Egypt. J. Chem. **Vol. 66**, No. 7 pp. 621 - 631 (2023)

Egyptian Journal of Chemistry

http://ejchem.journals.ekb.eg/

Application of Microwave or Magnetic Field Technique in Relation to Pickled Conventional Domiati Cheese Properties

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Abstract

This research aims to evaluate the effect of application of such new techniques, meaning microwave and magnetic field in Domiati cheese production versus the usual heat treatment on some technical, chemical, texture profile, microbiological and sensory properties of final product venin the presence of raw milk cheese. Domiati cheese samples were made using the full cream cow's milk (3%fat) for each previously either pasteurized at 72°C for 15 sec., microwave exposed for 30sec.,or magnetic field treatment with an intensity of 950 gauss for 30 min. Besides, Domiati cheese made from raw cow's milk was used as a control. The obtained results reveal that, the values of yield, moisture and salt/moisture of fresh Domiati cheese were lower in the control or magnetic-field cheese while the contents of titratable acidity (TA), soluble nitrogen / total nitrogen (SN/TN) and total volatile fatty acids (TVFA) were higher in the same cheeses. During pickling, more reductions in former parameters and more increases in the later ones were recorded. Domiati cheese of raw or magnetic treated milk was particularized with hardness as well as gumminess values higher and springiness value lower than those made using microwave or heat treated milk. During pickling of cheese, both hardness and gumminess values increased while that of springiness decreased. Control cheese had total bacterial count (TBC), spore forming bacteria and yeast & molds higher than those of pasteurized milk, microwave or magnetic one. Values of TBC increased in all samples during early pickling and then sharply decreased till the end. There was a remarkable inhibition in the growth of spore forming bacteria and yeasts & molds in magnetic treated one. It could be concluded that, magnetic field may be successfully apply in production of Domiati cheese without any significant variation in the physicochemical properties of that made traditionally using raw milk. Thus, these findings marks the magnetic field as an substitute to diminish of the initial load of microbes of raw milk, improve quality and increasethemilkshelf-lifebeforedifferentprocessing.However,thisremainsinsufficient to ensure that the product is free of pathogenic microbes, compared to that of milk treated with heat or microwaves.

***Keywords*:**Chemicalproperties–Microbiologicalsituation–Textureprofile– sensoryevaluation

1. Introduction

Cheese is the most worldwide popular dairy products. It made from raw or pasteurized milk. But sometimes the production of cheese suffered from poor microbiological quality of milk therefore milk pasteurization process became very important step to destroy the harmful pathogens and extends half life but the milk pasteurization may cause some disadvantages. It is very straight forward and efficient, but may lead to several technical, sensory acceptability and nutritional losses in the resultant product, particularly when heat treatment is implemented in poor quality milk, which possesses a high load of microbes and hence more heating process (temperature degree and/or time) is needed. A substitute method to decrease the load of microbial load of the milk is the use of substances that deactivate microorganisms without much change in milk safety and quality. Moreover, these materials may setback the production of enzymes by microorganisms during storage before heating treatmentandimprovethestabilityofproteininmilkdurin

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EJCHEM use only: Received date 03 October 2022; revised date 20 October 2022; accepted date 23 October 2022
DOI: 10.21608/EJCHEM.2022.166733.7055

gitsshelf-life (1).On the other hand, innovative, easy to implement, and rapid technologies are required for the modern food industry to meet the never ending demands of consumers (e.g. fresh and safe ready-to-eat products).

Microwave treatment may be used a promising method as it cause less damage in the food stuffs than done by the conventional heat treatment, due to the short treatment and radiation time. Where, microwave heating offers several distinct advantages when compared with conventional heating methods. The advantages include speed of heating, energy saving, precise process control, and faster start-up and shutdown times. Further, such treatment helps, at great extent, to keep the product quality, in terms of taste, texture, and nutritional benefits.

Magnetic field was found to be a powerful tool for sanitation and gaining growing interest. The sanitation with magnetic field may, be meetthestandardsofmodernfoodindustry.Italsomayaccomplishtheregulations of different food safety organizations as well as the consumer acceptability. It notices that, a growing interest in studying the impact of the magnetic field on living organisms (2). In addition, few studies have focused on the effect of magnetic field on growth and metabolisms of microorganisms have been published. The impact of the magnetic field energy lies in the stimulus to the events of significant changes in the characteristics of metabolic organisms; these are changes in the exchange of ions through the cell membrane in the movement of cells (3). The main theories that try to discuss the biological effects of magnetic fields are based on the possible effects on the permeability of the ionic channels in the membrane; this can affect ion transport into the cells and result in biological changes in the organism (4). This method may be used to treat milk resulting reduction in the bacterial counts from 25000 to 970CFU/ml at the field intensity of 12 Tesla, besides magnetic milk gives power and liveliness to exhausted people (5). Recently, magnetic fields are used as a good method to get rid of microorganisms, as the magnetic fields inhibit microorganisms that cause food spoilage (6).

