

EFFECT OF REINFORCEMENT RICOTTA CHEESE BY SKIM MILK POWDER AND MILK PROTEIN CONCENTRATE POWDER ON THE QUALITY OF THE CHEESE TARGET DURING STORAGE.

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ABSTRACT

Ricotta cheese was made from acidified skim milk by yogurt starter at pH 5.8- 5.9 and adding different concentration of skim milk powder and milk protein concentrate. Acidity ,Fat, Protein, Ash, Total solids and the yield% of cheese were increased with increasing of skim milk powder and milk prote in concentrate while pH values were decreased .The cheese made by yoghurt starter coagulant with adding 2% skim milk powder had a higher values for the rheological properties Hardness, adhesiveness, Cohesiveness (g), Springiness (mm), Gumminess(g) and Chewiness(g.mm) which were 5777(g) , 4318.9(g) ,0.56(g),9.34(mm),2656(g) and 24820.28 (g.mm) respectively, while aading 4% skim milk powder had the lowest rheological properties for Hardness and adhesiveness which were (2712(g)-3391.8(g) respectively .The rheological properties in treatment (6% skim milk powder) as follows, Cohesiveness (g),Springiness (mm), Gumminess(g) and Chewiness(g.mm) were 0.45(g),7.81(mm), 1219(g) and 9520.01(g.mm) respectively. On the other hand, Ricotta cheese made by yoghurt starter coagulant with 4% milk protein concentrate powder showed the highest properties .Hardness(g), Cohesiveness (g), Springiness (g), Gumminess(g) and Chewiness(g.mm) were 6119(g),0.62(g),10.63(mm),3778(g) and 43466.59(g.mm) ,respectively while , adding 6% milk protein concentrate powder gave the highest value for adhesiveness [4127.91(g)] .but the same treatment had the lowest value for the Hardness(g), Cohesiveness (g), Springiness (mm), Gumminess(g) and Chewiness(g.mm) values being 4377(g),0.39(g),7.95mm,1709 (g)and 13595 g.mm ,respectively.The microbiological tests showed that, the control samples contained the lowest of total bacterial counts (7×10^4 cfu/g), protolytic bacteria (6×10^3 cfu/g) and lipolytic bacteria(1×10^3 cfu/g),All samples were free from coliform bacteria and *staphylococcus. spp.* Addition of 2% skim milk powder and milk protein concentrate showed the highest total score points for Sensory evaluation (83.5 and 82.8%)., adding 6% skim milk powder and milk protein concentrate showed the lowest total score points for Sensory evaluation (77.8 and 78.8 %).Generally , this work was carried out to study the effect of use skim milk and milk protein concentrate by different percent on the composition and the quality of Ricotta cheese.

Keywords: Ricotta cheese- skim milk – milk protein concentration

INTRODUCTION

The consumption and manufacture of cheese is increasing worldwide at a rate of about 2% per year. As a result, the amount of cheese whey is also increased and is estimated to be about 130 million tons annually (Korhonen *et al.*, 1998). Ricotta cheese is a high moisture soft cheese (Modler and Emmons, 2001). It can be produced using cheese whey or milk, or a mixture of both (Pizzillo *et al.*, 2005). Ricotta cheese is very mild and it is

used in many Italian dishes. Several methods have been developed for utilization of whey. Fresh Ricotta cheese had a mild and mutty Flavour and is used as a Flavour enhance in Salad (Kosikowski, 1982). Several methods have been suggested for Ricotta cheese making. (Weather up, 1986 and Modler & Emmons, 1994). These include study the effect of type of acidulant on the quality of Ricotta cheese. Production of Ricotta cheese has been considered to be one of the economical ways for the utilization of whey. So, the manufacture of Ricotta cheese could easily be undertaken as an additional source of income (shukla et al., 1986). Therefore, this work was carried out to study the effect of use skim milk and milk protein concentrate on the composition and the quality of Ricotta cheese.

MATERIALS AND METHODS

Skim milk was obtained from Dairy Department, Faculty of Agriculture, Mansoura University having the following composition in the Table (1) .

