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SYNBIOTIC DOMIATI CHEESE

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ABSTRACT: This study aimed to make a good quality functional Domiati cheese by replacing milk fat with inulin which improve the body and texture of cheese and viability of bifidobacteria. Therefor 10 Domiati cheese were made. Control Domiati cheese treatment was made from milk standardized to 4% Fat. Another control was made from the same milk with adding *Bifidobacterium infantis* and four cheese treatments were made by replacing 25, 50, 75 and 100% of milk fat with inulin (Frutafit Tex®). The other four cheese treatments were made by replacing milk fat with inulin as mentioned previously and adding encapsulated bifidobacteria. Replacing milk fat with inulin caused a significant increase of cheese yield, titratable acidity, moisture content, soluble nitrogen, scores of organoleptic properties, total bacterial counts and counts of bifidobacteria, while decrease fat content and pH values and did not affect ash and total nitrogen content of cheese treatments. Adding *Bifidobacterium infantis* to cheese increased titratable acidity, total nitrogen content, scores of organoleptic properties and counts of bifidobacteria, while pH values, total bacterial counts and counts of mould and yeast decreased. On the other hand titratable acidity and soluble nitrogen content increased during pickling period, while cheese yield, total nitrogen content and pH values decreased. Cheese treatments were accepted by panelists, especially cheese treatment T_5, which was made by replacing 50% of milk fat with inulin and adding *Bifidobacterium infantis*. Therefore Domiati cheese could be a good vehicle to deliver the probiotic bacteria to consumers.

Key words: Domiati, Probiotic, Inulin, Synbiotic.

INTRODUCTION

Domiati cheese is one of the most popular soft white cheese in Egypt. It could be consumed fresh or after pickling in its salted whey (Kebary *et al.*, 2006).

Milk fat plays critical role in developing the flavor, appearance & body and texture of dairy products. The problem facing the manufacture of low-fat cheese are the lack of the typical flavor and proper body and texture (Anderson and Mistry, 1994). The use of fat replacers in low fat cheese had a greet attention as the resultant cheese retain while the same functional and organoleptic properties as full fat cheese (Kebary *et al.*, 2002).

The development of dairy products with a low-fat content is one of the most dairy companies because of health problems associated with high fat intake such as, some types of cancer, diabetes, hypertension, liver and heart diseases (Williams, 1985).

Using fat replacers as a possibility of making reduced or low-fat cheeses has been reviewed by Kebary *et al.*, (2006).

Bifidobacteria is a probiotic bacteria that cause hostility to some pathogens,the effect of the risk of diarrhea, normalizing the bowel movement, enhance immune functions, reduce cholesterol level, thus acting,effective effect of the riskof eczema,the synthesis of many several vitamins, protect from cancer and relieve the intolerance symptoms (Martin *et al.*, 2015). Because of these health benefits, there has been increasing interest in the use of bifidobacteria in the dairy industry. The effectiveness of added probiotic bacteria depends on the dosage level. To achieve its health benefits, it must be present in certain numbers in the digestive tract (10^6 – 10^7 cfu / g).

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The objectives of this study were to investigate the effect of incorporating inulin (carbohydrate-based fat replacer) and bifidobacteria on the quality of low-fat Domiati cheese, monitor the changes during storage of Domiati cheese and monitor the viability of bifidobacterial during the storage of Domiati cheese.

MATERIALS AND METHODS

Materials

Frutafit Tex® inulin (Average Chain Length ≥ 22 monomers) which used as fat replacer was gratefully provided by Sensus, Borchwerf, the Netherlands. Buffalo's milk given from Agriculture Faculty of Menoufia University, Shebin El-Kom, Egypt and separated in the pilot plant of Department of Dairy Sci. and Technology of the same Faculty. Active culture of *Bifidobacterium infantis* ATCC 15697 was obtained from Egyptian Microbial Collection (EMCC) at Microbiological Resources Center, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.

