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An Improvement of the Quality of Low Fat UF Soft Cheese Using Certain Fat Replacers.

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ABSTRACT

This research aimed to improve the quality of low fat UF soft cheese using cer fat replacers such as alginate gum, calcium alginate and sodium alginate. Low- fat milk retentate was divided into four equal rations. First ration with no additives attended through control of LFC, while the others were supplemented with alginate gum (0.05%, ALG), calcium alginate (0.05%, CaG) and sodium alginate (0.05%, NaG), respectively. The standardized fat milk retentate (15%fat) deprived of additives was controlled for FFC. The obtained results showed that moisture, fat, protein and ash contents of low fat UF-soft cheese treated with ALG, CaG and NaG were higher than low fat cheese sample (LFC). Treatment with calcium alginate and sodium alginate increased the acidity and water soluble nitrogen content compared with LFC when cheese was fresh. Rheological properties like hardness, adhesiveness, gumminess and chewiness decreased in most treated samples, and the maximum decrease was almost for treatment NaG. Evaluation of organoleptic properties showed that cheese with CaG and NaG had the highest score while the control (LFC) had the lowest score in this respect. In conclusion, use of calcium alginate and sodium alginate as fat replacer for manufacture of low fat UF- soft cheese improved the rheological and sensory properties.

Keywords: Low-fat UF soft cheese, Alginate gum, calcium alginate, sodium alginate .

INTRODUCTION

Recent studies in food sciences have shown the importance of soft cheeses produced by UF technology in nutrition and health, this is mainly due to the retention of whey proteins into the concentrated retentate (Sukkar and Bounous 2004; Fakhr-El Dein, *et al.,* 2010 and Rashidi, *et al*., 2015). The consumption of more fat leads to the risk of obesity, heart disease and blood pressure, so there is a desire to produce low fat products in the world (Kavas *et al.,* 2004 and Rashidi *et al*., 2015).However,it is well known that fat plays an important role in improving the quality of the product especially cheese and some other dairy products . It is believed that low-fat cheese is poor in sensory properties. Fat deficiency and increased protein lead to the formation of hard and rubbery texture and have an adverse impact on cheese quality. In addition, fat deficiency leads to some defects in flavour and bitterness. So it is very difficult to produce low - fat cheese with the same characteristics of full - fat cheese (Sipahioglu *et al.,* 1999). Content. On the other hand, fat replacers are ingredients that replace part of fat or full fat of the natural fat content of a food in order to reduce calories. Fat replacers also work to increase moisture and break the protein matrix in low fat cheese (Rashidi *et al*., 2015) such impact by its turn improves the sensorial attributes of the resultant cheese.

Phycocolloidis another term for polysaccharides such as agar, alginates and carrageenan and usually are obtained from seaweed (Zemke-White and Ohno, 1999). The algin in brown algae is found in the form of a mixed salt (sodium and/or potassium, calcium, magnesium) derived from alginic acid (McHugh 2003). Alginates are complex carbohydrates known as polysaccharides which are carbohydrates derived from brown seaweeds of the Class Phaeophyceae (Pawar 2012, Holdt and Kraan 2011, Mabeau and Fleurence, 1993). Alginates can be used for industrial purposes in foods such as thickener in the stabilizer, and emulsifier (Krasaekoopt *et al*., 2006).

Calcium algin is a polysaccharide extracted from brown algae. Studies have recently shown that it has functional properties, as the additives containing the calcium algin reduce lipid peroxidation in many products (Khotim chenko *et al.,* 2001). Also, improve the rheological properties that mainly due to their ability to retain water. Sodium alginate is a natural polysaccharide product extracted from brown seaweed that grows in cold water regions. Sodium alginate is also commonly used as a thickener, emulsifier and texture improver ingredient. Sodium salts of alginates are widely accepted because of their range of functional properties in the dairy products (Kumar 2012, Khanal *et al.* 2017 and Khanal *et al*. 2018). There is no scientific research study according to our knowledge on the effect of using alginate alone as a fat replacer, especially in low fat soft cheese.

The objectives of this work were to study the effect of alginate gum, calcium alginate and sodium alginate seperataly on the improving quality of low fat UF soft cheese. This is important for the Egyptian consumer, since soft cheese is the most popular cheese in Egypt.

