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Impact of Type of Filling on the Quality of Cream Cheese

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ABSTRACT

The effect of cold and hot filling on the chemical, microbiological and organoleptic properties of cream cheese was studied. Cheese was made from standardized buffalo's milk (5-12% milk fat). Results showed that the hot filling extended the shelf life of cream cheese up 6 weeks, while cold-pack cheese suffered from quick spoilage. Hot filling also improved the sensory properties and overall acceptability of single and double cream cheese.

Keywords: cream cheese – cold filling – hot filling –cheese properties.

INTRODUCTION

Cream cheese is a popular type of fresh soft cheese. In this respect, it was reported that the consumption of cream cheese of different types is widespread in many parts of the world such as North America and Europe (especially in UK, Germany and France), where it is consumed as a spread or as an ingredient for many desert products (Geng *et al.* 2008). Recently cream cheese is also widely consumed in Egypt. It is dairy oil-in-water emulsion, acidified by lactic acid bacteria (LAB) and textured in many cases by heat treatments and homogenization (Coutouly *et al.* 2014).

Cream cheese is a soft, rich, mild, unripened cheese, which is a creamy white, of slightly acidic tasting product with a diacetyl flavour. It is usually manufactured by the coagulation of cream or mixture of milk and cream by acidification with starter culture. This product does not need ripening, and it may be freshly consumed, usually after production and cooling (Guinee *et al.* 1993). Concerning the stability of cream cheese during cold storage, Coutouly *et al.* (2014) demonstrated that this cheese type is stable at least 3 months at 4^0C, and well fitted for sensory and nutritional studies. Some processing steps are certainly needed to achieve such long shelf-life of this type of cheese.

In general, cream cheese typically belongs to two product categories defined by their fat content: double fat cream cheese made with milk standardized to at least 9-11% (w/w) fat to give full fat cream cheese of 22-35% fat, and single fat cream cheese made with milk standardized to 4.5-5% fat to give low fat cream cheese of 5-15% fat (Guinee *et al.* 1993 ; Geng *et al.* 2008). there are many forms of cream cheese in North America and Europe such as plain and flavoured cream cheese (Han *et al.* 2008). Compositional requirements differ between countries. Egypt regulates that double cream cheese should have a minimum milk fat/dry matter of 60% (w/w), with a moisture content no greater than 62% (Egyptian Standards, 1008/2/2005).

Some cheeses like cream cheese are more susceptible than others to microbial contamination and spoilage. Food spoilage in general is of enormous economic problem worldwide. Through microbial activity alone, approximately one-fourth of the world's food supply is lost (Laszlo, 2007). The causes include both intrinsic factors (pH , water activity, nutrients inhibiting factors produced by starter cultures and non-starter microorganisms, competitive microflora, etc.) and extrinsic factors (microbial quality of materials used, production phases, ripening and packaging conditions, etc. (Prencipe *et al.,* 2010; Hosny *et al*., 2011., Giammanco *et al.,* 2011). However, undesirable microbes that can cause spoilage of dairy products are bacteria, yeasts, and moulds. For this reason, an increase emphases are needed for the microbiological examination of milk and dairy foods. Microbiological analysis is critical for the assessment of quality and safety, conformation with standards and specifications, and regulatory compliance. (Tatini and Kauppi, 2003).

Therefore, analysis of the two different prepared types of cream cheese was carried out as affected by the type of filling of the prepared cheese.

MATERIALS AND METHODS

The ingredients used in manufacture of cream cheese were standardized buffalo's milk (5% and 12% fat). Cheese starter culture consisting of *Lactococcus lactis* ssp. *Lactis* & *Lactococcus lactis* ssp. *cremoris* in ratio 1:1 (LAB) was obtained from Chr.Hansens Lab., Copenhagen, Denmark). Table salt (NaCl), and all of the other ingredients were obtained from the local market at Aswan governorate.

