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QUALITY OF RAS CHEESE MADE BY PROBIOTIC STRAIN OF *Lactobacillus rhamnosus*

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ABSTRACT

Five Ras cheese treatments were made by replacing normal cheese starter with *Lactobacillus rhamnosus*. Cheese treatments were microbiologically, chemically and organoleptically evaluated when fresh and after 1,2,3 and 4 months. Moisture content decreased, while total nitrogen, fat, ash, titratable acidity, soluble nitrogen, total volatile fatty acids (TVFA), Shilovich number and score of organoleptic properties increased by replacing the normal cheese starter with *Lactobacillus rhamnosus*, and the increases were proportional to the rate of replacing. Moisture content of all cheese treatments decreased during ripening period, while fat, total nitrogen, water soluble nitrogen, Shilovich number, TVFA and scores of organoleptic properties increased. *Lactobacillus rhamnosus* counts increased during the first month of ripening period then decreased. Cheese treatment (T4) being made, with adding 1.0% *Lactobacillus rhamnosus* exhibited the highest count, and even after the ripening period, it contained higher count of probiotic bacteria than that should be present to achieve the therapeutic effect. Also this cheese treatment was the most acceptable cheese treatment.

Keywords: Ras cheese - Probiotic bacteria – Hardness – Cheese quality.

INTRODUCTION

Ras cheese is the most popular hard cheese in Egypt. Probiotic bacteria are recognized currently as those promoting the health of human by exhibiting autigomitric effects towards enteropathogenic bacteria, reducing the risk of diarrhea, enhancing immune function, reducing cholesterol levels, reducing the risk of eczema, relieving lactose intolerance symptoms, synthesizing vitamins and exhibiting antitumonigenic activity (Kebary, 1995; Kebary *et al*., 2005; Hussein *et al*., 2006; Marteau *et al*., 2001 and Ibrahim *et al*., 2005). Therefore, efforts have been devoted to incorporate probiotic bacteria into dairy products. It is estimated that more than 90 probiotic products are produced worldwide (Shah, 2000). Products containing bifido bacteria have been reviewed (Kebary *et al*., 2005).

It has been speculated that minimal number of miable cells of probiotic bacteria should be more than 10^5/g to achieve the therapeutic effects (Samona and Robinson, 1991; Lee *et al*., 1996). Survival of probiotic bacteria in dairy products depends on the strain, species, fermentation and storage conditions (Martin, 1996; Dave and Shah, 1997). It is postulated that probiotic bacteria will maintain viability better in cheese than in fermented milk (Boylston, *et al*., 2004). Nevertheless, it is important to consider that cheese ripening might take long time and probiotic must remain viable for a longer time.

Probiotic bacteria in cheese especially lactobasilli possess several peptidases, which can hydrolyze peptides to oligopeptides and free amino acid and induce changes in flavor, body and texture and, consequently, in sensory properties of the cheese (Shihata and Shah, 2000; Soufa and Saad, 2009; Santillo and Albanzia, 2008). *Lactobacillus rhamnosus* has been used in the manufacture of hard cheese (Bergamini *et al.,* 2009; Chen *et al*., 2009; Kocoaglu-Vusma *et al*., 2008).

The objectives of this study are to investigate the possibility of making a good quality of probiotic Ras cheese using *Lactobacillus rhamnosus,* and to study the effect of incorporating *Lactobacillus rhamnosus* on the chemical, microbiological, rheological and organoleptic properties of Ras cheese and to monitor the changes in cheese properties during the ripening period.

MATERIALS AND METHODS

Active *streptococcus thermophiles* ENCC1043, *Lactobacillus delbruechii* subsp. *bulgaricus* EMCC1102 and *Lactobacillus rhamnosus* ATCC7460 were obtained from the Egyptian microbial culture collection (EMCC) at Cairo Microbiological Resources Center (Cairo Mircen), faculty of agriculture, Ain Shams University. These strains were activated individually by three successive transfers in sterile 10% reconstituted non-fat dry milk.

