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SOME FACTORS AFFECTING "BRIE" LIKE CHEESE PROPERTIES

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ABSTRACT

Effect of salting methods in manufacturing "Brie" like cheese from buffaloes', cows' and concentrated milk by ultrafiltration were investigated. "Brie" like cheeses were manufactured from buffaloes' milk and UF buffaloes and cows' milk, while control was made from cows' milk by traditional method. All cheeses were ripened for 28 days at 10C° and 90% relative humidity. Cheese samples were analyzed fresh and weakly for chemical and microbiological analysis, texture profile and organoleptic properties. The results showed that the moisture contents of fresh UF "Brie" like cheese was higher than those of control "Brie" like cheese. On the other hand, protein/ DM and fat/DM content of UF "Brie" like cheese were higher than those of control cheese. pH increased faster in the control "Brie" like cheese and dry or brine salted "Brie" like cheese than UF "Brie" like cheese which showed high ripening indices. On the other hand, cheese made by dry salting had soluble nitrogen, non protein nitrogen, amino acid nitrogen (as percentage of total nitrogen), soluble tyrosine, soluble tryptophan, total volatile fatty acids and total carbonyl compounds ratios higher than those of brine salted cheese. Buffaloes' milk cheese showed the highest hardness, cohesiveness, springiness, gumminess and chewiness value than those of cows' milk cheeses, UF "Brie" like cheese and brine salted showed the lowest texture profile analysis than those of control "Brie" like cheese. UF (cows' and buffaloes) "Brie" like cheese was lower in microbial (total bacterial counts, proteolytic bacterial counts, lipolytic bacterial counts and yeast & mould counts counts) than those of control "Brie" like cheese. Also, cheese made by brine salted had total bacterial counts, proteolytic bacterial counts, lipolytic bacterial counts and mould & yeast counts higher than those of dry salted. Concerning body & texture it was noticed that UF buffaloes' milk cheese (brine salted) showed firm body and firmer texture and typical "Brie" like cheese made from cows' milk by the dry salting methods.

Keyword: Brie cheese, Ultrafiltration, Texture profile analysis.

INTRODUCTION

Brie cheese is a soft type cheese consumed usually ripened and it is the queen of cheeses in France. It was originated the 15th century and its production was limited in France for a long time but in recent years many countries tried to produce such cheese. Brie cheese is characterized by the presence of *Penicillium candidium* or *P. caseicaolum* on the surface of cheese. This gives this cheese type a different appearance. Meanwhile, the high biochemical activities of *P. caseicaolum* produces very specific aroma and texture properties (Banks 1995).

Its well recognized that buffaloes milk represents a large proportion of the fresh milk supply in Egypt. The nature of casein micelles and fat globules of milk is associated with speeder rate of rennet coagulation, higher rate of syneresis , more firm and dry curd with higher rheological properties compared with cows milk (Kfoury *et al.,* 1989). During ripening of cheese, the

consistency changes in Brie cheese as softening process starts immediately below the rind and proceeds into the medal of the cheese. The cheeses can became so soft that it is impossible to measure the consistency by uniaxial compression (Molander *et al.* 1990).

Because of softening and texture development parallels with mould growth during usual ripening of mould surface-ripened cheese, it has been assumed by most in the past that proteolytic enzymes elaborated by penicillium and other ripening microflora cause the texture alterations in these cheeses (Knop and Peters 1971 and Lenior 1970, 1984).

UF surface mould ripened cheese should also be comparatively easy to develop since the softening of the interior of the traditional product depends mainly upon the migration of lactic acid to the surface and consequent rise in pH. This softening means that the presence of whey proteins is less likely to have significant effect on the texture of the cheese. In addition, there is migration of minerals from the interior of Camembert or Brie to the surface during ripening (Le Grat *et al.,* 1993). This may explain why it has been found so essential to control the mineral content of the retentate in the manufacture of this type of cheese (Lelievre and Lawrence 1988).

This paper relates the results of the possibility of making "Brie" like cheese under the Egyptian conditions from buffaloes', cows' milk and their retentate as affected by salting methods.

MATERIALS AND METHODS

Materials:

Fresh buffaloes' and cows' milk were obtained from Food Technology Research Institute. Retentate was prepared at Dept. of Dairy Technology, Animal Production Res. Institute Dokki, Cairo, Egypt. Rennet powder (Hanelase) was obtained from Chr. Hansen's Lab., Denmark.

