

EFFECT OF FAT REPLACER (SIMPLESSE® -100) ON THE QUALITY AND PROPERTIES OF LOW- FAT GOUDA LIKE CHEESE.

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ABSTRACT

Five batches of Gouda-like cheese were made to study the effect of simplese® -100 at rate 0.18 g/L milk on the quality of the resultant Gouda-like cheese during three months of ripening. Three batches of Gouda-like cheese were made from whole fat (3.5%), reduced fat (2.5%) and low-fat cow's milk (1.5%). Similarly another two batches of reduced (2.5%) and low-fat milk (1.5%) were made with addition of fat replacer (Simplese®-100) at a rate of 0.18 g/litre of milk. Results indicated that cheese treatments made by adding simplese characterized with a pronounced increase in moisture, total protein and titratable acidity. In addition, these chesses characterized with higher ripening indices (WSN/TP, PTN-SN/TP and NPN/TP) and total volatile fatty acids (TVFA) than the corresponding cheese treatments being made without simplese® -100, when fresh and during storage period. Moreover, results revealed that decreasing fat content of cheese had an obvious effect on chemical composition and ripening indices of the resultant cheese, when fresh and during storage period

Results revealed that decreasing fat content of cheese had a remarkable effect on total viable, proteolytic and lipolytic bacterial counts in the resultant cheeses during ripening period. Addition of simplese® -100 decreased the counts of total viable, proteolytic and lipolytic bacterial in resultant cheese compared with cheese free from simplese® -100 along the ripening period.

Furthermore, addition of simplese® -100 improved the sensory properties of low fat cheese especially its body and texture (T3 and 5) to be near to control one (full-fat cheese). Also, its more acceptable than chesses made without simplese® -100 (T2 and T4).

Keywords: Cow's milk, simplese® -100, chemical composition, ripening indices.

INTRODUCTION

Gouda cheese is one of the popular semi-hard Dutch cheeses. Consumption of this cheese in Egypt has been increased in the recent years, and it has been manufactured in some Egyptian dairy factories.

Over the past decade, dietary fat has been linked to risk of diseases such as coronary heart disease, obesity, cancer and blood cholesterol which are related to oxidation of lipid. (Akoh, 1998). This health risk has necessitated the need to improve the consumer awareness and a vivid change in the supply and demand for low fat foods including cheese. Furthermore, Fat plays an important role in the body & texture and flavour of cheese. Full-fat Gouda cheese characterized by a protein matrix interspersed with fat globules of varying shapes and size. Meanwhile, low-fat cheese tends to have low intensity of taste, typical flavor and hard and grainy texture (Mistry and Anderson, 1993). Low-fat cheese made by conventional methods was of poor functional properties and poor aroma and rubbery body and texture. It could also be observed an appearance of calcium lactate crystals (Rodrigues, 1998). In the light of this many ingredients and different technological strategies have been developed for enhancing quality of low-fat cheese.

Fat replacers are ingredients used to reduce fat content with a substantial decrease of caloric value and at the same time providing some of functional properties of fat. It divided into 2 groups: fat substitutes and fat mimetics. Fat substitutes are non-polar and soluble compounds providing sensory and functional properties of fats to food. However, fat mimetics are polar water soluble substances used to partially replace sensory and functional characteristics of fat. Fat mimetics were reported to improve sensory and functional characteristics of low fat cheese by binding water, and thereby improving texture and yields (Mistry, 2001).

According to a composition fat mimetics consist mainly of micro-particulates protein or carbohydrate-based materials (Kavas et al., 2004). Carbohydrate-based fat replacer are widely used in food processing to improve functional properties that are adversely affected by lowering of fat levels (Zisu and Shah, 2005). However, protein-based mimetics are also employed to replace fat in cheese manufacture.

The objective of this study is to investigate the effect of adding protein-based fat replacer (simplese® -100) on the quality of low-fat Gouda-like cheese during storage period.

MATERIALS AND METHODS

Fresh cow's milk was obtained from the herd of Sides experimental station, Animal Production Research Institute. Simplese® -100 a protein-based fat was obtained from CP KLCO, Chicago, IL, USA (its chemical composition was moisture 40%, ash > 7% and carbohydrate 39.5%). Salt was obtained from El-Naser Company, Alexandria, Egypt. Hansens's powder rennet from Chr. Hansen's laboratories, Copenhagen, Denmark.