Therefore, this research aims to evaluate the effect of application of such new techniques, meaning microwave and magnetic field in Domiati cheese production versus the usual heat treatment on some technical, chemical, texture profile, microbiological and sensory properties of the final product even in the presence of raw milk cheese.

Materials and methods

Materials:

Fresh cow's milk used in this study was obtained from Dina Farm, located at Alexandria desert road, Giza, Egypt. Microbial rennet Reniplus2250 international milk-clotting units per gram (imcu/g) obtained from Caglio Star Espana; Spain was used for coagulation of milk. The rennet was added at the rate of 5g/100 liter of milk. Commercial fine grade salt (Sodium- chloride, NaCl) was obtained from the Egyptian salts & minerals Co. (Emisal), Shakshok–Abshway–Fayoum –Egypt.

Experimental

Procedures: Domiati cheese manufacture:

Domiati cheese was manufactured using the traditional method as described by (7) using new techniques as follow: Eighteen Kg raw cow's milk was divided into four equal portions; the first stilled raw milk used as control, while the second portion was heated for 72°C for ~ 15 sec then rapidly cooled to 42°C (T1), and the third portion was exposed to microwave for 30sec (T2) using microwave oven Sharp model R-75MR(S). While the last portion was treated by magnetic field for 30 min using Tesla electromagnetic equipment, with Tube long: 25cm, Diameter: 12.5 mm. Gauss: 950, Electrical source: 220 single faze to control panel, the out from the equipment: 12 volt. Long of electromagnetic field is the long of tube, Egyptian Pacific Ocean Organism, Cairo, Egypt.

At 42°C all cheese milks were salted with 10% NaCl and renneted by adding rennet powder at the rate of 5g /100 liter milk. The complete coagulated curds were scooped in plastic frames lined with cheese cloth to drain whey. After 24 h of whey drainage, the cheese curd was cut into pieces (~500g) and transferred to plastic containers. The obtained cheeses were pickled in their respective whey (previously heated to 85°C and then cooled to 20°C) at the room temperature (~25°C). Cheese samples were taken for analysis when fresh and periodically during storage up to 6 months. Three replicates of each treatment were carried out. Method of Domiati cheese manufacture is summarized in the flow-diagram Figure (1).

Analytical methods:

Technical and chemical determinations:

The yield of cheese is a mathematical expression for the quantity of cheese obtained from a given quantity of milk as the formula given by (8):

Cheese yield =Amount of cheese (kg)/ Amount of original milk × 100

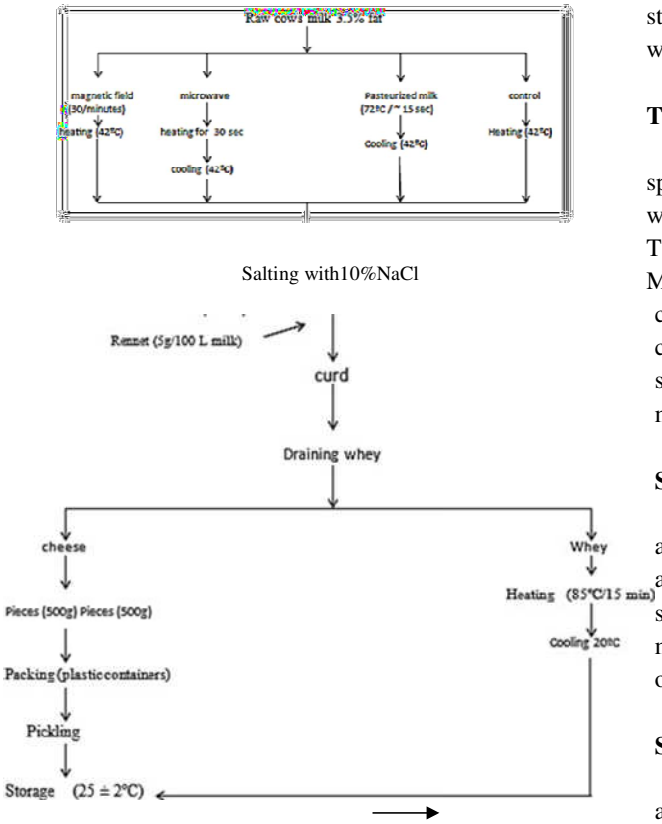

Figure (1): Flow diagram for making Domiati cheese

Moisture, ash, total and soluble nitrogen contents were determined by the method described in (9). Fat and Titratable acidity contents were determined as given in (10). Titratable acidity (TA) was expressed as lactic acid percentage. Salt content in cheese was determined according to the method of (11).Total volatile fatty acid (TVFA) was determined according to the method described by (12). The value was expressed as ml of 0.1N NaOH/100g cheese.

