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Physicochemical, Microbiological, And Sensorial Attributes of Rice bran or Soybean Oils Substituted Probiotic Soft Cheese Fat

Khaled G. EL-barbary, ELsayed A. Ismail, Abdelaty M. Abdelaty and Mohamed B. El-Alfy
Dairy Sci. Department., Faculty ofAgriculture., Moshtohor, Benha University, Egypt.
E-Mail: elbarbarykhaled11@gmail.com

Abstract

The present study was conducted to substitute cheese milk fat with soybean [represent the low-cost product] or rice bran oils [represent the expensive product], at a level of 25, 50 and 75%, besides to full fat control cheese [5% fat]. The experimental cheese samples were stored at 5±1ºC for three months, and chemically, microbiologically, and sensory evaluated at intervals of 0, 15, 30, 45, 60 and 90 days. The obtained results revealed that the substitution with 75% Rice bran oil treatments recorded the highest score points followed by 75% soybean oil. So, it was possible to produce 75% soybean oil substituted soft cheese [low-cost products] nearly with the same properties of the expensive cheese substituted with rice bran oil. Both soybean and rice bran oil substituted soft cheese fat were more preferred than the control and represent the shift toward reduced-fat or cholesterol-free, higher antioxidants, dietary fiber and phytoconstituents. Moreover, the health benefits of substituting cheese milk fat with such experimental oils.

Keywords: Soft cheese, Rice bran oil, Soybean oil, Probiotics

Introduction

Cheese is an integral part of the daily consumed diet, in Egypt; most Egyptians are familiar with both soft and hard types of cheese. moreover, fresh soft cheeses are very often produced domestically, and the production of soft cheese in Egypt accounted for 75% of total cheese production in 2020 **(European Union 2019 and Farrag *et al.*, 2020).** Cheese has various health benefits such as Angiotensin-converting enzyme (ACE) inhibitory properties, due to the presence of lactic acid bacteria, including probiotic strains. **(Hao *et al*., 2021).** In general fat consumption has been shown to be associated with an increased risk of obesity, atherosclerosis, coronary heart disease, elevated blood pressure, and tissue injury diseases associated with lipid oxidation **(Katsiari *et al.*, 2002).** Nowadays, according to the good nutritive health awareness of consumers, which make headway to produce low or free fat dairy product, this has led to impetus of finding fat replacers that act as fat substitutes and provide the same functional quality characteristic and have the same sensorial attributes. Therefore, there is a looking forward to plant-based dairy options and trends of demand for healthy and functional cheese. The present study aimed to involve the substation of cheese milk fat with two vegetable oils, one of them is Soybean oil which is a cheaper price, and the other is Rice bran oil which is expensive. Rice bran oil and its active constituents improve blood cholesterol by reducing total plasma cholesterol and triglycerides, because the oil contains substances that might decrease cholesterols 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 **(Silvia *et al.*, 2020).** Soybean oil is one of the main oils that contains high amounts of monounsaturated and polyunsaturated fatty acids (MUFA and PUFA). This specific fatty acid composition helps to reduce blood cholesterol fractions, thus lowering the risk of heart disease. **Naz *et al.*, (2005).** Soybean oil contains a high amount of unsaturated fatty acids important in the human nutrition: α-linolenic acid (omega-3 acid), linoleic, γ-linolenic and arachidonic acid (omega-6 acid), and oleic acid known as omega-9 **(Nikolic *et al.* 2009 and Olguin *et al.* 2003).** So, the present study was aimed to substitute cheese milk fat with rice bran or soybean oils at a level of 25, 50 and 75% for manufacturing acceptable quality of soft cheese besides to the health benefits based on comparing two of the most used oils all over the world.

Materials and Methods

Materials

Fresh mixed Cow's and Buffalo's milk (1:1) were obtained from the herds of Moshtohor, Fac., of Agric., Benha Univ. rice brane oil was obtained from local market, which important limited serin bran oil company, tayland. soybean oil was obtained from Aram Lubricants, 10th of Ramadan City. Emulsifier and Stabilizer. (Maltodextrin - mono and di glyceride) were obtained from Misr food Additives (MIFAD) company, Badr industrial city, Egypt. Freeze dried conventional yoghurt starter culture (FD-DVS YC-X11-YoFlex) containing *Streptococcus thermophilus and Lactobacillus delbrueckii ssp. bulgaricus* (1:1) was obtained from Chr. Hansen's Laboratories, Copenhagen, Denmark and purchased from MIFAD Company, Egypt. Freeze dried isolate of *Lactobacillus plantarum* 16 used in this study were obtained from Institute of Microbiology, Federal Research Center for Nutrition and Food, Kiel, Germany. Rennet was obtained from the Dairy Sci., Dept., Fac., of Agric., Moshtohor. A commercial pure fine grade table salt was obtained

from El Naser Company, Egypt. Potassium sorbate was obtained from El-Gomhoria Co., Cairo, Egypt.