Lactococcus lactis subsp. *lactis* was obtained from Cairo Microbiological Resource Center (MIRCEN), faculty of Agriculture, Ain Shams Univ, Egypt. Tryptone Glucose Extract agar medium code CM 127 (TG EA) and Nutrient agar medium were bought from Oxoid division of Oxoid LTD, London, UK. Five batches of Gouda-like cheese were made as follows:

- Treatment 1: made from full-fat ($3.5 \pm 0.1\%$) cow's milk and served as control (T1).
- Treatment 2: made from reduced fat milk ($2.5 \pm 0.1\%$) without adding simplese-100 (T2)
- Treatment 3: made from reduced fat milk ($2.5 \pm 0.1\%$) + simplese-100 0.18g/l milk (T3)

Treatment 4: made from low – fat milk ($1.5\pm 0.1\%$) without adding simplese -100 (T4)

Treatment 5: made from low – fat milk ($1.5\pm 0.1\%$) +simplese -100 0.18 g/l milk (T5).

Milk of all treatments was pasteurized at $74\text{ }^{\circ}\text{C}$ /20sec cooled to $32\text{ }^{\circ}\text{C}$ and 0.02% CaCl_2 was added. -: simplese 100 was added to milk. The rest steps of manufacturing process were carried out according to (scott , 1981) .Cheese of all treatments were ripened at $8\text{--}10\text{ }^{\circ}\text{C}$ for 3 months at 85% relative humidity . Cheese samples were periodically taken at 0, 1, 2 and 3 months of ripening for chemical, microbiological and sensory evaluation. Three replicates of this were done.

Moisture, fat, titratable acidity and total protein were determined according to ling (1963). PH value were measured using a calomel glass electrode PH-meter model HANNA instruments H 18424. Salt was determined according to method of Simov(1980) .Water soluble nitrogen was determined according the method described by kucoo and Fox(1982). Non- protein nitrogen was estimated according to IDF (1993) . Phosphotungstic acid (5%) and soluble nitrogen were determined according to Jarret , etal (1982) . Total volatile fatty acids was estimated with method described by kosikowski(1982) .

Total viable count was determined according to American Public Health Association method (APHA, 2004), proteolytic bacteria was determined according to Sharaf(1970), lipolytic bacteria was determined with method described by Davis(1955)

Organoleptic properties scored by the staff members Dairy Technology Department, Animal Production Research Institute according to Pappas, etal (1996)..Scoring scale, flavor (50) , body & texture(40) , appearance(10).

The general liner models procedure of Statistical Analysis System (SAS) was used to analyze the data. Analysis of variance for all cheese samples were performed to determined differences between samples. One–way randomized complete block design and least significant differences (L.S.D) were adopted in the resultant (SAS 1990).

RESULTS AND DISCUSSION

It is clear from Table (1) decreasing the fat in cow's milk cheese to 2.5% (reduced – fat milk) and 1.5% (low –fat milk) had a significant effect on the chemical composition of the resultant Gouda – like cheese, when fresh and during storage period. This reduction led to increasing the moisture and protein contents in the resultant Cheese. The moisture and protein of fresh full-fat cheese (T1) were 41.75 and 21.25% respectively and the corresponding values of reduced –fat cheese (T2) were 44.65 and 26.70% and low fat cheese (T4) were 47.32 and 30.22 % , in order .Addition of Simplese®–100 had a significant effect on moisture contents. Moreover, moisture contents were 46.88 and 49.87 % for fresh treatments (T3 and T5) containing Simplese®–100, respectively, being 42.53 and 44.99 % for the same treatments, after 3 months of ripening, in order. The addition of Simplese®–100

markedly increased the moisture contents of this treatments (T3 and T5) as compared with control .Generally, it was noted that the moisture contents of low fat cheese made with Simplese®–100 were higher than that in the control either fresh and during ripening .These results agreed with those reported by Mc Mahon *etal.* (1996) .They mentioned that low-fat cheese containing whey – based fat replacer had 2.2 to 2.3 % higher moisture content than, the corresponding one free from fat replacer. In addition, simplese was observed as microparticles embedded within the casein matrix, which allow greater moisture retention and curd syneresis was retreated during cheese making as a result of water being bound directly to the fat replacers, or fat replacer may interfere with shrinkage of the casein matrix, thus lowering the driving force involved in expelling water from the curd particles. Moreover, the results revealed that inverse relationship between the fat content of cheese milk and protein of cheese. This relationship was continued along the storage period. Cheese samples contained Simplese®–100 possessed highest values of protein compared to control cheese. The same trend was noticed, also by (Guinea etal, 1998 and Sahan etal, 2008).