Methods

- Encapsulation of *Bif. infantis*

Bif. infantis was encapsulated in alginate beads stated by the method of Sheu and Marshall (1993).

- Cheese making

This study examined the effect of fat content and adding bifidobacteria on the quality of Domiati cheese. Ten batches of Domiati cheese were made. one was made from buffalo's milk (Farm of the Faculty of Agriculture, Menoufia Univ., Shibin El-Kom, Egypt) standardized to 4.0% fat, (control cheese). Another package was made from buffalo's milk uniform for 4.0% fat and adding bifidobacteria (T_1) and four batches were made by replacing 25.0, 50.0, 75.0 and 100% of milk fat with inulin (T_2, T_4, T_6 and T_8, respectively). The other four batches were made by replacing 25.0, 50.0, 75.0 and 100% of milk fat and adding bifidobacteria (T_3, T_5, T_7 and T_9, respectively). All milk batches were heated to 72°C then cooled immediately to the renneting temperature (37°C). Inulin and encapsulated cells of *Bif. infantis were* added to warm milk at the rate of 1.0×10^7 cfu/ml milk and subsequently salt (5.0%), calcium chloride (0.02%) was added. Domiati cheese treatments were made from all milk batches according to Fahmi and Sharara (1950). Cheese batches were pickled in plastic bags (Badawi *et al.,* 2006), filled with its salted boiled whey and stored in refrigerator (6 – 8°C) for 3 months. Samples were taken from each batch every 15 days for microbiological, chemical and sensory evaluation. The entire experiment was tripled.

Chemical analysis

The pH value was measured using pH meter (Jenway electric pH meter). Titratable acidity, moisture content, ash content, protein content and soluble nitrogen were determined as stated by A.O.A.C (2007). The fat content was determined with original Gerber's method as described by Ling (1963).

Cheese yield

Cheese yield was evaluated as kg of fresh cheese per 100 kg buffalo milk used.

Microbiological examinations

The total bacterial counts were determined by using standard plate count agar medium (Marth, 1978). Modified MRS agar was used for containing solution of antibiotics was used for enumerating bifidobacteria (Ventling and Mistry, 1993). To each 100 ml of modified MRS 5.0 ml of the following solution 1-Neomycine sulphate 0.8% w/v,2-Paromycine sulphate 0.2% w/v,3-Nalidixic acid 0.3% w/v and Lithium chloride 6.0%. was added before pouring plates (Samona and Robinson, 1991).

Plates were incubated under anaerobic condition at 37°C for 72 hr. Yeasts and moulds were enumerated on Potato Dextrose Agar (acidified) medium (Difco, 1953).

Sensory evaluation

The organoleptic properties of Domiati cheese were assessed by 10 panelists from the staff members of Dairy Science Department, Faculty of Agriculture, Menoufia University, according to Mahmoud *et al.,* (2013).

Statistical analysis

2 × 3 factorial design was used to analysis all the data and Newman Keuls test was followed to make the multiple comparisons (Steel and Torrie, 1980) using CoStat program. Significant differences were calculated at $p \leq 0.05$.

RESULTS AND DISCUSSION

The yield of all cheese treatments decreased significantly as pickling period advanced ($p \leq 0.05$). This could be associated with the loss of moisture and some soluble constituents through the pickling period (Table 1). Cheese yield of all treatments decreased markedly during the first 45 days of pickling period then the rate of decrease begin to fall down gradually. These results agree with those reported by Mehanna *et al.* (2002). Replacement of milk fat with inulin caused a significant increased of yield, which might be due to the increase of moisture because inulin has higher water holding capacity than of fat (Torres *et al.*, 2010).