Starter cultures

Mesophilic multiple-species DL-culture DL-Mix M FZ 2-22 (MK); contain *Lactococcus lactis* subsp *lactis, Lactococcus lactis* subsp *cremoris, Lactococcus lactis* subsp *lactis biovr. diacetylactis* and *Leuconstoc mesenteroides* subsp *cremoris. Penicillium candidum* were obtained from IP Ingredient GmbH, Germany.

Methods of analysis:

Preparation of the experimental starter culture:

Freeze dried cultures were directly added to the vat; except *P. candidum* was in liquid culture of (0.005-0.01% of milk) (Engel *et al.,* 2001 a,b).

Experimental procedures

Four treatments of "Brie" like cheese were made by conventional method as reported by Scott (1981). Each treatment was made from 10kg milk or 5kg retentate as follows:

T1 : Cheese made from cows' milk (control)
T2 : Cheese made from cows' milk retentate
T3 : Cheese made from buffaloes' milk

T4 : Cheese made from buffaloes' milk retentate

Resultant cheese were dry salted on both flat surfaces (3% of their weigh) or brine salted (in saturated NaCl, solution, pH 5-5.3) for 1 hr at 14°C, and then drained, after 2 hours cheese was incubated at 12-14°C for 6-7 days. All cheese treatments were ripened for 21 days at 8-10°C and 90% relative humidity (RH). When the cheese develops a white felt mat of *P. caseicolum* mould, were packed in aluminum foil and kept at same temperature up to end of ripening. All treatment were sampled when fresh and after 15, 21 and 28 days of ripening for chemical, rheological and microbiological analysis.

Milk analysis:

Total solids, fat, total protein content and pH values were determined according to the methods described by Ling (1963).

Cheese analysis:

The moisture and salt contents of cheese were determined according to British Standards Institution (BSI, 1989). Fat and protein of resultant cheese samples were determined according to Ling (1963). pH was measured using pH meter (SGH).Water-soluble nitrogen (WSN), non-protein nitrogen (NPN) and amino acid nitrogen (AAN) of resultant cheese samples were determined according to AOAC (2000).

Total volatile fatty acids were determined as given by Kosikowski (1978). Soluble tyrosine and tryptophane contents were determined according to Vakauleris and Price (1959) and modified by Lin *et al.,* (1982). Total carbonyl compounds were determined as described by Basset and Harpar (1958).

Rheological properties:

Texture profile analysis test of "Brie" like cheese samples (which shape was 2×2×2 clyndrical) was done using a Universal Testing Machine (TMS-Pro) Food Technology Corporation, Sterling, Verginia, USA) equipped with 1000 N (250 lbf) load cell and connected to a computer programmed with Texture Pro^{TM} texture analysis software (program, DEV TPA With holding time between cycle two second). A flat rod probe (49.95 mm in diameter) to uniaxially compresse the "Brie" like cheese samples with the following parameters conduction to 50% of their original height. Each sample was subjected to two subsequent cycles (bites) of compression-decompression.

Data were collected on computer and the texture profile parameters were calculated from DEV TPA texture analyzer and computer interface. Calculation described by Szczesniak et al (1963) and Bourne (1978) was used to obtain the following texture profile parameters (Hardness, Cohesiveness, Springiness, Gumminess and Chewiness)

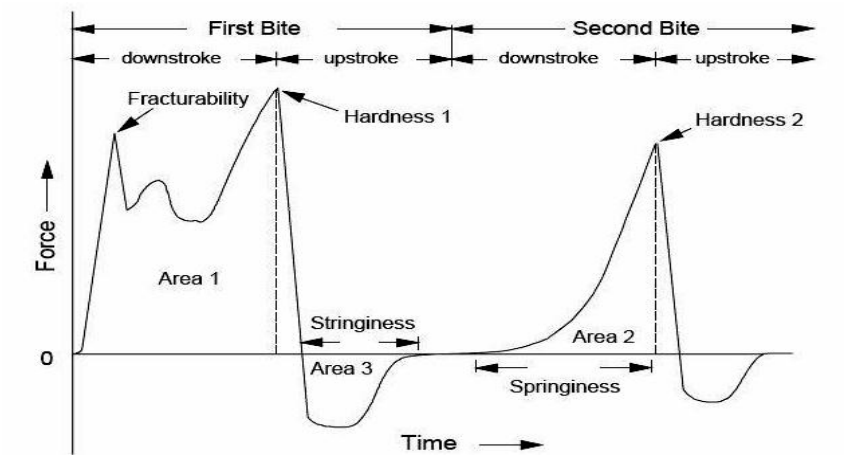

Fig.(1). Generalized texture profile curve obtained from the Instron Universal Testing Machine (from Brennan *et al*., 1975).