Microbiological examinations:

Total bacterial count (TBC) was enumerated according to (13) using medium of plate count agar at 32°C for 48h. The plates were incubated at 32°C for 3 days before counting. The plates were incubated at 37°C for 48 h. Yeasts and molds were determined on Malt-Extract Agar medium as suggested by (14). The plates were incubated at 25-27°C for 4 days. Spore forming bacteria were determined by heating suitable dilution to 80°C for 15 min, and cooling suddenly to 30°C before transferring one ml into Petri dish. Plating and counting was carried out as in total count reminded. Nutrient Agar medium + 0.1% soluble starch were used in this determination. The starch was incorporated as result of the work of (14).

Texture profile analyses:

The texture parameters, namely Hardness, springiness, cohesiveness and gumminess of cheese were measured according to (16) with a TA-XT2 Texture Analyzer TM (Multi Test 1- d Systems, Mecmesin, USA) using a two-bite compression of cylindrical samples (25-mm-diameter acrylic cylindrical probe (P25), strain rate programmed to a speed of 1 mm s1 and maximum penetration of 10 mm).

Sensory evaluation:

Cheese samples were organoleptically scored for appearance (10 points), body and texture (30 points) and flavor (60 points) according to the score card suggested by (17). Samples were judged by the staff members of the Food Science Department, Faculty of Agriculture, Ain shams University.

Statistical analysis:

The obtained data were statistically analyzed according to (18) using General Linear Model (GLM) with main effect of treatments. Duncan's multiple range was used to separate among of three replicates at $P \leq 0.05$.

Results and Discussion

1- Technical and chemical properties of Domiati cheese

As shown in Table (1), control Domiati cheese (made from raw milk) exhibited the lowest cheese yield while the heat treated milk cheese (T1) had the highest cheese yield among all treatments. The results indicated also that Domiati cheese samples made from heat treated milk (T1) and microwave treated milk (T2) possessed higher moisture content compared with Domiati cheese samples made from raw milk (control) and magnetic field treated milk (T3), whether when fresh or along pickling period. Treatment the milk by heat, microwave and magnetic field caused increase in the yield of cheese as

compared with control. These phenomena could be due to the relatively higher moisture retention into cheese matrix as a result of recovery of denatured whey proteins into cheese. These results agree with (19) who found that both the actual and adjusted yield values of Domiati cheese manufactured from pasteurized milk were higher than those of cheese produced from raw milk. Also, noticed that the highest Domiati cheese yield was obtained with pasteurized milk (72°C/15sec.) comparing with that of raw or heated milk (65°C/15sec.). This may be attributed to the effect of pasteurization on forming complex between k-casein and β-lactoglobulin and hence increasing the water holding capacity (20). On the other hand (23) found that Magnetic field caused increase inions movements such as calcium as an important salt in milk protein association and lead to higher yield production. Along pickling the yield gradually decreased with extending pickling period (21).

The moisture content of all cheese samples significantly decreased gradually as the pickling period of cheese prolonged. This lower in moisture content could be due to the acid development and the shrinkage occurred in the cheese matrix. Pickling caused changes in the composition of Domiati cheese as a result of chemical and biochemical changes that take place during pickling period. That leads to changes in the yield of the cheese. It is worthy to mention that, dry matter % of all samples are, indeed, in surrounding on the legal standard of (32) which provided that the DM content of Domiati cheese should be not less than 40%.

There were any significant differences neither in the fat/dry matter (DM) content nor in the ash/DM content among all fresh Domiati cheese samples. During pickling period, the ash/DM% of cheese showed a non-significantly gradual decrease in all treatments. On the contrary, the fat/DM% showed a gradual increase in all treatments along pickling storage period. The gradual increase in the fat/DM in Domiati cheese is correlated to the losses in the moisture content which increases the fat and dry matter contents. The fat content increase during the pickling period was in agreement with the results obtained by (21). The decrease occurred in ash content of Domiati cheese could be attributed to the cheese shrinkage and consequently the syneresis of pickle solution out cheese matrix. That could be also related to the increasingly acid development. The statistical analyses confirmed that, the protein/DM content of microwave and heat-treated milk fresh cheese was significantly higher than those of fresh cheese made either from raw or magnetic field treated milk. That could be ascribed to the retention of the thermal denatured whey proteins into cheese matrix in microwave and heat-treated milk cheese. During pickling period, the protein/DM content of all Domiati cheese samples increased as the pickling period advanced due to cheese shrinkage. Moreover, It could be observed that the salt/moisture content of Domiati cheese produced either from raw, heat, microwave and magnetic treated milk did not significantly differ from each other surrounding 11.06 to 11.42%, i.e., the salt content in the cheese water phase is nearly constant.