- Bulk fresh cows' milk (obtained from the herd of Toch Tanbash farm, Minufia, Egypt) was pasteurized at 63° for 30 min., cooled to 35°C and divided into five batches. Control cheese treatment (C) was made by adding 1.0% of normal starter (50% *Streptococcus thermophilus* + 50% *Lactobacillus delbruechii* subsp. *bulgaricus*) and the other four treatments were made by adding 0.75% normal starter + 0.25% *Lactobacillus rhamnosus* (T1); 0.50% normal starter + 0.50% *Lactobacillus rhamnosus* (T2); 0.75% normal starter + 50% *Lactobacillus rhamnosus*; (T3) and 0.50% normal starter + 1.0% *Lactobacillus rhamnosus* (T4). Ras cheese treatments were made according to Abdel-Tawab (1963) except that calcium chloride was added at the rate of 0.02% of milk.

The resultant cheese was ripened for four months. All cheese treatments were sampled and analyzed when fresh and after 1, 2, 3 and 4 months for chemical, microbiological, rheological and sensory properties. The whole experiment was duplicated.

- Cheese samples were analyzed for moisture, salt, fat, ash according to AOAC (2000). Titratable acidity, pH, water soluble nitrogen (WSN), and total nitrogen (TN) were determined as described by Ling (1963). Total volatile fatty acids (TVFA) were estimated by the method of Kosikowski (1966). Shilovich ripening index was determined according to Abdel-Tawab and Hofi (1966).
- Two cubes from each treatment were cut into 4X4X4 cm and tempered at room temperature. Cheese hardness was assessed using a penetrometer supplied by Koehler (Instrument Company Inc. New York, USA). The penetrometer spindle was adjusted to touch the surface of cheese sample,

and then the spindle was released to penetrate into the sample for 5 sec. The penetration depth was recorded in units of 0.1 mm penetrometer reading which is related inversely to the hardness of sample.

- Total viable bacterial counts were enumerated on standard plate count agar (Marth, 1978). Moulds and yeasts, libolytic and proteolytic bacterial counts were determined according to APHA (1994). MRS agar medium was used to enumerate *Lactobacillus* (DeMan, *et al.,* 1960) while LC agar medium was used to enumerate *Lb. rhamnosus* (Ravula and Shah, 1998).
- Cheese samples were evaluated for the appearance, flavor and body & texture according to the scoring sheet of El-Shafei *et al*., (1995) by the staff members of Dairy Science Dept., Food Technology Institute Agriculture Research Center, and Giza, Egypt.
- 2X3 factorial design was used to analyze all the data and the student Newman Keuls' test was used to make the multiple comparisons (Steel and Torrie, 1980), using Costat program. Significant differences were determined at p ≤0.05.

RESULTS AND DISCUSSION

Chemical composition of Ras cheese

Changes in moisture content during ripening of probiotic Ras cheese are presented in Table (1). Moisture content of Ras cheese decreased significantly (P≤0.05) by replacing the normal cheese starter with *Lb. rhamnosus* and this decrease was proportional to the rate of replacement. Cheese treatments that made by adding the highest ratio of *Lb. rhamnosus* (1.0%) contained the lowest moisture content (Tables 1, 6). These results might be due to the increase of cheese acidity, which consequently helps to expel the whey from the cheese curd.

Table 1. Moisture, Fat and total nitrogen (TN) content of Ras cheese as affected by probiotic bacteria and ripening period

Cheese Treatment	Ripening Period (months)					Ripening Period (months)					Ripening Period (months)				
	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4
	Moisture (%)					Fat (%)					TN (%)				
C*	44.36	42.23	41.92	41.19	36.96	27.9	28.3	29.5	29.1	29.3	3.36	3.46	3.65	3.81	3.82
T1	43.79	42.62	41.43	38.76	38.98	28.5	29.1	29.5	29.6	30.4	3.37	3.68	3.69	4.06	4.38
T2	40.26	38.36	37.48	36.38	35.75	28.9	25	25.3	25.4	25.6	3.42	3.76	3.81	4.01	4.46
T3	39.67	38.21	37.83	36.24	35.72	30.2	30.3	30.8	30.9	31.5	3.49	3.86	3.95	4.12	4.53
T4	37.99	37.77	36.92	36.2	33.26	31.4	31.5	31.7	32.1	32.3	3.56	3.86	4.07	4.22	4.77

C*: Control cheese made with the normal starter.
T1: Cheese made with 0.75% normal starter + 0.25% *Lb. rhamnosus*
T2: Cheese made with 0.50% normal starter + 0.50% *Lb. rhamnosus*
T3: Cheese made with 0.75% normal starter + 0.50% *Lb. rhamnosus*
T4: Cheese made with 0.50% normal starter + 1% *Lb. rhamnosus*

Moisture content of all probiotic Ras cheese decreased as ripening period proceeded. Moisture content decreased rapidly during the first months, and then decreased gradually up to the end of the ripening period. These results are in agreement with those reported by Badawi (1998), Hussein *et al*. (2006), Mehanna *et al*. (2002) and Kebary *et al.* (1996).