Microbiological analysis of cheese:

The total bacterial counts of "Brie" like cheese was determined according to the American Public Health Association (APHA 1992). Proteolyic bacterial counts were determined as described by Chabmer (1962). Lipolytic bacterial counts were determined according to Sharf (1970). Mould and yeast counts were determined using molt extract agar medium as described by Pitt, (1979).

Organolyptic properties of cheese:

The cheese samples were organolyptic evaluated. Maximum score points for flavour, body & texture as well as appearance were 50, 35, and 15 respectively according to the method of Scott (1981).

Statistical analysis

The results were analyzed statistical according to SAS System Users Guide (SAS Institute Inc., U.S.A. 1994)

RESULTS AND DISCUSSION

Chemical companion of milk and retentate.

Table (1) shows some chemical components of cows', buffaloes' and retentate used in the manufacture of "Brie" like cheese.

Table (1): Some chemical components of cows', buffaloes' milk and retentate.

Milk source	Total solids %	Fat %	Protein %
Cows' milk	12.4	3.72	4.2
buffaloes' milk	17.8	5.21	7.6
Retentate (cows' milk)	37.94	16.35	17.21
Retentate (buffaloes' milk)	39.21	17.42	19.45

Chemical composition of "Brie" like cheese:

Data presented in Table (2) shows the effect of ultrafiltration, source of milk and salting methods on chemical composition of "Brie" like cheese. The moisture content of fresh UF "Brie" like cheese was higher than those of control "Brie" like cheese. These results are in agreement with those reported by Gazar (1998). There were no recorded difference in moisture contents in related with salting method overall ripening period, similar results were found by Metwally (1995). During ripening period, the moisture contents decreased in all "Brie" like cheese samples similar results were found by Degeidi *et al.,* (2010) . Protein on dry matter content of UF "Brie" like cheese was higher than those of control cheese (Leliever and Lawrence 1988). Salting methods did not considerably affect the fat/DM and protein/DM contents of the resultant cheeses. Fat on dry matter content of control "Brie" like cheese or UF "Brie" like cheese didn't affect by salting methods. The fat/DM and protein/DM contents decreased during ripening period up to 28 days, this could be attributed to the decrease of moisture content, similar results were reported by (Mostafa *et al.,* 2002). These results indicated that the salt content slightly increased during ripening. This could be due to the loss of moisture of cheese. The changes of these parameters in control "Brie" like cheese were less than UF "Brie" like cheese. Similar results were reported by Degeidi *et al.,* (2010). PH values in all cheeses showed gradual increases during the ripening period. The pH increased rapidly in the contol "Brie" like cheese and the dry salted "Brie" like cheese than those of UF "Brie" like cheese and brine salted "Brie" like cheese. The increase in pH during the ripening period could be explained on basis that mould and yeast as the dominating microorganisms consume the lactate formed from lactose by lactic acid bacteria, thus increasing the pH of cheese. These results are in agreement with those of El Hofi and Esmeil (2000) and Farag (1987).

Ripening indices:

A- Nitrogen compounds and soluble tyrosine & tryptophan:

Table (3) shows the changes in the soluble nitrogen (SN), non protein nitrogen (NPN) and amino acid nitrogen (AAN) as percentages of total nitrogen (TN), and soluble tyrosine & tryptophan. Results indicated that the ripening indices in all treatments increased during ripening period. The nitrogen compounds soluble tyrosine & tryptophan of UF "Brie" like cheese were higher than those of control cheese similar results were reported by (Gazar 1998). The obtained results showed that dry salted "Brie" like cheese contained slightly higher level of nitrogen compounds and soluble tyrosine & tryptophan content than those of brine salted "Brie" like cheese samples similar results were found by (Godinho and Fox 1981). Moreover soluble tyrosine & tryptophan contents increased gradually during ripening due to the degradation of peptides and the liberation of free amino acids during ripening as described by Dolezalek *et al.,* (1981) and Marcos *et al.,* (1979).

B- Total volatile fatty acids and total carbonyl compound:

Table (4) shows the changes in total volatile fatty acids (TVFA) and total carbonyl compound (TCC).

