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CARBONATED RETENTATE FOR MAKING TALLAGA CHEESE

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ABSTRACT

Tallaga cheese was made from cow's skim milk retentate injected with 10, 20 or 30g/kg of carbon dioxide and tested for its chemical, microbiological and sensory properties during 30 days of refrigerated storage. The results showed that, injection of CO_2 significantly increased the acidity and decreased the pH and total solids in the retentate. The retentate holding capacity of CO_2 gradually increased up to the injection level of 20 g/kg, however decreased at 30 g/kg. The retentate content of CO_2 was inflected on the fresh cheese without detectable changes in its acidity and pH, however the acidity development significantly suppressed in the 10 and 20 g/ kg CO_2-cheese up to 20 days of storage that extended to 30 days in the 30g/kg CO_2-cheese. The Ca, K, Mg, Na and P minerals content of fresh cheese slightly decreased in that made with 30 g/kg CO_2. Fresh and cold stored carbonated cheese had significantly lower content of soluble tryptophane and total volatile fatty acids (TVFA) than the control cheese. This effect was enhanced by increasing the level of the injected CO_2. The microbiological analysis of retentate showed a gradual in the quality improvement with increasing the CO_2 injection level. Compared to control, increasing the level of CO_2 markedly improved the bacterial quality of cheese during storage. The carbonated cheese had higher sensory properties and over all acceptability than the untreated one.

INTRODUCTION

White soft Cheese is the most important dairy product in Egypt. It is consumed daily as a part of the Egyptian diet. According to the Egyptian authorities, the annual cheese production totals 310,000 tons. Nearly 70% of it is soft cheeses such as feta, Domiatti and Domiatti like cheese (Tallaga cheese). The per capita consumption of cheese is estimated to be 6 kg/year (Statistics year book Egypt, 2000).

Tallaga cheese is an Egyptian unripened soft cheese made by rennet coagulation of pasteurized milk with adding low concentration of salt. The cheese must be stored under cooling and consumed within two weeks of production. The low salt content of cheese makes it more healthy and suitable in the nutrition of patient, elderly people and children as well. On the other hand, over the course of extended cold storage periods the cheese quality may be severely deteriorated by the growth of psychrotrophic bacteria surviving pasteurization and/or post-processing microbial contamination.In this respect, several studies reported the presence of foodborne pathogenic bacteria in Tallaga and Domiati cheese (Abou –Dawood *et al.,* 2005; Abou-Donia, 2007 and El-kholy *et al*., 2008). Morever, Fromm and Boor (2004) identified the heat-resistant psychrotrophic gram-positive rods Paenibacillus, Bacillus, and Microbacterium as the predominant spoilage organisms in

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pasteurized milk samples from 3 commercial dairy plants. It has been estimated that 25% of all milk shelf life problems are due to thermoduric psychrotrophs and *Bacillus spp*. (Ternstrom *et al*., 1993 and Sorhaug and Stepaniak, 1997). These organisms produce extracellular proteases and lipases, which reduce the functionality of milk proteins, and often produce undesirable aroma.

The essential structure of the cheese matrix is formed by the caseins, which constitute about 80% of the milk proteins. The remaining 20%, the whey proteins, are lost to a large extent in the whey. Ultrafiltration technology has meanwhile been established on an industrial scale in modern dairies for different cheese production (King, 1986; Rao & Renner, 1988 and Hansen, 1989).

On the other side, the use of carbon dioxide are also being developed for improving the shelf life, quality, and yield of a diversity of dairy products, including raw and pasteurized milk, cheeses, yogurt, and fermented dairy beverages (Hotchkiss *et al*., 2006). Dissolved CO_2 was found to increase both the lag phase and the generation time in the growth cycle of microorganisms (King and Mabbitt, 1982 and Daniels *et al*., 1985), and in low levels it can control the growth of psychrotrophic bacteria in milk (King and Mabbitt, 1982 and Rashed *et al*., 1986).

The present study is an attempt to apply the technology of ultrafiltration and carbon dioxide treatment in the production of Tallaga cheese. The cow's skim milk retentate was standardized to cheese base, then carbonated and used for cheese production in order to improve its production process, keeping quality and nutritional value.

MATERIALS AND METHODS

Cheese making:

Cheese was made according to Fahmi and Sharara (1950) with some modifications. Cheese base was prepared as follows: Cow's milk (3.8% fat, 3.2% protein and 9.2% total solids,) was skimmed and concentrated to 8% protein by means of ultrafiltration (Sprial wound, Denmark). Then, the fat content was standardized to 25% using a mixture (50:50 w/w) of palm and palm carnal oils. Thereafter, 2.5% of dried skim milk (35% protein) was added and the mixture was homogenized and pasteurized at 70°C for 15 sec. After cooling to 45°C, sodium chloride (2%) and calcium chloride (0.02%) were added and gently mixed.