Table (1)
Chemical composition of Domiati cheese made from raw, heat, microwave or magnetic treated mil during pickling period

Pickling period (month)	Treatment			
	Control	T 1	T2	T 3
			Yield%	
fresh	23.87^{Ba}	26.48^{Aa}	25.41^{Aa}	24.53^{Ba}
1	21.16^{Cb}	23.33^{Ab}	22.62^{Bb}	21.43^{Cb}
2	$20,98^{Bb}$	23.12^{Ac}	22.41^{Ab}	21.28^{Bb}
3	20.82^{Bb}	22.89^{Ac}	22.18^{Ab}	20.97^{Bb}
4	20.12^{Bb}	21.96^{Acb}	21.53^{Ac}	20.55^{Bc}
5	19.59^{Bc}	21.74^{Ad}	21.37^{Ac}	20.25^{Bc}
6	19.42^{Bc}	21.56^{Ad}	20.75^{Ac}	19.89^{Bc}
			Moisture%	
fresh	64.71^{Ba}	65.92^{Aa}	65.37^{Aa}	64.88^{Ba}
1	60.95^{cb}	62.16^{Ab}	61.64^{Bb}	61.09^{cb}
2	59.66^{Cc}	61.79^{Ac}	60.65^{Bc}	60.11^{Cc}
3	58.87^{Cd}	60.95^{Ad}	59.77^{Bd}	59.12^{Bcd}
4	57.81^{Ce}	59.84^{Ae}	58.62^{Be}	58.02^{Bce}
5	57.08^{cf}	58.96^{Af}	57.86^{Bf}	57.18^{BcF}
6	56.78^{Cg}	58.34^{Ag}	57.11^{Bg}	56.74^{BCg}
			Protein/dry matter %	
fresh	29.46^{Ab}	29.84^{Ab}	29.77^{Ab}	29.51^{Ab}
1	29.51^{Aab}	29.93^{Aab}	29.87^{Aab}	29.62^{Aab}
2	29.64^{Aab}	30.09^{Aab}	29.98^{Aab}	29.71^{Aab}
3	29.7^{Aa}	30.15^{Aa}	30.00^{Aa}	29.82^{Aa}
4	29.78^{Aa}	30.21^{Aa}	30.14^{Aa}	29.97^{Aa}
5	29.84^{Aa}	30.26^{Aa}	30.19^{Aa}	30.00^{Aa}

6	29.89^{Aa}	30.31^{Aa}	30.29^{Aa}	30.11^{Aa}
		Fat/dry matter %		
fresh	37.77^{Ab}	37.12^{Ab}	37.25^{Ab}	37.18^{Ab}
1	38.13$^{Aa}_{b}$	38.56$^{Aa}_{b}$	38.73$^{Aa}_{b}$	38.43^{Aab}
2	38.29$^{Aa}_{b}$	38.61$^{Aa}_{b}$	38.83$^{Aa}_{b}$	38.52^{Aab}
3	38.32^{Aa}	38.75^{Aa}	38.86^{Aa}	38.62^{Aa}
4	38.41^{Aa}	38.86^{Aa}	38.94^{Aa}	38.77^{Aa}
5	38.48^{Aa}	38.91^{Aa}	38.98^{Aa}	38.82^{Aa}
6	38.51^{Aa}	38.98^{Aa}	38.00^{Aa}	38.95^{Aa}
		Ash/dry matter %		
fresh	27.18^{Aa}	27.67^{Aa}	27.57^{Aa}	27.29^{Aa}
1	26.46^{Ab}	26.58^{Ab}	26.51^{Ab}	26.44^{Ab}
2	26.32^{Ab}	26.48^{Ab}	26.44^{Ab}	26.31^{Ab}
3	26.13$^{Ab}_{c}$	26.33^{Ab}	26.25^{Ab}	26.28^{Ab}
4	26.00^{Ac}	26.2^{Abc}	26.19$^{Ab}_{c}$	26.15^{Abc}
5	25.91^{Ac}	26.1^{Ac}	26.05^{Ac}	26.11^{Ac}
6	25.86^{Ac}	25.94^{Ac}	25.9^{Ac}	25.87^{Ac}
		Salt/moisture %		
fresh	11.06^{Aa}	11.11^{Aa}	11.28^{Aa}	11.42^{Aa}
1	11.56^{Aa}	11.68^{Aa}	11.87^{Aa}	11.93^{Aa}
2	11.69^{Aa}	11.74^{Aa}	11.93^{Aa}	11.86^{Aa}
3	11.75^{Aa}	11.82^{Aa}	11.99^{Aa}	11.92^{Aa}
4	11.84^{Aa}	11.92^{Aa}	12.12^{Aa}	12.04^{Aa}
5	11.94^{Aa}	11.99^{Aa}	12.13^{Aa}	12.11^{Aa}
6	11.95^{Aa}	12.01^{Aa}	12.06^{Aa}	11.96^{Aa}