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It could be seen that making of "Brie" like cheese from both types of retentate enhanced the formation TVFA and TCC which were higher than those of control "Brie" like cheese. Moreover, salting methods did not remarkably affect the cheese TVFA and TCC contents during ripening. These results could be attributed to the stimulating effect of these additives on lipolysis and formation of volatile fatty acids which serve as precursors for the formation of carbonyl compounds through the *β* oxidation pathway of acids (Rabie 1989). Lamberet et al., (1982) found that the production of methyl ketones from caprylic and lauric acid by the mycelium of *P. candidum* increased during incubation time.

Rheological properties:

Table (5) shows The changes in rheological parameters which were determined by the texture profile analyzer in terms of hardness, cohesiveness, springiness, gumminess and chewiness of "Brie" like cheese samples. Buffaloes' milk cheese showed the highest values for hardness, cohesiveness, springiness, gumminess and chewiness than those of cows' milk cheese and its UF "Brie" like cheese. Brine salted UF cheese showed the lowest texture profile analysis than those of control Brie cheese, Similar results were reported by Le Grat *et al.,* (1993). The difference in texture profile analysis could be attributed to many factors, e.g. pH, soluble nitrogenous, mould strain and storage conditions Mpagana and Hardy (1985). Results indicated that the texture profile analysis value in all treatments decreased during ripening period, Similar results were found by Ahmed, (2011). Molander *et al.,* (1990) who found that the texture profile analysis value correlated well with the sensory evaluation, the firmness, the age, pH and proteolytic stat of the "Brie" like cheese.

Table (5): Texture profile analysis test of "Brie" like cheese made from different sources of milk and their retentate as affected by salting methods

Contents	Ripening Period In days	Cheese made from							
		Cows' milk				Buffaloes' milk			
		Fresh*		UF (retentate)		Fresh		UF (retentate)	
		Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting
Hardness (g)	Fresh	6.67	6.58	6.38	6.34	8.27	8.19	7.98	7.84
	15	6.28	6.19	6.12	6.08	7.91	7.84	7.49	7.39
	21	5.83	5.67	5.73	5.63	6.38	6.26	6.08	5.94
	28	5.61	5.60	5.34	5.22	6.24	6.13	5.86	5.78
Cohesiveness (ratio)	Fresh	0.31	0.30	0.29	0.29	0.42	0.40	0.39	0.37
	15	0.28	0.30	0.26	0.25	0.39	0.37	0.36	0.35
	21	0.26	0.24	0.24	0.22	0.36	0.35	0.34	0.32
	28	0.25	0.23	0.22	0.20	0.35	0.34	0.33	0.30
Springiness (mm)	Fresh	0.085	0.088	0.092	0.092	0.18	0.17	0.16	0.150
	15	0.064	0.088	0.054	0.041	0.16	0.15	0.13	0.120
	21	0.044	0.051	0.050	0.045	0.13	0.12	0.099	0.096
	28	0.041	0.043	0.045	0.038	0.11	0.098	0.096	0.094
Gumminess (g)	Fresh	2.067	1.974	1.850	1.838	3.473	3.276	3.112	2.900
	15	1.758	1.857	1.591	1.520	3.084	2.901	2.696	2.586
	21	1.515	1.360	1.375	1.238	2.296	2.191	2.067	1.901
	28	1.402	1.288	1.174	1.044	2.184	2.084	1.933	1.734
Chewiness (g/mm.)	Fresh	0.175	0.173	0.170	0.169	0.625	0.556	0.497	0.435
	15	0.112	0.163	0.086	0.062	0.493	0.435	0.350	0.310
	21	0.066	0.069	0.068	0.055	0.298	0.262	0.204	0.182
	28	0.057	0.055	0.052	0.039	0.240	0.204	0.185	0.162

*** control cheese (cheese made from cows' milk)**

Microbiological examinations:

Table (6) shows the microbiological properties of "Brie" like cheese. The total bacterial counts of UF "Brie" like cheese was lower than those of control "Brie" like cheese. Also, brine salted cheese contained slightly higher microbial counts than those of of dry salted cheese. Results illustrated that the total bacterial count and mould & yeast in the cheese of different treatments reached the maximum level after a ripening period of 15 days and then decreased as ripening advanced. It was also found that the lipolytic and proteolytic bacterial counts of all "Brie" like cheese decreased during ripening period samples similar results were found by (Metwally 1995).