The mixture was divided into 4 portions. One portion was served as a control and the others were injected with 10, 20 and 30 g/ kg CO_2 and hold for 10 min. To every portion, water diluted microbial rennet (Fromase, France) was added (3g/100kg) and rapidly mixed. The mixtures were immediately divided and filled into 120g plastic cubs, incubated at 40°C until complete coagulation and then stored under refrigeration (~7°C) for 30 days. Chemical and microbiological analysis were carried out in the fresh cheese base and the resultant Tallaga cheese at 10 days intervals. The cheese was sensory evaluated at the end of storage period.

1. Chemical analysis:

1.1. Cheese base:

Cheese base was analyzed for carbon dioxide content as described by El-Baz and Zommara,(2007). The pH value was measured using a pH meter 3020 Jenway (Jenway limited Gramsmore Grean, Felsteel Dummow, England). The mineral content (Ca, K, Mg, Na and P) was determined as previously described by Zommara *et al*., 2007.

1.2. Tallaga Cheese:

Cheese samples were analyzed when fresh and after 10, 20, and 30 days of refrigerated storage. Carbon dioxide content was determined as described by El-Baz and Zommara, 2007. The moisture content was determined according to the British Standard Institution (B.S.I, 1952). The conventional Gerber's method was followed for fat determination using the special butyrometer for cheese (Ling, 1963). The titratable acidity (%) and pH were estimated as according to Ling, 1963. Total volatile fatty acids (TVFA)content expressed as (ml 0.1N NaOH/100 gm cheese) was determined by direct distillation method according to Kosikowski (1978). Protein content was determined using kjeldahal method as described in the A.O.A.C (1990). Soluble tryptophane was determined according to Vakaleris and Price (1959).

2. Microbiological analysis:

Cheese base and Tallaga cheese were analyzed for total bacterial count as well as, lipolytic, proteolytic, thermophilic, psychrotrophic and spore forming bacterial counts and incidence of yeast and moulds. Total bacteria, thermophilic bacteria, thermoduric bacteria and psychrotrophs were counted on nutrient agar medium (Oxoid) as described by American Public Health Association (APHA, 1992). Proteolytic bacteria were counted on nutrient agar medium (Oxoid) with adding 12% sterilized skim milk before pouring the melted medium to Petri dishes (Harriagan and McCance, 1976). Lipolytic bacterial were enumerated using the same technique as in proteolytic bacterial count but with adding sterilized butter oil at the rate of 5% instead of skim milk. Yeast and moulds were counted on potato dextrose agar (PDA) medium according to the American Public Health Association (APHA, 1992).

3. Sensory evaluation:

The sensory properties of Tallaga cheese were scored on a hedonic scale for flavor (60), body and texture (30) and appearance (10) of samples by staff members of the Department of Dairy Science, Faculty of Agriculture, Kafrelsheikh University. The data were expressed as total score for each treatment.

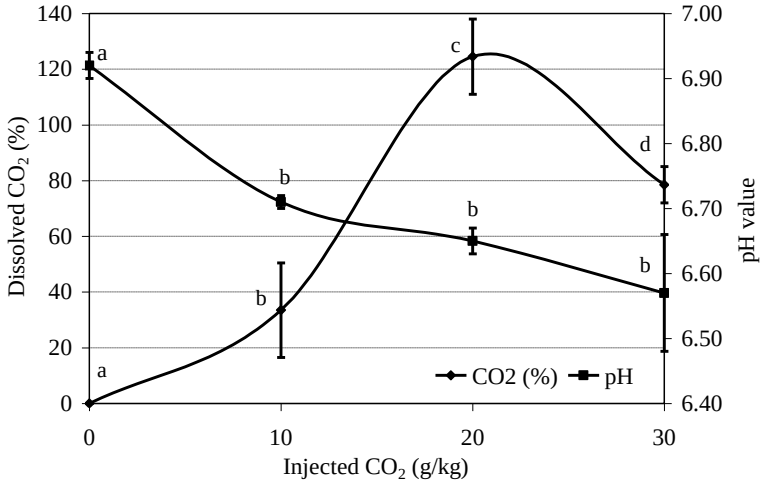
4. Statistical analysis:

Data were expressed as the mean ± SE of 3 replicates and significant variations were determined by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The CO_2 content (mg/kg) in the cheese bases was 200, 267, 449 and 357 for the control, 10, 20 and 30 g/kg CO_2, respectively. Figure (1) shows the percentage of the dissolved CO_2 in the cheese bases compared to the

control. The dissolved CO_2 was increased by 33.5, 124.5 and 78.5 in the 10, 20 and 30 g/kg CO_2 treatments, respectively. These results may be explained by the gas saturation capacity of the cheese base under the used injection conditions.



