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EFFECT OF MILK CONCENTRATION BY ULTRAFILTRATION ON THE PROTEOLYSIS AND RHEOLOGICAL PROPERTIES OF LOW-FAT SOFT WHITE CHEESE

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ABSTRACT

The effect of milk concentration by ultrafiltration on the chemical composition, proteolysis and rheological properties of full and reduced fat soft white cheese during pickling was determined. Protein breakdown, rheological properties as well as pH and chemical composition changes were monitored during cheese pickling for 0, 30, 60 and 90 days. It was observed that moisture and pH decreased with time, while salt content, hardness and protein breakdown increased during the first 2 months of pickling. The UF cheeses had more moisture content, yield, fat and protein recoveries compared to traditional cheeses. The protein breakdown was higher in traditional cheeses than in UF cheeses. The hardness was lower in UF cheeses than in traditional cheeses, while the adhesiveness and gumminess were higher in UF cheeses than in traditional cheeses. Reducing the milk fat in UF and traditional cheeses resulted increasing in cheese moisture, protein, hardness, adhesiveness and gumminess and decreasing in the contents of moisture in nonfat substance, fat in dry matter and yield compared to full fat cheeses.

Keywords: UF soft white cheese, reduced fat cheese, proteolysis, electrophoresis, texture

INTRODUCTION

Domiati cheese is basically a pickled cheese, although it may be sold and consumed fresh, which is considered to be the most popular soft white cheese in Egypt and in other Middle Eastern countries. Domiati cheese is made mainly from buffalos' milk, cows' milk, or a mixture of both, but it is also made from sheep or goat milk (Abou-Donia, 1986; Mehaia, 2002). Skimmilk cheese usually lacks the smoothness and richness of cheeses made from whole fat milk . The role of fat in improving cheese quality is well known . In spite of this fact , fat free cheese or cheese made with low fat milk are preferred by many people for perceived health reasons , (Ibrahim *et al*.,2001). Application of the membrane processing technologies to the cheese industry has been widely investigated (Green, *et al.,* 1981; Leievre & Lawrence, 1988; Rao & Renner, 1988, Erdem, 2005). Using milk concentrated by ultrafiltration (UF) for cheesesmaking offers the advantages of increased plant efficiency, savings in energy & labor costs, lower rennet & starter costs, reduced cheese vat requirements, increase yield, and more flexibility in disposal of the unwanted milk components. Other advantage of UF, reduce the transportation costs, if the milk is concentrated at the farm. No significant changes in the process appear to be required for satisfactory Cheddar cheesesmaking from milk concentrated by UF up to 2-fold (Sharma *et al*., 1989). However, the use of a conventional making procedure with higher concentration of milk results in losses of fat, and in the production of cheeses of abnormal composition, flavour and texture (Green, *et al*., 1981; Sutherland and Jameson, 1981). Furthermore, it has been observed that there are some problems, i.e. textural and compositional defects for semi-hard and hard cheeses manufactured from ultrafiltred milk (Fox, 1987; Grandison & Glover, 1994). Erdem (2000) suggested that the micelle size was decreased and possibly rearranged via hydrophobic bonds to a more compact structure during the ultrafiltration process. This rearrangement causes some physicochemical changes in the milk protein systems during the renneting. However, knowledge regarding the changes in milk proteins and fat of whole milk during UF and its effect on manufacturing of cheese is limited. In whole milk, the fat is present in the form of globules which are surrounded and stabilized by their own membrane; it consists mainly of phospholipids and proteins (Dalgleish & Banks, 1991). It is known that fat plays an important role in the characteristic cheese flavour, texture and acceptability (Rodriguez *et al*., 1999). The concentration and the ratio of fat and casein are two very important parameters affecting cheese quality (Fox & Mc Sweeney, 1998).

Proteolysis changes that occur in cheese during ripening play a major role in the development of cheese texture and flavor. For the development of an acceptable cheese flavor, a well-balanced breakdown of the curd protein (that is, casein) into small peptides and amino acids is necessary (Sing *et al.* 2003). These products of proteolysis themselves are known to contribute to flavor (Visser, 1993) or act as precursors of flavor components during the actual formation of cheese flavor. However, increasing milk protein by UF had little effect on cheese composition (Guinee *et al.,* 1994), while it resulted in slower proteolysis and maturation in Cheddar cheese (Guinee *et al.,* 1994, Rao and Renner, 1989).