Total nitrogen, fat and ash contents of probiotic Ras cheese increased significantly (P≤0.05). With the increase of the rate of replacing normal cheese starter by *Lb. rhamnosus*, and as ripening period progressed. These results could be attributed to the loss of moisture content (Table 1, 2 and 6). Similar trends were reported by Badawi (1998); Mehanna *et al.* (2002), Kebary *et al.* (1996), Chen *et al.* (2009) and Fayed *et al*. (2006).

Titrtable acidity of propiotic Ras cheese treatments is illustrated in Table (2). Titratable acidity of Ras cheese increased significantly (P≤0.05) by replacing the normal cheese starter with Lb. rhamnosus (Tables 2, 6). There were positive correlation between cheese acidity and the rate of replacement, which means that cheese acidity increased by increasing the rate of replacing normal cheese starter with *Lb. rhamnosus.* These results are in accordance with those reported by Mehanna *et al.* (2002), who reported that this increase in cheese acidity could be attributed to the ability of *Lb. rhamnosus* to produce acetic and lactic acids from lactose and/or producing some short chain fatty acids. On the other hand, titratable acidity of all cheese treatments increased significantly (P≤0.05) as ripening period advanced. (Tables 2, 6). Similar trends were reported by Badawi (1998), Mehanna *et al.* (2002) and Fayed *et al.*(2006).

Table 2. Salt, Titratable acidity and Ash content of Ras cheese as affected by probiotic bacteria and ripening period

Cheese Treatment	Ripening Period (months)					Ripening Period (months)					Ripening Period (months)				
	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4
	Salt (%)					Titratable acidity (%)					Ash (%)				
C*	1.18	1.26	1.32	1.41	1.55	1.15	1.4	1.6	1.75	2.25	5.7	5.7	6.1	6.2	6.5
T1	1.19	1.36	1.4	1.57	1.66	1.3	1.5	1.98	2.0	2.4	5.88	5.9	7.06	7.35	7.62
T2	1.21	1.36	1.49	1.63	1.78	1.4	1.9	2.0	2.25	2.5	5.9	5.95	7.13	7.39	7.68
T3	1.27	1.43	1.57	1.66	1.8	1.5	1.9	2.0	2.25	2.6	6.1	6.17	7.31	7.66	7.68
T4	1.30	1.44	1.77	1.77	1.9	1.9	2	2.2	2.55	2.75	6.3	6.29	7.4	7.7	7.73

C*: Control cheese made with the normal starter.
T1: Cheese made with 0.75% normal starter + 0.25% *Lb. rhamnosus*
T2: Cheese made with 0.50% normal starter + 0.50% *Lb. rhamnosus*
T3: Cheese made with 0.75% normal starter + 0.50% *Lb. rhamnosus*
T4: Cheese made with 0.50% normal starter + 1% *Lb. rhamnosus*

Ripening indices of Ras cheese

Changes in ripening indices {water soluble nitrogen (WSN), total volatile fatty acids (TVFA), Shilovich number (Sn)} during ripening of probiotic Ras cheese are shown in Table (3). WSN, TVFA and Sn increased significantly (P≤0.05) by increasing the rate of replacing normal starter with *Lb. rhamnosus* (Tables 3, 6). There were positive correlation between the rate of replacement and the values of WSN, TVFA and Sn. These results are

in agreement with those reported by Chen *et al*. (2009) and Mehanna *et al*., (2002). These results could be attributed to the presence of proteolytic and lipolytic system of *Lb. rhamnosus* (Bergamini *et al*., 2009). Also WSN, TVFA and Sn of all cheese treatments increased significantly (P≤0.05). Throughout the ripening period (Tables 3, 6).

These results are in agreement with those reported by Badawi (1998), Mehanna *et al.* (2002); Fayed *et al.* (2006) and Chen *et al*. (2009). Cheese treatment (T4) being made with adding 1.0% *Lb. rhamnosus* showed the highest values for WSN, TVFA and Sn (Tables 3,6).

Table 3. Effect of brobiotic bacteria on Ras cheese ripening indices.