Table (6): Microbiological examinations of "Brie" like cheese made from different sources of milk and their retentate as affected by salting methods

Contents	Ripening Period In days	Cheese made from							
		Cows' milk				Buffaloes' milk			
		Fresh*		UF (retentate)		Fresh		UF (retentate)	
		Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting
Total bacterial count (logx 10^6 cfu/g)	Fresh	8.28	8.34	8.18	8.26	8.20	8.21	8.11	8.17
	15	8.32	8.49	8.29	8.41	5.25	8.29	8.26	8.28
	21	8.18	8.29	8.13	8.26	8.08	8.06	7.97	7.98
	28	7.99	8.08	7.83	7.88	7.92	7.83	7374	7.63
Proteolytic bacterial count (logx 10^4 cfu/g)	Fresh	5.91	5.96	5.82	5.85	5.85	5.80	5.96	5.79
	15	5.88	5.81	5.61	5.71	5.76	5.72	5.50	5.64
	21	5.57	5.46	5.34	5.54	5.46	5.36	5.27	5.36
	28	5.27	5.23	5.23	5.25	5.04	4.77	4.69	4.95
Lipolytic bacterial count (logx 10^4 cfu/g)	Fresh	5.83	5.81	5.77	5.78	5.69	5.68	5.65	5.68
	15	5.69	5.61	5.60	5.65	5.59	5.56	5.46	5.47
	21	5.39	5.27	5.36	5.43	5.27	5.25	5.17	5.20
	28	5.11	4.95	5.04	5.14	4.77	4.69	4.60	4.69
Total mold & yeast count (logx 10^3 cfu/g)	Fresh	5.21	5.42	5.19	5.33	5.10	5.32	5.13	5.29
	15	5.31	5.47	5.29	5.36	5.28	5.31	5.24	5.25
	21	5.26	5.31	5.24	5.29	5.15	5.03	5.05	5.09
	28	5.11	5.27	4.94	5.15	5.02	4.81	4.87	4.98

*** control cheese (cheese made from cows' milk)**

Organoleptic properties:

The data in Table (7) show the effect of using UF and salting methods on the organoleptic properties of "Brie" like cheese. The highest total score was obtained for control "Brie" like cheese made from cows' milk than those of UF "Brie" like cheese. The flavour of all cheeses improved with the progress of ripening period. This could be due to the accumulation of volatile fatty acids and carbonyl compounds. However, a typical "Brie" like cheese flavour was more pronounced in "Brie" like cheese made by the dry salting methods. Concerning body & texture it was noticed that buffaloes' milk cheese showed firm body and firmer texture, while cows' milk cheese showed smooth texture.

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This could be due to the higher moisture contents and the more rate of proteolysis in cows' milk cheese compared with buffaloes' milk cheese. The obtained results agreement with those reported by Farag *et al.,* (1992).

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بعض العوامل المؤثرة على خواص الجبن الشبية بالبراى

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يهدف هذا البحث لدراسة مدى تاثير طرق التمليح المختلفة على خواص الجبن شبيهة البراى المصنع من اللبن الجاموسى والبقرى والمركز الناتج من الترشيح الفائق للالبان السابقة.

حيث تم تصنيع الجبن الشبيهة البراى بالطريقة التقليدية من اللبن البقرى (كنترول) واللبن الجاموسى واللبن الناتج من الترشيح الفائق لألبان البقر والجاموس وتم التمليح بطريقتين التمليح الجاف والرطب. وخلال فترة التسوية التى بلغت ٢٨ يوم تم اخذ عينات من الجبن لدراسة التغيرات الكيميائية والريولوجية والبكتريولوجية والحسية حيث تم اخذ عينات من الجبن الطازج وعلى فترات ١٥ ، ٢١ ، ٢٨ يوم.

واتضح من النتائج ان طرق التمليح (الجاف – الرطب) لم تؤثر على محتوى الرطوبة فى الجبن سواء الكنترول او المعاملات الاخرى، وان محتوى البروتين والدهن للمادة الجافة كان مرتفعا بالجبن المصنع من المركز الناتج من الترشيح الفائق عن الكنترول، قيم الـpH كانت مرتفعة بالجبن الكنترول عن المصنع من اللبن الناتج من الترشيح الفائق حتى نهاية التسوية، قيم النيتروجين الذائب والنيتروجين الغير بروتينى ونيتروجين الاحماض الامينية بالنسبة للنيتروجين الكلى والتيروزين والتربتوفان اعلى فى التمليح الجاف عن التمليح الرطب ، ارتفعت قيم الاحماض الدهنية الطيارة الكلية ومركبات الكربونيل الكلية فى الجبن المصنع من اللبن الناتج من الترشيح الفائق كذلك فى التمليح الجاف.