MATERIALS AND METHODS

Alginate gum was obtained from Danisco A/S, Denmark. Sodium alginate, and calcium alginate were obtained from Aldrich. UF- milk retentate samples (5 and 15% fat content) were obtained from Dairy Processing Unit, Animal Production Res., Inst., Agric. Res. center, Min. of Agric., Egypt. Fine cooking salt produced by EL-Naser Company and liquid rennet were obtained from the local market.

Manufacture of UF- soft Cheese:

Low- fat milk retentate (5 % fat) was divide into 5-equal portions. A sample without additives was served as control (LFC) whie the others contained alginate gum (0.05%, ALG), calcium alginate (0.0.05%, CaG) and sodium alginate (0.05%, NaG), respectively. The standardized fat milk retentate (15% fat) without additives was utilized as a positive control (FFC). UF-soft cheese was made according to the method described by Renner and Abd El-Salam (1991). Cheese made with a gum preparation was added to pre-pasteurized milk, and well mixed in a blender with high speed. All samples were heated at 75°C for one minute and cooled to 38°C. Finally, sodium chloride (3%) and calcium chloride (0.02%) were added to milk retentate with sufficient quantity of rennet. The pre-cheese was immediately filled into plastic containers and incubated at 37°C to complete coagulation within 40 min. before cooling at refrigerator temperature (7°C) and stored for 28days. Chemical analyses were done in the resultant cheeses when fresh and after 14 and 28 days. In addition, the rheological properties and sensory evaluation were carried out. Two replicates were done from each treatment.

Cheese samples were analyzed for moisture, fat and ash according to AOAC (2000). Titratable acidity, water soluble nitrogen (WSN), and total nitrogen (TN) were determined as described by Ling (1963). Total volatile fatty acids content (TVFA) was estimated by the method of Kosikowski, (1978).

Textural properties of cheese were estimated by Bourne, (1978). Then according to Bodyfelt *et al.,* (1988). cheese sample were organoleptically evaluated by 7 panelists from Dairy Scienc. Statistical analysis was carried out using SPSS program Inc. software (version 10.0; SPSS Inc., Chicago, IL) and the statistically different treatments were determined by the Duncan's multiple rage test (SPSS, 1998).

RESULTS AND DISCUSSION

From Table (1) it was noticed that moisture, fat, protein and ash varied among the different treatments of cheeses. The moisture content significantly increased as a result of alginate addition. As moisture increased, the dry matter decreased which fresh cheese made with CaG and NaG had the highest moisture (71.98 and 71.85%) compared with cheese made as full fat cheese (FFC) or cheese with low fat (LFC).

Table 1. Moisture, fat, protein and ash contents of low fat UF soft cheese made with alginate gum, calcium alginate and sodium alginate during storage period

Treatments	Storage/ day		
	Fresh	14	28
		Moisture, %	
FFC	67.28±0.40^{Ac}	65.53±0.31^{Ac}	64.27±0.31^{Ac}
LFC	69.63±0.36^{Bb}	67.82±0.34^{Ba}	67.17±0.14^{Ba}
ALG	70.38±0.23^{Bc}	68.50±0.21^{Bb}	67.09±0.27^{Ba}
CaG	71.98±0.24^{Cc}	70.32±0.24^{Cb}	68.95±0.22^{Ca}
NaG	71.85±0.01^{Cc}	70.61±0.23^{Cb}	69.28±0.22^{Ca}
		Fat, % (dry basis)	
FFC	45.62±0.66^{Ca}	43.10±1.49^{Ba}	42.18±1.16^{Ba}
LFC	15.67±0.55^{Aa}	15.61±0.49^{Aa}	16.01±0.29^{Aa}
ALG	16.32±0.08^{Aba}	16.26±0.11^{Aa}	16.33±0.10^{Aa}
CaG	17.25±0.28^{Ca}	17.08±0.20^{Aa}	17.04±0.12^{Aa}
NaG	17.48±0.35^{Ca}	17.93±0.38^{Aa}	17.54±0.11^{Aa}
		Protein,% (dry basis)	
FFC	32.60±1.11^{Aa}	31.23±0.67^{Aa}	31.68±1.02^{Aa}
LFC	36.72±0.52^{Bb}	35.21±0.14^{Ba}	35.54±0.39^{BCab}
ALG	37.03±0.19^{BCc}	35.46±0.16^{Bb}	34.45±0.15^{Ba}
CaG	39.00±0.23^{CDc}	37.43±0.25^{Cb}	36.27±0.12^{Ca}
NaG	38.53±0.10^{Db}	37.72±0.36^{Cb}	35.98±0.54^{BCa}
		Ash, % (dry basis)	
FFC	16.36±0.17^{BCa}	16.25±0.68^{Ba}	16.37±0.48^{Ca}
LFC	12.85±0.34^{Aa}	13.45±0.68^{Aa}	13.09±0.14^{Aa}
ALG	13.98±0.86^{Aa}	13.31±0.05^{Aa}	14.84±0.03^{Ba}
CaG	15.99±0.07^{Cb}	15.92±0.37^{Ba}	15.38±0.03^{Ba}
NaG	15.38±0.13^{Ba}	14.81±0.40^{ABa}	15.48±0.31^{Ba}

