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Characterization of Soft Cheese Supplemented with Rice Bran Oil

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ABSTRACT

UF soft cheese was prepared from ultra-filtrated milk (11% fat) as a control.Rice bran oil (RBO) replaced milk fat at level 25,50,75 and 100%,the resultant cheese was stored for 4 weeks. The resultant cheese samples were stored at 5 ± 1 ° C for 4 weeks. The resulting cheese samples were analyzed for total solids, fats, pH values, acidity, total nitrogen, soluble nitrogen and total volatile fatty acids. The physical properties of the cheese were also estimated fresh and during storage. The rheological properties at the end of the storage period and the microbiological properties were analyzed. The obtained results indicated that the bacterial population increased gradually during the first and second week of storage, then decreased at the beginning of the third week of storage. White soft cheese manufactured with 25% RBO had excellent sensory properties similar to the control. Accordingly, the results showed that it is possible to prepare an alternative soft cheese with 25% of rice bran oil as an alternative to milk fat, so also characteristics of the resultant cheese are similar to the control, which had satisfactory properties with that the preferred body in addition to the health benefit of rice bran oil.

Keywords: UF cheese, soft cheese, Rice Bran Oil

INTRODUCTION

Rice is one of the most important crops throughout the world, as it contributes toward satisfying the food demand of much of the global population. It is well known that rice contains considerable number of by-products, among which rice bran deserves particular attention. UF Soft Cheese products are widely consumed for their benefits and refreshing effects. It could be saying that their popularity attributed to the effective use of consumer-driven flavors and milder cultures. These products already have a positive health imagewhich can be further enhanced by using of probiotic bacterial strain with therapeutic properties(Valli, and Traill, 2005, Jensen and Kroger, 2000 and Jensen and Kroger, 2000).

Rice bran (*Oryza sativa*) is a by-product of milling factories normally used as animal and poultry feed.Using of RBO and its fraction in food industry is recent trend. The most rice bran derived product is the oil made from the pericarp and germ of the *Oryza sativa* seeds. It also contains unsaturated fatty acids as oleic, linoleic acid and linolenic acids, and palmitic and stearic acids as saturated fatty acids. It contains also a rich unsaponifiable fractions as sterols, triterpene and alcohols Myristic, palmitic and stearic were also isolated from rice bran. Similar contents of unsaturated and monounsaturated fats in rice bran oil peanut oil was found.. Rice bran oil also contains about 2% omega 3 fatty acids (more than olive oil), and 33% omega 6 fatty acids. Its omega 6-to-omega 3 ratio is much higher than olive oil. A high omega 6-to-omega 3 ratio can be a factor in increasing inflammation (Orthoefer, 2005, Abbas, *et al*., Paul, *et al*.2012, and 2016 Silvia,2020).

Rice bran oil and its active constituents improve blood cholesterol by reducing total plasma cholesterol and triglycerides, and to increase the proportion of HDL cholesterol, and decreases the total cholesterol to 62% in LDL cholesterol, when researchers supplemented test subjects' diets (for animal) with fractionated vitamin E obtained from rice bran oil. Rice bran might help lower cholesterol because the oil it contains has substances that might decrease cholesterol absorption and increase cholesterol elimination. One of the substances in rice bran might decrease calcium absorption; this might help reduce the formation of certain types of kidney stones. [www.webmd.Com]. Abdel-Ghany*et al*. (2020) studied effect of rice bran oil on chemical composition, antioxidant activity and oxidative stability of full-fat, half fat and low-fat processed cheese.

So; the present paper was planned to investigate the physicochemical and microbiological properties of UF soft cheese product prepared by supplemented with rice bran oil.

MATERIALS AND METHODS

Ultrafiltrated skimmed milk (retentate) and cream were obtained from Dairy manufacture Unite, Animal Production Research Institute, Agriculture Research Center, Giza, Egypt. Rice bran oil (RBO) was obtained from THAI EDIBLE OIL Co., LTD, Product of Thailand. Its composition is serving size 1 Tbsp (15 ml); total fat 14 g (22%);saturated fat (18%) trans- fat (0%), Mono-saturated fat 6g, poly saturated fat 4.5g, cholesterol 0%.Sodium was 0%, total carbohydrate, fiber, sugars and protein were 0%; while vitamin E was 4%.

UF retentate milk was divided into five portions. First was applied as control (TS 37% and fat 11%). Milk fat

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in the four treatments was replaced with rice bran oil (RBO) at 25, 50, 75, 100 % (T1, T2, T3, T4), respectively. Soft white cheese was made according to Omar*et al*., (2016). Treated cheese was analyzed for chemical and organoleptical properties and during cold storage at (5˚C+1ºC) when fresh and after at, 1, 2, 4 weeks. Three replicates of each treatment were conducted.