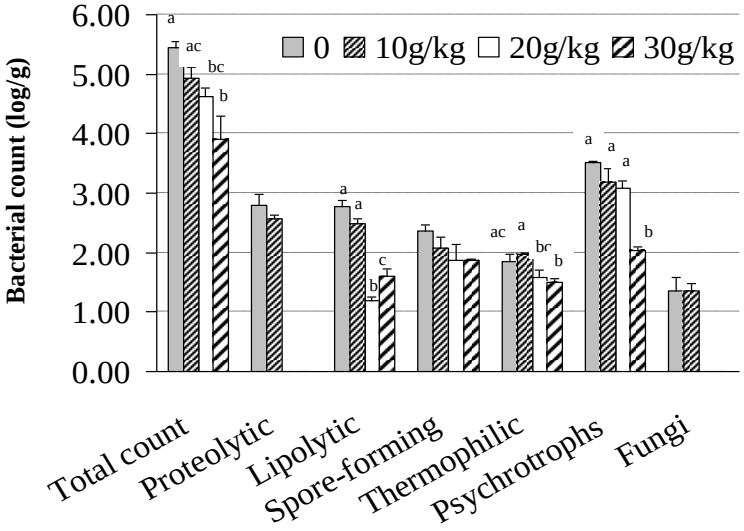
Data are means ± SE of 3 replicates.
Means with unlike superscript letters are significantly different (p <0.05).

Fig. (1). Percentage of dissolved carbon dioxide (CO_2) and pH in cheese base injected with different levels of CO_2.

Figure (1) also shows the pH values in the carbonated cheese bases. Injection of 10 g/kg CO_2 significantly reduced the pH value of cheese base compared to control, however increasing the injection level to 20 and 30 g/kg resulted in no change in the pH values. The resistance of pH to change in spite of the increase of the injected CO_2 may be explained by the buffering capacity effect of milk retentate. Ma and Barbano (2003) examined the effect of protein concentration and type in CO_2 treated utrafiltrated milk on the pH of the produced milk retentate, and found that increasing either casein or soluble protein increased the buffering capacity of milk.

As shown in Fig. (2), the microbiological analysis of the cheese bases showed a gradual quality improvement effect with increasing the CO_2 injection level which was prominent in the 20 and 30 g/kg CO_2 treatments. This effect was evaluated by reduction of total, lipolytic, thermophilic, psychrotrophic and spore forming bacterial counts in all treatments compared to control and disappearance of the proteolytic bacteria and fungi in cheese base treated with 20 and 30 g/kg CO_2. Many studies on the effect of CO_2 on milk quality have focused on the microbiological quality of milk. The cheese industry is concerned about the damage to milk components due to proteolysis and lipolysis. Increased proteolysis reduces the economic value of milk by its negative impact on protein functionality. Proteolysis can reduce cheese yield and cause bitter off flavors in dairy foods. Also, development of

high levels of FFA due to lipolysis imparts a rancid off flavor in dairy products, making them unacceptable (Ma *et al*., 2003 and Hotchkiss *et al*., 2006).



Data are means ± SE of 3 replicates.
Means with unlike superscript letters are significantly different (p <0.05).

Fig. (2). Microbial flora of cheese bases injected with different levels of CO_2 (g/kg).

Table (1) shows CO_2 content, acidity and pH of Tallaga cheese made from the carbonated cheese base. The content of CO_2 in the cheese bases was inflected on the resulted Tallaga cheese. The fresh carbonated cheese had significantly higher CO_2 content than the control one. The CO_2 content in the 10, 20 and 30 g/kg CO_2 cheese was increased by 200%, 216% and 122%, respectively compared to control cheese. On the other hand, the cheese CO_2 content was dramatically decreased after 10 days of storage for the 20 and 30 g/kg CO_2 cheese and after 20 days for the 10 g/kg CO_2 cheese and then gradually increased till the end of storage period (30 days). This effect may be explained by the formation of CO_2 during microbial growth in cheese. In this respect, Jaros *et al.*, (2006) stated that growth and activity of yeasts has to be considered as the most important source for carbon dioxide formation during ripening of quarg cheese.

In comparison to the control cheese, injection of CO_2 gradually increased the acidity in the fresh cheese and during storage period. On the other hand, the acidity of the control cheese declined after 20 days of storage. Generally, increasing the level of CO_2 suppressed the development of cheese acidity during storage period. This effect was prominent in the 30 g/kg CO_2 treated cheese which was more resistance to the changes in the pH

up to 20 days of storage than the other carbonated cheese. On the other hand, cheese pH gradually decreased during storage however, the carbonated cheese had significantly higher pH values after 30 days of storage compared to the control (Table 1).

Table (1): Carbon dioxide (CO_2), acidity and pH of Tallaga cheese made from milk retentate treated with different levels of CO_2 during cold storage.

