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Influence of Fat Type and Protein / Fat Ratio on Tallaga Cheese Attributes

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ABSTRACT

Fat source and protein/fat (P/F) ratio differences have a salient effect on the quality of Tallaga cheese (TC). So this work aims to evaluate the rheological, organoleptic and microbiological effects of mentioned factors on soft white Tallaga cheese. Resultant cheese from different treatments were compared with Tallaga cheese made from natural components and have protein/ fat ratio (0.4) as control treatment. samples were analyzed for some rheological, microbiological and Organoleptic properties either they were fresh or throughout Targeted period (30 days), Results indicated that all (TC) have an acceptable properties by all P/F ratios (0.5,0.4,0.3). Moreover, the (TC) made by p/F (0.4) in two techniques gained the highest organoleptic scores and rheological properties among other treatments and control. All cheese treatments were free from *E coli* either it were fresh or until the end of storage period on the other hand some growth of molds and yeast appeared either it were fresh and increased at the end of the storage period. Also, the (TC) made by P/F ratio (0. 3) in two techniques had The highest total Bacterial counts among other treatments. From previous properties soft white cheese and low producing costs about (62%: 64 %), can be processed by using cacao butter as milk fat replacer with P/F ratio (0.4).

Keywords: Tallaga cheese, Protein/Fat Ratio, Organoleptic Properties, Rheological characteristics

INTRODUCTION

No one deny that dairy products are very important and healthy for human body, specially Tallaga cheese (TC) which is one of the most common cheese in several countries specially Egypt, it has many health effects, such as, body weight management, lower blood pressure and reduced risk of type 2 diabetes. Cheese consumption has shown no adverse effects on cholesterol levels. Moreover, the production technique makes a great action on the economic value of dairy technology. Dairy fat has been considered as hyper cholesterolemic substance due to its high levels of cholesterol and saturated fatty acids. Many researchers have tried to reduce the fat content of cheese, because of the negative health effects of dairy fat. IRENA (2000) and Eda (2017)

Fat replacers are used to provide some or all of the fat present effect providing fewer calories than the fat being replaced. Fat substitutes are lipid-like substances intended to replace fats on a one-to-one basis. Fat mimetics are protein or carbohydrate ingredients which function by imitating the physical, textural mouth feel and organoleptic properties of real fats. Carbohydrate-based fat replacers are derived from cereals, grains and plants, these ingredients include both digestible and indigestible complex carbohydrates.

While natural dairy products are high in cost, making the product expensive, synthetic dairy row materials used in the manufacture of soft cheese are low –cost, reducing economic seriousness and making it desirable and satisfying consumers.

For this trend the manufacturers and scientific researchers searched about cheaper fat replacer or using any other raw material give the fatty effects and properties, also decrease the economic production costs by using cheaper sources of fat vegetative oil such as sunflower oil, coconut oil, palm oil, and cacao butter oil which used to carry out this research, due to its cheaper price than milk fat which leading to reduce the total production costs (Abo-El-Naga *et al*. 1994). moreover choice the more suitable Protein/Fat ratio that get on acceptability of consumers and their demands.

So, this work aims to produce soft white cheese variety (Tallaga Cheese). With minimal cost and some functional properties of this variety of soft cheese. It was targeted as the following :-

- improve the properties of white soft (Tallaga) cheese with keeping the quality.
- reducing the economic cost of producing the cheese by using fat by real vegetable oil (cacao butter) instead of milk fat with other milk ingredients such as milk protein concentrate and skimmed milk powder.

MATERIALS AND METHODS

Skim milk powder (SMP) made in Poland by "AARIMEX", milk protein concentrate powder (MPC) made in Poland by "AARIMEX", Microbial rennet powder (Formase TL2200) was obtained from Ch. Hansen's Laboratories, Copenhagen, Denmark, the addition ratio for pre-cheese mix was 7.5 gram /100 kg ingredient pre cheese. Dry commercial food grade salt used during this investigation obtained from El-Nasr Saline's Company, Egypt., Cacao butter oil Attaqa Swiz, Egypt, made in Malyzia, potassium sorbate as Fine grade (edible) obtained from CHAS-Pfizer Co. Inc. New York, USA. was used as preservative material by recommended ratios.

Emulsifier blend named high cream 100 (consists of gelatin, carrageenan, diglycerides) was obtained from Misr Food Additives Co., Egypt. Was used by 0.1-0.2 % addition ratio.

Analytical grade calcium chloride obtained from El-Gomhouria Company, Egypt. has been used in this investigation by 0.05 % addition ratio.