Protein = TN×6.38

Means (±SE) with unlike capital or small superscripts within column (treatments) and row (storage period), respectively are significantly different (P≤0.05). FFC, Full Fat Control; LFC-Low Fat Control; ALG - Low Fat Cheese with Alginate gum; CaG - Low Fat Cheese with Calcium Alginate and NaG - Low Fat Cheese with Sodium Alginate.

Previous studies reported the ability of polysaccharides to enclose water and reduce syneresis from curd cheese that increase moisture (Aminifar and Emam-Djome, 2016 and Benjamin *et al*., 2018). Several authors reported that using of alginate increased the moisture content in the treated with it cheese. (McMahon *et al.,*1996, Kumar 2012 and Khanal *et al*., 2018. Fat, protein and ash in dry matter increased in cheeses when fresh and during storage as result of the addition of ALG,CaG or NaG . This might be due to the increase of moisture content, and lower fat content in the treated of cheeses.

It was also noticed from Table (2) that the acidity increased in some fresh treated cheese, specially iin the prsence of CaG and NaG (0.39 and 0.43%), respectively. This increase may be due to the corresponding increase of moisture content. Benjamin *et al.,* (2018) observed that a slight increase in cheese conductivity when moisture levels were higher due to quicker ion diffusion into the curd. During storage period the acidity continued to increase in all cheese samples and there were significant ($p \leq 0.05$) differences between the treatments of cheese (Treatment of NaG had the highest value being 0.66 while FFC had the lowest acidity of 0.55%).

Table 2. Changes in acidity, WSN / TN (%) and total volatile fatty of low fat UF soft cheese made with alginate gum, calcium alginate and sodium alginate during storage period

Treatments	Storage/ day		
	Fresh	14	28
		Acidity (%)	
FFC	0.28±0.02^{Aba}	0.37±0.04^{Aa}	0.55±0.06^{Ab}
LFC	0.38±0.02^{ABa}	0.51±0.03^{Bb}	0.65±0.01^{BC}
ALG	0.34±0.01^{ABa}	0.43±0.02^{ABb}	0.52±0.01^{Ac}
CaG	0.39±0.04^{Ba}	0.48±0.05^{ABab}	0.54±0.01^{Ab}
NaG	0.43±0.05^{Ba}	0.52±0.05^{Ba}	0.66±0.02^{Bb}
		WSN/TN (%)	
FFC	23.46±1.09^{Ca}	27.00±1.58^{Bab}	29.48±1.63^{Cb}
LFC	14.09±1.12^{Aa}	17.75±0.63^{Ab}	20.66±0.56^{Bc}
ALG	16.75±0.31^{Ba}	16.00±0.41^{Aa}	17.30±0.19^{Aa}
CaG	15.75±0.46^{ABa}	17.96±0.78^{Ab}	20.73±0.46^{Bc}
NaG	17.19±0.43^{Ba}	18.21±0.37^{Aab}	18.72±0.43^{ABb}
		TVFA (ml 0.1N Na OH/100g cheese)	
FFC	4.71±0.06^{Ba}	5.53±0.17^{Cb}	6.65±0.05^{Cc}
LFC	2.75±0.14^{Aa}	3.80±0.16^{Bb}	4.80±0.09^{Bc}
ALG	2.59±0.15^{Aa}	2.84±0.17^{Aa}	3.87±0.19^{Ab}
CaG	2.68±0.05^{Aa}	2.78±0.05^{Aa}	3.99±0.19^{Ab}
NaG	2.54±0.20^{Aa}	3.94±0.17^{Bb}	4.55±0.14^{Bc}