CO_2 (g/Kg)	Storage period (days)			
	Fresh	10	20	30
CO_2 (mg/Kg cheese)				
0	335 ± 0.50^{aA}	108 ± 0.25^{bA}	207 ± 0.30^{cA}	239 ± 0.35^{dA}
10	672 ± 2.15^{aB}	239 ± 0.35^{bB}	163 ± 0.25^{cB}	204 ± 0.50^{dB}
20	724 ± 2.40^{aC}	262 ± 0.35^{bC}	362 ± 1.20^{cC}	176 ± 0.05^{dC}
30	409 ± 0.90^{aD}	172 ± 0.40^{bD}	204 ± 0.55^{cD}	221 ± 1.00^{dD}
Acidity (%)				
0	0.18 ± 0.04^{a}	0.63 ± 0.03^{bA}	1.23 ± 0.00^{cA}	1.05 ± 0.05^{dA}
10	0.20 ± 0.01^{ac}	0.40 ± 0.00^{bB}	0.72 ± 0.02^{cB}	1.08 ± 0.02^{dA}
20	0.22 ± 0.00^{bc}	0.30 ± 0.01^{bC}	0.56 ± 0.01^{cC}	0.98 ± 0.03^{dA}
30	0.24 ± 0.01^{b}	0.28 ± 0.00^{bD}	0.40 ± 0.00^{bD}	0.66 ± 0.01^{cB}
pH				
0	6.53 ± 0.00^{aAB}	6.45 ± 0.01^{aA}	6.30 ± 0.09^{bA}	5.86 ± 0.00^{cA}
10	6.61 ± 0.07^{aA}	6.42 ± 0.02^{bAB}	6.30 ± 0.00^{bA}	6.03 ± 0.03^{cB}
20	6.43 ± 0.01^{aB}	6.38 ± 0.02^{bB}	6.22 ± 0.01^{cB}	5.95 ± 0.00^{dC}
30	6.47 ± 0.03^{aB}	6.45 ± 0.01^{aA}	6.38 ± 0.07^{aAB}	6.23 ± 0.03^{bD}

Data are means ± SE of 3 replicates.
Means with unlike superscript small and capital letters within row and column are significantly different (p <0.05).

Table (2): Chemical composition of Tallaga cheese made from milk retentate treated with different levels of CO_2 during cold storage.

CO_2 (g/Kg)		Storage period (days)			
		Fresh	10	20	30
TS[1] (%)	0	40.6 ± 0.18^{aA}	41.7 ± 0.09^{bAB}	41.4 ± 0.41^{ab}	41.1 ± 0.18^{ab}
	10	40.9 ± 0.21^{aA}	42.3 ± 0.31^{bA}	41.4 ± 0.16^{a}	41.5 ± 0.13^{a}
	20	39.7 ± 0.27^{B}	40.7 ± 0.07^{B}	39.4 ± 2.32	41.1 ± 0.09
	30	39.0 ± 0.00^{aC}	41.2 ± 0.55^{bB}	40.4 ± 0.44^{b}	41.5 ± 0.46^{b}
P/TS[2] (%)	0	23.7 ±1.90	22.9 ± 1.19	23.2 ± 0.74	24.1 ± 0.55
	10	23.4 ±2.00	23.1 ± 0.82	23.1 ± 1.02	23.5 ± 1.17
	20	24.4 ± 1.86	23.5 ± 1.25	24.4 ± 0.31	24.4 ± 1.14
	30	23.6 ±1.51	23.5 ± 1.20	23.7 ± 1.45	24.6 ± 1.22
F/TS[3] (%)	0	61.0 ± 0.35	59.6 ± 0.72	59.5 ± 1.19	61.2 ± 0.84
	10	58.4 ± 0.52	58.6 ± 1.02	60.7 ± 1.35	62.0 ± 1.16
	20	59.8 ± 1.05	60.8 ± 0.72	61.6 ± 1.54	62.2 ± 1.76
	30	61.4 ± 0.64	62.0 ± 0.45	61.4 ± 0.50	61.8 ± 0.25

[1]Total solids, [2]protein/total solids, [3]fat/total solids
Data are means ± SE of 3 replicates.
Means with unlike superscript small and capital letters within row and column are significantly different (p <0.05).

Table (2) shows total solids and protein and fat: total solids ratio for Tallaga cheese. The cheese total solids slightly increased in all cheese after 10 days of storage which may be attributed to the drainage of whey. Increasing the CO_2 level in the cheese base decreased the total solids in the resulted fresh cheese which could be traced to the acidity development as shown in Table (1) with no significant changes during storage period. Table 2 also shows that the ratio between cheese protein and fat to its total solids content were comparable among all cheese treatments during the storage period.

The calcium (Ca), potassium (K), magnesium (Mg), sodium (Na) and phosphorus (P) content of milk retentate and Tallaga cheese are shown in Table (3). The cheese resulted in remarkable increase in the measured minerals compared to milk retentate. This increase can be ascribed to the salt (sodium chloride) add during cheese production which may contain some impurities of other minerals. Among all cheese, there was a significant reduction in the minerals content in the fresh cheese made with 30 g/ kg CO_2. This finding could be attributed to the loss of minerals in cheese whey that resulted in the decrease of cheese total solids as shown in Table 2. On the other hand, all cheese contained comparable mineral contents after 30 days of cold storage (Table 3).