In the last 25 years the commercialization of reduced and low fat cheese production around the world has significantly accelerated. It is known that reduction in fat content usually results in excessively firm and elastic (often described as “rubber” or hard, dry, and possibly grainy cheese (Mistry, 2001). Due to the relative deficiency of fat globules, there is more structural matrix per unit cross-sectional area in reduced-fat cheeses (Irudayaraj *et al.,* 1999), which tend to accelerate syneresis during cheese manufacture. Texture is one of the major criteria which consumers use to judge the quality of cheese. When a cheese produces a physical sensation in the mouth (hard, soft), the consumer has a basis for determining the cheese quality, (Prentice *et al*., 1993). The high casein content in the reduced fat Cheddar cheese imparts a firm and rubbery body and texture to the cheese (Mistry and Anderson, 1993; Mistry, 2001). These defects in reduced fat cheeses are partially overcome by increasing cheese moisture content (Anderson *et al*., 1993). To give a ratio of moisture in low-fat cheese similar to that in full fat cheese, the manufacturing procedures of reduced-fat and low fat Cheddar cheese have been modified in an attempt to increase the moisture content of the cheese (Drake *et al*., 1996; Mistry, 2001). Therefore, many attempts have been made by cheese manufacturers to develop low fat cheese. (Mistry, 2001).

In low fat variants there is inadequate breakdown of casein and, therefore, the cheese appears to have a relatively firm texture. The extent of hydrolysis depends on the moisture and salt content of the cheese (Mistry and Kasperson, 1998).

Much information is available on the effects of protein standardization by UF on fat and protein recoveries and proteolysis on full fat cheese (Green *et al*., 1981; Sharma *et al*., 1989; Rao and Renner, 1989). However, there are few reported results on the effect of concentration the milk by ultrafiltration on the proteolysis and reological properties of reduced fat cheese. Our objective is to study the effect of concentration the milk by ultrafiltration on the chemical composition of reduced-fat soft white cheese and their relation to proteolysis and rheology during ripening.

MATERIALS AND METHODS

Skim bulk cows' milk was concentrated to 2x using a module type of Tubular UF unit "Carbosep Company ", Model 2S 37 (with surface area 2 x O.48m^2). Patent design consists of a layer of zirconium oxide on a carbon support. The unit was operated with inlet pressure of 5-6 bar and outlet pressure of 2-3 bar at 50 ± 2 °C. The retentate was immediately pasteurized at 63 °C for 30 min and cooled to 4 °C and stored overnight at the same temperature. Pasteurized retentate or skim milk and cream were blended to give standardized liquid milk and its retentate with protein / fat ratio 0.86 for full fat or 1.66 for reduced fat.

The following 4 treatments of cheese were made: full fat cheese made using traditional method (TR-FF), reduced fat cheese made using traditional method (TR-RF), full fat cheese made using UF milk (UF-FF), and reduced fat made using UF milk (UF-RF). The cheeses were manufactured according to the standard procedure of Domiati cheese making (Fahmi and Sharara 1950). The standardized milks or its retentate were warmed to 40 °C, salted (7 % salt), adding 0.02 % $CaCl_2$ and Commercial lactic culture (DVS YY47) was obtained from Chr. Hansen's Laboratory, Denmark. The YY47 culture contained *Lactococcus lactis* subsp *lactis*, *Lactococcus lactis* subsp *cremoris, Sterptococcus thermophilus and Lactobacillus helveticus*. After one hour of ripening, the treatments were coagulated at 40 °C by using the liquid rennet (30 ml / 30 L milk and 8 ml/ 15 L retentate) to clot the milk within 120 min. The resultant cheese were separately pickled in brine solution (12% salt) and kept at refrigerator (5 ±2 °C for 90 days).

Cheese analysis

Cheeses were analyzed for moisture by oven method (AOAC, 2000), protein and fat contents according to (AOAC, 2000), salt (Ling, 1963). The pH was measured in slurry prepared by macerating 20 g of grated cheese in 20 ml of deionized water.