Total solids, fat, titratable acidity, soluble nitrogen, total protein were determined according to AOAC (2012). The pH values were measured using a digital laboratory pH meter (H1 93/400, Hanna instruments) with glass electrode. Total volatile fatty acids (TVFA) content was determined according to (kosikowski, 1987).

The texture profile measurements of cheese samples were evaluated according to IDF (1991) using the double compression tester (Multitest 1d Memesin, Food Technology Corporation, Slim fold, W· Sussex, UK). A 25-mm-diameter perplex conical-shaped probe was used to perform the TPA analysis at five different points on the sample surface. The generated plot of force (N) versus time(s) was recorded. Hardness (N) = maximum force of the 1st compression, Springiness (mm) = length 2nd compression/length 1st compression (L2/L1), Cohesiveness = area under the 2nd compression/area under the 1st compression (A2/A1), Gumminess (N) = Hardness × cohesiveness and Chewiness (N*mm) = gumminess × springiness.

Total bacterial counts were enumerated using plate count agar medium (Oxoid). The plates were incubated at 37ºC for 48h (APHA, 1994). Moulds and yeasts were determined according to Standard methods for Examination of Dairy products (APHA, 1992), using Molt extract agar (oxoid) acidified to pH 3.5. Plates were incubated at 30ºC for 5 days.

Cheese samples were sensory evaluated as described by Scott, 1981.

RESULTS AND DISCUSSION

Table (1) revealed that total solids (TS) content of cheese samples made by replacing rice bran oil as a substitute for milk fat increased with the increase in the storage period, which might be attributed to natural evaporation and the development of acidity in the cheese samples. White soft cheese supplemented with 100% rice bran oil (T4) was of the lowest total solids content, followed by (T3). Replacing the milk fat with RBO did not affect the TS content. These results agreed with those reported by Abbas *et al.*(2016).

Table 1.Total solids content of UF soft cheese with Rice bran oil during the Storage periods

Cheese Treatments	Storage Period (weeks)				
	Fresh	1	2	3	4
C	37.18	37.87	38.16	38.38	38.82
T1	37.05	37.75	38.05	38.20	38.76
T2	36.90	37.59	38.02	38.16	38.59
T3	36.50	37.46	37.95	38.13	38.25
T4	36.48	36.85	36.86	37.07	37.14

C: Control cheese made without rice bran oil T1: Cheese made with 25% rice bran oil T2: Cheese made with 50% rice bran oil T3: Cheese made with 75% rice bran oil. T4: Cheese made with 100 % rice bran oil.

Results in Table (2) revealed that the effect of storage period on fat content of RBO-treated soft white cheese. The fat content was 10.8, 10.9, 11.2, 11.3, and 11.6% in fresh cheese (control, T1, T2, T3 and T4, respectively). The fat content increased with increasing the storage period. It was clear that cheese made by substitution of milk fat with 100% RBO(T4) was of the highest fat content at the end of storage of 4 weeks, depending on the loss of moisture. It could also be noticed that cheese made by replacing RBO at different concentrations had higher fat contents.

Table 2. Fat content of UF soft cheese with Rice bran oil during the Storage periods

Cheese Treatments	Storage Period (weeks)				
	Fresh	1	2	3	4
C	10.8	11.3	11.6	11.7	12.0
T1	10.9	11.5	11.8	12.1	12.2
T2	11.2	11.6	12.0	12.3	12.6
T3	11.3	11.8	12.1	12.5	12.7
T4	11.6	12.1	12.3	12.6	12.9

See Table 1

Data in Tables (3 and 4) revealed no differences among all treatments and control UF cheese in the pH values or titratable acidity however, slight decrease in the pH was observed in all treatments during the storage period. This might be due to the inverse relationship between the exponential values and the pH, which increases with increasing storage period. The control cheese characterized with the lowest of pH value and the highest titratable acidity, which might be due to the higher antimicrobial activity of rice bran oil (Friedman, 2013).