Methods

Making soft cheese

The experimental substituted fresh milk fat either by rice bran or soybean oil at a level of 0, 25, 50, and 75%, [which represented by C, R25, S25, R50, S50, R75 and S75 as treatments]. all milk treatments were blended with 0.2% w/w mono and di glyceride as emulsifier and 1% w/w maltodextrin as stabilizer then pasteurized at 72 ±1ºC for 5min, cooled to 40-42ºC and used for cheese manufacture according to **EL-Alfy *et.al.*, (2010)** with same modification as follows: 2% of starter culture (yoghurt starter + *lactobacillus plantarum*) and 4% of salt were added. required amount of standard rennet solution was added and kept at 40°C until complete coagulation. The cheese curd was filled in perforated moulds ½Kg capacity and was left overnight to drain whey by the gravity. The moulds turned upside down and left up to 4 hours. The moulds then taken out and the resultant cheese stored refrigerated 5±1ºC with sterilized 4% brine solution in a plastic container. Cheese samples were analyzed when fresh and after 15, 30, 45, 60 and 90 days, respectively for chemical, microbiological, and organoleptic properties**.**

Chemical analysis

Total solids, ash, titratable acidity, pH values, fat and salt were determined according to the methodology mentioned in **IDF (1987), AOAC (2012), IDF (1996) and BSI (1989),** respectively. Total nitrogen (T.N), Soluble nitrogen (S.N) were determined according to **AOAC (2012)**. Total volatile fatty acids (TVFA) according to **Kosikowski (1978)**. Shilovich ripening indices according to **Abd El-Tawab and Hofi (1966).**

Microbiological analysis

Total bacterial counts were counted as described by **IDF (1991).** Lactobacilli counts were performed on MRS agar and incubated anaerobically at 37ºC. Yeast and mold counts were enumerated as described by **APHA (2004).** Coliform bacterial group was tested as suggested by the **BSI (1993).**

Sensory evaluation

Organoleptic evaluations were done by 10 experienced Food members of Dairy Sci., Dept., Fac., of Agric., Moshtohor, Benha Univ., Egypt. according to the scheme described by **IDF (1997).**

Statistical analysis

All data were expressed as means ± stander error of means (SEM) and were subjected to analysis of variance (ANOVA) using **SAS (2004).** Duncan multiple-rang test ($P<0.05$) was used to define the differences among treatment groups. The applied static model was as follows: $Xijk= \mu + Ti + eijk$, whereas: μ = Overall mean, Ti = Effect of the i^{th} treatment (i, 1-3), eijk = Random error associated with the individual observation.

Results and Discussion

Chemical composition

Chemical composition of the cheese milk used for various treatments is shown in **Table [1].** The obtained data represents T.S., fat, protein, lactose % and pH & acidity for the full fat milk 3/4, 2/4 and 1/4 fat milk. Table [1]

Results of titratable acidity and pH values of different cheese samples are presented in Fig. [1] which revealed a significant increase ($P<0.05$). of cheese samples acidity all over the storage period up to 90 days. The full fat control cheese had the highest values of titratable acidity either when fresh or throughout the storage period followed by 25, 50, and 75% oil substituted in the same order for both rice bran and soybean oils cheese treatments. The values of titratable acidity were also non-significant less in soybean compared with that of rice bran oil cheese treatments ($P<0.05$). This is due to the adverse effect of soybean oil on the activity of lactic acid bacteria (Abd EL-Halim et al., 2007 .(

On the opposite, pH values of all cheese treatments were significantly decreased by progressing of the storage time at the same normal trend of titratable acidity ($P<0.05$). Khalil et al 2022 & Abdel-Salam and Alichanidis (2004). reported that during storage of cheese lactic acid bacteria could produce alkaline acidic proteolytic products and affect the balance between proteolysis and acid production.