Table (1) Chemical composition of skim milk

TS%	TP%	FAT%	Lactose%	pH value
9.38	3.47	0.45	5.0	6.57

Yoghurt starter (*streptococcus thermophilus* and *lactobacillus delbrukii subsp bulgaricus*) were obtained from ch Hansen's Laboratories Denemark and were added at 40 °c .

Skim milk powder was obtained from local Company having the follows composition as shown in Table (2)

Table (2) chemical composition of skim milk powder.

Components	Percentages
Moisture%	2.75
T.P%	36
Lactose%	52
Fat%	1.25
Ash%	8

Milk protein concentrate powder was obtained from local Company having the follows composition as shown in Table (3)

Table (3) chemical composition of milk protein concentration

Components	Percentage
Moisture%	4.4
T.P%	69.8
Lactose%	17.2
Fat%	1.4
Ash%	7.2

Ricotta cheese was made as recommended by (Scott, 1981) with some modification as follows:

- 1- Standardization of fresh skim milk .
- 2- Acidified fresh milk of all treatments to pH 5.8-5.9 by adding yoghurt starter culture.

- 3- Adding of the skim milk powder and milk protein concentrate powder with ratios of 2% ,4% and 6% .
- 4- Heating of the milk of all treatments to 80°C with stirring to produce flakes of curd in clear whey.
- 5- Scooping the curd from the surface of the clear whey into perforated tinned steel containers lined with open weave cloth.
- 6- Cooling the filled containers in cold water then covering with calico and putting crushed ice on the top.
- 7- Salt was added (0.5%) in milk and the all samples were stored in the refrigerator $4\pm 1^{\circ}\text{C}$.

1- Chemical analysis: acidity, fat, total protein, ash and Total solids were determined according to Ling (1963) .pH value were measured using laboratory pH meter with glass electrodes pH-meter Jan way 3010 – England

2- Rheological properties of cheese: The texture properties of cheese samples were evaluated using (Texture analyzer by (CNS / FARNELLFRA, Borechamwoad, Hertfordsimre, England). Control and experimental cheese samples were taken from fresh cheeses and 21 days of storage, then were measured immediately. Cheese sample size was 30 mm of diameter and 20 mm of high. Speed was 1 mm / s and 10 mm was the distance of penetration. Samples were allowed to stand at ambient temperature for at least 20 min prior testing. The probe used was TA15-45°C perplex cone. Data were collected on computer and the texture profile parameters were calculated from LFRA texture analyzer and computer interface.

The following texture profile parameters were obtained and calculated as describe by Bourne (1978):

- i) The compressive force (g) recorded at maximum compressive during in the first bite as a measure of Hardness
- ii) The ratio of the positive force area under the curve during the second compression (bite) to that during the first compression (a_2/a_1) as a measure of cohesiveness.
- iii) The height (mm) to which the sample recovered during the time that clasped between the end of the first bite the start of the second bite, as a measure of Springiness.
- iv) The product of hardness X Cohesiveness (g), as a measure of gumminess.
- v) The product of gumminess X springiness (g.mm), as a measure of chewiness.
- vi) The modulus (the slope of force, representative of sample rigidity).

3- Microbiological test: Total bacterial counts were determined using the melted media (Difco1971). Lipolytic bacterial count and Proteolytic bacterial count were carried out as described by Chalmers (1962) .Coliform bacteria were counted by using Macconky broth. *Staphylococcus sp.* was counted by using staphylococcus medium 110. The plates were incubated at 37°C for 24-36 hrs and examined for orange colonies.