Table (3): Mineral content (mg/kg) of milk retentate and carbonated Tallaga cheese when fresh and after 30 days of cold storage.

	Ca	K	Mg	Na	P
Retentate	**1501 ± 28**	**873 ± 22**	**103 ± 2**	**685 ± 30**	**1030 ±11**
CO_2 (g/ kg)	**Fresh cheese**				
0	1894 ± 70^{ab}	1321 ± 20^{a}	139 ± 3^{a}	5073 ± 82^{a}	1358 ± 30^{a}
10	1955 ± 34^{a}	1423 ± 56^{a}	142 ± 1^{a}	5161 ± 69^{a}	1409 ± 20^{a}
20	1923 ± 12^{a}	1361 ± 14^{a}	139 ± 1^{a}	5098 ± 19^{a}	1365 ± 15^{a}
30	1786 ± 16^{b}	1199 ± 24^{b}	127 ± 1^{b}	4812 ± 46^{b}	1263 ± 10^{b}
	Stored cheese*				
0	1957 ± 11	1396 ± 17	145 ± 2	5261 ± 107	1450 ± 4^{a}
10	1975 ± 24	1490 ± 19	148 ± 4	5202 ± 84	1412 ± 34^{ab}
20	1909 ± 37	1315 ± 18	138 ± 3	5329 ± 118	1354 ± 19^{b}
30	1948 ± 37	1352 ± 39	144 ± 3	5374 ± 75	1378 ± 32^{ab}

*** After 30 days of storage.**
Data are means ± SE of 3 replicates.
Means with unlike superscript letters are significantly different (p <0.05).

As shown in Table (4), fresh and cold stored carbonated cheese had significantly lower content of soluble tryptophane and total volatile fatty acids (TVFA) than the control cheese. This effect was enhanced by increasing the level of the injected CO_2 which may be explained by the reduction of the microbial proteolytic and lipolytic enzymes activity due to the inhibition of the proteolytic and lipolytic bacterial growth (Fig. 2 and 3). In this respect, injection of cheese base with 20 and 30 g/kg CO_2 showed the best results.

Table (4): Soluble tryptophane and total volatile fatty acids (TVFA) of carbonated Tallaga cheese during cold storage.

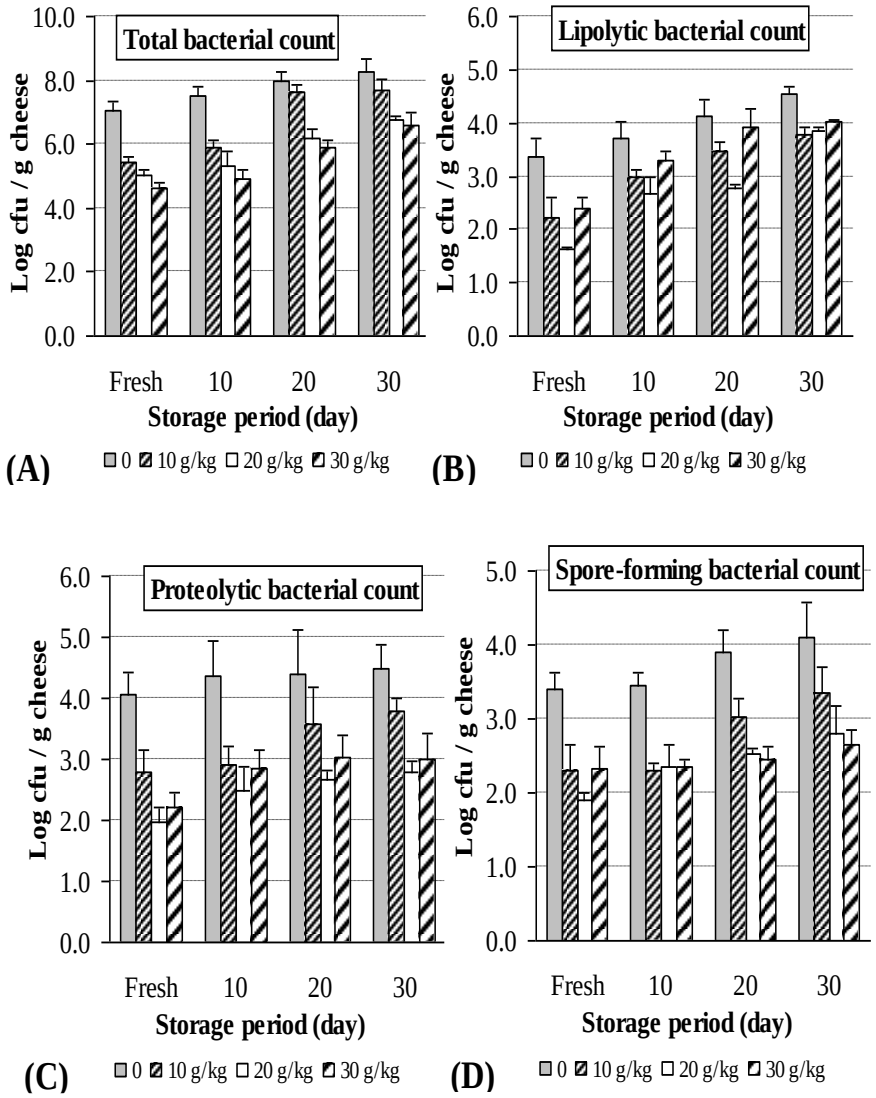
CO_2 (g/Kg)	Storage period (days)			
	Fresh	10	20	30
Soluble tryptophane (mg/100g cheese)				
0	99 ± 0.79^{aA}	98 ± 0.14^{aA}	111 ± 0.27^{b}	117 ± 0.16^{cA}
10	98 ± 0.20^{aAC}	102 ± 0.97^{bB}	110 ± 0.06^{c}	114 ± 0.05^{dB}
20	95 ± 0.05^{aB}	94 ± 0.98^{aC}	111 ± 1.52^{b}	115 ± 0.17^{cC}
30	97 ± 0.70^{aC}	92 ± 0.96^{bC}	109 ± 0.58^{c}	112 ± 0.19^{dD}
TVFA (ml 0.1N Na OH/100g cheese)				
0	7.0 ± 0.11^{aA}	7.0 ± 0.13^{aA}	7.2 ± 0.20^{aA}	9.9 ± 0.12^{bA}
10	5.9 ± 0.13^{aB}	6.8 ± 0.10^{bA}	7.5 ± 0.13^{cA}	8.5 ± 0.17^{dB}
20	4.3 ± 0.20^{aC}	4.2 ± 0.17^{aB}	4.3 ± 0.11^{aB}	7.0 ± 0.20^{bC}
30	4.6 ± 0.12^{aC}	5.8 ± 0.26^{bC}	6.1 ± 0.18^{bC}	7.3 ± 0.11^{cC}