Table 3. Effect of Rice bran oil on pH values of UF soft cheese

Cheese Treatments	Storage Period (weeks)				
	Fresh	1	2	3	4
	pH values				
C	6.00	5.78	5.72	5.62	5.49
T1	6.02	5.82	5.77	5.67	5.51
T2	6.11	5.94	5.83	5.71	5.54
T3	6.14	6.05	5.88	5.74	5.63
T4	6.23	6.14	5.92	5.86	5.72

See Table 1

Table 4. Effect of Rice bran oil on titratable acidity percent of UF soft cheese

Cheese Treatments	Storage Period (weeks)				
	Fresh	1	2	3	4
	Acidity %				
C	0.40	0.51	0.58	0.64	0.69
T1	0.38	0.48	0.55	0.58	0.65
T2	0.37	0.46	0.52	0.56	0.62
T3	0.35	0.44	0.49	0.55	0.59
T4	0.32	0.39	0.43	0.47	0.56

See Table 1

Results in Table (5) indicate the total nitrogen (TN %) content in all UF treatments at 5 ° C ± 1°C during the storage period for 4 weeks. Slight decrease in the total nitrogen content was obtained with increasing the concentration of the substituted RBO with milk fat. The results showed gradual increase of TN up to the end of storage period in all UF soft cheese treatments. It could also be seen that the control treatment had the highest TN value, while the lowest was observed in T4.

Table 5.Total Nitrogen content of UF soft cheese supplemented with Rice bran oil during the Storage periods

Cheese Treatments	Storage Period (weeks)				
	Fresh	1	2	3	4
	TN %				
C	1.55	1.63	1.67	1.76	1.79
T1	1.51	1.61	1.66	1.73	1.76
T2	1.50	1.58	1.64	1.72	1.74
T3	1.48	1.55	1.61	1.71	1.73
T4	1.45	1.53	1.58	1.67	1.70

See Table 1

Results inTable (6) included the SN% content of the examined treatments of the soft white cheese, while fresh and throughout the storage period. SN% content increased during storage period. This is due to the rate of protein degradation which occurs during the storage, SN% increased by increasing the substitution rate with RBO. These results are agreement with Ramadan *et al*. (2014).

Table 6.Soluble Nitrogen content of UF soft cheese supplemented with Rice bran oil during the Storage periods

Cheese Treatments	Storage Period (weeks)				
	Fresh	1	2	3	4
	SN %				
C	0.051	0.105	0.118	0.123	0.135
T1	0.054	0.115	0.121	0.136	0.142
T2	0.058	0.127	0.132	0.139	0.146
T3	0.063	0.129	0.138	0.144	0.149
T4	0.068	0.135	0.145	0.148	0.156

See Table 1

The obtained results indicated that the TVFA content in soft cheese samples increased during the storage period in different treatments with an increasing RBO (table 7). This might be attributed to the lipolytic degradation and not the difference effect of replacing milk fat with RBO as reported by Halida*et al*., 2020. Cheese containing rice bran oil had higher TVFA content than the control cheese. Similar results were obtained by Abd El-Aziz *et al*. (2012). The ash content was higher in control cheese than all the other treatments. It was clear that ash content in fresh cheese decreased with increasing of RBO substitution (Table 8).

Table 7. Effect of Rice bran oil on the TVFA content of supplemented UF soft cheese.

Cheese Treatments	Storage Period (weeks)				
	Fresh	1	2	3	4
	TVFA (mg 0.1 Na OH/ 100g)				
C	8	14	15	17	22
T1	10	16	19	22	25
T2	12	17	20	23	28
T3	13.5	19	24	26	31
T4	15	19.5	25	28	32

See Table 1

Table 8. Ash Content of fresh UF soft cheese supplemented with Rice bran oil.

Cheese Treatments	Control	T1	T2	T3	T4
Fresh	6.23	6.14	6.11	6.02	6.0

See Table 1

Texture Profile Analysis (TPA):

Results in Table (9) summarize the different TPA curves. Hardness is commonly evaluated when determining the texture of a cheese. Hardness values of all UF soft cheese treatments increased with the increase of storage period. The hardness of the control was higher than all other cheese treatments. Similar results were reported by Abbas *et al.* (2017). The hardness of control white soft cheese was higher than the RBO cheese treatments due to the high total solids content of the control cheese, compared to the experimental cheeses, which agree with Calvo*et al.*2007and Karameh*et al.* 2009).

The cohesiveness was evidently taken the same trend of the hardness of the control cheese. Bhaskaracharya and Shah (1999) reported that the cheese with high protein content showed a higher consistency, which might explain the present result. using of RBO apparently decreased the springiness of soft white cheese made from concentrated ultrafiltrated milk; which depends on the level of RBO added. Thus the white cheese made with 100% RBO substitution was found to be of the the lowest purity.