الجبن المصنع من اللبن الجاموسى كان اكثر صلابة من الجبن المصنع من اللبن البقرى واعطى خواص ريولوجية اقل جودة من الكنترول ، عند استخدام مركز اللبن الجاموسى الناتج من الترشيح الفائق فى صناعة جبن الشبيهة البراى تحسنت الخواص الريولوجية للجبن الناتج.

الاعداد الكلية للبكتريا والبكتريا المحللة للبروتين والدهون والخمائر والفطريات انخفضت فى الجبن المصنع من المركز الناتج من الترشيح الفائق (بقرى وجاموسى) عن الجبن الكنترول ، كما ارتفعت قيم الاعداد البكتريولوجية عند التمليح الرطب عن التمليح الجاف.

تحسنت الصفات الحسية للجبن الناتج من اللبن الجاموسى عند استخدام الترشيح الفائق والتمليح الرطب حيث اصبح قوام وتركيب الجبن اكثر طراوة ونعومة وقربت صفاتة من الجبن الكنترول المصنع من اللبن البقرى.

قام بتحكيم البحث

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Table (2): Chemical composition of "Brie" like cheese made from different sources of milk and their retentate as affected by salting methods.

Contents	Ripening Period In days	Cheese made from								L.S.D.
		Cows' milk				Buffaloes' milk				
		Fresh*		UF (retentate)		Fresh		UF (retentate)		
		Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting	
Moisture %	Fresh	57.05^{cd}	56.73^{d}	61.53^{a}	60.93^{ab}	52.84^{e}	52.41^{e}	57.42^{c}	56.71^{d}	2.7421
	15	54.85^{c}	54.21^{c}	58.31^{a}	57.52^{ab}	50.23^{ef}	49.56^{f}	53.56^{cd}	52.41^{de}	2.4712
	21	53.20^{c}	^{c} 52.68	57.32^{a}	56.71^{ab}	48.51^{de}	47.92^{e}	51.07^{cd}	50.21^{de}	1.9574
	28	51.53^{bc}	50.93^{cd}	53.81^{a}	52.93^{ab}	48.01^{e}	47.37^{ef}	50.24^{cd}	49.83^{de}	2.0148
Protein on dry metter %	Fresh	42.28^{f}	42.82^{e}	44.56^{cd}	44.87^{cd}	45.08^{c}	45.61^{bc}	46.21^{ab}	46.42^{a}	0.4687
	15	41.72^{d}	41.55^{d}	43.87^{bc}	44.23^{b}	43.96^{bc}	43.85^{bc}	45.83^{a}	46.61^{a}	0.5761
	21	40.89^{d}	40.82^{d}	42.56^{bc}	43.54^{ab}	42.49^{c}	43.10^{bc}	45.43^{a}	45.63^{a}	0.4621
	28	39.79^{e}	40.43^{e}	41.93^{c}	42.83^{b}	42.58^{bc}	42.94^{b}	44.93^{a}	45.21^{a}	0.4215
Fat on dry metter %	Fresh	44.64	44.70	44.83	44.92	45.66	45.75	45.86	45.97	ns
	15	43.86	44.02	44.61	44.73	45.45	45.51	45.73	45.76	ns
	21	43.67	43.69	44.32	44.54	45.00	45.12	45.29	45.38	ns
	28	42.88	43.08	43.82	44.02	44.81	44.85	45.01	45.12	ns
Salt %	Fresh	1.66	1.59	1.64	1.57	1.79	1.57	1.63	1.57	ns
	15	1.84	1.73	1.94	1.82	1.95	1.83	1.84	1.82	ns
	21	2.09	2.12	2.15	2.02	2.21	2.15	2.31	2.04	ns
	28	2.38	2.23	2.51	2.42	2.53	2.34	2.37	2.31	ns
pH value	Fresh	5.21	5.32	5.53	5.41	5.22	5.31	5.61	5.68	ns
	15	5.28^{cd}	5.41^{ab}	5.34^{bc}	5.26^{cd}	5.26^{cd}	5.21^{d}	5.45^{a}	5.52^{a}	0.0181
	21	5.77^{abc}	5.67^{bcd}	5.81^{ab}	6.01^{a}	5.60^{de}	5.45^{e}	5.73^{bc}	5.72^{bc}	0.0184
	28	6.44^{ab}	6.21^{abc}	6.71^{a}	6.52^{ab}	5.90^{cd}	5.71^{d}	6.23^{abc}	6.13^{bc}	0.0231