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Methods:-

Recombined Tallaga cheese was processed according to the method described by (Baraka, (2015) with some modification. control treatment which have P/ f ratio 0.4 was processed from raw milk ingredients and by the same processing steps, another six recombined cheese treatments were carried out by replacing milkfat with cacao butter Oil and using high cream 200 (0.1% w/w) as stabilizer.

The following is a flow sheet diagram for Tallaga cheese processing steps for recombined treatments:-

milk protein concentrate
↓
Aging for 20 minutes on cold water, with the addition high cream 200
↓
Heating at 37+ skimmed milk powder
↓
Add cocoa butter, heating for 52 ° C and homogenization for 15 minutes
↓
Heating the mixture for 63 ºC holding for 30 minutes
↓
Cooling to 42º C
↓
Add 2.5% table salt and 0.05% calcium chloride
↓
Pour into stainless steel trays for cheese and add diluted rennet water solution (7.5g/100kg pre cheese)
↓
holding for two hours in ambient room temperature
↓
Storage at refrigerated condition for 6 h
↓
Cutting + 6.5% saline solution was added (4 ºC)
↓
Marketing

Milk and fresh cream used for control treatment processing were analyzed for total solids (TS), fat, protein and lactose contents using laboratory milkoscan. pH was measured using a ML 1010 pH meter with a glass electrode according to the standard method described by ling (1963). Cheese mix ingredients quantity were calculated as the method recommended by (Baraka 2015).

The evaluation of microbial quality of Tallaga cheese during storage period at 4±1˚C was assessed by counting the following microbial groups (Total bacterial count (T. C), Coliform bacteria (*E. coil*), Molds and yeasts) according to the method described by the American Public Health Association (A.P.H.A., 1978)

Trained Staff members of dairy department, Faculty of Agriculture, Mansoura University were determined the organoleptic properties of Tallaga cheese according to International Dairy Federation methodology (IDF, 1987).

Texture profile analysis: The evaluation of Texture Profile Analysis (TPA) was carried out by using at least three samples for each treatment with Universal Testing Machine (Cometech, B type, Taiwan), provided with the software. Back extrusion cell with 35 mm diameter compression disc was used. Two cycles were applied at a constant crosshead velocity of 1 mm secG1 to 35% of sample depth then returned. From the resulting force-time curve the values for texture attributes, i.e., hardiness, chewiness, cohesiveness, gumminess and springiness were calculated TPA graphic. (Baraka, (2015), The principal goal of this study is reducing the economic cost of cheese and keeping the quality. The results showed that cheese made from synthetic milk with the use of cacao butter substitute oil, containing a protein-fat ratio (0.4 = 7.2/18) reduced the economic cost of the mentioned ratio with the production of cheese with good qualities and a high degree of acceptance among consumers.

RESULTS AND DISCUSSION

Tallaga cheese was calculated and processed from recombined ingredients, according to (Baraka, 2015) by using different protein/fat ratios. the resultant cheese samples were organoleptically, microbiologically and rheologically evaluated either it were fresh or throughout 30 days of storage period.

The chemical composition and the amount of the different ingredients used for Tallaga cheese making were illustrated on Table (1-5) /100kg (35 % Total Solids).

Data presented in Table (1) indicate the quantities by kilograms of used raw materials (Skim Milk Powder, Milk Protein Concentrate, Cacao butter oil 98 F, Salt, Stabilizer (high cream 200), Calcium Chloride (CaCl2), Water) (9.09, 8.44, 18.36, 2.5, 0.001,0.005, 63.6) respectively. Resultant Tallaga cheese by using this formula have (18% fat, 6%lactose, 9%protein, 2.5% salt, 0.1%stabilizer).

Table 1. The chemical composition and the amount of ingredients for (0.5) P (9) / F (18) ratio Tallaga cheese (recombined ingredients and cacao butter)

Components	Quantity in kg	Fat %	Lactose %	P %	T.s %
SM Powder	9.09	-----	5	3.09	8.09
MPC	8.44		1.2	5.91	7.11
Cacao butter oil 98 F	18.36	18		-----	18.00
Salt	2.5				2.50
Stabilizer	0.001				0.100
Cacl2	0.005				0.005
	38.4				35.7
Water	63.6				