See Legend to Table (1) for details

The soluble nitrogen content of cheese, as WSN/TN is shown in Table (2). All treatments resulted an increase in WSN/TN in fresh cheese. The increase of WSN during storage period might be due to proteolysis activity of the residual rennet and the proteases in starter and non-starter bacteria (Farkye, 1995). The maximum average was observed in FFC, followed by the other fresh treatments with NaG>ALG>CaG>LFC,and the ranking was different at the end of storage period being FFC>CaG>LFC>NaG>ALG. These results agree with Haque *et al.,* (2007) and Kumar (2012).

Table (2) shows the content of total volatile fatty acids (TVFA), where the highest value of TVFA was found in FFC and the rest of the treatments were not significantly different when cheese was fresh. TVFA content increased markedly in all cheese samples as storage period progressed. This is might be due to enhancing the growth of lipolytic bacteria. Kebary *et al.,* (2006) also noticed the same increase of TVFA during storage of low-fat Domiati cheese.

All cheese samples were analyzed for the rheological properties when cheese fresh and after 28 days of storage period (table3). Hardness values of fresh samples were 482.67, 550.00, 460.30, 362.70 and 276.67 N in FFC, LFC, ALG, CaG and NaG treatments, consequently. Such differences were statistically significant (p≤0.05). The lowest hardness of NaG. treatment is claimed to capacity of alginate to bind water. Therefore, it contained more moister and formed discrete gel particles in situ in the presence of Ca2+ (Khanal *et al.,* 2017 and *Khanal et al.,* 2018). So, fat replacers may be utilized as plasticizer among protein molecules and helps in forming soft cheese (Sahan *et al.,* 2008). All the prementioned values great decreased in the stored cheeses, samples with significant differences among treatment cheese which had lower hardness than those of FFC and LFC.

Table 3. Rheological properties of fresh and stored (28 days old) of low fat UF soft cheese made with alginate gum, calcium alginate and sodium alginate

Treatments	Hardness (N)	Adhesiveness (J)	Springiness (mm)	Cohesiveness (ratio)	Gumminess (N)	Chewiness (J)
			Fresh			
FFC	482.67±9.96^{C}	29.35±0.79^{C}	6.84±0.07^{AB}	0.75±0.01^{C}	363.7±10.5^{CD}	2489.4±96.2^{C}
LFC	550.0±12.1^{D}	25.15±0.61^{B}	7.27±0.19^{BC}	0.69±0.00^{A}	381.4±10.2^{D}	2776.6±124.9^{C}
ALG	460.3±12.4^{C}	24.73±0.72^{B}	6.52±0.08^{A}	0.72±0.00^{B}	331.4±8.9^{C}	2163.4±82.4^{B}
CaG	362.7±15.1^{B}	28.15±0.80^{C}	7.46±0.12^{C}	0.74±0.01^{BC}	267.4±14.8^{B}	1991.6±90.1^{B}
NaG	276.67±15.7^{A}	21.34±0.18^{A}	6.80±0.23^{AB}	0.68±0.00^{A}	187.1±9.6^{A}	1276.5±108.8^{A}
			Stored (28 days old)			
FFC	343.0±1.2^{C}	29.68±0.23^{D}	7.20±0.05^{A}	0.60±0.00^{A}	204.7±1.8^{C}	1473.0±21.3^{B}
LFC	354.3±8.7^{C}	26.61±0.18^{B}	8.36±0.09^{B}	0.59±0.01^{A}	210.1±2.3^{C}	1756.7±8.9^{C}
ALG	385.7±3.0^{D}	23.49±0.17^{A}	8.82±0.06^{C}	0.61±0.02^{A}	235.3±6.0^{D}	2075.4±63.1^{D}
CaG	274.7±2.0^{B}	28.34±0.04^{C}	7.08±0.09^{A}	0.58±0.01^{A}	160.3±2.9^{B}	1135.01±33.8^{A}
NaG	252.0±2.3^{A}	29.17±0.18^{D}	7.19±0.02^{A}	0.59±0.00^{A}	149.5±1.6^{A}	1075.0±9.3^{A}

See Legend to Table (1) for details

Adhesiveness values of both fresh and stored (28day) cheese samples are tabulated in Table (3). Adhesiveness values of fresh cheese showed decrease with using fat replacers, and such decrease was significant in case of ALG and NaG compared with FFC. Treatments with ALG and NaG showed adhesiveness values in fresh cheese of 24.73 and 21.34J, respectively, while FFC was 29.35 J. The other treatments were in between. These values except those of ALG increased with advancing storage period, which might be due to cheese in protein molecules which makes the cheese softer (Sahan *et al.,* 2008). In relation to the decreased hardness, the adhesiveness followed the same trend of the obtained results (Table 3).