It is clear from Table (1) the addition of Simplese®–100 had significant effect on F/DM of the resultant cheese when fresh and during storage period. Control cheese (T1) had higher F/DM content than other treatments. Whereas, low fat Gouda like cheese made with Simplese®–100 (T3 and T5) had slight higher fat content than corresponding low fat Gouda like cheese made without Simplese®–100 (T2 and T4). Similar trends was obtained by EL-Aidie (2005). Who mentioned that addition fat replacers to Edam cheese had no pronounced effect on the F/DM contents of the resultant cheeses compared to the control one, during ripening period .Moreover , as the ripening period progressed , the F/DM of all cheese treatments were gradually increased reaching to maximum values after three months of ripening. This could be attributed to the reduction of its moisture content throughout the storage period.

Results, also, showed that salt contents of cheese contained Simplese®–100 were slightly higher than cheese without Simplese®–100 when fresh and during storage period.

From data in Table (2) ,it could be noticed that adding Simplese®–100 to milk cheese had remarkable effect on titratable acidity (TA) .Cheese made with Simplese (T3 and T5) had higher TA than corresponding cheese made without Simplese®–100 (T2and T4). These results might be due to the higher moisture content (higher water activity), which enhances the growth of cheese microflora and subsequently developing acidity .Similar results were reported by Lucy and Gorry (1993).In addition, the TA of all cheese treatments had the same trend of increasing along storage period .The trend of the changes in pH values of all treatments was opposite to that acidity .It decreased gradually in all cheese treatments during storage period .Furthermore, it can be observed that the reduction of cheese fat content ,led to the decrease in

the TA(T2 and T4) compared with the control(T1) when there is an opposite trend was observed when simplese fresh and during storage period. On the other hand, was added (T3 and T5).

Table (1). Effect of adding simplese- 100 to cheese milk on the chemical composition of low – fat Gouda- like cheese during storage period.

Ripening period (months)	Treatments*					L.S.D
	Full-fat (control) T1	Reduced-fat T2	T3	Low- fat T4 T5		
Moisture (%)						
Fresh	41.75	44.65	46.88	47.32	49.87	0.3719
1	40.40	42.96	44.96	45.93	48.02	
2	39.50	41.18	43.75	44.77	46.89	
3	38.8.	40.26	42.53	42.68	44.99	
Mean	40.11 ^c	42.26 ^d	44.53 ^c	45.18 ^b	47.44 ^a	
Fat/DM (%)						
Fresh	48.51	40.34	41.60	30.00	31.12	8.5302
1	49.63	41.17	42.70	30.70	32.13	
2	50.65	41.98	42.94	31.14	32.76	
3	51.30	42.75	43.47	32.80	33.81	
Mean	50.02 ^a	41.56 ^a	42.68 ^a	31.16 ^b	32.46 ^b	
Total Protein (%)						
Fresh	23.25	26.70	27.86	28.30	30.22	1.1767
1	25.30	27.52	29.63	29.60	31.60	
2	26.63	28.44	30.83	30.83	32.37	
3	27.36	29.92	31.56	31.56	33.49	
Mean	25.64 ^d	28.15 ^c	29.97 ^b	30.07 ^b	31.92 ^a	
Salt (%)						
Fresh	2.18	2.10	2.32	2.08	2.24	0.2024
1	2.67	2.58	2.68	2.54	2.65	
2	2.92	2.82	2.94	2.80	2.89	
3	3.08	2.99	3.15	2.97	3.11	
Mean	2.71 ^a	2.62 ^a	2.77 ^a	2.60 ^a	2.72 ^a	

T1: Full-fat cheese (control) T2: Reduced fat cheese (2.5%) T3: Reduced fat cheese (2.5%) + simplese
 T4: low fat cheese (1.5%) T5: low fat cheese (1.5%) + simplese

Table (2). Effect of adding simplese @–100 on titratable acidity and pH value of low – fat Gouda- like cheese, during storage period.