- 4- Organoleptic properties of cheese:** Ten trained panelists from the staff members of the Dairy Department of Faculty of Agriculture, Mansoura University evaluated of each cheese sample and used a quality rating score card for evaluation of flavor, body and texture, appearance were 40%, 30% and 30 % respectively according to Hassan (1996)

RESULTS AND DISCUSSION

Chemical properties

- 1- Acidity and pH values in Table(4), show that little difference were occurred in acidity and pH value of cheese in the different treatments .At the same time, the acidity were decreased and increased in pH values had the opposite trend by increasing concentration of milk protein concentrate and skim milk powder. Also, it was observed that the addition of 2 % milk protein concentrate caused more increasing in acidity and decreasing in pH values The same was observed with the same properties of skim milk powder during the storage period in pH values were detected during storage. Also, the addition of 6 % milk protein concentrate resulted in the highest acidity and the lowest pH value.
- 2- Fat content It can be seen from Table (4), that the increase of skim milk powder and milk protein concentrate resulted in an increase in fat content. While, the addition of 2% caused more increase in the fat content of milk protein concentrate when compared with the same percent of skim milk powder. The same effect was observed among other percentage of addition of skim milk powder and milk protein concentrate powders. Also, the addition of 6 % milk protein concentrate caused a highest fat content when compared with the same level of skim milk powder. It was observed the highest rate of increase when 2 % milk protein concentrate was added
- 3- Total protein (T.P) As shown in Table (4) Increasing of the percentage of added milk protein concentrate caused on increase in T.P % comparing with the skim milk powder in different concentration
- 4- Ash content Table (4), showed that the addition of 2 % milk protein concentrate resulted more increase in ash content when compared with the same level of skim milk powder. The same effect was observed if more addition of skim milk and milk protein concentrate powder were used. Also, it was observed that addition of 6 % percent of milk protein concentrate had the highest ash content compared with same percent of skim milk powder.
- 5- Total solids (T.S) in Table (4), showed that, in general, the increasing of skim milk powder and milk protein concentrate addition caused an increase in total solids contents, Also, it was observed addition of 2,4, 6 % milk protein concentrate caused the highest total solid content, compared with 2, 4 and 6% skim milk powder
- 6- Cheese yield Data in Table(4) ,indicates that the yield of Ricotta cheese made using skim milk with acidification by yoghurt starter with the addition of different levels of skim milk powder and milk protein

concentrate powder (2, 4 and 6%). It can be, seen that the addition of 2 % milk protein concentrate caused the highest cheese yield,. The Ricotta cheese made by skim milk with acidification by yoghurt starter with addition of different concentration of skim milk powder and milk protein concentrate powder (2, 4 and 6%) had the highest yield compared with the Ricotta cheese made by skim milk with acidification by phosphoric acid with addition of different levels of skim milk powder and milk protein concentrate powder (2, 4 and 6%) .

Table (4): Effect of addition of different concentration of skim milk powder and milk protein concentrates powder on chemical properties of Ricotta cheese`

Test	Storage Period (days)	Treatments						
		control	skim milk powder %			milk protein concentrate %		
			2%	4%	6%	2%	4%	6%
Acidity%	Fresh	0.23	0.37	0.42	0.55	0.29	0.36	0.51
	7	0.24	0.39	0.45	0.58	0.32	0.38	0.54
	14	0.26	0.45	0.48	0.61	0.35	0.42	0.68
	21	0.29	0.51	0.52	0.68	0.38	0.45	0.72
pH values	Fresh	5.09	4.78	4.62	4.55	4.95	4.82	4.61
	7	4.96	4.65	4.56	4.51	4.80	4.75	4.58
	14	4.90	4.61	4.50	4.46	4.75	4.66	4.51
	21	4.85	4.58	4.43	4.39	4.68	4.58	4.35
FAT%	Fresh	2.00	2.50	2.63	2.75	3.00	3.20	3.35
	7	2.15	2.55	2.68	2.82	3.25	3.45	3.55
	14	2.25	2.61	2.76	2.85	3.31	3.66	3.71
	21	2.30	2.67	2.81	2.90	3.50	3.75	3.80
TP%	Fresh	24.15	26.97	29.10	31.71	29.55	31.80	33.55
	7	24.44	27.50	29.83	31.85	29.78	31.95	33.74
	14	24.61	28.28	30.54	31.96	30.85	32.10	33.89
	21	25.02	28.71	30.76	32.12	30.95	32.42	34.14
Ash%	Fresh	1.98	2.672	2.753	2.842	2.568	2.655	2.985
	7	2.06	2.714	2.798	2.924	2.650	2.823	3.115
	14	2.13	2.842	2.815	3.012	2.751	2.915	3.235
	21	2.21	2.867	2.995	3.150	2.840	3.125	3.355
TS%	Fresh	30.15	33.50	37.40	39.30	35.35	39.30	41.30
	7	30.45	33.97	37.76	39.53	35.90	39.95	41.65
	14	30.86	34.25	38.12	40.76	36.15	40.20	42.42
	21	31.01	34.58	38.34	40.98	36.70	40.65	42.95
Yield%		17.5	23.0	30	34.3	24	32	35