Springiness values of fresh cheese sample were 6.84, 7.27, 6.52, 7.46 and 6.80 mm for FFC, LFC, ALG, CaG and NaG, consequently. Springiness of control cheese increased with the reduction in fat. After storage period the corresponding springiness values became 7.20, 8.36, 8.82, 7.08 and 7.19 mm, respectively. Springiness was the highest in fresh cheese treated with CaG and was the lowest in cheese treated with AL. According to results in Table (3) springiness of the fresh FFC was significantly different compared with fresh cheeses made with CaG. However, the differences in case of stored cheese were insignificant. At the end of storage period treated samples LFC and ALG differed significantly than the other samples, whereas no significant differences were recorded with samples FFC, CaG and NaG. Low fat UF- soft cheeses is known to possess more springiness because fewer fat globules are present and hence more casein is deformed per unit volume (Koca and Metin 2004; and Rashidi, *et al.,* 2015).

Results in Table 3 show that cohesiveness of FFC and fresh cheese from CaG were significantly higher than those of LFC and NaG cheese, while the differences were insignificant in the stored samples (p≤0.05). The level of cohesiveness was found higher also in FFC than that of LFC (Rashidi *et al.,* 2015; Benjamin *et al.,* 2018). Conversely, Koca and Metin (2004), Romeih *et al.* (2002) and Khanal *et al.,* (2017) claimed that fat replacers increased the cohesiveness but they decreased after storage for four weeks. This reduction might be due to the proteolytic activity. It decreases the structural-integrity of protein-matrix and that causing lower cohesiveness.

It could also be seen from Table (3) shows the changes in gumminess in fresh and stored cheese. Using alginates (Gum, Ca and Na) decreased significantly gumminess in fresh cheese. At the end of storage period gumminess of all samples decreased, CaG and NaG treatments had the lowest significant values. This may be due to the increased recorded moisture of low-fat cheeses and disruptance of protein matrix of cheese so that less force was needed to disrupt the texture of cheese in compression stage. Romeih *et al.,* (2002); Rashidi *et al.,* (2015) and Khanal *et al.* (2018), attributed the gumminess reduction to the functional properties of the individual fat replacers or their higher proteolysis levels.

Chewiness values of fresh and stored cheese are tabulated in Table (3). Using ALG, CaG and NaG resulted in significant decline in chewiness values. LFC had the highest value while treatment NaG had the lowest one when cheese was fresh or stored. After storage period all values decreased. Cheese samples with CaG and NaG had the lowest values while treatment with ALG caused the highest chewiness. So, fat-replacer would enhance or decrease chewiness because of differences between the used types. Koca and Metin (2004), Romeih *et al.,* (2002) Khanal *et al.,* (2017 and 2018) claimed also the same conclusions when they used different fat replacers in making some varieties of soft or hard cheese.In general, the present results of rheological properties and those from the literature also suggested that there was a continuous enhancement in the textural parameters in cheeses throughout ripening. This may be due to on-going proteolysis (Romeih *et al.,* 2002). Textural qualities were also altered due to increasing alginate concentration as given also in some previously metioned studies. This was mainly due to forming softer rennet gel, while alginate particles represented as fillers in protein matrix for softening the texture of gel (Khanal *et al.,* 2017). In general texture of cheese is straightaway affected by the water holding capacity (WHC) of the rennet gel. WHC of protein gels by its turn is affected by the interfaces of milk proteins and sodium alginate. Protein- polysaccharide interfaces that disturb WHC capacity by including interaction assisted by hydrophobic or hydrogen bonding between proteins and its hydroxyl groups of mannuronic or guluronic acid residues (Chen *et al.,* 2016).