Control: Domiati cheese made from raw milk, T1: Domiati cheese made from heat treated milk. T2: Domiati cheese made from Microwave, T3: Domiati cheese made from magnetic milk.

A, B, C: Means with same letter among treatments in the same pickling period are not significantly different.

a, b, c : Means with same letter for same treatment during pickling periods are not significantly different

2- Ripening indices:

The ripening indices of Domiati cheese throughout the pickling period are showed in Table (2). The results clearly indicated that control cheese made from raw milk had the highest titratable acidity (TA) % among all treatments. There were significant differences in TA% between magnetic-field treated milk cheeses, microwave- or heat-treated milk cheese. This may be due to the effect of heat and microwave treatments on the microflora and enzymes activities in cheese milk. The results agree with those of (23), who reported a significant increase in TA% and significant decrease in total bacterial count of cheese produced from magnetize milk. Further, (19) found that, TA% of pasteurized milk cheese were lower than those of raw milk cheese. Also, the rates of acid development during storage period were lower in former cheese than the later one. Titratable acidity of all cheese samples increased as the pickling period progressed. This is mainly being due to the consistent ability of microorganism in fermenting lactose to different acids. Similar trending in the rate of acid development in Domiati cheese was observed by (19). They stated that the acidity progressively increased during the pickling period. It could be noticed that among treatments, cheese sample made from heat treated milk (T1) possessed the lowest TVFA and soluble nitrogen (SN) contents, while control cheese made from raw milk had the highest values. Furthermore, T1 and T2 showed non-significant differences in TVFA and SN contents between them but highly differences in TVFA and SN values were exhibited between control and magnetic field cheeses. Heat and microwave treatments may affect negatively the activity of proteolysis and lipolysis enzymes in Domiati cheese. During pickling, gradual increases in TVFA and SN values of all treatments were occurred due to the activity of bacteria and hence both of their proteolytic as well as lipolytic enzymes. Similar observations were reported by (24) and (19), who stated that, pasteurization of milk decreased values of TVFA which could be attributed to destroying some of lipolytic bacteria species and their enzymes by heat treatment. Also, Numbers of spore forming bacteria were higher in raw milk cheese than those of pasteurized milk cheese. Likewise, (25) and (20) found that, the lower rate of ripening in heat treated milk cheese may be due to the destructive effect of heat treatment on the natural milk flora and enzymes which in turn affect fat and protein degradation.

Table (2)

The ripening parameters of Domiati cheese made from raw, heat, microwave or magnetic treated milk during pickling

Pickling period (month)	Treatment			
	Control	T1	T2	T3
	Titratable acidity(as lactic acid %)			
fresh	0.25^{Ad}	0.18^{Ce}	0.15^{Ce}	0.24^{Bd}
1	0.87^{Ac}	0.52^{Cd}	0.59^{Bd}	0.75^{Bc}
2	1.21^{Ac}	0.61^{Cc}	0.68^{Bc}	1.07^{Ab}

3	1.33^{Abc}	0.73 ^{Cb}	0.73^{Cb}	1.12 ^{Bab}
4	1.47^{Ab}	0.81^{Cab}	0.86 ^{Cab}	1.21 ^{Bab}
5	1.66^{Aa}	0.88 ^{Ba}	0.90 ^{Ba}	1.44^{Aa}
6	1.75^{Aa}	0.92^{Ba}	0.95^{Ba}	1.56^{Aa}
Total volatile fatty acids (ml 0.1 N NaoH /100gcheese)				
fresh	5.3^{Ag}	3.4^{Cg}	3.6^{Cg}	4.5^{Bg}
1	8.8^{Af}	6.7^{Bf}	6.2^{Bf}	8.1^{Af}
2	9.9^{Ae}	7.5^{Be}	7.6^{Be}	9.3^{Ae}
3	11.4^{Ad}	7.6^{Cd}	8.5^{cd}	10.2^{Bd}
4	12.1^{Ac}	9.7^{Bc}	9.2^{Bc}	12.9^{Ac}
5	14.2^{Bb}	11.4^{Cb}	11.5^{Cb}	15.7^{Ab}
6	18.1^{Aa}	14.2^{Ca}	16.7^{Ba}	17.5^{Aa}
Soluble nitrogen/total nitrogen(%)				
fresh	13.93^{Af}	9.97^{cg}	10.89^{cg}	12.61^{Bg}
1	29.06^{Ae}	15.88^{cf}	19.09^{cf}	28.67^{Af}
2	30.89^{Ae}	16.75^{Ce}	23.30^{Be}	29.93^{Ae}
3	33.73^{Ad}	21.45^{Dd}	26.06^{Cd}	32.50^{Bd}
4	37.11^{Ac}	26.13^{Dc}	30.13^{Cc}	35.19^{Bc}
5	43.48^{Ab}	31.74^{Cb}	33.75^{cb}	40.03^{Bb}
6	46.22^{Aa}	35.62^{ca}	36.39^{ca}	43.29^{Ba}