Gumminess and chewiness of cheese samples were affected by the level of RBO. It was clear that gumminess and chewiness could be observed in the same trend of hardness. The control treatment had the highest gumminess and chewiness in fresh samples compared with the other treatments; this may be due to the high protein content in the sample of this treatment.

Table 9. Changes in the textural properties of UF soft cheese supplemented with rice bran oil.

Treatments	Hardness N	Cohesiveness Aerea (B/A)	Springines Mm	Gumminess N	Chewiness m/N
			Fresh		
Control	6.90	0.733	0.788	11.819	9.313
T1	6.60	0.716	0.771	9.544	7.358
T2	6.50	0.697	0.746	6.752	5.037
T3	6.10	0.679	0.725	6.179	4.479
T4	6.00	0.664	0.705	4.368	3.079
			After 4 weeks		
Treatments	Hardness N	Cohesiveness Aerea (B/A)	Springines Mm	Gumminess N	Chewiness m/N
Control	17.80	0.556	0.619	4.139	2.562
T1	13.20	0.550	0.574	3.588	2.063
T2	10.30	0.524	0.513	3.507	1.578
T3	9.90	0.433	0.456	2.750	1.411
T4	8.10	0.392	0.450	2.469	1.126

See Table 1

Data in Table (10) show that there are differences in the total viable bacterial counts between control treatment and the other treatments in soft cheese made from concentrated milk by ultrafiltration (UF), when fresh or during the storage periods at (5 ° C ± 1 ° C) up to 4 week. Besides, cheese made by using RBO had less total viable

bacterial counts when fresh and in the second week of storage period. This might be due to the higher antimicrobial activity of rice bran oil.

It could also be seen that the total viable bacteria for all UF soft cheeses increased in the examined fresh samples up to second weeks of the storage period, then decreased to reach the lowest number at the end of the storage period (4 weeks). These results came in agreement with the results obtained byKebary*et al*. (2015).

Yeast and mould began to appear after three weeks. Treatments of soft cheese with RBO had lower yeast and mould than that of control cheese. This may be due to the higher antimicrobial activity of rice bran oil (Friebman, 2013).

Table 10. Changes in microorganisms count of cheese supplemented with rice bran oil during storage period.

Properties	Treatments	Storage period (weeks)				
		Fresh	1w	2w	3w	4w
Total bacterial count (CFU/gm)	Control	$98x10^3$	$152x10^3$	$173x10^3$	$138x10^3$	$42x10^3$
	T1	$77x10^3$	$131x10^3$	$154x10^3$	$131x10^3$	$37x10^3$
	T2	$63x10^3$	$125x10^3$	$137x10^3$	$122x10^3$	$30x10^3$
	T3	$51x10^3$	$115x10^3$	$121x10^3$	$88x10^3$	$17x10^3$
	T4	$33x10^3$	$88x10^3$	$102x10^3$	$75x10^3$	$12x10^3$
Yeast&Mould	Control	ND	ND	ND	$19x10^1$	$32x10^1$
	T1	ND	ND	ND	$16x10^1$	$29x10^1$
	T2	ND	ND	ND	$11x10^1$	$25x10^1$
	T3	ND	ND	ND	$5x10^1$	$18x10^1$
	T4	ND	ND	ND	$2x10^1$	$12x10^1$

See Table 1

As with the sensory evaluation of the examined cheese, results in Table (11) show that soft cheese T1 has a good flavor and is very close to the control cheese, whether fresh or during storage. As for taste and flavor, no differences were obtained with respect to the pH of UF cheese and rice bran oil, which is likely to be close to that of control cheese. Similar results have been reported by Weimer, (2007). Appearance of the cheese made from ultrafiltrated milk supported with rice bran oil was closely similar to each other in T1, T2, T3, and T4, which are similar to the control treatment. Also, there was a clear convergence between cheese manufactured by substituting milk fat with rice bran oil in proportion (T1) and control cheese in terms of texture and composition, whether fresh or at the end of the storage period. In general, the highest overall score for the organoleptic properties of UF cheese without rice bran oil (control cheese), followed by substitution of fats with 25, 50, 75 and 100% rice bran oil respectively when fresh and at the end of the storage period (4th week). However, UF cheese with T1 rice bran oil was the same grade as control cheese until the end of the storage period. The shelf life of cheese generally depends on the hydrolysis of proteins and the formation of flavor compounds. It was mentioned that the texture is greatly influenced by the fat level, which in turn influences the consumers' perception in terms of the texture of the resulting cheese. The high fat content contributes to a poor protein build-up, and, accordingly, to an increase in the softness of the resulting cheese, while in other cases, it is undesirable to consumers who prefer firmer cheeses. This may correspond to higher fineness in higher fat cheese samples, and higher NPN / TN ratios. The tissue of high fat samples was generally described as "too soft" or "too liquid", which also led to the breakdown of the "truncated sample" during sensory evaluation by. In general, it is known that the consumer's perception of cheese is based on several factors, including appearance, smell, flavor and texture, which came in harmony with Hirslth *et al*. 2005 and Hirslth*et al*. (2005). Panelists in this study rated cheese samples according to appearance, smell, flavor, texture, and general acceptability on a nine-point scale ranging from "I don't like very much" to "I like very much".