The cheese yield was expressed as the ratio between the cheeses obtained before cutting and the weight of milk. Protein and fat recoveries were calculated as the weight of the component in the cheese divided by the original weight of the component in the milk.

Proteolysis Assessments

Determination of Water-soluble nitrogen (WSN): Fat-free cheese homogenates were prepared according to the method developed by (Kuchroo and Fox, 1982). Ten grams of cheese were blended in 100 ml of distilled water at 40 °C for a min at low speed. The cheese emulsion was kept at 40 °C for 1h and the fat layer was removed by centrifugation at 4300 xg for 30 min at 4 °C, and filtered through filter paper (Watman, No 4). WSN was determined by the micro-Kjeldahl (AOAC, 2000).

Gel electrophoresis was performed according to Andrews, (1983). Fat in cheese sample was removed by frozen acetone. 20 mg of each dried extract was dissolved in 1 ml sample buffer containing 8 M urea and centrifuged at 5000 x g at 4 °C for 30 min and 15 µl were applied to the gel.

Texture determination

Texture profile analysis of the cheese samples was carried out by using the Texture Analyzer (CNS-Farnell, England). Cheese samples were cut into cubes 5 cm^3 and kept at 12 °C for 1 h before analysis. The probe was TA 15 (45º and 30mm diameter), at speed 1 mm/sec and 10 mm distance, using cycle or hold programs. Hardness, consistency, cohesiveness, springiness, gumminess and adhesiveness were calculated as described by Szczesniak *et al.,* (1963) and Bourne, (1978).

RESULTS AND DISCUSSION

Cheese Composition

The fat and protein recoveries and yield were higher in UF cheeses – as expected - than in traditional cheeses (Table 1). These parameters were also higher in full fat cheeses comparing with those of reduced fat cheeses. Reducing the milk fat in control cheese resulted in markedly increases in cheese moisture , protein and noticeable decreases in the contents of moisture in nonfat substance (MNFS), fat and yield compared to full fat cheese (Tables 1&2). The compositions of the experimental reduced fat soft white cheeses are summarized in Table 2. Concentration the milk by UF resulted increasing the cheese moisture, yield and moisture in nonfat substance and a slight decrease in the fat compared to traditional reduced fat cheese. While there is a general trend of decreasing of moisture during the pickling period (up to 60 days), but it is noticed a slight increase of moisture by the end of pickling period (90 days), which could be attributed mainly to adsorption or rehydration of water as reported by Salem, (1977), resulting in small swelling of cheese .

Table (1). Chemical composition of milk & UF concentrate, cheese yield, fat & protein recovery in cheese

	Fat %	Protein %	Cheese yield %	Fat recovery in cheese %	Protein recovery in cheese%
Full fat milk	3.6	3.12	19.76	92.82	78.64
Reduced fat milk	1.9	3.17	16.26	85.66	77.89
UF-full fat	6.7	5.83	41.72	95.23	81.08
UF- Reduced fat	3.8	6.38	34.03	89.95	80.12

The protein content in the fresh UF cheese was slightly higher than that of traditional cheese (Table 2), and during the pickling period, there were slight increases among the treatments which could be correlated and attributed mainly to the decreases of moisture in cheeses. The salt in moisture content in all treatments were very similar when they were fresh , which increased markedly up to 90 days as a result of pickling. However, the slight fluctuation of salt in moisture content could be attributed mainly and correlated to similar fluctuation of moisture in cheese as a result of cheese water rehydration (Salem,1977). In general the compositional characteristics of fresh soft white cheeses, made by traditional or UF processes, were within the normal composition range for soft white Domiati cheese (Abou-Donia, 1986).