Control: Domiati cheese made from raw milk, T1: Domiati cheese made from heat treated milk. T2: Domiati cheese made from Microwave, T3: Domiati cheese made from magnetic milk.
A, B, C: Means with same letter among treatments in the same pickling period are not significantly different.
a, b, c : Means with same letter for same treatment during pickling periods are not significantly different

3- Microbiological properties:

Microbiologically, all treatments T1, T2 and T3 possessed lower bacterial count than that of the control. The lowest count of total viable bacterial count (TBC) of these treatments is, indeed due to the bacterial growth inhibition compared with raw-milk Domiati cheese. Through pickling period the TBC of all cheese samples increased up to the first month and then sharply decreased till the end of pickling period. This decrease would be evidently attributed to the increase in developed acidity which inhibits the bacterial growth or act as bactericidal agent with (26-29) who stated that, during ripening period, the numbers of different microbial groups were significantly decreased reaching their minimum at the end of ripening period. Control cheese had the highest viable spore forming bacterial count whether when fresh or along pickling period. On the contrary, treatments T1, T2 and T3 inhibited to a certain extent the growth of aerobic spore forming bacteria in cheese. Spore forming bacteria gradually decreased with prolonging the pickling period of Domiati cheese. This may be due to the ability of bacteria to produce high acidity and specific antimicrobial substances (19). Aerobic spore forming bacterial count was appreciably decreased because the relatively high salt content possessed Domiati cheese.

Table (3)
The microbiological properties of Domiati cheese made from raw, heat, microwave and magnetic treated milk during pickling period

Pickling period (month)	Treatment			
	Control	T1	T2	T 3
Total viable bacterial Log count (log cfu/g)				
Fresh	7.15^{Aa}	6.65^{Bb}	6.63^{Ba}	6.98^{ABa}
1	7.38^{Aa}	6.78^{Ba}	6.74^{Ba}	6.97^{Aba}
2	6.97^{Aa}	6.41^{Bc}	6.37^{Bb}	6.79^{ABab}
3	6.55^{Ac}	6.15^{Bc}	5.96^{Bc}	6.38^{ABb}
4	6.34^{Ac}	5.84^{Bd}	5.66^{Bc}	5.94^{Bc}
5	5.55^{Ad}	5.19^{Be}	5.16^{Bd}	5.34^{ABcd}
6	5.33^{Ad}	5.01^{Be}	5.09^{Bd}	5,19^{Ad}
Spore forming bacterial Log count (log cfu/g)				
Fresh	5.31	2.25	2.23	2.29
1	5.28	2.0	1.95	2.11
2	4.84	1.66	1.61	1.65
3	3.78	1.57	1.50	1.59
4	3.55	1.16	1.11	1.33
5	2.34	N.D	N.D	N.D
6	1.24	N.D	N.D	N.D
Yeasts and molds Log count (logcfu/g)				
Fresh	4.60	1.11	1.12	1.28
1	5.16	2.45	2.48	2.47
2	6.49	3.58	3.50	3.66
3	7.55	4.68	4.59	3.75
4	8.72	6.76	5.68	5.89
5	8.87	7.88	6.78	6.92
6	9.90	7.96	6.85	7.00

Control: Domiati cheese made from raw milk, T1: Domiati cheese made from heat treated milk. T2: Domiati cheese made from Microwave, T3: Domiati cheese made from magnetic milk. ND: not detected.
A, B, C: Means with same letter among treatments in the same pickling period are not significantly different.
a, b, c : Means with same letter for same treatment during pickling periods are not significantly different