*** control cheese (cheese made from cows' milk)**

****Different letters in the same row or column (a,b,c,….) means that multi comparisons are different from each other, letter a is highest mean followed by b,c,…. Etc.**

Significant at 0.05 level

Ns = non significants

Table (3): Nitrogen fractions of "Brie" like cheese made from different sources of milk and their retentate as affected by salting methods

Contents	Ripening Period In days	Cheese made from								L.S.D.
		Cows' milk				Buffaloes' milk				
		Fresh*		UF (retentate)		Fresh		UF (retentate)		
		Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting	
Soluble nitrogen (% of TN)	Fresh	13.28^{ab}	13.17^{ab}	14.31^{a}	14.21^{a}	10.59^{d}	10.32^{d}	11.31^{cd}	11.51^{c}	0.724
	15	18.66^{ab}	17.61^{bc}	19.81^{a}	19.52^{a}	15.03^{d}	13.94^{e}	17.35^{bc}	16.25^{c}	0.771
	21	27.47^{b}	25.56^{c}	29.35^{a}	28.16^{ab}	20.81^{e}	20.23^{e}	24.56^{cd}	23.19^{d}	1.023
	28	34.11^{b}	31.25^{c}	36.75^{a}	34.61^{ab}	27.42^{de}	26.56^{e}	30.65^{cd}	28.76^{d}	0.845
Non protein nitrogen (% of TN)	Fresh	5.50^{d}	5.67^{d}	6.31^{bc}	6.15^{cd}	7.58^{ab}	7.27^{ab}	8.01^{a}	7.87^{a}	0.645
	15	8.38^{cd}	8.13^{d}	9.46^{abc}	9.19^{bc}	10.21^{ab}	9.93^{ab}	11.21^{a}	10.87^{a}	0.475
	21	17.26^{ab}	15.41^{cd}	18.51^{a}	16.83^{bc}	14.61^{de}	13.52^{e}	16.72^{bc}	15.31^{d}	1.156
	28	21.91^{ab}	19.31^{c}	23.15^{a}	22.16^{ab}	18.06^{de}	17.42^{e}	20.21^{bc}	19.32^{c}	0.741
Amino acid nitrogen (% of TN)	Fresh	2.39^{d}	2.41^{ab}	2.56^{a}	2.43^{ab}	1.82^{de}	1.74^{e}	1.93^{c}	1.88^{cd}	0.712
	15	4.26^{b}	3.92^{bc}	4.97^{a}	4.63^{ab}	3.21^{cd}	3.21^{cd}	3.94^{bc}	3.76^{c}	0.401
	21	6.06^{b}	5.61^{bc}	7.31^{a}	6.81^{ab}	4.62^{cde}	4.16^{de}	5.31^{c}	5.12^{cd}	0.398
	28	8.33^{ab}	7.82^{b}	8.92^{a}	8.45^{ab}	6.92^{cd}	6.59^{d}	7.31^{bc}	7.24^{bc}	0.541
Soluble tyrosine (mg/100g)	Fresh	24.38^{bc}	23.92^{c}	25.34^{a}	25.21^{a}	25.28^{a}	25.37^{a}	24.97^{ab}	24.64^{b}	1.243
	15	37.42^{ab}	35.26^{b}	40.32^{a}	39.32^{a}	29.69^{d}	29.91^{d}	32.41^{c}	30.56^{c}	1.326
	21	45.83^{b}	40.57^{c}	49.74^{a}	46.31^{ab}	38.75^{d}	37.51^{d}	41.73^{c}	38.91^{d}	0.984
	28	52.46^{b}	49.25^{bc}	58.15^{a}	56.31^{a}	43.01^{d}	41.52^{d}	49.25^{bc}	47.21^{c}	1.956
Soluble tryptophan (mg/100g)	Fresh	12.62^{ab}	12.52^{b}	13.56^{a}	13.24^{a}	11.54^{cd}	11.36^{d}	12.12^{bc}	11.94^{c}	0.947
	15	17.48^{cd}	16.93^{d}	20.71^{a}	19.37^{a}	18.68^{b}	17.93^{c}	19.02^{ab}	18.45^{b}	1.234
	21	25.95^{bc}	23.81^{c}	29.74^{a}	26.85^{b}	23.18^{cd}	22.56^{d}	24.32^{c}	23.92^{c}	1.331
	28	32.19^{bc}	29.71^{cd}	38.39^{a}	34.56^{b}	29.96^{cd}	28.71^{d}	32.15^{bc}	30.16^{c}	2.986