Table (2). Chemical composition of cheese during pickling

	Pickling Time (Days)	pH	Moisture %	Protein %	Fat %	Salt %	MNFS %
TR-FF	0	6.37	61.24	11.25	21.45	5.98	77.96
	30	5.89	58.34	11.31	22.75	7.45	75.53
	60	5.06	56.10	12.39	23.65	7.89	73.50
	90	5.23	57.04	12.64	23.50	7.79	74.56
TR -RF	0	6.34	65.25	15.67	11.85	5.32	74.06
	30	5.76	61.84	16.18	12.45	6.89	70.63
	60	5.21	60.98	16.87	13.05	7.35	70.14
	90	5.54	61.63	16.68	13.00	7.64	70.84
UF- FF	0	6.57	64.14	11.98	18.85	5.65	79.68
	30	6.17	62.68	12.53	20.55	6.87	78.11
	60	5.67	62.43	12.78	20.95	7.21	78.28
	90	5.48	62.97	12.86	21.00	7.12	79.21
UF- RF	0	6.51	67.14	16.15	10.95	5.17	75.42
	30	6.26	64.29	16.88	12.00	6.56	73.07
	60	5.76	61.57	17.01	12.55	7.69	70.41
	90	5.52	62.26	16.79	12.50	7.58	71.15

TR-FF: full fat cheese made using traditional method,
TR-RF: reduced fat cheese made using traditional method,
UF-FF: full fat cheese made using UF milk,
UF-RF: reduced fat cheese made using UF milk.
MNFS: Moisture in non fat substance

pH value

The pH values of experimental cheeses during pickling are given in Table 2. The concentration of milk by UF has a markedly effect on cheese pH values on the 1st day of manufacture, that the pH values of UF cheeses were higher than those of traditional cheeses. It was reported by (Green *et al*., 1981; Rao and Renner, 1988; Mehaia, 2002) that the higher pH of UF cheeses is caused by the higher buffering capacity and minerals concentration of retentate compared to milk. There was a drop in pH values of all cheeses during the 1st month, then slightly increased after 2 months of pickling concerning traditional cheeses but with continuous decreasing in UF cheeses.

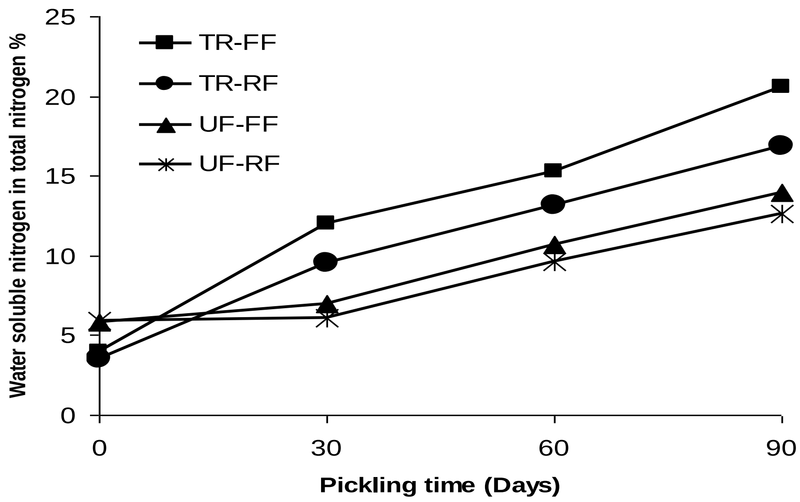
Proteolysis

Water-soluble nitrogen (WSN) in total nitrogen (TN) content of all experimental cheeses increased over the ripening period (Figure 1,A). The concentration of WSN was markedly affected by the UF processes and storage time. At 1 day of manufacture, the average level of WSN/TN in the UF cheese was markedly higher than that of traditional cheeses, which reflects the higher intrinsic whey protein retention in the UF cheese. The opposite trend was found after 30 days as the WSN was higher in traditional cheeses comparing with those of UF treatments. It could be concluded that the high WSN/TN in traditional cheeses is related to higher chymosin residual in traditional cheeses, while, the inhibition the proteolysis of UF cheeses is due to the high concentration of retained whey proteins. The presence of denatured β-lactoglobulin led to inhibit plasmin-initiated proteolysis of β-casein (Lelievre and Lawrence, 1988). Components of the native whey protein system are considered as inhibitor of α_{s1}-casein breakdown initiated by chymosin (Harper *et al*., 1989). The reduced rate of proteolysis in UF cheese may include whey proteins physically interfering with the ability of residual rennet to diffuse through the casein matrix, or rennet diffusion being hindered by the highly viscous retentate, (Lawrence, 1989).