Data are means ± SE of 3 replicates.
Means with unlike superscript small and capital letters within row and column are significantly different ($p < 0.05$).

Figure 3 (A, B, C, D, E, F and G) shows the incidence of different microbial groups in cheese expressed as log bacterial counts/g cheese. Injection of CO_2 significantly inhibited the microbial growth in cheese compared to the control. This effect was enhanced by increasing the level of CO_2 in cheese and was prominent in 20 and 30 g/kg CO_2 treatments. The reduction in the cheese microbial flora in the carbonated cheese would improve the keeping quality of cheese. This effect may be attributed to the growth inhibition of the lipolytic and the proteolytic bacterial that produces heat resistance lipolytic and proteolytic enzymes and suppression the fungi growth as well. These results are in consistence with other results obtained in several studies (King and Mabbitt, 1982, Rashed *et al*., 1986, Zommara, 1987, Ma *et al*., 2003, Hotchkiss *et al*., 2006 and Jaros *et al*., 2006). They demonstrated that the beneficial effect of injection CO_2 to raw milk and other dairy products mainly attributed to the growth inhibition of the psyrotrophic bacteria during cold storage. These bacteria are known to produce heat resistance proteolytic and lipolytic enzymes leading to off flavors in cheese during storage.

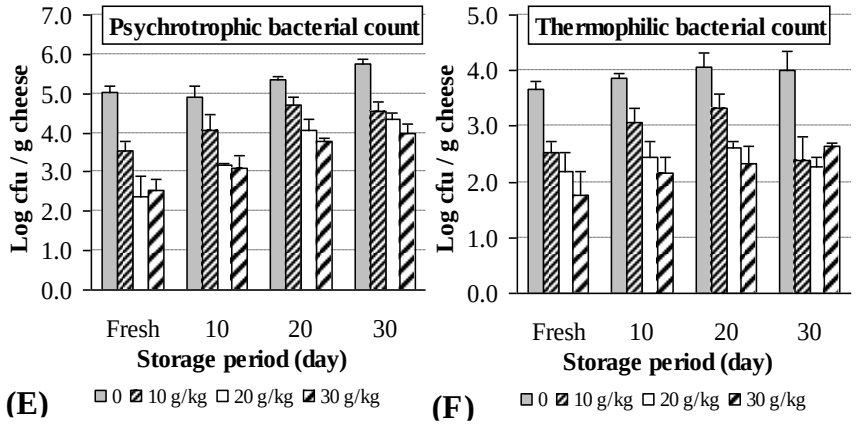
The sensory properties of Tallaga cheese during storage period are shown in Table (5). The carbonated cheese had higher organoliptic scores than the control cheese that improved in all treatments during storage. The relatively low sensory scores in the fresh cheese (77.5-83.5) were directly attributed to the palm oil flavour as given by the panelist.

In conclusion, Tallaga cheese production from milk retentate carbonated with 20 g/kg CO_2 could be promising for increasing the keeping quality of cheese through suppressing the growth of spoilage microorganisms, prolonging cheese shelf life and improving its sensory properties.



Data are means ± SE of 3 replicates.