Moreover, significant increase of titratable acidity and decrease of pH values for all cheese treatment throughout the storage period up to 90 days could be due to accumulation of lactic and other organic acids produced by starter culture and or metabolic activity of probiotic strains Astawan et al., (2012) and Gamage et al., (2016). Fig. [1]

Table (1) Chemical composition of the cheese milk used for various treatments.

Parameter	Milk			
	Full Fat	**3/4 Fat**	**2/4 Fat**	**1/4 Fat**
%Total solid	14.5	13.3	12	10.8
% Fat	5	3.7	2.5	1.2
% Protein	3.91	3.88	3.85	3.82
% Ash	0.85	0.84	0.82	0.80
% Lactose	4.74	4.88	4.83	4.98
% Acidity	0.14	0.15	0.16	0.16
pH value	6.65	6.63	6.61	6.60
Specific gravity	1.032	1.033	1.034	1.035

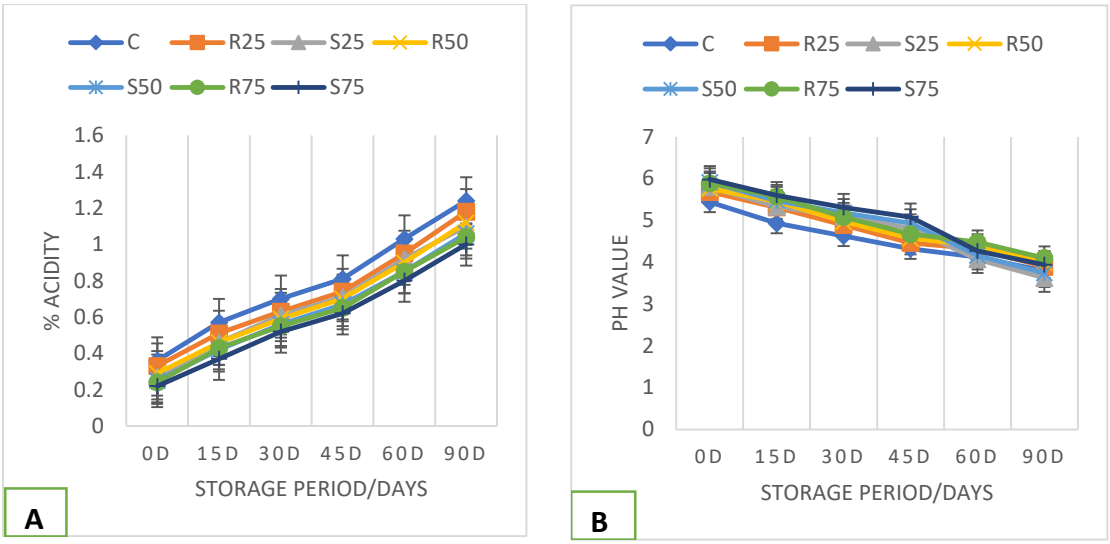


Fig (1) Titratable acidity (A) and pH (B) values of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during storage at 5±1ºC up to 90 days. C: Control full-fat cheese milk 5% fat + Yoghurt starter (2%) ,**R25**: substituted 25% of milk fat by Rice bran oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **S25**: substituted 25% of milk fat by Soyabean oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **R50**: substituted 50% of milk fat by Rice bran oil + Yoghurt starter+ *Lactobacillus plantarum* (1:1), **S50**: substituted 50% of milk fat by Soyabean oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **R75**: substituted 75% of milk fat by Rice bran oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **S75**: substituted 75% of milk fat by Soyabean oil + Yoghurt starter + *Lactobacillus plantarum* (1:1).

The moisture content slightly differ among fresh control and other cheese treatments. The moisture content did not differ significantly (P<0.05). among fresh cheese treatment and ranged from 66.33 to 67.71% for 25% and 75% oil replacement of both rice bran and soybean oil cheese treatments. The non-significant differences among the cheese treatments may be due the differences in protein content, of such cheese, the kind of oil added and its ability of holding moisture **(Abd EL-Halim *et al.*, 2007).**

During storage, the moisture content of cheese treatments decreased gradually and the values of T.S in **Table (2**) significantly increased (P<0.05). and this could be attributed to the contraction of the curd due to acidity development during the storage period, which led to whey expelling from the interior of the cheese body **Abd-Rabou *et al.*, (2016).** Moreover, probiotic soft cheese substituted with 75% rice bran or soybean oil were the lowest total solid contents followed by the substituted level of 50% as recorded by **Nasr *et al* (2020).** who recorded the same meaning for rice bran oil at substitution level of 100%. Table (2)

Table (2) Total solids content of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during cold storge at 5±1ºC up to 90 days.