Ripening period (months)	Treatments				
	Full-fat (control) T1	Reduced-fat T2	T3	Low- fat T4 T5	
Acidity (%)					
Fresh	0.82	0.76	0.95	0.74	0.90
1	0.99	0.94	1.08	0.92	1.10
2	1.26	1.23	1.46	1.15	1.39
3	1.50	1.68	1.93	1.53	1.89
pH value					
Fresh	5.61	5.72	5.53	5.80	5.73
1	5.54	5.65	5.56	5.67	5.58
2	5.49	5.51	5.47	5.61	5.53
3	5.24	5.22	5.15	5.27	5.20

T1: Full-fat cheese (control) T2: Reduced fat cheese (2.5%) T3: Reduced fat cheese (2.5%) + simplese
 T4: low fat cheese (1.5%) T5: low fat cheese (1.5%) + simplese

From the data in Table (3), it could be noticed that adding Simplese @–100 to low - fat Gouda like cheese (T3 and T5) was accompanied by high level of SN/TN, PTA-SN/TN and NPN/TN. In addition, the ripening indices decreased as the fat content decreased. Moreover, as the storage period advanced the ripening indices (SN/TN, PTA-SN/TN and NPN/TN %) gradually increased to reach the maximum values at the

end of the storage period. These variations may be due to the higher moisture content, acidity and the action of proteolytic bacteria during storage period. Similar trend were obtained by Shehata et.al.(2004) and Ali (2006).

As can be seen from Table (3) results of ripening indices revealed that there is a direct relationship between the fat content of cheese and its content of TVFA, as the fat content of the cheese increased the

level of TVFA increased. Addition of Simplesse®-100 had a great effect on TVFA. Moreover, cheese containing Simplesse®-100 (T3 and T5) had higher TVFA contents when fresh and during ripening than control cheese (T1) and low fat Gouda-like cheese (T2 and T4). Sahan *et al* (2008) stated that addition of fat replacer to kashar cheese increased the liberation of TVFA in the resultant cheese than control and low fat

cheese. Also, Fox *et al.* (2004) reported that during ripening, many starters lose viability and release their intracellular enzymes due to autolysis. These enzymes play a crucial role in maturing the cheese and participate greatly in proteolysis and lipolysis process. Subsequently, increasing the value of ripening indices and TVFA, along the ripening period.

Table (3) Ripening indices of reduced and low-fat Gouda-like cheese as effected by the addition of simplesse-100 to cheese milk, during storage period.

Ripening period (months)	Full-fat (control)		Treatments		Low-fat
	T1	T2	Reduced-fat	T4	
			T3	T5	
			WSN/TN(%)		
Fresh	8.64	7.28	7.62		7.32
1	9.92	8.82	8.97		8.22
2	11.61	9.63	10.24		9.42
3	12.64	10.78	11.52		10.65
			PTA-SN/TN(%)		
Fresh	1.12	1.01	1.32		1.18
1	1.75	1.54	1.68		1.51
2	2.84	2.63	2.75		2.49
3	3.36	2.99	3.21		2.98
			NPN/TN(%)		
Fresh	3.87	3.16	4.36		3.75
1	4.72	4.33	4.62		4.16
2	5.12	4.82	4.95		4.56
3	5.99	4.90	5.77		5.33
			Total volatile fatty acids (TVFA)%		
Fresh	8.07	6.9	8.18		8.12
1	12.8	11.8	13.34		12.9
2	16.6	14.6	17.14		16.8
3	19.4	16.7	20.21		19.9

TVFA: milliliter of 0.1N NaoH/100 g cheese.

T1: Full-fat cheese (control)
fat cheese (1.5%)

T2: Reduced fat cheese (2.5%)
T5: low fat cheese (1.5%) + simplesse

T3: Reduced fat cheese (2.5%) + simplesse

T4: low

Counts of bacteria, yeast and mould present in cheese contribute in a positive manner to the maturation process either directly through their metabolic activity or indirectly through the release of enzymes into the cheese matrix through autolysis. From data in Table (4), it could be noticed that counts of total viable (TC), proteolytic and lipolytic bacteria were higher in fresh full-fat cheese (T1) than the other treatments. This reduction was more in low-fat cheese (T3 and T5) than in reduced-fat cheese (T2 and T4). This decrease may be due to the variations in chemical composition between full-fat cheese and reduced or low fat cheese. Moreover, the results indicated that there is gradual increase was observed throughout the storage period up to 30 days in all cheese treatments. Then the number of bacteria decreases gradually with storage. The TC of full fat cheese (T1) were $8.5 \text{ cfu} \times 10^7/\text{g}$ at the beginning of ripening decreased to $7.2 \text{ cfu} \times 10^7/\text{g}$ at the end of the storage period. Whereas, counts of TC in T2 and T4 were $7.7 \text{ cfu} \times 10^7/\text{g}$ and $6.8 \text{ cfu} \times 10^7/\text{g}$ declined to $6.6 \text{ cfu} \times 10^7/\text{g}$ and $5.2 \text{ cfu} \times 10^7/\text{g}$. Decreasing the moisture content, increasing acidity and the end products of metabolism process may be participating in this

reduction. Similar trends were obtained by Haque *et al.* (2007).