Fig. 3 : (A, B, C, D, E, F and G): Microbial flora of Tallaga cheese made from milk retentate with different levels of CO_2 during cold storage.



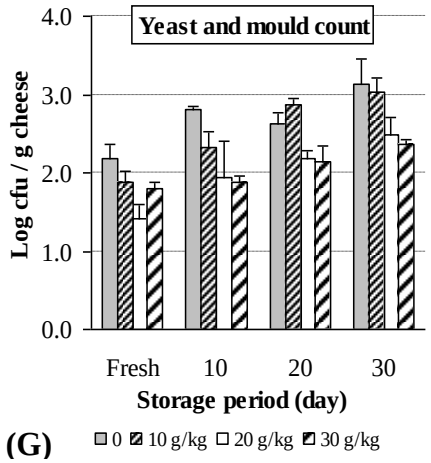


Fig. 3 (A, B, C, D, E, F and G). continued.

Table (5): Total organoliptic scores of carbonated Tallaga cheese during cold storage.

		Storage period (days)			
		Fresh	**10**	**20**	**30**
CO_2 (g/Kg)	0	77.5 ± 0.50^{aA}	78.5 ± 0.50^{acA}	79.5 ± 0.50^{bc}	80.0 ± 0.00^{bA}
	10	81.0 ± 1.00^{aB}	80.5 ± 0.50^{aAB}	81.0 ± 0.00^{a}	83.8 ± 0.25^{bB}
	20	80.8 ± 0.75^{B}	82.5 ± 1.50^{B}	81.5 ± 1.50	83.5 ± 0.50^{B}
	30	81.5 ± 1.50^{B}	83.5 ± 1.50^{B}	82.5 ± 1.50	84.5 ± 0.50^{B}

Data are means ± SE of 3 replicates.
Means with unlike superscript small and capital letters within row and column are significantly different (p <0.05).

REFERENCES

Abou-Dawood,A.I.; Taha, S.H. and Mohamed, M.N. (2005). Chemical and microbiological quality of raw milk, soft and hard cheeses collected from some districts at Giza governorate. Egyptian J. Dairy Sci.33:201.

Abou- Donia ,S.A. (2007). Recent development in Egyptian Domiati cheese research: An overview. Egyptian J. Dairy Sci. 35:1.

American Public Health Association (APHA) (1992). Standard Methods of the Examination of Dairy products. 16th ed. American Public Health Association, Washington, USA.

AOAC "Association of official analytical chemists" 15th ed., Helrich, K. Ed. (1990). Association of Official Analytical Chemists. Washington D.C.

British Standard Institution B. S. I. (1952). Methods for the Chemical Analysis of Cheese B. S. I. No. 770.

Daniels, J. A., Krishnamurthi, R. and Rizvi, S. S. H. (1985). A review of effects of carbon dioxide on microbial growth and food quality. J. Food Proc. 48:532.

Duncan, D. B. (1955). Multiple range and Multiple F tests. Biometrics, 11: 1.

El-Baz, M. A. and Zommara, M. A. (2007). Characteristics of carbonated stirred yoghurt-bifidum milk fortified with honey and vitamin C. Egyptian J. Dairy Sci., 35: 45.

El-Kholy, W.I.; Hosny , I.M. and El-Dairouty, R.K. (2008). Rapid microbiological analysis and foodborne microorganisms in Tallaga cheese. Egyptian J .Dairy Sci. 36:73.

Fahmi, A. H. and Sharara, H. A. (1950). Studies on Egyptian Domiati cheese. J. Dairy Res., 17: 312.

Fromm, H. I. and Boor, K. J. (2004). Characterization of pasteurized fluid milk shelf–life attributes. J. Food Sci., 69: M207-M214.

Hansen, R. (1989). Cheese making in a new way. North Eur. Food Dairy Ind., 54: 310.

Harrigan, W. F. and McCance, E. (1976). Laboratory Methods in Food and Dairy Microbiology. Academic Press New York.

Hotchkiss, J. H., Werner, B. G. and Lee, E. Y. C. (2006). Addition of carbon dioxide to dairy products to improve quality: A comprehensive review. Comprehensive Rev. Food Sci. Food Safety, 5: 158.

Jaros, D., Hofmann, T. and Rohm, H. (2007). The potential for carbon dioxide formation during ripening of acid curd cheese. LWT., 40: 1140.

King, D. W. (1986). White cheese by ultrafiltration. Food Tec. New Zealand, 21: 22.

King, J., and Mabbitt, L. A. (1982). Preservation of raw milk by the addition of carbon dioxide. J. Dairy Res. 49: 439.

Kosikowiski, F. V. (1978). Cheese and Fermented Milk Food .2nd Ed., Published by the author, Cornell Univ., Ithaca, New York, USA.

Ling, E. F. (1963). A Text Book of Dairy Chemistry Practical 4th Ed Vol. 2 Chapmanand Hall Ltd. London.