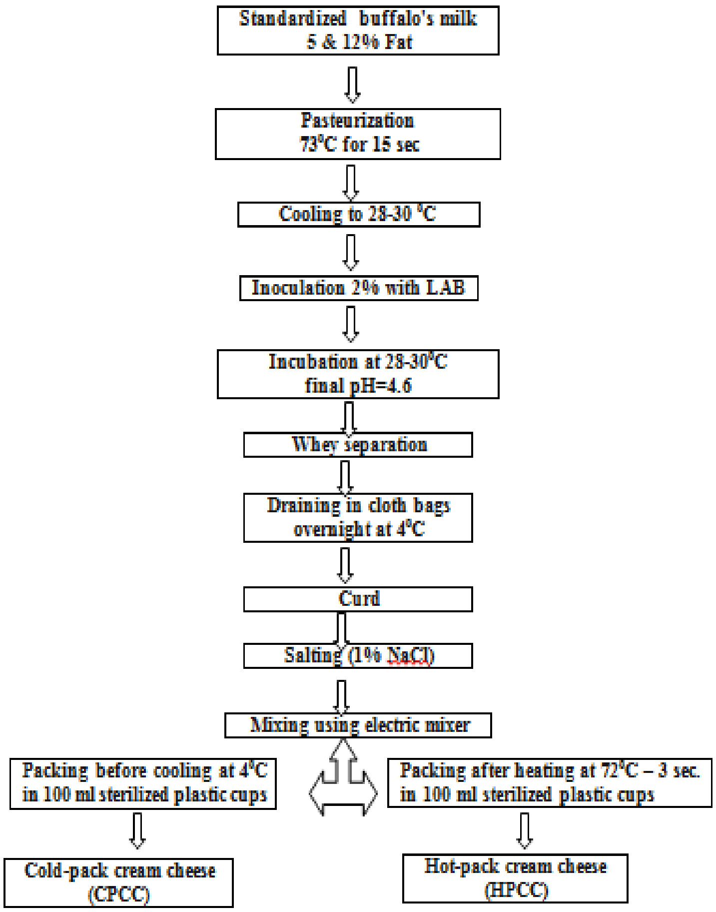
Cheese analysis of the examined samples were carried in three replicates. The moisture content, total protein (TP), ash, fat and the titratable acidity were determined according to the method described by AOAC (2012). The pH of the samples was done using pocket pH meter (IQ Scientific USA, Model IQ 125). The total nitrogen content was detected by Kjeldahl method and used to calculate the total protein (TP) content (TN×6.38).

Total volatile fatty acids (TVFA) of cream cheese samples were determined according to Kosilkowski (1978).

For the microbiological examination of the tested cheese samples, the total bacterial count (T.B.C) and Moulds & Yeasts were enumerated according to standard procedures Marshall (1992).

All samples were evaluated for their sensory characteristics according to Nelson and Trout, 1980 ; Wendin *et al.,* 2000 and Coutouly *et al.* (2014). The organoleptic evaluation was done by 10 panelists from staff members and others.

Cream cheese making was carried out as described by Guinee *et al.* (1993) as indicated below:



All data were expressed as means ± Standard Deviation (SD). The influence of cold and heat packed single and double cream cheese was analysed using analysis of variance (ANOVA) and Duncan's multiple range tests. Significant differences were defined at $p \le 0.05$. All analysis was performed using SPSS program (version 16.0 SPSS Inc.).

RESULTS AND DISCUSSION

1- Chemical analysis of cold-pack cream cheese (CPCC):

It could be observed from the data given in Table (1) that the fresh single cream cheese (A) contained higher moisture and total protein (TP) contents (68.46 and 16.80%, in order), compared with the fresh double cream cheese (B) which recorded higher values of fat, FDM and acidity contents (25.67 , 66.21 and 0.60%, respectively). The recorded differences were statistically significant ($P<0.05$). Such differences could be attributed to richness of double cream cheese with fat, which also significantly increased the total volatile fatty acids content. However, the differences in ash and pH were insignificant ($P>0.05$). Such trend of these results was also observed after one week of storage, since cheese A had higher moisture and TP and lower fat, FDM, acidity and TVFA, when compared with cheese B of the same age. Most of the prementioned contents increased during storage in the two types of cheese, reaching the maximum at the end of storage period (2 weeks). Only the moisture content decreased resulting in corresponding increase in the other constituents, while the pH value had an opposite trend of acidity.

On the other hand, the reduction in moisture content of double cream cheese and the increase of each of TP and ash contents in single cream cheese were significant ($P<0.05$) with the progress of storage period. The result also indicated that the titratable acidity insignificantly increased and pH decreased with advancing storage period. TVFA significantly increased with more rate in double cream cheese, which is mainly due to the high content of fat and the lactic acid formation by a predominating lactic acid bacteria (Mahran *et al*., 2000; El Owni and Hamid, 2008). Reduction of pH value during storage time of cream cheese is a natural process caused by continuous production of lactic acid and other organic acids by the starter bacteria, which came in harmony with those results of Kuipers *et al.* (2000) and Shah (2007). Increasing in fat, FDM and TP contents in all the samples with the progress of storage period was mainly due to the corresponding decrease in moisture content.