Yeasts and molds were detected in all cheese

treatments and control. This is may be due to the suppressive effect of treatments on yeasts and molds counts. From the Table (3) it is noticed that the magnetic field have appositive effect on decreasing the growth of yeast & molds and other microbes from milk, this is due to magnetic field causes a transfer of energy into ions which produce stream of ions which hit in high velocity. Similar observations were found by (23). (30) reported that, the contamination of dairy products with these microorganisms, more specifically of cheese, originates from the technological equipment at dairy processing plants, from water, brine and other components. Yeasts and molds grow within a wide temperature and pH range, and these factors do not limit their harmful effect on dairy products, because of both (13) Proposed their amount as a criterion for the sanitary condition of dairy products. The obtained yeasts and molds results are in accordance to (22) and (32), who provided that their count should not exceed the sum of 410 cfu/g white soft cheeses, those equalize the log count of 2.61. During pickling period total yeasts and molds counts gradually increased till the end of storage. These results agree with (23), who stated that total yeasts and molds counts gradually increased until 60 days of refrigerated pickling of Domiati cheese. This increase can be explained by the sufficient change in the environmental conditions which happen during cheese pickling and allow the growth and multiplication of microorganisms. (33) reported that, the occurrence of yeasts in cheese with a stable population until the last day of ripening is attributed to the tolerance to severe environmental conditions such as low pH, decreased water activity, and high salt concentration, and thus, they appear to affect organoleptic properties of cheese due to lipolytic and proteolytic activities.

4- Texture profile of Domiati cheese

Data displaying in Table (4) present the parameters of texture profile, namely hardness, adhesiveness, cohesiveness, springiness, gumminess as well as chewiness of Domiati cheese made from cow's milk when raw or alternatively treated either by conventional heat, microwave, magnetic field whether when fresh or during pickling room temperature for 6 months.

Hardness is defined as the force required reaching a given deformation or the maximum load from first compression cycle "max force attained during the first compression cycle" (34). However, it is a parameter that describes the product situation (soft, firm, or hard) related to the strength of Domiati cheese structure under compression. It is clear from these data that the cheese samples made from heat and microwave treated milk had higher hardness value than those cheese samples made from raw or magnetic field treated milk. That could be positively related to the protein/DM content given in Table (1). Moreover, it could be seen from the results that the hardness values increased significantly by increasing the pickling period. That is may be due to cheese shrinkage during pickling at the room temperature. It is noticed also that the cheese made from heat treated milk distinguished also the higher hardness value during the pickling period. The obtained results are in harmony with those present in (35), who found that, cheese firmness increased either as the protein content or storage period raised.

Adhesiveness value appeared different trends, when fresh, control cheese had the highest value followed by heat and magnetic treated milk, while the microwave treated-milk cheese came in the last order. Domiati cheese pickling was associated with obvious reduction in the value of this criterion along all treatments.

Cohesiveness is defined as the strength of internal bonds making up the body of the product; it is the ratio of the positive area during the second compression to that of the first peak during the first compression.

Cohesiveness quantifies the internal resistance of food structure. Briefly, cohesiveness is the ability of a material to stick itself according to (36). In cheese, cohesiveness is a measurement of the strength of the internal bonds of the protein mycelium (37).The results in Table (4) indicated that, neither the method of cheese milk treatment nor the cheese pickling period led to any significant difference in cohesiveness.

Springiness (referred to as "elasticity") is the rate at which a deformed material returns to its original shape on removal of deforming force. The height that the material recovers during the time elapsed between the end of the first bite and the start of the second is taken as springiness according to (38). Another word, springiness measures elasticity by determining the extent of recovery between the first and second compression as defined by (39). Data of Table (4) show that, the springiness value of magnetic-treated cheese did not vary from that of the control one, while both of them exhibited springiness value higher than that either of heated or microwave treated milk

cheese. Regardless the kind of cheese milk treatment, all springiness values increased at the end of pickling period (6 months).

Gumminess defined as "the energy required for disintegrating a semisolid food product to a state ready for swallowing," and is the product of the primary parameters of hardness and cohesiveness according to (36). The obtained results revealed that, opposite to those observed in hardness criterion, Domiati cheese made from raw or magnetic-treated milk possessed gumminess value higher than that exhibited from microwave or heat-treated milk cheese. Nevertheless, it behaved trending like of hardness towards pickling storage period (Table, 4).

It is a perception of Domiati cheese "rubber" in the mouth, and is a measure of how much the Domiati cheese structure is recovered after the initial compression. The obtained data revealed that the springiness values of Domiati cheese behaved trending similar to those of gumminess. Where, it was lower in cheese made from microwave and heat treated milk versus those made from raw and magnetic-treated milk. Likewise it increased as pickling period of cheese prolonged.