There are higher levels of WSN/TN in the full fat cheeses, compared with reduced fat cheeses during pickling period. The levels of WSN %, expressed as g/100 g of cheese (i.e., total weight of cheese) (Fig. 1,B) increased in all cheeses during pickling but was not widely different between full fat and reduced fat cheeses. Hence, fat content had no noticeable effect on the concentration of WSN %. Fenelon *et al*., (2000) also found that the fat content in Cheddar cheese made using standard procedure had no effect on pH4.6-SN %. They suggested that the reduction in pH4.6-SN/TN as the fat content decreased was due to the concomitant increase in protein content in the cheese.

Gel-Electrophoresis

Gel electrophoresis of the different cheeses is shown in Figure 2. The overall degradation pattern of the control cheese was similar to the reported elsewhere for soft white cheese (Awad *et al*., 2001). In general, the trend of the separated zones observed with Urea-PAGE was consistent with those for WSN trend. The overall level of proteolysis in traditional cheeses is higher than that of UF cheeses. Storage resulted in a decrease in the concentration of α_{S1}-casein in all cheeses and a concomitant increase in the concentration of α_{S1}-I- casein (f24-199) and its degradation product, α_{S1}- casein (f102-199). The intensities of α_{S1}- casein (f24-199) at all analysis time were highest for the traditional cheeses, which could be due to its higher chymosin activity. It was reported earlier that the amount of α_{S1}-□ peptide increases during ageing of cheese ripening, (Creamer and Richardson, 1974), with a concomitant decrease of the native α_{S1}-CN, (Marcos *et al*., 1979).



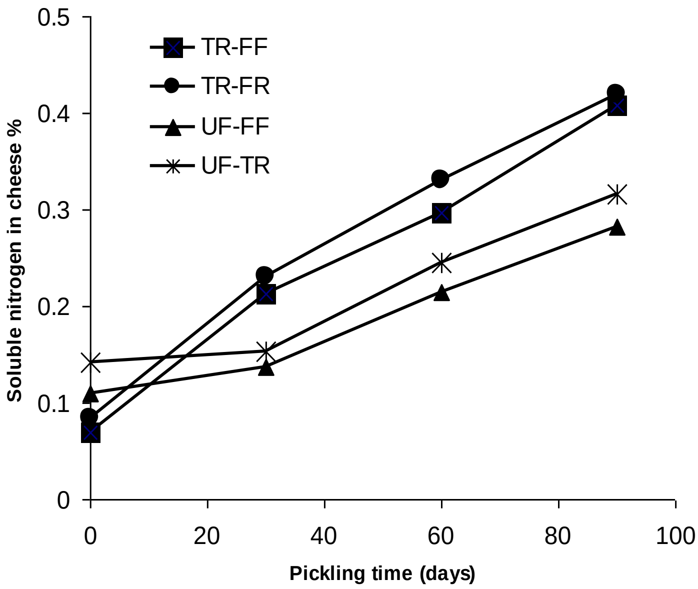


Fig (1). Evolution of water soluble nitrogen (WSN) as a percent of total nitrogen (A), and as a percent of cheese (B) of white soft cheese made from normal or UF milk.

TR-FF: full fat cheese made using traditional method,
TR-RF: reduced fat cheese made using traditional method,
UF-FF: full fat cheese made using UF milk,
UF-RF: reduced fat cheese made using UF milk.

β-casein was degraded in all cheeses during storage, to an extent depending on milk used. At most analysis times, the overall levels of proteolysis β-casein were lower in all cheeses compared to α_{s1}-casein. Degradation of β-casein in all cheeses coincided with the formation of γ-caseins, the concentration of which increased during storage, suggesting that β- casein was degraded primarily by the indigenous milk enzymes, mainly plasmin, which has a high specificity for β- casein (Fox *et al*., 1993).However, it is reported that UF cheese – in general due to its higher whey proteins – showed less proteolysis than traditional cheese ,(Nawar,1996). There were no wide differences between reduced fat and full fat cheeses of UF and normal milk.