Treatments		Storage Period (days) 5±1ºC					
		0	15	30	45	60	90
		%T. S					
C		33.67^{Da}	35.73^{Ca}	36.61^{BCa}	37.72^{ABa}	38.44^{ABa}	39.28^{Aa}
25% Oil	R25	32.97^{Dab}	35.00^{Cab}	36.16^{BCab}	37.23^{ABab}	37.96^{ABa}	38.66^{Aa}
	S25	32.86^{Dab}	34.75^{Cab}	35.75^{BCab}	36.73^{ABab}	37.73^{Aa}	38.45^{Aab}
50% Oil	R50	32.58^{Dab}	34.56^{CDab}	35.71^{BCab}	36.80^{ABab}	37.59^{ABa}	38.46^{Aab}
	S50	32.56^{Dab}	34.37^{Cab}	35.41^{BCab}	36.41^{ABab}	37.29^{Aa}	38.17^{Aab}
75% Oil	R75	32.24^{Dab}	34.07^{CDab}	35.49^{BCab}	36.65^{ABab}	37.42^{ABa}	38.18^{Aab}
	S75	32.29^{Dab}	34.11^{Cab}	35.13^{BCab}	36.11^{ABab}	37.04^{Aa}	37.87^{Aab}

$^{A, B, C}$, ….: Means with same letter for same treatment during storage period are not significantly different (P<0.05). $^{a, b, c,}$ ….....: Means with same letter among treatments in the same storage period are not significantly different (P<0.05).

The fat and Fat/DM content of rice bran, and soybean oil substituted soft cheese are presented in **Table (3).** The fat content of various treatments significantly increased along the storage period up to 90 days (P<0.05). to had the highest fat contents, depending on the loss of moisture as mentioned by **Nasr *et al.*, (2020).** The control full fat cheese recorded a slight higher fat content than other fresh or stored treatments substituted either by soybean or rice bran oil, and this could be attributed to the kind of oil and its ability of holding moisture as recorded by **Abd EL-Halim et al., (2007). Table (3)**

Data presented in **Table (4)** revealed no significant differences in protein and protein/dry matter content among treatments of substituted soft cheese with soybean or rice bran oil at levels of 25, 50, and 75% (P<0.05). Protein and protein/dry matter content had slightly significant increase throughout the storage period to be the highest values at 90 days (P<0.05). The increase of protein content could be attributed mainly to loss of moisture during cheese storage **Milani *et al.*, (2014) & Khalifa *et al.*, (2017).**

Table (3) Fat and Fat/DM content of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during cold storge at 5±1ºC up to 90 days.

Treatments		Storage Period (days) 5±1ºC					
		0	15	30	45	60	90
		%Fat					
C		13.80^{Fa}	15.35^{Ea}	16.50^{Da}	17.30^{Ca}	18.10^{Ba}	19.25^{Aa}
25% Oil	R25	13.40^{Eab}	14.85^{Dab}	15.90^{Cb}	16.80^{Bab}	17.35^{Bbc}	18.65^{Ab}
	S25	13.35^{Fab}	14.75^{Ebc}	15.95^{Db}	16.75^{Cab}	17.53^{Bab}	18.70^{Ab}
50% Oil	R50	12.93^{Ebc}	14.55^{Dbc}	15.50^{Cbc}	16.40^{Bbc}	16.90^{Bbcd}	18.10^{Acd}
	S50	12.95^{Fbc}	14.30^{Ebcd}	15.45^{Dbc}	16.30^{Cbc}	17.10^{Bbcd}	18.30^{Abc}
75% Oil	R75	12.50^{Fc}	14.20^{Ecd}	15.10^{Dc}	15.85^{Cc}	16.50^{Bd}	17.75^{Ad}
	S75	12.50^{Fc}	13.85^{Ed}	15.05^{Dc}	15.90^{Cc}	16.65^{Bcd}	17.70^{Ad}
		%Fat/DM					
C		40.99^{Ea}	42.96^{Da}	45.08^{Ca}	45.87^{Ca}	47.09^{Ba}	49.00^{Aa}
25% Oil	R25	40.64^{Eab}	42.43^{Dab}	43.99^{Cabc}	45.14^{Bab}	45.71^{Bbc}	48.24^{Aa}
	S25	40.62^{Fab}	42.44^{Eab}	44.63^{Dab}	45.61^{Cab}	46.61^{Bab}	48.63^{Aa}
50% Oil	R50	39.73^{Ebc}	42.10^{Dbc}	43.42^{Cbc}	44.58^{Bbc}	44.97^{Bcd}	47.06^{Abc}
	S50	40.09^{Fabc}	41.61^{Ec}	43.64^{Dbc}	44.76^{Cabc}	45.84^{Bbc}	47.93^{Aab}
75% Oil	R75	38.75^{Ed}	41.68^{Dbc}	42.57^{CDc}	43.39^{BCd}	44.12^{Bd}	46.49^{Ac}
	S75	39.18^{Fcd}	40.60^{Ed}	42.85^{Dc}	43.72^{Ccd}	44.93^{Bcd}	46.73^{Ac}