Moisture content of all treatments decreased significantly ($p \leq 0.05$) as pickling period advanced (Tables 1,7). These results are in agreement with reported by El-Sheikh *et al.* (2001). The rate of decreasing was higher during the first 30 days. Moisture content of all cheese treatments increased by replacing milk fat with inulin and this increase was proportional to the rate of replacement (Table 1). These results could be associated with the higher water holding capacity of inulin (Alnemr, 2013). Cheese containing encapsulated bifidobacteria contained lower moisture content than corresponding cheese treatments those made without adding encapsulated bifidobacteria, which might be due to the development of acidity that helps to expel whey from cheese curd (Effat *et al.*, 2001).

There were significant differences among all Domiati cheese treatments in titratable acidity which means that adding inulin and bifidobacteria had significant effect on titratable acidity of cheese treatments. Cheese treatments those made with incorporating inulin and encapsulated bifidobacteria exhibited the highest acidity which could be because of the stimulating effect of inulin on the growth and activity of lactic acid bacteria and bifidobacteria (Mahmoud *et al.*, 2013). Also, the titratable acidity of all Domiati cheese treatments increased significantly ($p \leq 0.05$) as pickling period progressed (Table 2). These results are in agreement with reported by Mahmoud *et al*,. (2013).

The changes of pH values as affected with adding inulin and encapsulated bifidobacteria and pickling period followed an opposite trend to titratable acidity. These results are in agreement with those of Alnemr *et al.* (2013).

Fat content increased significantly ($p \leq 0.05$) in each and every cheese treatments during pickling period (Table 1). As expected fat content of cheese decreased significantly ($p \leq 0.05$) by replacing milk fat with inulin (Tables 1,7). There was negative correlation between the fat content and the rate of the replacement, which means that fat content decreased as the rate of replacing milk fat with inulin increased. Control Domiati cheese contained the highest fat content. Similar results were reported by Badawi *et al.* (2008) and Hussein (2008). Treatments made with inulin and encapsulated bifidobacteria contained higher fat content than those made by adding inulin only and this might be due to the low moisture content of these treatments and subsequently increasing total solids, fat content and decreasing the activity of breakdown (Kamaly *et al.*, 2017).

Table (1): Effect of adding inulin and bifidobacterial on Cheese yield, Fat, Moisture and Ash contents (%) during storage at (6 – 8°C) for 3 months.

Treatments◘	Pickling period (weeks)					
	0	2	4	6	8	12
	Cheese yield (%)					
C	27.40	25.31	24.72	23.60	22.19	21.76
T_1	27.70	25.5	24.80	23.65	22.25	21.80
T_2	29.17	26.95	25.40	24.17	23.38	22.46
T_3	29.95	28.52	26.42	25.80	24.65	23.74
T_4	30.12	28.55	27.42	26.16	25.93	24.18
T_5	30.85	28.85	27.76	26.95	26.12	24.85
T_6	31.16	29.47	28.86	27.08	26.66	25.40
T_7	31.43	29.50	28.18	27.12	26.80	25.70
T_8	32.04	30.16	29.46	27.19	26.85	25.85
T_9	32.45	30.25	29.65	27.25	27.12	26.01
	Fat content (%)					
C	11.1	13.2	16.0	17.6	20.6	22.2
T_1	11.5	13.7	16.9	18.7	21.4	23.6
T_2	8.5	9.8	12.5	14.0	16.9	18.5
T_3	8.8	10.4	13.0	14.8	17.5	19.5
T_4	5.9	7.2	10.3	12.0	14.8	15.5
T_5	6.2	7.6	10.8	12.5	15.2	16.8
T_6	2.7	4.5	6.3	7.5	9.5	12.8
T_7	3.0	4.8	6.5	8.0	10.2	14.0
T_8	1.2	3.2	5.0	7.1	10.9	12.0
T_9	1.8	3.8	5.5	7.5	11.2	12.8
	Moisture content (%)					
C	64.72	62.84	60.69	59.29	58.00	56.74
T_1	63.83	61.17	59.67	57.84	55.46	54.06
T_2	67.42	64.82	63.32	61.52	58.72	57.32
T_3	66.22	63.56	62.06	60.23	57.40	56.00
T_4	70.12	67.52	65.72	63.92	61.12	59.72
T_5	68.92	66.26	64.76	62.93	60.10	58.70
T_6	72.82	69.68	68.18	66.38	63.58	62.18
T_7	71.62	68.96	67.46	65.63	62.80	61.40
T_8	75.82	73.22	71.72	69.92	67.12	65.72
T_9	74.62	71.96	70.46	68.63	65.80	64.40
	Ash content (%)					
C	6.22	6.22	6.31	6.35	6.41	6.45
T_1	6.23	6.23	6.29	6.38	6.46	6.50
T_2	6.25	6.25	6.38	6.40	6.45	6.52
T_3	6.27	6.27	6.35	6.43	6.49	6.55
T_4	6.31	6.31	6.40	6.45	6.50	6.57
T_5	6.33	6.31	6.42	6.49	6.52	6.59
T_6	6.38	6.38	6.47	6.50	6.57	6.61
T_7	6.40	6.40	6.49	6.59	6.62	6.65
T_8	6.44	6.44	6.54	6.63	6.67	6.69
T_9	6.46	6.46	6.55	6.65	6.69	6.72