On the other hand, the increase of TVFA up to the end of cold storage might be to due to fat hydrolysis being occurred during the processing and storage. Similar results were reported by Mehanna *et al.* (2000) and Kebary *et al.* (2006)

Table 1. Chemical changes in single (A) and double (B) cold-pack cream cheese (CPCC) during storage.

Treatments	Moisture (%)	Fat (%)	FDM (%)	TP (%)	Ash (%)	Acidity (%)	pH	TVFA *
Fresh cream cheese								
A	68.46±0.08^{aA}	13.50±0.50^{bA}	42.80±1.58^{bA}	16.80±0.10^{aB}	0.92±0.01^{aB}	0.55±0.10^{bA}	4.62±0.08^{aA}	2.10±0.04^{bB}
B	61.23±0.28^{bA}	25.67±0.58^{aA}	66.21±1.01^{aA}	12.24±0.41^{bA}	0.92±0.01^{Ba}	0.60±0.10^{aA}	4.61±0.15^{aA}	3.20±0.08^{aC}
After one week								
A	67.76±0.62^{aA}	13.80±0.46^{bA}	42.88±2.11^{bA}	17.02±0.02^{aAB}	0.95±0.02^{aB}	0.61±0.09^{bA}	4.56±0.08^{aA}	3.70±0.04^{bA}
B	60.68±0.18^{bB}	26.19±0.55^{aA}	66.62±1.42^{aA}	12.37±0.29^{bA}	0.94±0.007^{aA}	0.65±0.07^{aA}	4.57±0.14^{aA}	4.26±0.07^{aB}
After two weeks								
A	67.67±0.47^{aA}	13.84±0.46^{bA}	42.47±2.41^{bA}	17.39±0.45^{aA}	0.96 ±0.01^{aA}	0.63±0.08^{bA}	4.52±0.09^{aA}	4.62±0.04^{bA}
B	60.60±0.20^{bB}	26.25±0.55^{aA}	66.62±1.61^{aA}	12.46±0.21^{bA}	0.94±0.01^{bA}	0.69±0.08^{aA}	4.49±0.05^{bA}	5.10±0.08^{aA}

*** FDM= Fat on dry matter ; TP= total protein ; TVFA= Total volatile fatty acids expressed as ml. 0.1 N-NaOH/ 100g.**
- Average with different small letters among treatments and capital letters due to storage differed significantly (P≤0.05).

2- Microbiological analysis of cold-pack cream cheese (CPCC):

Results in Table (2) reveal the microbiological analysis of single and double cream cheese (CPCC). No significant variations between the treatments were observed. The total bacterial count increased through the first two weeks of storage, followed by decrease then after. Concerning the yeasts & moulds count, they were not detected in fresh cheese, but after 2 weeks of storage, they detected and resulted in spoilage of all cheese samples. So, all cheese samples were not analysed any more for chemical and microbiological properties.

Table 2. Microbiological analysis of single (A) and double (B) cold- pack cream cheese (CCPC) during storage*.

Treatments	Total bacterial count (log cfu/g)			Yeasts and moulds (log cfu/g)		
	Storage period (weeks)			Storage period (weeks)		
	Fresh	1 week	2 weeks	Fresh	1 week	2 weeks
A	7.21^{aB}	7.87^{aA}	7.79^{aB}	ND*	ND	2.9^{a}
B	7.32^{aB}	8.11^{aA}	8. 0^{aA}	ND	ND	3.1^{a}

***see legend to Table (1) for details**
- ND means not detected.

3- Chemical analysis of hot-pack cream cheese (HPCC):

Results in Table (3) show that the fresh single cream cheese (C) was the highest in moisture of 68.05% and TP contents of 16.75%, while fresh double cream cheese (D) recorded the highest value in fat, FDM and acidity of 24.83 , 63.86and 0.92% respectively. Results of moisture are in agreement with those given by Abd EL-Khair (2003). The corresponding FDM values were 72.7 and 40.6% in order. However significant differences were observed for the effect of type of cream cheese on pH values, acidity and TVFA. Reduction in moisture and TP contents of double cream cheese, compared to single cream cheese was also significant (*P<0.05*).

The decrease in moisture content of cream cheese was gradual, while the increase in acidity and TVFA was almost significant in all the samples with the progress in cooling storage period. The results also indicated that the pH decreased significantly (*P<0.05*) with storage period, and this decrease was more in double cream cheese. Similar changes in cream cheese during storage but at different temperatures (4±1^{0}C , 21±1^{0}C) were given by Perveen *et al.* (2011), who attributed the reduction of moisture to the corresponding increase in acidity (specifically reduced pH) that causes the protein matrix in the curd to contract and squeeze out moisture. (Mahran *et al.* 2000 ; El-Owni and Hamad 2008)

Table 3. Chemical changes in single (C) and double (D) hot-pack cream cheese (HPCC) during storage.