Organoleptic scores of the resultant fresh cheese are presented in Table (4). Statistical analysis revealed that the differences in flavour scores among some treatments were significant. It could be seen that control full fat cheese treatment (FFC) obtained the highest score (40.36 out of 50) while the lowest was obtained in the LFC and ALG treatment 30.07 and 28.93 out of 50, respectively. The scores of body and texture among the treatments were different. Thus, no significant differences were recorded between FFc and cheese from treatments CaG and NaG, wheras the lowest body and texture scores were given for LFC and ALG-treated cheese. In fresh cheese, the appearance of control (LFC) and ALG had ranked the lowest score, while treatments of FFC, CaG and NaG got the highest score. Statistical analysis revealed that the differences in flavour, body &textural, appearance and total scores among the treatments were almost significant. These results are in agreement with Khanal et al. (2018). In conclusion, the effect of adding alginates like calcium and sodium alginate improved the organoleptic properties of cheese with no adverse impact on the other properties of the resultant cheese.

Table 4. Sensory evaluation of fresh low fat UF soft cheese made with alginate gum, calcium alginate and sodium alginate.

Overall acceptability	Appearance (10)	Body &Texture (40)	Flavour (50)	Treatments
84.89 ± 2.80^{B}	9.13 ± 0.46^{C}	35.40 ± 1.17^{B}	40.36 ± 1.30^{B}	FFC
65.54 ± 2.85^{A}	7.47 ± 0.44^{A}	28.00 ± 0.85^{A}	30.07 ± 2.08^{A}	LFC
66.83 ± 1.68^{A}	7.83 ± 0.24^{AB}	30.07 ± 1.19^{A}	28.93 ± 0.88^{A}	ALG
82.90 ± 3.17^{B}	9.09 ± 0.17^{C}	36.11 ± 1.22^{B}	37.71 ± 1.98^{B}	CaG
82.40 ± 1.52^{B}	8.50 ± 0.15^{BC}	34.04 ± 0.71^{B}	39.86 ± 1.08^{B}	NaG

See Legend to Table (1) for details

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تحسين جودة الجبن الطري منخفض الدهن المنتج بواسطة الترشيح الفوقي باستخدام بعض بدائل الدهون.

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هدف البحث الحالي تحسين جودة الجبن الطري منخفض الدهن المنتج بواسطة الترشيح الفوقى باستخدام بدائل الدهون وهي صمغ الآلجينات وألجينات الكالسيوم وألجينات الصوديوم حيث تم تقسيم مركز اللبن منخفض الدهن (٥%) إلى أربعة أقسام: القسم الأول منها كان بدون إضافات (الكنترول) ، أما المعاملات الأخرى فقد أضيف إلى كل منها (٠.٠٥%) من كل من صمغ الألجينات ، ألجينات الكالسيوم ، وألجينات الصوديوم على التوالي. أما المركز المحتوى على ١٥ % دهن فلم يضف إليه أية إضافات وتم إستخدامه ككنترول ايجابي . وقد توصل البحث إلى عدد من النتائج من بينها: إرتفاع محتوى كل من الرطوبة والدهن والبروتين والرماد في الجبن المنخفض الدهن المعامل بالألجينات مقارنة بالجبن المنخفض الدهن (الكنترول) ، كما تبين أيضاً من نتائج البحث إرتفاع الحموضة والنيتروجين الذائب في الجبن المعامل بالألجينات مقارنة بالكنترول منخفض الدهن عندما كانت الجبن طازجة. أشارت نتائج البحث أيضا إلي إنخفاض الخواص الريولجية في الجبن الطازج مثل: الصلابة والآلتصاق ، الصمغية ، والقابلية للمضغ عند إستخدام الألجينات ، وتبين أن أعلى إنخفاض كان في الجبن المعامل بألجينات الصوديوم واختلفت معظم القيم للصفات المذكوره في حالة الجبن المخزن.أوضحت نتائج التقييم الحسي أن الجبن المعاملة بألجينات الكالسيوم والجينات الصوديوم حصلت على أعلى درجات مقارنة بالكنترول منخفض الدهن ، ولم يتضح وجود فرق معنوي بينهما وبين الكنترول الايجابي المصنع من مركز كامل الدهن . يوصي البحث بامكانية إستخدام الجينات الكالسيوم والجينات الصوديوم كبدائل للدهن لتحسين جودة الجبن الطرى منخفض الدهن المصنع من مركز اللبن المحضر بطريقة الترشيح الفائق.