Fig (2) Urea-PAGE of soft white cheese made from UF concentrated or liquid cow's milk.

Lanes (1 and 10) sodium caseinate as standard
Lanes (2-5) and (6-8) cheeses made from UF full fat and reduced fat milk at 0, 30, 60 and 90 days of pickling respectively.
Lanes (11-14) and (15-18) cheeses made traditionally from full fat and reduced fat milk at 0, 30, 60 and 90 days of pickling respectively.

Texture profile analysis

The changes in primary parameters (hardness, adhesiveness, cohesiveniess, springiness) and secondary parameters (Gumminess) of the texture during pickling of experimental cheeses are shown in Table (3). Hardness, the force required to compress a sample between the molars, is one of the important factors in determining cheese texture. Reduction of fat content in fresh cheese increased the hardness very widely (Table 3). Both of reduced fat cheeses, in general either from traditional or UF milks showed higher hardness than that of full fat cheeses, either when they were fresh or along the pickling period.

Table(3): Rheological properties of cheese during pickling

	Pickling time	Rheological parameters				
		Hardness	Cohesiveness	Adhesiveness	Springiness	Gumminess
	days	g	ratio	g/sec	mm	g/sec
TR-FF	0	245	1.18	9.32	13.04	289
	30	286	1.22	11.23	14.65	349
	60	302	1.30	11.22	15.34	393
	90	268	1.25	10.67	14.76	335
TR-RF	0	367	1.32	14.34	15.55	484
	30	401	1.43	15.43	16.44	573
	60	423	1.23	14.56	16.44	520
	90	386	1.13	13.22	14.87	436
UF-FF	0	215	1.08	11.43	11.54	232
	30	269	1.25	12.23	13.33	336
	60	278	1.32	14.33	13.87	367
	90	231	1.23	12.87	13.72	284
UF-RF	0	327	1.24	15.65	13.78	405
	30	365	1.28	15.59	14.33	467
	60	345	1.37	16.54	14.23	473
	90	297	1.36	14.44	13.31	404

TR-FF: full fat cheese made using traditional method,
TR-RF: reduced fat cheese made using traditional method,
UF-FF: full fat cheese made using UF milk,
UF-RF: reduced fat cheese made using UF milk.

Chemical analysis of full fat and reduced fat cheeses indicate a higher value of moisture content for reduced fat cheese (Table 2). The increase of cheese moisture as the fat reduced did not improve its hardness. Water acts as a lubricant or plasticizer between proteins, what soften the protein matrix is not the total moisture but the MNFS (moisture in non fat substance), (Lucey *et al*., 2003). Change in hardness of reduced fat cheeses indicated that the minor increase in moisture content of these cheeses did not compensate the higher casein content. The structural matrix of cheese is a cross-linked casein-calcium phosphate network in which fat globules are physically entrapped (Prentice, 1993). Both full fat and reduced fat of UF cheeses showed lower hardness than the corresponding of traditional cheeses. This may be attributed to the high moisture and whey protein content in UF cheeses than traditional cheeses.

After 30 days of pickling, the hardness increased widely in all cheeses. The increasing of hardness was at higher rate in UF cheese compared to traditional cheese. This increasing is related to the reduction in moisture content during the 1st month of pickling (Table 2).

Pickling of cheeses for 3 months showed lower hardness comparing with those after 1 month of pickling. The decrease in hardness at the end of pickling is due to the initial rubbery texture of cheese, which rapidly transforms into a smoother and softer product due to proteolysis of casein network and solubilization of calcium collide phosphate (CCP) in cheese. The casein network is greatly weakened when Phe_{23}-Phe_{24} bond in the α_{s1}-casein is hydrolyzed by the residual coagulant to give the peptide α_{s1}-I-casein (Creamer and Olson, 1982; Lucey *et al*., 2003). During cheeses storage, the solubilization of CCP results in a weaker association between casein molecules, which decrease the cheese rigidity (Lucey *et al*., 2003).