Ma, Y. and Barbano, D. M. (2003). Serum protein and casein concentration: effect on pH and freezing point of milk with added CO_2. J Dairy Sci., 86: 1590.

Ma, Y., Barbano D. M. and Santos, M. (2003). Effect of CO_2 addition to raw milk proteolysis and lipolysis at 4°C. J. Dairy Sci., 86:1616.

Rao, D. V. and Renner, E. (1988). Studies on the application of ultrafiltration for the manufacture of Cheddar cheese. 1. Determination of the optimum temperature for heat denaturation of whey proteins in UF-concentrate. Milchwissenschaft, 43: 216.

Rashed, M. A., Mehanna, N. M. and Mehanna, A. S. (1986). Effect of carbon dioxide on improving the keeping quality of raw milk. J. Soc. Dairy Technol., 39: 62.

Sorhaug, T. and Stepaniak L. (1997). Psychrotrophs and their enzymes in milk and dairy products: quality aspects. Trends Food Sci. Technol., 8: 35.

Statistics year book Egypt (2000). Central Agency for Public Mobilization and Statistics of Egypt.

Ternstrom, A; Lindberg, A. M. and Molin, G. (1993). Classification of the spoilage flora of raw and pasteurized bovine-milk, with special reference to Pseudomonas and Bacillus. J. Appl. Bacteriol., 75: 25.

Vakaleris, D. G and Price, W. V. (1959). A rapid spectrophotometric method for measuring cheese ripening. J. Dairy Sci., 42: 264.

Zommara, M. A. (1987). Studies on recent methods for preserving and cooling raw milk. M.Sc thesis, Faculty of Agriculture, Tanta University, Egypt

Zommara, M. A., Prokisch, J., Széles, E. and Zoltán, G. (2007). Utilization of whey from the manufacture of Kareish cheese enriched with organic selenium in bread making. The 10th Egyptian Conference for Dairy Science and Technology, 549-564, Cairo.

انتاج جبن الثلاجة من مركز اللبن الفرزالمعامل بثانى أوكسيد الكربون

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تم دراسة الخصائص الكيماوية والميكروبيولوجية والحسية لجبن الثلاجة المصنع من مركز اللبن البقرى الفرز المعامل بغاز ثانى أوكسيد الكربون (ك أ٢) بتركيز ١٠، ٢٠، ٣٠ جم/كجم والمخزن تحت تبريد لمدة ٣٠ يوم. أوضحت النتائج أن الحقن بغاز ك أ٢ احدث زيادة معنوية فى حموضة مركز اللبن الفرز وانخفاضا فى قيمة الأس الهيدروجينى (pH) والجوامد الصلبة الكلية له. وقد زادت قدرة المركز على الاحتفاظ بالغاز بزيادة تركيز الحقن إلى ٢٠جم/كجم بينما انخفضت هذه القدرة عند مستوى ٣٠جم/كجم. انعكس محتوى المركز من غاز ك أ٢ على محتواه فى الجبن الطازج الناتج بدون تأثير على حموضة الجبن وقيمة الـ pH. وقد أدى الحقن بالغاز إلى إعاقة تطور الحموضة فى الجبن المعامل بالغاز بتركيزات ١٠، ٢٠جم/كجم حتى ٢٠ يوم من التخزين بينما زادت هذه المدة لتصل إلى ٣٠ يوم فى الجبن المعامل بتركيز ٣٠جم/كجم. احتوت الجبن الطازجة المعاملة بتركيز ٣٠جم/كجم ك أ٢ على تركيز أقل من الكالسيوم والبوتاسيوم والماغنسيوم والصوديوم والفسفور الذى قد يرجع ذلك إلى زيادة فقد الشرش (تشريش) لهذه المعاملة وخروج نسبة من هذه العناصر فى الشرش الناتج. حدث انخفاض معنوى فى محتوى الجبن المعامل بالغاز من التربتوفان الذائب والأحماض الدهنية الطيارة مقارنة بعينة الكنترول، وقد ذاد هذا التأثير بزيادة مستوى الغاز المستخدم فى الحقن مما يدلل على انخفاض فى تحلل البروتين والدهن بها. أوضحت نتائج التحليل الميكروبيولوجى للمركز حدوث تحسن تدريجى فى الجودة الميكروبية بزيادة تركيز الغاز المحقون به وقد انعكس ذلك على الجودة الميكروبية للجبن الناتج مقارنة بالكنترول. فقد انخفضت أعداد المجاميع الميكروبية المقدرة وخاصة البكتريا المقاومة للبرودة والمحللة للدهون والبروتينات وكذلك أعداد الفطريات والخمائر أثناء مدة التخزين مما حسن من الخواص الحسية للجبن المعامل بالغاز. توضح الدراسة إمكانية استخدام الرتنتات والحقن بتركيز ٢٠جم/كجم غاز ك أ٢ كوسيلة لتحسين جودة جبن الثلاجة واطالة مدة تخزينها بدون تأثيرات غير مرغوبة على خواصها الحسية.