Table (4)
Texture profile parameters of Domiati cheese made from raw, heat, microwave and magnetic treated milk during pickling

Pickling period (month)	Treatment			
	Control	T1	T2	T3
	Hardness(N)			
Fresh	6.557	6.882	6.775	6.547
6	7.439	7.775	7.643	7.449
	Adhesiveness((mJ)			
Fresh	2.09	1.87	0.15	0.89
6	1.22	0.3	0.1	0.81
	Cohesiveness(Ratio)			
Fresh	0.37	0.39	0.48	0.3
6	0.4	0.55	0.49	0.42
	Springiness(mm)			
Fresh	5.66	4.78	4.22	5.67
6	6.36	5.83	5.43	6.45
	Gumminess(N)			
Fresh	2.55	2.44	0.79	2.58
6	4.04	3.27	1.23	4.15
	Chewiness(mJ)			
Fresh	11.89	14.69	3.36	11.98
6	16.33	20.66	4.78	14.67

Control: Domiati cheese made from raw milk, T1: Domiati cheese made from heat treated milk. T2: Domiati cheese made from Microwave, T3: Domiati cheese made from magnetic milk.

5- Organoleptic properties:

The scores of sensory evaluation of cheese is shown in Table (5). Appearance of cheese showed slight differences among all cheese treatments and generally decreased with extending the pickling period. Control and T3- cheese whether when fresh or along pickling period were slightly preferable in appearance than that of T1 or T2. It was noticed that, control and magnetic-milk cheese remarkably gained the highest sensory score attributes either of flavor intensity, body & texture or/and consequently the total acceptability. This may be attributed to the relatively higher acidity development in such cheeses which could enhance the texture. Body & texture as well as flavor and consequently cheese acceptability improved during pickling of cheese up to different periods. Similar observations were found by (19) who declared that, the flavor of raw milk cheese had the highest total score compared to pasteurized cheese. This may be due to the natural flora initially present in raw milk which participates in aroma production. Also, (23) stated that, cheese produced from magnetic milk was organoleptically significantly better than that produced from pasteurized milk.

Extending the pickling time for samples caused deterioration in body & texture being very firm and less preferable. The flavor enhancement in cheese of control and magnetic field is due to the role of bacteria in hydrolyze the milk component involved in cheese flavor such as proteins, fats, lactose, citrates and phosphates. There were no significant differences in flavor score of fresh Domiati cheese treatments including control. This is due to salty taste in Domiati cheese that covers the cheese aroma. In conclusion, the acceptability of cheese increased during the first period of pickling and decreased with extending the storage period. The improvements were very slow in pasteurization while, it was faster in magnetic field.

Table (5)
Organoleptic scores of Domiati cheese made from raw, heat, microwave and magnetic treated milk during pickling

Characteristic	Pickling period	Treatments			
	(month)	Control	T1	T2	T3
Appearance	Fresh	8	9	9	9
(out of 10)	1	8	8	9	9
	2	7	8	8	9

	3	7	7	7	8
	4	7	6	7	8
	5	6	6	6	8
	6	6	5	6	7
Body &Texture (out of 30)	Fresh	28^{Ab}	24^{Bb}	25^{Bb}	28^{Ab}
	1	28^{Ab}	24^{Bb}	26^{Bb}	28^{Ab}
	2	28^{Ab}	25^{Bab}	26^{Bb}	28^{Ab}
	3	28^{Ab}	25^{Bab}	27^{Bab}	29^{Aa}
	4	29^{Aa}	26^{Ba}	27^{Bab}	29^{Aa}
	5	29^{Aa}	26^{Ba}	28^{Ba}	29^{Aa}
	6	29^{Aa}	27^{Ba}	29^{Ba}	29^{Aa}
Flavor (out of 60)	Fresh	ND	39	39	ND
	1	ND	42	41	ND
	2	51	42	42	48
	3	52	44	43	50
	4	52	44	43	52
	5	52	47	47	52
	6	54	48	47	53

Control: Domiati cheese made from raw milk, T1: Domiati cheese made from heat treated milk. T2: Domiati cheese made from Microwave, T3: Domiati cheese made from magnetic milk. ND: not determined.

ND: not determined.

A, B, C: Means with same letter among treatments in the same pickling period are not significantly different.

a, b, c : Means with same letter for same treatment during pickling periods are not significantly different.

Conclusion:

Finally, it could be concluded that, magnetic field may be successfully apply in production of Domiati cheese without any significant variation in the physicochemical properties of that made traditionally using raw milk. Thus, these findings marks the magnetic field as an substitute to diminish of the initial load of microbes of raw milk, improve quality and increase the milk shelf-life before different processing. However, this remains insufficient to ensure that the product is free of pathogenic microbes, compared to that of milk treated with heat or microwaves.

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