Data presented in Table (2) indicate the type and amounts of raw materials used for producing Tallaga Cheese containing 35 % Total Solids, Cheese resultant description (18% fat, 6%lactose, 7.2%protein, 2.5% salt, 0.1%stabilizer) these ingredients and its quantities were as the following: (Skim Milk Powder, Milk Protein Concentrate Cacao butter oil 98 F, Salt, Stabilizer (high cream 200), Calcium Chloride (CaCl2), Water) quantities by kilograms (9.9, 5.870, 18.36, 2.5, 0.001,0.005, 59.940)

Table 2. The chemical composition and the amount of ingredients for (0.4) P(7.2) / F(18) ratio Tallaga cheese (recombined ingredients and cacao butter)

Components	Quantity in kg	Fat %	Lactose %	P %	T.s %
SM Powder	9.09	-----	5	3.09	8.09
MPC	5.870		0.82	4.11	4.93
Cacao butter oil 98 f	18.36	18		-----	18
Salt	2.5				2.5
Stabilizer	0.001				0.100
Cacl2	0.005				0.005
	35.827				33.520
Water	59.940				

Data presented in Table (3) indicate the quantities by kilograms of used raw materials for making Tallaga Cheese containing 35 % Total Solids, Cheese resultant description (22.5% fat, 6% lactose, 7.2% protein, 2.5% salt, 0.1% stabilizer) these ingredients and its quantities were as the following (Skim Milk Powder , Milk Protein Concentrate, Cacao butter oil 98 f, Salt, Stabilizer (high cream 200), Calcium Chloride (CaCl2), Water) quantities by kilograms (9.09, 8.44, 22.95, 2.5, 0.001,0.005, 71.9)

Data presented in Table (4) indicate the type and amounts of raw materials used for producing Tallaga Cheese

containing 35 % Total Solids, Cheese resultant description (18% fat, 6%lactose, 5.4%protein, 2.5% salt, 0.1%stabilizer) these ingredients and its quantities were as the following: (Skim Milk Powder, Milk Protein Concentrate Cacao butter oil 98 F, Salt, Stabilizer (high cream 200), Calcium Chloride (CaCl2), Water) quantities by kilograms (10.00, 2.875, 18.36, 2.5, 0.001,0.005, 57.149)

Table 3. The chemical composition and the amount of ingredients for (0.4) P(9)/F(22.5) ratio tallaga cheese (recombined ingredients and cacao butter)

Components	Quantity in kg	Fat %	Lactose %	P %	T.s %
SM Powder	9.09	-----	5	3.09	8.09
MPC	8.44		1.18	5.91	7.09
Cacao butter oil 98 f	22.95	22.5		-----	22.5
Salt	2.5				2.5
Stabilizer	0.001				0.100
Cacl2	0.005				0.005
	43				40.19
Water	71.9				

Table 4. The chemical composition and the amount of ingredients for (0.3) P(5.4)/F(18) ratio Tallaga cheese (recombined ingredients and cacao butter)

Components	Quantity in kg	Fat %	Lactose %	P %	T.s %
SM Powder	10		5.5	3.4	8.9
MPC	2.857		0.4	2	2.4
Cacao butter oil 98 f	18.36	18			18
Salt	2.5				2.5
Stabilizer	0.001				0.100
Cacl2	0.005				0.005
	33.725				31.806
Water	57.149				

Data presented in Table (5) indicate the ingredients of raw materials (Skim Milk Powder, Milk Protein Concentrate, Cacao butter oil 98 F, Salt, Stabilizer (high cream 200), Calcium Chloride (CaCl2), Water) by kilograms (9.09, 8.44, 30.610, 2.5, 0.001,0.005, 85.6) respectively For producing Tallaga Cheese containing 35 % Total Solids. Resultant cheese by using this formula have (30% fat, 6%lactose, 9%protein, 2.5% salt, 0.1%stabilizer).

Table 5. The chemical composition and the amount of ingredients for (0.3)P(9)/F(30) ratio.

Components	Quantity in kg	Fat %	Lactose %	P %	T.s %
SM Powder	9.09		5	3.09	8.09
MPC	8.44		1.18	5.91	7.09
Cacao butter oil 98 f	30.610	30			30
Salt	2.5				2.5
Stabilizer	0.001				0.100
Cacl2	0.005				0.005
	50.65				47.69
Water	85.6				

Data Illustrated in Table (6) show the microbial quality of cheese treatments for two variable techniques used to carry out this search work. these data showed that, all cheese sample either control which processed from raw milk components and fresh cream or other treatments which made from recombined milk with vegetable fat, are free from coliform group bacteria from the beginning or throughout the storage period. Moreover, it was noted that the microbial content of all treatments as well as the control increased with the progress at the storage period. Also, it was shown from the results in the same Table that the rate of increasing in (T.C) were decreased among all treatments in general and with the control sample, for example S2T1(3.25) percent rate (7.1). In addition, the rate of increasing was less with the decrease in the percent of protein content.as S2T2(3.23) percent rate (6.6), These results may be due to the rising in (F/DM), as well as the decrease in the percentage of added protein. And this might be explained the effect of fat content on delaying the development of microbial growth.