C : Control Domiati cheese with 4% milk fat.
T_1: Domiati cheese with 4% milk fat and *Bif.infantis* (encapsulated cells).
T_2: Domiati cheese with replacing 25% of milk fat with inulin.
T_3: Domiati cheese with replacing 25% of milk fat with inulin and adding *Bif.infantis* (encapsulated cells).
T_4: Domiati cheese with replacing 50% of milk fat with inulin.
T_5: Domiati cheese with replacing 50% of milk fat with inulin and adding *Bif.infantis* (encapsulated cells).
T_6: Domiati cheese with replacing 75% of milk fat with inulin.
T_7: Domiati cheese with replacing 75% of milk fat with inulin and adding *Bif.infantis* (encapsulated cells).
T_8: Domiati cheese with replacing 100% of milk fat with inulin.
T_9: Domiati cheese with replacing 100% of milk fat with inulin and adding *Bif.infantis* (encapsulated cells).
◘ Each value in the table was the mean of three replicates.

Table (2): Effect of adding inulin and bifidobacterial on Total nitrogen (%), soluble nitrogen (%), titratable acidity (%) and pH value during storage at (6 – 8°C) for 3 months.

Treatments◘	Pickling period (weeks)					
	0	2	4	6	8	12
	Total nitrogen (%)					
C	2.19	2.09	1.98	1.92	1.86	1.84
T_1	2.28	2.17	2.06	2.00	1.99	1.93
T_2	2.20	2.08	1.96	1.90	1.89	1.81
T_3	2.30	2.18	2.09	2.03	2.00	1.95
T_4	2.23	2.10	1.98	1.90	1.86	1.83
T_5	2.32	2.20	2.15	2.05	2.03	1.97
T_6	2.24	2.11	1.97	1.89	1.82	1.79
T_7	2.35	2.23	2.11	2.09	2.05	2.00
T_8	2.26	2.14	2.03	1.96	2.91	1.87
T_9	2.38	2.26	2.14	2.10	2.07	2.03
	Soluble nitrogen (%)					
C	0.15	0.39	0.62	0.73	0.80	0.86
T_1	0.16	0.40	0.65	0.79	0.88	0.95
T_2	0.18	0.40	0.66	0.78	0.86	0.97
T_3	0.19	0.41	0.70	0.84	0.90	0.99
T_4	0.21	0.36	0.57	0.69	0.79	0.84
T_5	0.23	0.43	0.73	0.87	0.93	1.02
T_6	0.26	0.47	0.77	0.91	0.97	1.06
T_7	0.28	0.50	0.79	0.94	1.00	1.09
T_8	0.33	0.53	0.80	0.97	1.05	1.12
T_9	0.38	0.57	0.82	1.00	1.10	1.16
	Titratable acidity (%)					
C	0.32	0.54	0.73	0.84	1.05	1.19
T_1	0.34	0.58	0.74	0.95	1.17	1.28
T_2	0.36	0.62	0.78	0.99	1.21	1.32
T_3	0.37	0.63	0.79	1.00	1.23	1.33
T_4	0.39	0.65	0.81	1.02	1.24	1.35
T_5	0.42	0.68	0.85	1.04	1.28	1.36
T_6	0.44	0.70	0.86	1.08	1.30	1.40
T_7	0.46	0.72	0.88	1.10	1.31	1.42
T_8	0.48	0.74	0.90	1.12	1.33	1.44
T_9	0.52	0.78	0.93	1.15	1.37	1.48
	pH value					
C	6.15	5.50	5.20	4.80	4.50	3.80
T_1	6.10	5.00	4.70	4.10	3.80	3.20
T_2	6.05	5.30	5.00	4.60	4.30	3.60
T_3	5.95	5.65	5.25	4.55	4.25	3.55
T_4	5.80	5.50	5.10	4.40	4.10	3.40
T_5	5.78	5.08	4.68	4.38	4.08	3.38
T_6	5.70	5.00	4.70	4.30	4.01	3.31
T_7	5.65	4.95	4.55	4.25	3.95	3.25
T_8	5.63	4.93	4.63	4.23	3.93	3.23