Table 11. Effect of Rice bran oil on the sensory evaluation of UF soft cheese

Cheese Treatments	Storage Period (weeks)					Storage Period (weeks)					Storage Period (weeks)					Storage Period (weeks)				
	Fresh	1	2	3	4	Fresh	1	2	3	4	Fresh	1	2	3	4	Fresh	1	2	3	4
	Flavour (50)					Body and Texture (40)					Appearance (10)					Total score (100)				
C	48	48	47	46	46	39	39	39	38	37	10	10	10	10	9	97	97	96	94	92
T1	47	46	45	44.5	44	39	39	39	37	37	10	10	10	9.5	9	96	95	94	91	90
T2	47	45	45	43	42	37	37.5	36	36	33	10	9.5	9	9	9	94	92	90	88	84
T3	45	44	45	40	40	36	36	33	33	31	10	9	9	9	8	91	89	87	82	79
T4	43	41	41	38	36	34	32	30	30	30	10	9	9	9	8	87	82	80	77	74

C: Control cheese made without rice bran oil T1: Cheese made with 25% rice bran oil T2: Cheese made with 50% rice bran oil T3: Cheese made with 75% rice bran oil. T4: Cheese made with 100 % rice bran oil.

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إنتاج جبن أبيض طرى مدعم زيت نخالة الأرز

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تم تصنيع الجبن الطري من اللبن المركز بتكنولوجيا الترشيح الفائق UF (١١٪ دهن). تم تصنيع الجبن من اللبن المركز وبدون إحلال لدهن اللبن كمعاملة كنترول (معاملة المقارنة). تم خلط وتجنيس اللبن المركز (retentate) مع ٢٥،٥٠،٧٥،١٠٠٪ زيت نخالة الأرز التجاري (RBO) لتصنيع أربع معاملات (T1 ، T2، T3، T4) على التوالى. تم تخزين عينات الجبن الناتجة عند ٥ ± ١ درجة مئوية لمدة ٤ أسابيع. تم تحليل عينات الجبن الناتجة من حيث المواد الصلبة الكلية، الدهن، قيم الأس الهيدروجيني، الحموضة، النيتروجين الكلي، النيتروجين الذائب واجمالي الأحماض الدهنية الطيارة طازجا وخلال فترة التخزين (٤ أسابيع). كما تم اختبار الجبن الناتج للخصائص الريولوجية طازجًا وفي نهاية فترة التخزين فقط. تم تحليل الخواص الميكروبيولوجية، وأظهرت النتائج التي تم الحصول عليها زيادة كل من الجوامد الكلية، الدهن، النيتوجين الكلى، البتروجين الذائب والأحماض الدهنية الطيارة خلال مدة التخزين. كان هناك تطور للحموضة وانخفاض لقيم الـpH فى جميع عينات الجبن أثناء فترة التخزين. كما تحسنت الخواص الريولوجية للجبن الناتج. زاد العدد الكلى للبكتيريا تدريجياً خلال الأسبوع الأول والثاني من التخزين ثم تناقصت الأعداد في بداية الأسبوع الثالث. لم يتم ظهور للفطريات والخمائر إلا مع بداية الأسبوع الثالث من التخزين. كان للجبن المصنع من اللبن المركز باستبدال ٢٥% من دهن اللبن بزيت نخالة الارز (T1) خصائص حسية ممتازة والتي كانت قريبة جدًا من معاملة الكنترول. وبناءًا عليه، فمن الممكن إنتاج الجبن الابيض الطري بنجاح بنسبة ٢٥٪ من زيت نخالة الأرز كبديل لدهن اللبن، بحيث تكون خصائص الجبن الناتج مماثلة للجبن المصنع من اللبن المركز وبدون استبدال لدهن اللبن والتي أعطت خصائص مرضية ومقبولة بالإضافة إلى الفوائد الصحية لزيت نخالة الأرز.