On the other hand, addition of Simplesse®-100 resulted in lower counts of these populations in cheese when fresh and during ripening, compared to other treatments. This reduction of bacterial counts was referred to the reduction of water activity because the fat replacer has higher water holding capacity which subsequently affect and inhibiting the bacterial growth. Banwart (1981). The counts of proteolytic and lipolytic bacteria decreased by decreasing the fat content in the cheese when fresh and during storage period. At the ripening period advanced, the proteolytic and lipolytic counts of all treatments gradually increased up to the end of the ripening period. This trend of increase was found to be opposite to that happened in TC. Full-fat cheese (T1) recorded the highest counts, after 3 months of ripening, (118 and $64 \text{ CFu} \times 10^3/\text{g}$ for proteolytic and lipolytic, in order). The lowest counts were found in low-fat cheese containing Simplesse®-100 (T5). (Gilles and Lawrence, 1973) stated that four parameters influence the gross composition of the cheese, Salt in moisture, non-fat substances, fat in dry matter and PH

value. These parameters in turn influence the environment in which the microorganisms proliferate. The primary environmental factors controlling growth of microorganisms in cheese include water and salt

content , PH value , presence of organic acids and nitrate , redox potential and ripening temperature(Beresford *etal* ,2001) .

Table (4). Effect of adding simplesse-100 to gouda-like cheese milk on the total, proteolytic and lipolytic bacterial counts of the resultant cheese, along the ripening period.

Ripening period (months)	Treatments				
	Full-fat control T ₁	Reduced-fat T ₂ T ₃		Low-fat T ₄ T ₅	
	Total bacterial count (CFu× 10 ⁷ /g)				
Fresh	8.5	7.7	6.7	6.8	5.6
1	10.4	9.5	8.5	8.8	7.3
2	9.1	8.8	7.2	7.3	6.2
3	7.2	6.6	5.1	5.2	4.4
	proteolytic bacterial count (CFu× 10 ³ /g)				
Fresh	41	36	33	33	30
1	79	68	63	57	51
2	99	82	76	66	62
3	118	101	93	85	81
	lipolytic bacterial count (CFu× 10 ³ /g)				
Fresh	28	18	16.2	14.2	11
1	49	33	28.3	26	22.3
2	57	40	35	33.3	30
3	64	45	40.1	36	32

T1: Full-fat cheese (control)
T4: low fat cheese (1.5%)

T2: Reduced fat cheese (2.5%)
T5: low fat cheese (1.5%) + simplesse

T3: Reduced fat cheese (2.5%) + simplesse

Significant differences were noticed between the organoleptic properties of full and low fat cheese during storage period. Full –fat Gouda cheese (T1) characterized by smooth body, open texture and clean acid flavor. Moreover, control cheese (T1) gained the highest scores when fresh and during storage period as compared to the other treatments contained or free from simplesse. Awad *etal*. (2003) reported that no fracture was observed when full –fat Gouda cheese sample compressed in the hand and it was of a pliable body & texture. On the other hand, low –fat cheese was of the lowest sensory properties among the other treatments, along the ripening period. Its characterized by flat flavour, more firmer body and elastic texture, crumbling under compression force than the control cheese .These results are close with that found by (Madeson & Ardo, 2001) and (Awad *etal* 2003).In addition , Drake *etal* .(2010) showed that differences documented between full-fat and low-fat cheeses , are not due to solely to differences in matrix and flavour release but also to distinct differences in ripening biochemistry , which leads to an imbalance of many flavour contributing compounds.