T_9	5.60	4.90	4.60	4.20	3.90	3.20

◘ Each value in the table was the mean of three replicates.

Total nitrogen of all cheese treatments decreased significantly ($p \leq 0.05$) as pickling period progressed (Tables 2,7). These results were perhaps because of the protein breakdown during pickling period and coming into being of water soluble nitrogen compounds, which lost in the pickling solution (El-Shafei *et al.,* 2008). These results are in agreement with those observed by Badawi and Kebary (1996) and El-Abd *et al.* (2003). Total nitrogen content of all cheese treatments decreased sharply during the 45 days then decreased slightly up to the end of pickling period (90 days) (Tables 2,7). Cheese treatments C, T_2, T_4, T_6 and T_8 were not significantly different from each other, which means that replacement of milk fat with inulin did not have significant effect on total nitrogen content of cheese (Tables 2,7). Cheese treatments those made with adding bifidobacteria contained higher total nitrogen content, which might be due to the lower moisture content and consequently increasing total nitrogen and decreasing the rate of proteolysis activity (Salem *et al.,* 2007).

Table (1) shows that neither the addition of inulin nor the encapsulated bifidobacteria affected significantly ($p>0.05$) the ash content of the resultant Domiati cheese. Ash content of all cheese treatments increased slightly during pickling period, which might be due to the moisture content of cheese. These results are in agreement with those reported by Alnemr *et al.* (2013).

Soluble nitrogen content (SN) of all cheese treatments increased significantly ($p \leq 0.05$) throughout the pickling period (Tables 2,7). Similar results were reported by Al-Abd *et al.* (2003). Water soluble nitrogen content of all cheese increased sharply during the first 45 days then increased gradually up to the end of pickling period (Tables 2,7). Significant differences in the WSN among all Domiati cheese treatments (Table 2) were noticed, which means that incorporating of both bifidobacteria and inulin affected significantly ($p \leq 0.05$) the WSN of Domiati cheese. Cheese treatment T_9 which made with replacing 100% milk fat with inulin and encapsulated bifidobacteria contained the highest WSN (Table 2). These results can be attributed to the enhancing effect of inulin on the growth and activity of lactic acid bacteria and bifidobacterial consequently increasing the rate of proteolysis. These results are in accordance with those reported by El-Den and Kamaly (2017).