Table 6. Effect of P /F ratio variation on microbial properties of recombined SWTC stored for (21 days/4°c)

Treatments	Storage period (days)	T.C* 10^6	Percent rate	M,Y* 10^5
	T1			
C	7	1	32	2
	21	33		3
S1	7	1	15	1
	21	16		2
S2	7	3	7.1	2
	21	25		2
S3	7	5	6.1	2
	21	36		2
	T2			
S2	7	3	6.6	2
	21	23		2
S3	7	5	5.6	2
	21	33		2

T1: Different protein ratios with constant fat ratio
p : protein% F : fat %
C control P/F : 7.2/18 = 0.4 (row milk and fresh cream
T2: Different fat ratios with constant protein ratio
S2, : P/F : 9/22.5 = 0.4 S3 : P/F: 9/30 = 0.3

As for Mold and Yeast, It was noted that control treatment had the highest Mold and Yeast content when compared with other cheese treatments and these might be due to presence of natural milk ingredients which have encouraging effect for all microbial types. Also from the same Table, there isn't pronounced different among tested cheese treatments either on the beginning or the end of storage period and this might be as a result to many factors which include the presence of vegetable fat (cacao butter) and the increasing of the fat on dry matter by the decreasing of P/F ratios and the total solid content of the resultant cheese.

Data Illustrated in Table (7) show the sensory properties of cheese treatments for two variable techniques used to carry out this search work. these data indicate that the first technique treatments (T1) which have constant fat percent and variable protein percent s, on the other hand the second technique (T2) treatments have constant protein percent and variable fat percents.

Table 7. comparison between total organoleptic scores in two types of Tallaga cheese (recombined ingredients and cacao butter) stored for 21 days/4°c.

Samples	Treatments	Storage period	
		7 days	21days
c	T1	91.3	84
	T2		
S1	T1	91.8	81
	T2		
S2	T1	92	88
	T2	77	72
S3	T1	87	80
	T2	74	71

In general for sensory properties the treatments which had constant fat percent gained Highest scores when compared with other treatments which had constant protein percent, for example treatment S2 were (92and 77) for constant fat percent and constant protein respectively also S3 had the same behavior for the sensory properties as for in the sensory properties as for S2 in the two main Type.

In general data presented in Table (8) show the value of texture profile analysis (TPA) which included (hardness, cohesiveness ratio, Springiness, Gumminess, Chewiness,) there were strong differences among all treatments either for the type of raw materials used for processing or the differences in P/F ratio.

Table 8. Effect of P /F ratio variations on Rheological properties of Tallaga cheese (recombined ingredients and cacao butter) stored for 21 days/4°c.

	Storage period / day	C	S1	S2	S3	S2	S3
				T1		T2	
Hardness N	Zero	1.63	1.5	1.4	0.5	1.15	0.4
	21	2.3	1.67	2.3	1	1.2	0.5
cohesiveness ratio	0	0.60	0.485	0.605	0.5	0.55	0.74
	21	0.64	0.49	0.76	0.695	0.77	0.79
Springiness mm	0	5.5	5	5	5	5	4.97
	21	3.39	4.9	5	5	4.99	5.0
Gumminess N	0	0.97	1.25	0.9	0.25	1.00	0.3
	21	1.5	0.9	0.6	0.7	0.6	0.15
Chewiness mj	0	1.25	1.22	1.18	1.1	1.11	1.00
	21	0.99	0.98	0.95	0.95	0.9	0.885

p : protein% F : fat% **C control P/F: 7.2/18 = 0.4 (raw milk and fresh cream)**

S1,: P/F : 9/18 = 0.5 **S2T1, : P/F : 7.2./18 = 0.4** **S3T1 : P/F : 5.4/18 = 0.3**

S2T2, : P/F : 9/22.5 = 0.4 **S3T2 : P/F : 9/30 = 0.3**

Where,S2T1,S3T1 (recombined milk components with constant Cacao butter with variable protein percent)

Where,S2T2,S3T2 (recombined milk components with variable Cacao butter and constant protein percent)

These data revealed that there were strong differences among all treatments either for the type of raw materials used for processing or the differences in P/F ratio.