Results revealed that reduction of cheese fat had a reverse effect on the organoleptic properties of

resultant cheese. Furthermore, adding Simplesse @–100 has significant effect on organoleptic properties of low fat - Gouda like cheese. Moreover, it improve greatly its sensory attributes "especially body and texture". These results are in line with those reported by Drake *etal* .(1996) .They stated that the function of simplesse (a whey protein fat replacer) is decreasing the available hydrophobic sites at the fat /water surface in ripe cheese and did not full substitute the role of fat in aroma and flavour binding capacity . Therefore, data in table (5) show that reduced and low-fat cheese containing simplesse (T3 and T5) had lower score points than full-fat cheese (T1), throughout the ripening period and had higher scores than cheeses free from simplesse (T2 and T4). These results are consistent with that reported by Aryana *etal* (2001).They stated that fat replacers reduced the continuous protein matrix of low – fat cheese (compact body and firmness) and increased the openness texture of the resultants cheese (smoothness).

As the ripening period progressed the organoleptic properties of all cheeses were improved and enhanced as a result of the chemical and microbiology changes occurred.

Table (5):-Organoleptic properties of Gouda- like cheese as affected by reducing cheese milk-fat and addition of Simplesse 100, during storage period.

Treatments	Ripening period (months)	Appearance (10)	Body & texture (40)	Flavor (50)	Total scores (100)
Full-fat cheese (F) Control	Fresh	8	30	30	68
	1	8	33	35	76
	2	8	35	44	87
	3	9	36	47	92
Reduced fat Cheese (R _i)	Fresh	7	26	25	58
	1	7	28	30	65
	2	8	30	37	75
	3	8	32	41	81
Reduced fat Cheese+ simplesse-100	Fresh	8	28	27	62
	1	8	30	32	69
	2	8	32	40	79
	3	9	34	46	87
Low-fat cheese	Fresh	6	23	25	54
	1	6	25	28	59
	2	7	26	35	68
	3	7	29	38	74
Low-fat cheese+ simplesse-100	Fresh	7	26	26	59
	1	7	28	30	65
	2	8	30	36	74
	3	8	32	42	82

T1: Full-fat cheese (control)

T2: Reduced fat cheese (2.5%)

T3: Reduced fat cheese (2.5%) + simplesse

T4: low fat cheese (1.5%)

T5: low fat cheese (1.5%) + simplesse

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تأثير أضافة بديل الدهن 100-@simplese على صفات الجبن المشابه للجبن الجودا المنخفض الدهن

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يهدف هذا البحث الى دراسة تأثير اضافة بديل الدهن @simplese -100 الى اللبن البقرى على الخواص الكيماوية والميكروبيولوجية والحسية للجبن المشابه للجودا المنخفض الدهن .

تم تصنيع الجبن المشابه للجبن الجودا من لبن بقرى كامل الدسم 3.5% دهن، ومنخفض الدهن 2.5% - 1.5% دهن كلا على حده بدون اضافة بديل الدهن وكانت المعامله 3.5% دهن هي الكنترول وتم تصنيع معاملتان اخرتين من لبن بقرى 2.5% دهن و 1.5% دهن مع اضافة بديل الدهن بمعدل 18 . 1/كجم لبن بقرى .

اظهرت النتائج ما يلى :

ان اضافة بديل الدهن @simplese -100 ادى الى :

• زادت قيم كل من الرطوبة والحموضه والبروتين الكلى ودلائل التسويه والاحماض الدهنيه الطياره مقارنة بنظيره الخالى من بديل الدهن @simplese -100 طوال مدة التسويه.

• سجل الجبن المصنع من لبن بقرى 2.5% دهن والمحتوى على بديل الدهن @simplese -100 اعلى قيم من الحموضه – دلائل التسويه – الحماض الدهنيه الطياره طوال مدة التسويه مقارنة بنظيره 1.5% دهن .

• كما ادى انخفاض الدهن الى زيادة كل من الرطوبة – البروتين الكلى – نسبة الدهن في ماده الجافة الكليه – دلائل التسويه – الاحماض الدهنيه الطياره بالمقارنه بالكنترول والجبن المضاف اليه بديل الدهن @simplese -100 .

• انخفض العدد الكلى للبكتريا واعداد البكتريا المحلله للبروتين والمحلله للدهن بأضافه بديل الدهن @simplese -100 وكذلك انخفضت اعدادها بانخفاض نسبة الدهن.

• كان الجبن المحتوى على بديل الدهن @simplese -100 افضل في صفاته الحسيه

• (خصوصا القوام والتركييب) عن نظيره الخالى منه كما ان انخفاض نسبة الدهن ادى الى انخفاض الصفات الحسيه.

• كان الجبن الكامل الدهن افضل حسييا من باقى المعاملات طوال مدة التسويه.