Rheological properties of cheese: The changes in texture primary parameters (hardness, adhesiveness, cohesiveness, and springiness) and texture secondary parameters (Gumminess and Chewiness) of Ricotta cheeses made from skim milk and coagulated with yoghurt starter at zero time of manufacture and after 21 days storage are shown in

Table(5).Hardness at zero time of manufacture, the fresh cheese made using 4% skim milk powder showed lower hardness than other treatments either fresh cheese or during storage periods, while the highest values of hardness were found in cheeses made using 2% skim milk powder either fresh cheese and 4% milk protein concentrate during storage periods. Cheese made using 4% skim milk powder recorded little higher hardness than that made by using Yoghurt starter only but cheese made by using yoghurt starter recoded higher hardness than that made by using 2 and 6% skim milk powder at 21day. There was little difference in hardness between cheese made with 4 and 6% skim milk powder. The results indicates that the addition of 2% skim milk powder or 2% milk protein concentrate increased the hardness of Ricotta cheese, while the addition of 6% of skim milk powder or milk protein concentrate decreased the hardness in ricotta cheese. this is related mostly to the high level of dry matter and protein content in cheeses made using 2% skim milk powder or milk protein concentrate comparing with cheese made without addition. The dry matter and protein contents were higher in 6% skim milk powder and milk protein concentrate, while the hardness was lower than that in cheese made without addition. This may be attributed to the breakdown of the texture and body by increasing the dry matter and protein level of Ricotta cheese, but is not in other rennet coagulated cheese. Our results are in parent with those obtained by (Awad, S; 2011)Hardness decreased consistently during 21 days of storage. The decrease in hardness during the 21 days of storage was related to decreasing moisture content which acts as a plasticizer in the protein matrix, thereby making it less elastic and more susceptible to fracture upon compression this agree with data obtained by (Fox *et al.*, 2000). A reduction in hardness at 21 days of storage has been noticed in all cheese. The decrease in hardness after storage is due to the initial rubbery texture of cheese, which rapidly transforms into a smoother, and more soft product due to attributed to a number of factors: (1) proteolysis of casein network,; (2) increasing the protein hydration as the moisture content decreased at 21 days of storage comparing to that at 1st day of manufacturing. The proteins in cheese are highly hydrated and even buried water molecules in globular proteins can exchange with bulk solvent on a nanosecond to microsecond timescale and the protein matrix absorbed the water originally located in the fat-serum channels as mentioned by (Donald *et al.*, 1999; Guinee (2002) Lucey *et al.*, 2003); and (3) solubilization of CCP in cheese as the soluble calcium increased during acidification and storage. During cheeses storage, the solubilization of CCP resulted in a weaker association between casein molecules, which decrease the cheese rigidity (Lucey *et al.*, 2003).

Adhesiveness As shown in Table(5) The adhesiveness was higher in cheese made with addition 6% skim milk powder than that in all cheeses made by using skim milk powder or milk protein concentrate. It was noticed that the cheeses made using skim milk powder had higher adhesiveness values than that made using milk protein concentrate, and there were a positive or negative correlation between increasing the level of skim milk powder or milk protein concentrate and adhesiveness. After 21 days of storage, the adhesiveness reduced in all cheeses except the cheese made

with 2% skim milk powder, which recorded high level of adhesiveness after 21 days when compared with fresh Table (5).