Microbiological examinations

The results showed that total bacterial counts increased until the fourth week of pickling period, then decreased as the pickling period advanced. These results are in agreement with Mahmoud *et al.* (2013). Adding inulin caused a significant increase of the total bacterial count which might be due to prebiotic effect of inulin. Incorporating of bifidobacteria caused a significant reduction of total bacteria counts which might be due to the production of antimicrobial agents by bifidobacteria (Olieveira *et al.,* 2009).

The counts of *Bif. infantis* of Domiati cheese treatments increased up to the fourth week of pickling storage and then gradually decreased up to end of pickling period (Table 4). Thus, the maximum number (81×10^7 cfu/g) of *Bif. infantis* was observed after four weeks of pickling period and then decreased markedly to 93×10^5 cfu/g at the end of pickling period (Table 4) (Kebary *et al.,* 2008 and Nada, 2009). Therefore, high begining number of probiotic is needed to supply the recommended number in the last product. Adding inulin caused a significant ($p \leq 0.05$) increase in the count of bifidobacteria due to the bifidogenic effect of inulin that enhance the growth of bifidobacteria (Gibson and Roberfroid, 1995).

On the other hand, the mould and yeast increased gradually during pickling period to reach its maximum at the end of pickling period for all cheese treatments (Table 5). Domiati cheese treatments made with adding encapsulated bifidobacteria contained the lower counts of mould and yeast than those of cheese treatments without adding encapsulated bacteria. These results are in agreement with those reported by Mahmoud *et al.* (2013).

Table (3). Effect of adding inulin and bifidobacterial on Total bacterial counts (log cfu/g) during storage at (6 – 8°C) for 3 months.

Treatments◘	Pickling period (weeks)					
	0	2	4	6	8	12
C	7.22	7.31	7.45	7.30	7.18	7.12
T_1	7.10	7.20	7.38	7.25	7.14	7.02
T_2	7.50	7.65	7.85	7.56	6.48	6.45
T_3	7.46	7.60	7.19	7.52	6.41	6.38
T_4	7.64	7.74	8.00	7.60	6.65	6.60
T_5	7.55	7.68	7.90	7.57	6.50	6.45
T_6	7.67	7.80	8.10	7.64	6.70	6.65
T_7	7.60	7.72	8.08	7.60	6.62	6.95
T_8	7.70	7.82	8.22	7.70	6.79	6.74
T_9	7.64	7.76	8.13	7.64	6.68	6.62

◘ Each value in the table was the mean of three replicates.

Table (4). Effect of adding inulin and bifidobacterial on Bifidobacteria count (log cfu/g) during storage at (6 – 8°C) for 3 months (log_{10} cfu /g).

Treatments◘	Pickling period (weeks)					
	0	2	4	6	8	12
C	ND	ND	ND	ND	ND	ND
T_1	7.42	7.52	7.70	7.20	7.00	6.74
T_2	ND	ND	ND	ND	ND	ND
T_3	7.54	7.70	7.87	7.32	7.13	6.96
T_4	ND	ND	ND	ND	ND	ND
T_5	7.70	7.81	8.06	7.86	7.52	7.30
T_6	ND	ND	ND	ND	ND	ND
T_7	7.84	7.90	8.40	8.16	8.00	7.58
T_8	ND	ND	ND	ND	ND	ND
T_9	7.44	7.55	7.61	7.21	7.08	6.65

◘ Each value in the table was the mean of three replicates.

Table (5). Effect of adding inulin and bifidobacterial on Moulds and Yeasts counts(log cfu/g) during storage at (6 – 8°C) for 3 months.