Cheese Treatment	Ripening Period (months)					Ripening Period (months)					Ripening Period (months)				
	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4
	WSN (%)					TVFA (ml 0.1 NaOH/100g)					Shilovich Number				
C*	0.159	0.2	0.25	0.297	0.384	8	24	36	50	50	10	50	70	70	100
T1	0.18	0.248	0.3	0.347	0.445	10	36	50	56	60	10	60	90	100	130
T2	0.182	0.267	0.31	0.38	0.532	16	40	52	56	64	10	90	110	120	135
T3	0.186	0.28	0.37	0.38	0.61	24	40	54	68	80	30	100	120	130	145
T4	0.22	0.284	0.39	0.42	0.68	24	56	58	76	80	30	120	140	150	160

C*: Control cheese made with the normal starter.
T1: Cheese made with 0.75% normal starter + 0.25% *Lb. rhamnosus*
T2: Cheese made with 0.50% normal starter + 0.50% *Lb. rhamnosus*
T3: Cheese made with 0.75% normal starter + 0.50% *Lb. rhamnosus*
T4: Cheese made with 0.50% normal starter + 1% *Lb. rhamnosus*

Cheese hardness

Values of penetration, which are inversely related to cheese hardness, are presented in Table (4). Replacement of normal cheese starter with *Lb. rhamnosus* resulted in a significant (P ≤0.05) decrease in cheese hardness and this decrease was proportional to the rate of replacement (Tables 4, 6). On the other hand, hardness of all cheese treatments decreased during ripening period (Tables 4, 6). These results might be due to the degradation of protein and fat during ripening period (Badawi, 1998).

Table 4. Hardness of Ras cheese as affected by probiotic bacteria and ripening period

Cheese Treatment	Ripening Period (months)				
	0	1	2	3	4
	Hardness (mm)				
C*	1.2	2.3	4.4	4.6	9.9
T1	2.4	3.3	4.5	5.8	11.7
T2	2.8	3.3	4.6	6.3	11.7
T3	3.3	5.4	6.6	8.9	12.8
T4	3.4	5.7	6.7	9.4	17.5

Organoleptic evaluation of Ras cheese

Scores of organoleptic properties (flavour, body& texture, appearance and total scores are presented in Table (5). Scores of flavour, body& texture, appearance and total scores of all Ras cheese treatments followed similar trends. Scores of organoloptic properties (flavour and total scores) of all cheese treatments increased as ripening period progressed (Tables 5, 6).

Table 5. Effect of incorporating probiotic bacteria on sensory evaluation of the Ras cheese

Cheese Treatments	Organoleptic properties																			
	Flavour Ripening Period Months (%)					Body and Texture (40) Ripening Period Months (%)					Appearance (10) Ripening Period Months (%)					Total (100) Ripening Period Months (%)				
	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4	0	1	2	3	4
C*	39	41	42	42	44	26	39	31	33	35	6	7	7	8	9	71	77	80	83	88
T1	40	41	42	44	45	30	31	32	32	34	7	7	7	8	9	77	79	81	84	88
T2	39	41	42	44	46	31	32	34	36	37	7	8	8	8	8	77	81	84	88	91
T3	40	42	43	45	47	32	32	33	33	38	7	7	8	8	8	79	81	84	86	93
T4	42	43	46	46	49	35	36	36	36	39	7	8	8	8	9	84	87	90	90	97

C*: Control cheese made with the normal starter.
T1: Cheese made with 0.75% normal starter + 0.25% *Lb. rhamnosus*
T2: Cheese made with 0.50% normal starter + 0.50% *Lb. rhamnosus*
T3: Cheese made with 0.75% normal starter + 0.50% *Lb. rhamnosus*
T4: Cheese made with 0.50% normal starter + 1% *Lb. rhamnosus*

Table 6. Statistical analysis of properties of Ras cheese as affected by probiotic bacteria