*** control cheese (cheese made from cows' milk) ** See Table (1).**

Table (4): Total volatile fatty acids and total carbonyl compounds of "Brie" like cheese made from different sources of milk and their retentate as affected by salting methods

Contents	Ripening Period In days	Cheese made from								L.S.D.
		Cows' milk				Buffaloes' milk				
		Fresh*		UF (retentate)		Fresh		UF (retentate)		
		Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting	
Total volatile fatty acid (ml 0.1 N NaOH/100ml)	Fresh	10.81^{cd}	10.93^{bc}	11.35^{a}	11.21^{ab}	8.31^{fg}	8.21^{fg}	9.31^{e}	9.21^{ef}	0.845
	15	15.34^{bc}	14.93^{cd}	17.52^{a}	16.31^{ab}	13.25^{de}	13.02^{de}	16.21^{ab}	15.91^{bc}	1.245
	21	28.34^{ab}	27.15^{bc}	30.26^{a}	29.32^{ab}	24.21^{cd}	22.05^{d}	27.21^{bc}	26.56^{c}	1.542
	28	36.12^{cd}	35.13^{bc}	39.32^{a}	37.91^{ab}	30.15^{ef}	28.16^{f}	33.25^{cd}	32.16^{de}	2.471
Total carbonyl compounds (mg/100g)	Fresh	13.25^{bc}	13.03^{bc}	14.56^{a}	14.25^{ab}	11.61^{de}	11.21^{de}	12.31^{cd}	12.02^{cd}	0.847
	15	23.16^{c}	22.56^{cd}	30.25^{a}	28.91^{ab}	20.25^{de}	19.56^{e}	22.56^{cd}	20.16^{de}	0.896
	21	37.56^{bc}	35.16^{cd}	42.56^{a}	41.25^{ab}	31.71^{e}	29.56^{ef}	35.91^{cd}	35.41^{cd}	1.024
	28	53.12^{c}	50.17^{de}	60.23^{a}	58.31^{ab}	45.12^{f}	39.17^{g}	51.23^{cd}	50.81^{e}	3.021

*** control cheese (cheese made from cows' milk) ** See Table (1).**

Table (7): Organoleptic properties of "Brie" like cheese made from different sources of milk and their retentate as affected by salting methods

Ripening Period In days	Properties		Cheese made from								L.S.D.
			Cows' milk				Buffaloes' milk				
			Fresh*		UF (retentate)		Fresh		UF (retentate)		
			Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting	Dry salting	Brine salting	
15	Appearance	15	14	14	12	12	13	13	12	12	ns
	Body & texture	35	29a	28^{ab}	26^{b}	25^{bc}	25^{bc}	24^{c}	23^{cd}	22^{d}	0.854
	Flavour	50	40^{a}	39^{a}	37^{ab}	35^{b}	37^{ab}	35^{b}	32^{c}	36^{b}	0.742
	Total	100	83^{a}	81^{a}	75^{ab}	72^{b}	75^{ab}	72^{b}	67^{c}	70^{bc}	0.655
21	Appearance	15	14	14	13	13	12	12	13	12	ns
	Body & texture	35	32^{a}	31^{a}	29^{b}	29^{b}	28^{bc}	27^{c}	27^{c}	26^{c}	0.947
	Flavour	50	43^{a}	43^{a}	44^{a}	42^{ab}	39^{c}	38^{cd}	38^{cd}	37^{d}	0.623
	Total	100	89^{a}	88^{a}	86^{a}	84^{b}	79^{c}	77^{cd}	78^{c}	75^{d}	1.123
28	Appearance	15	14	14	13	12	12	13	12	11	ns
	Body & texture	35	34^{a}	33^{a}	32^{ab}	32^{ab}	30^{b}	31^{bc}	29^{c}	29^{c}	1.243
	Flavour	50	47^{a}	46^{a}	45^{ab}	44^{b}	41^{c}	42^{c}	41^{c}	40^{c}	1.543
	Total	100	95^{a}	93^{a}	90^{b}	88^{bc}	83^{d}	86^{c}	82^{de}	80^{e}	2.103

*** control cheese (cheese made from cows' milk)**

**** See Table (1).**