Hardness the force necessary to attain a given deformation. In sensory terms, it is the force necessary to compress cheese between the molar teeth (Chevanan *et al*., 2006).

Results on Table (8/T1) show that control cheese which processed from raw milk and natural milk fat source (cream) gained the highest value among other treatments either on the beginning or throughout the storage period (1.63, and 2.3, respectively). Also, the data on the same Table indicates that, there were reverse relation between the hardness value and the type of fat source and p/F ratio, where, S1 for soft cheese which have variation on the protein percent with constant fat percent have the highest value(1.5,1.67) among other treatments ,also S3(T2) which have variation on fat percent with constant protein percent gained the lowest value (0.4,0.5) among other treatments and control cheese, moreover, the progress on the storage period had increasing effect on the values of hardness and have the same trend in all treatments and control cheese and that might be as a result to decreasing the moisture content of all treatments at the end of its shelf life. The variations on the hardness values among all treatments and control cheese may be due to the protein matrix, this protein Matrix become weak as relation with the increasing of fat content at F/DM This finding is in agreement with (Bryant *etal*., 1995) who reported that the high protein densities in cheese are associated with high values of hardness.

Cohesiveness is a measurement of the extent to which the cheese can be deformed before it ruptures. In sensory terms, it is the degree to which a substance is compressed between the teeth before it breaks). In cheese, cohesiveness (is a measurement of the strength of the internal bonds of the protein mycelium (Chevanan *etal*., 2006)

Results on Table (8) show that the control cheese which processed from raw milk and cream gained the highest value among other treatments either on the beginning or throughout the storage period (0.60, and 0.64) respectively. Also from data on the same Table there were reverse relation between the cohesiveness value and the type of fat source and p/F ratio where S1 for soft cheese made from recombined ingredients and vegetable fat have the lowest value (0.485,0.49) among other treatments ,also S3 (T2) treatment on cheese which have variation on fat percent with constant protein percent gained the highest value of Cohesiveness (0.74,0.79) among other treatments and control cheese, moreover, the development on the storage period had a rising effect of the values of Cohesiveness and have the same trend in all treatments and control cheese. These results may be due to the strength of cheese protein matrix which have a weak behavior as a relation with the increasing of fat content in general. Also, this effect had more obviously when the source of the fat is a vegetable type and these results came in computable with the obtained results by by Lobato-Calleros *etal*. (2007). They found that, the cohesiveness value was positively correlated with WPC level in soft cheese.

Springiness is a measurement of the recovery of the original un deformed condition after the first compression force is removed during a TPA test). In sensory terms, it is the degree to which a product returns to its original shape once it is compressed between the teeth. From the illustrated data on the same Table clears that, there were slight differences among all treatments and control cheese either on the beginning or throughout the storage period, also, from these data there were insignificant changes as a relation with the type of raw material or the changes on the p/f ratio. These data came in harmony with those reported by Chevanan *etal*., (2006) and Zalazar *etal*., (2002) who observed that the high-fat content cheese not have obvious effect on the springiness values.

The gumminess (energy required to disintegrate a semi-solid food to a state ready for swallowing) and chewiness (it is a measurement of the energy required to masticate cheese the gumminess (energy required to disintegrate a semi-solid food to a state ready for swallowing) and chewiness (it is a measurement of the energy required to masticate cheese into a uniform state before swallowing). In sensory terms, it is the energy required to disintegrate the cheese and to change it to a consistency suitable for swallowing.

From the illustrated data in Table (8) values for gumminess followed the same trend of hardness and cohesiveness and had the same differences of means between the cheese types. Also, it could be seen that, the milk fat replacement with cacao butter and/or MPC had decreased effect on some cheese properties at the end of storage period specially at the treatments which contained high fat percent, also Gumminess and chewiness taken the same behavior it was decreased on the beginning or throughout the storage period and this was more obviously on the treatment which had high F/DM. So, Gumminess in S3 (T1) was (0.25,0.7) S3(T2) (0.3,0.15) and these values were (1.1,0.95) for S3(T1) and were (1.00,0.885) S3 (T2) for chewiness property. The previous data came in agreement with Baraka (2015) who

reported that, the institution of native milk fat with other vegetable fats in fresh Tallaga cheese have a pronounced effect on the parameters of hardness, cohesiveness, gumminess and chewiness but not affected springiness.