Cheese Properties	Effect of treatment							Effect of ripening per.(Month)					
	Mean Squares	Multiple Comparisons						Mean Squares	Multiple Comparisons				
		C	T1	T2	T3	T4*			0	1	2	3	4
Chemical Properties													
Moisture (%)	305.5.062*	A	B	C	D	E		46.863*	AB	AB	B	A	C
Fat (%)	101.548*	E	D	C	B	A		3.532*	C	BC	BC	AB	A
TN (%)	1.640*	E	D	C	B	A		1.579*	E	D	C	B	A
Acidity	0.587*	D	C	B	B	A		2.400*	E	D	C	B	A
SN (%)	0.059*	D	C	C	B	A		0.238*	D	C	B	B	A
TVFA(ml 0.1N NaOH/ 100gm)	892.32*	E	D	C	B	A		5988.72*	E	D	C	B	A
Sal. Number	5838*	E	D	C	B	A		27618*	E	D	C	B	A
Salt (%)	0.353*	D	C	B	B	A		1.125*	D	C	B	A	A
Cheese Hardness (ml)	17.923*	A	B	B	C	D		230.382*	A	B	C	D	E
Ash (%)	3.064*	D	D	C	B	A		5.758*	D	D	C	B	A
Organoleptic:-													
Flavour (50)	15.30*	D	D	C	B	A		100.50*	E	D	C	B	A
Body and texture (40)	68.580*	D	C	B	B	A		34.680*	C	C	B	A	A
Color and appearance (10)	4.380*	B	A	A	A	A		2.580*	A	A	A	A	A
Total Score (100)	186.180*	D	C	BC	B	A		252.73*	E	D	C	B	A

- See Table (1)
- Significant at 0.05 level. For each effect the different letters in the same row means the multiple comparisons are different from each other letter A is the highest mean followed by B.C….etc.

Similar results were reported by Badawi (1998); Fayed *et al*. (2006) and Mehanna *et al*., (2002). On the other hand, scores of organoleptic properties increased with replacement of normal starter with *Lb. rhamnosus* (Tables 5, 6). There were positive correlation between the rate of replacement and scores of organoleptic properties. Cheese made with adding 1.0% *Lb. rhamnosus* gained the highest score.

Microbiological quality of Ras cheese

Counts of Proteolytic bacteria, lipolytic bacteria, total viable bacteria, *Lb. rhamnousus* and yeasts & moulds in all cheese treatments followed similar trends (Table, 7). Counts of these bacteria in all cheese treatments increased during the first month of ripening period then decreased up to the end of storage period. Cheese treatment (T4) being made with adding 1.0% *Lb. rhamnousus* exhibited the highest count of *Lb. rhamnousus* and even after ripening for 4months it contained higher count of *Lb. rhamnousus* than the count should be present to achieve their therapeutic effect.

Table 7. Microbiological analysis of Ras cheese as affected by probiotic bacteria and ripening period

Properties	Treatments*	Ripening Period (months)				
		Fresh	1M	2M	3M	4M
Total count (c.f.u./gm)	Control	$16x10^5$	$15x10^6$	$7x10^7$	$13x10^7$	$3x10^8$
	T1	$7x10^5$	$23x10^6$	$35x10^7$	$18x10^8$	$58x10^8$
	T2	$11x10^6$	$25x10^7$	$6x10^8$	$23x10^8$	$52x10^8$
	T3	$55x10^7$	$33x10^7$	$15x10^8$	$21x10^8$	$33x10^7$
	T4	$17x10^6$	$32x10^7$	$97x10^7$	$22x10^8$	$37x10^8$
Lactobacillus rhamnosus	Control	$76x10^3$	$33x10^5$	$6x10^3$	$13x10^2$	$2x10^1$
	T1	$86x10^3$	$3x10^5$	$42x10^3$	$7x10^3$	$4x10^1$
	T2	$96x10^3$	$29x10^6$	$56x10^3$	$96x10^2$	$5x10^1$
	T3	$36x10^3$	$35x10^6$	$3x10^4$	$25x10^2$	$26x10^1$
	T4	$67x10^3$	$54x10^6$	$33x10^3$	$73x10^2$	$5x10^1$
Pro. bacteria	Control	$24x10^1$	$29x10^1$	$24x10^2$	$29x10^2$	$24x10^3$
	T1	$29x10^1$	$31x10^1$	$29x10^2$	$24x10^3$	$44x10^3$
	T2	$27x10^1$	$32x10^1$	$32x10^2$	$29x10^3$	$15x10^4$
	T3	$31x10^1$	$45x10^1$	$42x10^2$	$4x10^4$	$16x10^4$
	T4	$45x10^1$	$55x10^1$	$4x10^3$	$13x10^4$	$25x10^4$
Lip.bacteria	Control	$24x10^1$	$97x10^2$	$17x10^3$	$35x10^3$	$37x10^3$
	T1	$54x10^1$	$19x10^3$	$37x10^3$	$8x10^4$	$9x10^4$
	T2	$24x10^2$	$32x10^3$	$7x10^4$	$9x10^4$	$12x10^4$
	T3	$98x10^2$	$36x10^3$	$14x10^4$	$11x10^4$	$23x10^4$
	T4	$97x10^2$	$9x10^4$	$21x10^4$	$29x10^4$	$31x10^4$
Yeast & Mould	Control	N.D	N.D	$2x10^1$	$3x10^2$	$15x10^2$
	T1	N.D	N.D	$26x10^1$	$9x10^2$	$77x10^2$
	T2	N.D	N.D	$15x10^1$	$27x10^2$	$59x10^2$
	T3	N.D	N.D	$36x10^1$	$55x10^2$	$83x10^2$
	T4	N.D	N.D	$3x10^1$	$13x10^2$	$24x10^2$