Treatments	Moisture (%)	Fat (%)	FDM (%)	TP (%)	Ash (%)	Acidity (%)	pH	TVFA *
Fresh cream cheese								
C	68.05±0.05^{aA}	12.60±0.53^{bA}	39.44±1.61^{bA}	16.75±0.13^{aA}	0.93±0.02^{aC}	0.90±0.01^{bC}	4.60±0.00^{aA}	2.85±0.00^{bD}
D	61.13±0.23^{bA}	24.83±0.55^{aB}	63.86±1.04^{aAB}	12.20±0.43^{bA}	0.94±0.01^{aA}	0.92±0.01^{aD}	4.53±0.06^{bA}	3.60±0.01^{aD}
After one week								
C	67.85±0.30^{aAB}	12.64±0.52^{bA}	39.33±1.48^{bA}	16.72±0.16^{aA}	0.93±0.03^{aC}	0.93±0.01^{bC}	4.53±0.03^{aB}	4.10±0.04^{bC}
D	60.70±0.40^{bAB}	24.93±0.50^{aAB}	63.44±0.64^{aB}	12.18±0.43^{bA}	0.94±0.01^{aA}	0.95±0.01^{aCD}	4.47±0.03^{bAB}	4.65±0.08^{aC}
After 2 weeks								
C	67.68±0.42^{aAB}	12.72±0.45^{bA}	39.34±1.35^{bA}	16.72±0.16^{aA}	0.94±0.02^{aC}	0.94±0.00^{bC}	4.50±0.00^{aBC}	4.80±0.02^{bB}
D	60.62±0.51^{bAB}	25.17±0.58^{aAB}	63.90±0.95^{aAB}	12.17±0.50^{bA}	0.95±0.01^{aA}	0.97±0.01^{aBC}	4.43±0.06^{bBC}	4.80±0.30^{aC}
After 3 weeks								
C	67.57±0.37^{aAB}	12.82±0.49^{bA}	39.52±1.37^{bA}	16.68±0.19^{aA}	0.95±0.03^{bBC}	0.95±0.02^{bBC}	4.47±0.06^{aCD}	4.90±0.04^{bB}
D	60.37±0.56^{bAB}	25.50±0.60^{aAB}	64.33±0.65^{aAB}	12.13±0.45^{bA}	1.04±0.10^{aA}	1.003±0.04^{aB}	4.38±0.03^{bC}	5. 0±0.08^{aB}
After 4 weeks								
C	67.42±0.45^{aAB}	12.90±0.53^{bA}	39.58±1.33^{bA}	16.66±0.19^{aA}	0.97±0.01^{bB}	1.00±0.05^{bAB}	4.42±0.03^{aDE}	5.10±0.04^{bAB}
D	60.22±0.47^{bB}	25.58±0.51^{aAB}	64.30±0.53^{aAB}	12.11±0.48^{bA}	1.05±0.09^{aA}	1.04±0.01^{aA}	4.30±0.00^{bD}	5.20±0.08^{aB}
After 5 weeks								
C	67.38±0.47^{aAB}	12.97±0.54^{bA}	39.76±1.40^{bA}	16.64±0.18^{aA}	1.00±0.01^{bA}	1.02±0.04^{bA}	4.37±0.06^{aE}	5.20±0.04^{aA}
D	60.16±0.47^{bB}	25.80±0.35^{aAB}	64.76±0.14^{aA}	12.10±0.50^{bA}	1.06±0.09^{aA}	1.06±0.02^{aA}	4.30±0.00^{bD}	5.25±0.03^{aB}
After 6 weeks								
C	67.23±0.47^{aB}	13.02±0.58^{bA}	39.72±1.62^{bA}	16.60±0.17^{aA}	1.00±0.01^{bA}	1.03±0.03^{bA}	4.40±0.00^{aE}	5.20±0.04^{bA}
D	60.02±0.42^{bB}	25.87±0.33^{aA}	64.71±0.18^{aAB}	12.03±0.45^{bA}	1.06±0.09^{aA}	1.07±0.03^{aA}	4.27±0.06^{bD}	5.70±0.08^{aA}

*** see legend to Table (1) for details.**

4- Microbiological analysis of hot-pack cream cheese (HPCC):

Table (4) reveals the results of microbiological analysis of hot-Pack cream cheese. No significant variations were observed between the treatments C and D up to 2 weeks of storage, whereas TBC were higher in D with advancing storage. The TBC increased through the first 3 weeks. then decreased after 4 weeks of storage period. Concerning the counts of yeasts & moulds, they were not detected also in all cheese samples but appeared after 5 weeks of the storage. The above results reflect a good sanitation conditions during making and storing cream cheese.