Treatments◘	Pickling period (weeks)					
	0	2	4	6	8	12
C	ND	ND	3.88	3.92	4.02	4.27
T_1	ND	ND	ND	3.85	3.95	4.20
T_2	ND	ND	3.82	3.90	4.00	4.10
T_3	ND	ND	ND	3.87	3.96	4.05
T_4	ND	ND	3.90	3.98	4.05	4.00
T_5	ND	ND	ND	3.92	3.33	3.97
T_6	ND	ND	4.00	4.09	3.40	3.95
T_7	ND	ND	ND	4.00	3.30	3.80
T_8	ND	ND	4.11	3.90	3.60	3.68
T_9	ND	ND	ND	3.32	3.50	3.50

◘ Each value in the table was the mean of three replicates.

Table (6). Effect of adding inulin and bifidobacterial on Organoleptic properties during storage at (6 – 8°C) for 3 months.

Treatments◘	Flavour (50)						Body and Texture (35)						Colour and Appearance (15)						Total scores (100)					
	Pickling period (weeks)																							
	0	2	4	6	8	12	0	2	4	6	8	12	0	2	4	6	8	12	0	2	4	6	8	12
C	42	41	41	40	39	39	30	30	28	26	27	26	13	12	10	9	9	8	85	83	79	75	75	73
T_1	43	42	42	41	40	39	31	30	30	28	27	28	13	13	12	10	10	9	87	86	84	82	77	76
T_2	44	44	43	42	42	41	32	32	32	31	30	30	14	14	14	13	12	12	90	90	89	86	84	83
T_3	44	44	43	42	42	41	32	32	32	31	31	30	14	14	14	13	12	12	90	90	89	86	85	83
T_4	48	48	48	45	45	44	35	35	34	33	32	31	15	15	15	14	14	14	98	98	97	92	91	89
T_5	48	48	48	45	46	44	35	35	35	33	32	31	15	15	15	14	14	14	98	98	98	92	92	89
T_6	45	46	45	46	43	43	34	34	33	33	33	30	14	14	14	13	13	13	93	94	93	92	89	86
T_7	46	46	44	46	43	43	34	34	33	33	32	30	14	14	14	13	13	13	94	93	91	92	88	86
T_8	45	45	45	43	42	42	33	32	32	31	31	28	14	13	13	12	11	11	92	90	89	86	84	81
T_9	45	45	44	43	42	42	33	33	32	31	31	29	14	13	13	12	11	11	92	91	89	86	84	82

◘ Each value in the table was the mean of three replicates.

Table (7). Statistical analysis of domiati cheese properties.

Domiati cheese properties	Effect of treatments											Effect of pickling period (weeks)						
		Multiple comparisons●											Multiple comparisons●					
	Mean squares	C◘	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	Mean squares	0	2	4	6	8	12
Yield (%)	43.192*	I	J	G	H	E	F	C	D	B	A	108.369*	A	B	C	D	E	F
Moisture (%)	29.201*	I	J	G	H	E	F	C	D	A	B	421.346*	A	B	C	D	E	F
Titratable acidity (%)	0.1006*	I	HI	GH	G	F	E	D	C	B	A	3.867*	F	E	D	C	B	A
pH value	0.8164*	A	B	C	D	E	F	G	GH	HI	I	22.125*	A	B	C	D	E	F
Fat (%)	281.364*	A	A	B	C	E	D	G	F	I	H	555.939*	F	E	D	C	B	A
Ash (%)	0.1399	A	A	A	A	A	A	A	A	A	A	0.439*	C	BC	AB	A	A	A
Total nitrogen (%)	0.082*	B	A	B	A	B	A	B	A	B	A	0.643*	A	B	CD	D	E	F
Soluble nitrogen (%)	0.098*	G	G	FG	F	EF	E	D	C	B	A	2.218*	F	E	D	C	B	A
Organoleptic properties																		
Flavor	66.687*	F	E	C	C	A	A	B	B	D	D	64.760*	A	A	B	C	D	E
Body and texture	67.867*	D	C	A	A	A	A	B	B	B	B	32.480*	A	A	A	B	B	B
Color & appearance	34.467*	D	C	B	B	A	A	B	B	AB	AB	20.999*	A	A	A	B	BC	C
Total scores	471.697*	E	D	C	C	A	A	B	B	B	B	326.490*	A	A	AB	BC	CD	D

◘See Table (1).