C*: Control cheese made with the normal starter.
T1: Cheese made with 0.75% normal starter + 0.25% *Lb. rhamnosus*
T2: Cheese made with 0.50% normal starter + 0.50% *Lb. rhamnosus*
T3: Cheese made with 0.75% normal starter + 0.50% *Lb. rhamnosus*
T4: Cheese made with 0.50% normal starter + 1% *Lb. rhamnosus*

It could be concluded that replacement of normal starter with *Lb. rhamnousus* caused a significant increase of water soluble nitrogen, TVFA, Shilovich number, total nitrogen, acidity, organoleptic scores, and counts of *Lb. rhamnousus.* Cheese treatment (T4) was the most acceptable cheese and contained the highest values of WSN, TVFA, and Sn and contained the highest counts of *Lb. rhamnousus*. Therefore it is possible to make a good quality probiotic Ras cheese with adding 1.0% *Lb. rhamnousus.*

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جـــودة الجـــبن الـــراس المصـــنع باســـتخدام البادئـــات الحيويـــة *Lactobacillus rhamnosus*

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يهدف هذا البحث لدراسة إمكانية تصنيع جبن الراس الداعم للحيوية ولذلك فقد تم تصنيع خمس معاملات، الكنترول بإستخدام البادىء الطبيعى بينما المعاملات الأربع الأخرى تم أستبدال البادىء العادى للجبن بإستخدام بكتريا*Lactobacillus rhamnosus* وهى معروف أنها من البكتريا الداعمة للحيوية ولقد تم تسوية الجبن لمدة أربع أشهر كانت تؤخذ عينات من كل المعاملات كل شهر وذلك لإجراء التحليلات الكيماوية والميكروبيولوجية والريولوجية والحسية

ولقد أوضحت النتائج المتحصل عليها بعد تحليلها أحصائيا ما يلى:-

١. أدى استبدال بادىء الجبن العادى بواسطة بكتريا *Lactobacillus rhamnosus* إلى إنخفاض نسبة الرطوبة وإزداد الإنخفاض فى الرطوبة بزيادة معدل الأستبدال.
٢. إزدادت نسبة النيتروجين الذائب فى الماء والأحماض الدهنية الطيارة ورقم سلوفيتس ودرجات التحكيم وعدد بكتريا *Lactobacillus rhamnosus* بزيادة معدل إستبدال بادىء الجبن العادى بواسطة بكتريا *Lactobacillus rhamnosus* فى حين إنخفضت صلابة الجبن بزيادة معدل الأستبدال.
٣. إنخفضت نسبة الرطوبة وكذلك صلابة الجبن بتقدم فترة التسوية فى حين ازدادت نسب كل من النتروجين الكلى والذائب والدهن و الأحماض الكلية الدهنية الطيارة ورقم سلوفيتس ودرجات التحكيم.
٤. حصلت العينة التى صنعت بإضافة ١% من بكتريا *Lactobacillus rhamnosus* على أعلى درجات التحكيم وأى نسب دلائل التسوية ولقد أحتوت على أعلى عدد للبكتريا *Lactobacillus rhamnosus* ولقد أحتوت حتى بعد التسوية لفترة ٤ أشهر على عدد من البكتريا أعلى من العدد الذى يجب تواجده فى المنتج الغذائى لتحقيق الفوائد الصحية مما يوضح أنه يمكن تصنيع جبن راس داعم للحيوية جيد الصفات وذلك بأضافة ١% من بكتريا *Lactobacillus rhamnosus*

قام بتحكيم البحث

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