Table 4. Microbiological analysis of single (C) and double (D) hold- pack cream cheese (HCPC) during storage*.

Treatments	Total bacterial count (log cfu/g)							Yeasts and moulds (log cfu/g)						
	Storage period (weeks)							Storage period (weeks)						
	Fresh	1	2	3	4	5	6	Fresh	1	2	3	4	5	6
C	6.65^{aE}	7.22^{aD}	7.79^{aB}	7.75^{bA}	7.80^{bA}	7.52^{bC}	6.80^{bDE}	ND*	ND	ND	ND	ND	3.2^{aA}	3.5^{aA}
D	6.54^{aD}	7.34^{aBC}	8.00^{aA}	8.12^{aA}	8.10^{aA}	7.90^{aB}	7.15^{aC}	ND	ND	ND	ND	ND	3.4^{aA}	3.6^{aA}

***see legend to Table (1) for details**
- ND means not detected.

5- Organoleptic properties of hot-pack cream cheese (HPCC):

Table (5) reveals the scores given for the organoleptic properties of HPCC. The attained results for overall acceptability revealed significant differences between C and D treatments and also, with the progress storage period. Treatment D recorded higher values for all attributes than C. the given started to decrease after 4 weeks of storage. The role of fat in improving the sensorial properties of cheese is well known. This was more clear in cream cheese, since smoothness and spreadability were noticed in D treatment compared to C treatment.

Table 5.Scores of the organoleptic properties of single (C) and double (D) hot- pack cream cheese (HPCC) during storage*.

Attribute	Degree	Storage period (week)													
		Fresh		1		2		3		4		5		6	
General appearance and colour	(10)	C	D	C	D	C	D	C	D	C	D	C	D	C	D
1 Homogeneous	5	4.6	4.8	4.8	5	4.8	5	4.8	4.8	4.4	4.8	4.4	4.8	4.0	4.4
2 Bright	5	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.6	4.8	4.4	4.4
Body and texture	(40)														
1 Silky and smooth	20	16	18	18	20	18	20	18	20	18	20	16	18	16	18
2 Spread and spreadability	20	18	18	18	20	18	20	18	20	18	20	18	18	18	16
Flavour	(50)														
1 Creamy	9	7	9	7	9	8	9	8	9	8	9	8	9	8	9
2 Mild acid	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8
3 Sour and yeasty	9	9	9	9	9	9	9	9	9	9	9	8	9	7	8
4 Flat	9	8	8	8	8	8	8	8	8	8	8	8	8	7	8
5 Rancid, oxidized	9	9	9	9	9	9	9	9	9	9	8	9	8	9	7
Overall acceptability	(100)	84.40^{bB}	88.60^{aAB}	86.60^{bB}	92.80^{aA}	87.60^{bA}	92.80^{aA}	88.60^{bA}	92.60^{aA}	87.20^{bB}	91.60^{aA}	84.0^{bC}	87.60^{aB}	81.40^{bD}	82.80^{aC}

CONCLUSION

In conclusion, role of fat in making good quality cream cheese was recommended, while hot packing of the prepared cream cheese is quite important for improving the keeping quality and for extending the shelf life of the product during the cold storage.

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تأثير نوع التعبئة على جودة جبن الكريمة

وائل فتحي القط و أسامه صفوت فوزي خليل

قسم علوم وتكنولوجيا الألبان ، كلية الزراعة والموارد الطبيعية ، جامعة أسوان ، أسوان ، مصر

هدف هذا البحث إلى دراسة تأثير التعبئة على البارد والتعبئة على الساخن على التركيب الكيماوي والميكروبيولوجي وكذلك الخواص الحسية لجبن الكريمة. حيث تم تصنيع الجبن من لبن جاموسي معدل ذونسبة دهن (٥-١٢%) . دلت النتائج أن تعبئة جبن الكريمة على الساخن أدت لزيادة عمروفترة الصلاحية للجبن الناتج لـ ستة أسابيع بينما تسبب تعبئة الجبن على البارد للفساد السريع للجبن . أيضاً كان للتعبئة على الساخن تأثيراً إيجابياً في تحسين الخواص الحسية والقبول العام للجبن الكريمة منخفض وعالي الدهن .