياسر محمدعبد العزيز الدروي[١] و أسماء حسنى منيب[١]

[١]قسم علوم الالبان ، كلية الزراعة ، جامعة أسيوط ، أسيوط ٧١٥٢٦ ، مصر.

[٢]كلية العلوم ، جامعة حفر الباطن ، ص. ب: ١٨٠٣ ، المملكة العربية السعودية.

في هذه الدراسة ، تم تصنيع جبن دمياطي من حليب بقري كامل الدسم يحتوي على خمسة مستويات من اللبن المجفف على النحو التالي: الكنترول تم فيه تصنيع جبن دمياطي بدونای اضافات. في المعاملات الأخرى: T1 و T2 و T3 وT4 ، تمت إضافة مسحوق اللبن المجفف إلى اللبن البقري الطازج كامل الدسم قبل البسترة بنسبة ١٠ و ٢٠ و ٣٠ و ٤٠٪ على التوالي. تم تخزين الجبن من المعاملات المختلفة في الشرشعلى درجة ٥ درجات مئوية لمدة ٦٠ يومًا وتم تحليلها بعد ١٥ و ٣٠ و ٤٥ و ٦٠ يومًا من التخزين. كانت عينات الكنترول ذات رطوبة أعلى وكانت اقل في كل من التصافي، الحموضة ، الدهن ، البروتين الكلي (TP) ، الملح ، النيتروجين الذائب (SN) ، إجمالي الأحماض الدهنية المتطايرة (TVFA)، التيروسينوالتريبتوفانعن الجبن المصنوع من خليط اللبن البقري و اللبن مجفف. مع زيادة مسحوق اللبن المضاف في صناعة الجبن كانت هناك زيادة في التصافى ، الحموضة ، الدهن ، TP، الملح ، SN، TVFA، التيروسينوالتريبتوفان في جميع المعاملات. كما ادت زيادة فترة التخزين الى انخفاض التصافى والرطوبة وزيادة في الحموضة والدهن ، TP، SN، TVFA،التيروسينوالتريبتوفان.ظهر ارتفاع في إجمالي عدد البكتيريا ، وبكتيريا حمض اللاكتيك ، والبكتيريا المحللة للبروتينات والخميرة والعفن في جميع المعاملات بزيادة نسبةاللبن المجفف المضاف في صناعة الجبن ومع تقدم فترة التخزين. لم يكن هناك اكتشاف لبكتيريا القولون في جميع المعاملات. لقد حصل الجبن الدمياطي المصنوع بمزيج من اللبن البقري ومسحوق اللبن المجفف على درجات أعلى في المظهر والقوام والتركيب والنكهة والقبول العام مقارنة بعينات الكنترول. مع العلم أنه بحلول نهاية فترة التخزين كانت المعاملة T2 هي الأعلى في التقييم الحسي.

الكلمات الرئيسية: جبن دمياطي؛لبن مجفف؛ التركيب الكيميائي؛ التحليل الميكروبيولوجي؛ الجودة الحسية.