● For each effect the different letters in the same row means the multiple comparisons are different from each other, letter A is the highest mean followed by B, C, … etc.

* Significant at 0.05 level ($p \leq 0.05$).

All cheese treatments were accepted by panelists till the ending of pickling period. Generally, scores of flavour, appearance, body and texture increased gradually after four weeks of pickling period (Table 6). The treatments made with inulin and encapsulated bifidobacteria had higher scores than those treatments made with inulin only. Cheese prepared with adding 50% inulin and encapsulated bifidobacteria gained highest scores.

These results showed that Domiati cheese made by adding 50% inulin and encapsulated bifidobacteria exhibited the highest texture and the acceptability score comparing with control. Similar results have been reported by Alnemr *et al.* (2013).

It could be concluded that adding inulin and encapsulated bifidobacteria increased the acceptability of Domiati cheese and improved the survival of bifidobacteria. Until after the end of storage, the number of bifidobacteria in cheese made with 50% inulin and encapsulated bifidobacteria (T_5) was higher than the count should be existing in cheese to realize the health benefits of probiotic bacteria. Also, T_9 was the most agreeable cheese treatment. These results are in agreement with those by Abd-Elhamid (2012), Mahmoud *et al.* (2013) and Kebary *et al.* (2014). Addition of 50% inulin and encapsulated *Bif. infantis* can be recommended to develop a new synbiotic Domiati cheese of acceptable quality and health benefits.

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إنتاج جبن دمياطي مُعدل وظيفيًا

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الهدف من هذه الدراسة هو صناعة جبن دمياطي وظيفي ذو خصائص جيدة وذلك باستبدال دهن اللبن بالإنيولين والذى يعمل علي تحسين قوام وتركيب الجبن وأيضًا حيوية البفيدوبكتريا. ولذلك تم تصنيع 10 معاملات جبن دمياطي وكانت كالتالي:

المعاملة الكنترول صنعت من لبن جاموسى 4% دهن ومعاملة كنترول (2) صنعت من لبن جاموسي 4% دهن مضاف له *Bifidobacterium infantis* و 4 معاملات أخرى صنعت بنسب استبدال 25 و 50 و 75 و 100% من دهن اللبن بالإنيولين (Frutafit Tex®) و 4 معاملات أخرى صنعت باستبدال دهن اللبن كما ذكر سابقًا بالإضافة إلي كبسولات البفيدوبكتريا.

وكانت النتائج كالتالى:

1- حدث زيادة واضحة في تصافي الجبن والحموضة والرطوبة والنيتروجين الذائب ودرجات التقييم الحسى وأعداد البكتريا الكلية وعدد البفيدوبكتريا باستبدال دهن اللبن بالإنيولين، ومن ناحيةٍ أخرى انخفض الدهن وقيم الـ pH بينما لم تؤثر على قيم الرماد والنيتروجين الكلي في معاملات الجبن.

2- وجد أن إضافة *Bifidobacterium infantis* أدى إلى زيادة الحموضة والنيتروجين الذائب ودرجات التحكيم وأعداد البفيدوبكتريا بينما انخفضت قيم الـ pH والعدد الكلي للبكتريا وأعداد الفطريات والخمائر.

3- بمرور فترة التخزين زادت الحموضة والنيتروجين الذائب بينما انخفضت نسبة التصافي والنيتروجين الكلي وقيم الـ pH.

وكانت أفضل المعاملات T_5 التى صنعت باستبدال 50% دهن اللبن بالإنيولين وبإضافة *Bifidobacterium infantis*.

وبذلك وُجد أنه يُمكن تصنيع جبن دمياطي مُدعَّم بالبكتريا الحيوية باستبدال 50% من دهن اللبن بالإنيولين.