Cohesiveness Also it can be seen from the same table that. there was no marked difference in cohesiveness among cheese made with different concentration of skim milk powder or milk protein concentrate at fresh and 21days of storage, while the cohesiveness is higher in cheese made without addition, while all cheese made from skim milk powder or milk protein concentrate received lower cohesiveness values compared with cheese made without addition. The cohesiveness values did not change after 21 days comparing with fresh cheese of manufacture.

Table (5): Effect of addition of different concentration of skim milk powder and milk protein concentrates powder on Rheological properties of Ricotta cheese.

Components	Storage Period (days)	Treatments						
		control	skim milk powder %			milk protein concentrate %		
			2%	4%	6%	2%	4%	6%
Hardness (g)	Fresh	5119	5777	2712	2738	5351	6119	4377
	21	2000	1548	1236	1525	2662	4317	3229
Adhesiveness (g)	Fresh	764.05	4318.9	3391.8	4924	2878	2867	4127.
	21	744.43	2699.0	2053.96	2695	1551	1489	2344.8
Cohesiveness (g)	Fresh	0.74	0.56	0.49	0.45	0.61	0.62	0.39
	21	0.71	0.53	0.50	0.46	0.62	0.63	0.49
Springiness (mm)	Fresh	11.42	9.34	8.25	7.81	10.63	10.63	7.95
	21	8.39	6.72	5.82	5.84	7.84	11.53	7.38
Gumminess (g)	Fresh	3793	2656	1323	1219	3265	3778	1709
	21	1420	664	621	701	1623	2718	1581
Chewiness (g.mm)	Fresh	43336	24820	10912.42	9520	34697	43466	13595
	21	11921	4464	3615.46	4094	12723	31347	11666

Springiness in Table (5).shows the effect of supplemented milk to made Ricotta cheese by skim milk powder and milk protein concentrate on Springiness values. The Springiness at fresh and 21 days of storage was lower in cheeses made using milk supplemented by skim milk powder and milk protein concentrate when comparing with control. However, increasing the percentage of skim milk powder or milk protein concentrate decreased the springiness value as compared to control cheeses. However, springiness reduced after 21 days of storage in all samples made with different concentration of skim milk powder, milk protein concentrate and control. It may be attributed to the release of calcium ions from mono-calcium and di-calcium Para K-caseinate molecules. These molecules have been reported to be responsible for the springiness of cheese curd (Kanawjia, *et al.*, 1995).

Gumminess is the energy required to disintegrate a semisolid food for swallowing. In general, the trend of gumminess values was comparable with hardness at 1st day of manufacturing (Table 5). Gumminess values were decreased by increasing the levels of skim milk powder or milk protein concentrate except in 4% protein concentrate when compared to control cheese. The lower gumminess values were in cheeses made using 6% skim

milk powder or milk protein concentrate when compared to that made using 2% skim milk powder or milk protein concentrate. The gumminess decreased in all cheeses at 21 days of storage comparing to that at 1st days of storage. Chewiness is the energy required to chew a solid food product to a state where it is ready for swallowing. The chewiness values were well compared with Gumminess values in all cheese (Table 5). As chewiness values decreased by increasing the levels of skim milk powder or milk protein concentrate when compared to control cheese. The lower Chewiness values were in cheese made by using 6% skim milk powder or milk protein concentrate when compared to that made using 2% skim milk powder or milk protein concentrate. There was a correlation between cheese hardness and chewiness, harder cheese is more difficult to chew (Beal and Mittal, 2000).