In general the presence of Milk Protein Concentrate (MPC) has been considered an interesting fat-substitute ingredient due to its functional and technological properties (Vidigal etal., 2012)

Table 19. Total cost of 100 kg Tallaga cheese (p/F = 0.4) from raw milk components and from recombined milk components with vegetable fat replacer (cacao butter).

Ingredients	Quantities (kg)/100kg	Unit price (LE)	Total cost
Cheese from raw milk components (p/f=0.4)			
Skimmed Milk	50	6.00	300
Cream	25.710	100.00	2571
M P C	7.430	120.00	891
S.M.P	6.8	60	408
Total costs			4170
cheese from recombined milk components (p/f=0.4)			
S.M. P	10.00	60	600
Vegetable fat replacer	18.370	20	367
MPC	5.430	120	651.5
Total costs			1618.5
Decreasing % for total production costs	100 – (1618.5/4170)× 100= 62 %		
Decreasing % for one Kg on final cheese after 7% of the yield	100- (16.2/45)× 100= 64%		

P/F=7.2/18=0.4 Quantities per 100 kg of cheese / alternative raw
P: protein F: fat S M P: skimmed milk powder MPC: milk protein concentrate

Table (19) showed that, two types of Tallaga cheese which were (4170 LE) for 100 kg for cheese made from raw milk component and (1618.5 LE) for the same amount of cheese made from recombined milk with vegetable fat replacer (cacao butter). The processing of Tallaga cheese from recombined milk reduced the economic cost approximately (62%) from total cost, while maintaining the quality of the product and its conformity with food standard specifications in accordance with the legislation and laws in force in this field can be carried out.

CONCLUSION

In general from maintained results we recommended the using of P/F ratio (0.4) which were more preferable for the organoleptic evaluation staff members and gained the best results for other evaluation methods used for determining the (TC)quality.

Tallaga cheese made from recombined milk with vegetable fat replacer (cacao butter) reduced the economic cost and its conformity with food standard specifications in accordance with the legislation and can be carried out.

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تأثير نوع الدهن و نسبة البروتين الى الدهن على خصائص جبن الثلاجة

اسماء عبدالسميع خليل ، الطاهرة محمد احمد عمار، متولي محمد ابوسريع و محمد صبري مصطفى

قسم الالبان كلية الزراعة جامعة المنصورة – مصر

الملخص

تم استبدال دهن اللبن بدهن نباتي (بديل زبدة الكاكاو) مع استخدام ثلاث نسب من البروتين الى الدهن : (0.3,0.4,0.5) لدراسة التأثير على خصائص جبن الثلاجة ثم مقارنته بالجبن المصنعة من خامات لبن طبيعية لاختيار اقرب نسبة اليها في الخصائص من حيث جودة التصنيع وخفض التكلفة الاقتصادية . تم اجراء الاختبارات الحسية والميكروبيولوجية والريولوجية على فترات متباينة (بداية التصنيع – 7 ايام – 14 يوم - 21 يوم) وأظهرت النتائج ان الجبن المصنع والمحتوي على نسبة بروتين الى دهن 18/7.2 = 0.4 في كلتا المعاملتين حققت اعلى قيم للتقييم الحسي خلال فترات الحفظ في حين نالت جميع المعاملات قبولا من المحكمين فيما يتعلق بالخواص الحسية كذلك اظهرت النتائج خلو جميع المعاملات من بكتيريا القولون. وفيما يتعلق بالخمائر والفطريات اظهرت النتائج خلو جميع المعاملات منها خلال فترات التقييم الاولى في حين ظهرت بعض نموات من الخمائر والفطريات في نهاية فترة التقييم في جميع المعاملات وكان اكثرها المعاملة (0.3) في كلتا المرحلتين ومن خلال النتائج اتضح ان استخدام نسبة بروتين الى الدهن (0.4) تميزت بانها الافضل من حيث الخواص الحسية والميكروبيولوجية والريولوجية وكذلك خفض التكلفة الاقتصادية . اظهرت حسابات التكلفة الاقتصادية الإجمالية وجود فرق واضح في التكلفة لنوعي جبن الثلاجة الابيض الطري حيث كانت التكلفة الاجمالية (4170 جنيهاً مصرياً) من اجل تصنيع 100 كجم من الجبن المصنوع من الحليب الخام مقابل (1618.5 جنيهاً مصرياً) (تم خفض تكلفة الانتاج الفعلية لاكثر من 62 %) لعمل نفس كمية الجبن المصنوع من اللبن المعاد تركيبه مع استخدام بديل الدهن النباتي (زبدة الكاكاو) .