Cohesiveness is the strength of internal bonds making up the body of the product. Cohesiveness was similar between cheeses reduced fat made using UF and normal milk at 1st day of manufacture. Reduction of fat content in fresh reduced fat cheese increased the cohesiveness and as fat content of fresh UF cheese increased by high recovery of fat, the cohesiveness decreased comparing with traditional cheese. The nature of the protein matrix and the extent of fat dispersion may contribute to cohesiveness or the tendency of cheese to adhere to itself (Bryant *et al*., 1995). Cohesiveness was lower in UF cheeses compared to traditional chesses at 1st day of manufacture. This is related to some factors; high moisture and whey protein retained in UF cheeses compared with traditional cheeses.

Springiness is the rate at which a deformed material returns to its original shape on removal of deforming force. The springiness, or elasticity, is the distance a cheese recovers during the second compression in texture analysis. This parameter was lower in fresh full fat cheeses either traditional or UF than that of reduced fat cheeses (Table 3), while during the extended period of pickling there were no clear trend between treatments which accompanied with slight differences.

The earlier studies demonstrated reduced fat Cheddar cheese was springier than full fat Cheddar cheese hypothesizing that reducing fat content resulted in fewer fat globules with more casein being deformed per unit volume evidenced by electron micrographs (Bryant *et al*., 1995). However, springiness was reduced after 3 months of pickling in reduced-fat samples.

Adhesiveness is the work necessary to overcome the attractive forces between the surface of the cheese and the surface of other materials with which the cheese comes into contact (e.g. tongue, teeth, palate), work required to pull cheese away from a surface. Reduction of fat content in fresh cheese increased the adhesiveness (Table 3). During the pickling, the adhesiveness was markedly fluctuated slightly in all cheeses, and the lowest value was in full aft traditional cheese (10.67 at 90 days) and the highest value was in reduced fat UF cheese (16.54 at 60 days). Bryant *et al*., (1995) reported that the hardness and springiness increased while adhesiveness and cohesiveness of the 3-month old Cheddar cheese decreased with decreasing fat content. Olson and Johnson (1990) reported that low-fat cheeses exhibiting a higher degree of stickiness when masticated.

Gumminess is the energy required to chew a semi-sold food product to a state where it is ready for swallowing. The gumminess was lower in full fat cheeses either traditional or UF than reduced fat cheeses (Table 3). The gumminess was lower in UF cheeses either full fat or reduced fat than in corresponding traditional cheeses. Generally, the gumminess increased through the first 60 days of pickling and then increased thereafter in all treatments.

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تأثير تركيز اللبن بالترشيح الفوقي علي التحلل البروتيني و الخواص الريولوجية للجبن الأبيض الطري منخفض الدهن

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تم دراسة تأثير تركيز اللبن باستخدام الترشيح الفوقي علي التركيب الكيماوي و التحلل البروتيني و الخواص الريولوجية للجبن الأبيض الطري كامل الدسم و منخفض الدهن خلال فترة التخليل. و قد أظهرت النتائج أن كل من الرطوبة و رقم pH قد انخفضا ، بينما كل من نسبة الملح و الصلابة Hardness و التحلل البروتيني زاد خلال شهرين من التخليل. الجبن المصنع من اللبن المركز بالترشيح الفوقي تميز باحتوائه علي نسبة رطوبة مرتفعة كما كان نسبة التصافي و البروتين و الدهن مرتفع بالمقارنة بالجبن المصنع من اللبن الطبيعي. التحلل البروتيني كان مرتفع في الجبن المصنع من اللبن الطبيعي مقارنة بالجبن المصنع من اللبن المركز بالترشيح الفوقي. الصلابة كانت منخفضة بينما كانت الالتصاق Adhesiveness و القدرة علي المضغ Gumminess مرتفعة في الجبن المصنع من اللبن المركز بالمقارنة بالجبن المصنع من اللبن الطبيعي. و لقد ارتفع كل من الرطوبة و البروتين و الصلابة و الالتصاق و القدرة علي المضغ بينما انخفض نسبة الدهن و نسبة التصافي و نسبة الرطوبة في المادة غير الدهنية في الجبن منخفض الدهن سواء مصنع من لبن طبيعي أو لبن مركز بالترشيح الفوقي مقارنة بالجبن كامل الدسم.