Table (6): Effect of addition of different concentration of skim milk powder and milk protein concentrate powder on microbiological properties of Ricotta cheese.

microbiological properties	Storage Period (days)	Treatments						
		control	skim milk powder %			milk protein concentrate %		
			2%	4%	6%	2%	4%	6%
TCx10 ⁴ cfu/g	Fresh	7.0	9.0	14.0	17.0	12.0	15.0	18.0
	7	9.0	11.0	15.0	20.0	16.0	18.0	22.0
	14	15.0	20.0	27.0	31.0	21.0	29.0	32.0
	21	22.0	26.0	31.0	34.0	29.0	35.0	37.0
Pr. b x10 ³ cfu/g	Fresh	6.0	7.0	10.0	14.0	8.0	12.0	15.0
	7	8.0	10.0	13.0	16.0	12.0	15.0	17.0
	14	11.0	13.0	17.0	21.0	14.0	19.0	23.0
	21	14.0	16.0	20.0	31.0	15.0	22.0	27.0
Ly.b x10 ³ c.f.u/g	Fresh	1.0	3.0	4.0	6.0	4.0	5.0	8.0
	7	2.0	4.0	7.0	8.0	5.0	8.0	10.0
	14	5.0	6.0	9.0	12.0	8.0	11.0	13.0
	21	7.0	9.0	11.0	14.0	12.0	15.0	18.0
Coliform(E.coli) & Staphylococcus sp bacteria x10 ³ c.f.u/g	Fresh	ND	ND	ND	ND	ND	ND	ND
	7	ND	ND	ND	ND	ND	ND	ND
	14	ND	ND	ND	ND	ND	ND	ND
	21	ND	ND	ND	ND	ND	ND	ND

T.C.: total bacterial count

Pro. b: proteolytic bacterial counts

Ly. b: lipolytic bacterial counts

CFU: colony forming unit

N.D: not detectives

Microbiological tests of Ricotta cheese made by the addition of different concentration of skim milk or milk protein concentrate powder, it can be seen from the results in Table(6) that the control cheese had the lowest total bacterial count compared with other treatments,. While the addition of 2% skim milk powder or milk protein concentrate had the lower total count of bacteria Compared with different concentration of skim milk powder or milk protein concentrate powder. Also, cheese control made by acidification using yoghurt starter had the lower Proteolytic, lipolytic bacterial counts compared with other treatment, either when addition skim milk

powder or milk protein concentrate. Addition of 2% skim milk powder had the lowest Proteolytic and lipolytic bacterial count compared with the same percent of milk protein concentrate. The same effects were observed among other percent addition skim milk powder and milk protein concentrate, either fresh cheese or during storage periods. Generally, cheese from different treatments were free from coliform (*E. coli*) and *Staphylococcus sp* . The same effects were observed among other percent addition skim milk powder and milk protein concentrate.

Organoleptic properties Table(7), shows that the Ricotta cheese made by the addition of 2% skim milk powder and 2% milk protein concentrate had the highest total score points, compared with the other levels and control either fresh or during storage periods.

Table (7): Effect of addition of different concentration of skim milk powder and milk protein concentrate powder on organoleptic properties of Ricotta cheese'

Properties	Storage Period (days)	Treatments						
		control	skim milk powder %			milk protein concentrate %		
			2%	4%	6%	2%	4%	6%
Flavour (40)	Fresh	34.0	35.0	34.0	34.0	34.5	34.0	33.0
	7	34.5	35.5	34.0	33.5	34.5	34.2	33.3
	14	33.0	34.8	34.4	31.0	33.7	34.0	32.0
	21	33.0	33.5	33.0	30.0	33.2	33.0	31.0
Body & Texture (30)	Fresh	24.5	26.0	25.0	25.0	25.5	24.5	25.0
	7	26.0	26.5	24.2	25.3	26.0	24.9	25.3
	14	24.0	25.8	24.5	25.0	25.8	24.5	25.0
	21	23.5	24.0	24.0	24.0	25.0	24.0	24.3
Appearance (30)	Fresh	25.4	26.0	24.0	24.0	26.0	25.0	24.0
	7	25.7	26.4	24.6	24.5	26.4	25.3	24.2
	14	26.0	26.1	24.2	24.2	26.0	24.5	24.0
	21	25.5	25.3	24.0	23.8	25.3	24.5	23.5
Total (100)	Fresh	83.9	87.0	83.0	83.0	86.0	83.5	82.0
	7	86.2	88.4	83.8	83.3	86.9	84.2	82.8
	14	83.0	86.7	83.1	80.2	85.5	83.0	81.0
	21	82.0	82.8	81.0	77.8	83.5	81.5	78.8

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تأثير تدعيم جبن الريكوتا باللبن الفرز المجفف ومركز بروتين اللبن علي جودة الجبن الناتج اثناء التخزين
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تم تصنيع جبن الريكوتا من اللبن الفرز بواسطة التجبن الحراري الحمضي باستخدام بادئ الزبادي لدرجة $5.8\text{pH} - 5.9$ علي درجة حرارة $87-88^\circ\text{C}$. وتم إضافة اللبن الفرز المجفف ومركز بروتين اللبن بنسب مختلفة 2% ، 4% ، 6% ، وأوضحت النتائج ان الحموضة ونسبة الدهن ، نسبة البروتين ، الرماد ، الجوامد الصلبة الكلية ، وتصافي الجبن زادت بزيادة تركيز اللبن الفرز المجفف ومركز بروتين اللبن بينما ال pH فقد انخفضت . و بالنسبة للخواص الريولوجية وجد أنه باضافة اللبن الفرز المجفف بنسبه 2% اعطي اعلي درجات للخواص الريولوجية (الصلابة والالتصاق والتماسك والمرونة واللزوجة ومعدل المضغ وهي علي التوالي ($5777\text{ جم} - 4318,9\text{ جم} - 0,56\text{ جم} - 9,34\text{ مم} - 2656\text{ جم} - 28,28\text{ جم.مم}$) بينما إضافة 4% من اللبن الفرز المجفف حصل علي اقل قيم للصلابة والالتصاق ($2712\text{ جم} - 3391,8\text{ جم}$) وإضافة 6% من اللبن الفرز المجفف حصل علي اقل قيم للخواص الريولوجية (التماسك والمرونة واللزوجة ومعدل المضغ) ($0,45\text{ جم} - 7,81\text{ مم} - 1219\text{ جم} - 9520,01\text{ جم.مم}$) . . كذلك حصل الجبن الناتج باضافة 4% من مركز بروتين اللبن علي اعلي قيم للخواص الريولوجية (الصلابة والتماسك والمرونة واللزوجة ومعدل المضغ) ($6119\text{ جم} - 0,62\text{ جم} - 10,63\text{ مم} - 3778\text{ جم} - 43466,59\text{ جم.مم}$) بينما الجبن الناتج باضافة 6% من مركز بروتين اللبن حصل علي اعلي قيم للالتصاق ($4127,91\text{ جم}$) وحصل الجبن الناتج باضافة 6% بروتين من مركز بروتين اللبن علي اقل قيم للخواص الريولوجية (الصلابة - التماسك - المرونة - اللزوجة ومعدل المضغ) ($4377\text{ جم} - 0,39\text{ جم} - 7,95\text{ مم} - 1709\text{ جم} - 13595,24\text{ جم.مم}$) . اوضحت الاختبارات الميكروبيولوجية ان عينات جبن المقارنه احتوت علي اقل اعداد كلية للبكتريا والبكتريا المحلله للبروتين والبكتريا المحلله للدهن وان جميع المعاملات كانت خالية تمام من بكتريا الكلورفورم وبكتريا الاستاف . و بالنسبة للاختبارات الحسية حصل الجبن الناتج باضافة 2% سواء من اللبن الفرز المجفف او مركز بروتين اللبن علي اعلي عدد درجات للتقييم الحسي ($82,8$ و $83,5$) بينما حصل الجبن الناتج باضافة 6% سواء من اللبن الفرز المجفف او مركز بروتين اللبن علي اقل درجات للتقييم الحسي ($77,8$ و $78,8$) . و عموما فان هذا العمل يهدف الي دراسته تأثير اضافته اللبن الفرز المجفف و مركز بروتين اللبن المجفف بنسب مختلفه علي تركيب و جوده الجبن الريكوتا .