$^{A, B, C}$, ….: Means with same letter for same treatment during storage period are not significantly different (P<0.05). $^{a, b, c,}$ …....: Means with same letter among treatments in the same storage period are not significantly different (P<0.05).

Table (4) Protein and Protein/DM content of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during cold storge at 5±1ºC up to 90 days.

Treatments		Storage Period (days) 5±1ºC					
		0	15	30	45	60	90
		%Protein					
C		11.38^{Da}	12.29^{CDa}	12.69^{BCa}	13.20^{ABCa}	13.63^{Aa}	13.97^{Aa}
25% Oil	R25	11.22^{Da}	12.09^{CDa}	12.57^{BCa}	13.08^{ABCa}	13.50^{Aa}	13.87^{Aa}
	S25	11.18^{Da}	12.08^{CDa}	12.52^{BCa}	13.08^{ABCa}	13.47^{Aa}	13.83^{Aa}
50% Oil	R50	11.17^{Da}	11.98^{CDa}	12.51^{BCa}	13.03^{ABCa}	13.46^{Aa}	13.84^{Aa}
	S50	11.10^{Da}	12.02^{CDa}	12.47^{BCa}	13.02^{ABCa}	13.42^{Aa}	13.79^{Aa}
75% Oil	R75	11.11^{Da}	11.92^{CDa}	12.48^{BCa}	12.99^{ABCa}	13.44^{Aa}	13.80^{Aa}
	S75	11.03^{Da}	11.96^{CDa}	12.42^{BCa}	12.98^{ABCa}	13.37^{Aa}	13.74^{Aa}
		%Protein/DM					
C		33.78^{Ba}	34.37^{ABa}	34.64^{ABa}	34.97^{Aa}	35.43^{Aa}	35.55^{Aa}
25% Oil	R25	34.03^{Ba}	34.53^{ABa}	34.74^{ABa}	35.14^{Aa}	35.58^{Aa}	35.86^{Aa}
	S25	33.88^{Ba}	34.73^{ABa}	34.99^{ABa}	35.60^{Aa}	35.74^{Aa}	35.96^{Aa}
50% Oil	R50	34.27^{Ba}	34.63^{ABa}	35.00^{ABa}	35.39^{Aa}	35.77^{Aa}	35.96^{Aa}
	S50	34.09^{Ba}	34.95^{ABa}	35.19^{ABa}	35.73^{Aa}	35.95^{Aa}	36.10^{Aa}
75% Oil	R75	34.46^{Ba}	34.90^{ABa}	35.14^{ABa}	35.46^{Aa}	35.88^{Aa}	36.12^{Aa}
	S75	34.16^{Ba}	35.04^{ABa}	35.32^{ABa}	35.91^{Aa}	36.06^{Aa}	36.26^{Aa}

$^{A, B, C}$, ….: Means with same letter for same treatment during storage period are not significantly different (P<0.05). $^{a, b, c,}$ …....: Means with same letter among treatments in the same storage period are not significantly different (P<0.05).

Salt content and salt-in moisture ratio also followed the same pattern of other cheese constituents, there were significant increase (P<0.05). in salt content during storage period of both substituted soft cheese with rice bran or soybean oil treatments presented in **Table [5]**. The increase in salt content due to the loss of moisture during storage which confirmed by **ALgarni (2016). Table [5]**

Ash and Ash/Dry matter content of control and substituted soft cheese with soybean oil or rice bran oil are greatly associated with moisture contents, and the significant increase (P<0.05). could be attributed to loss of moisture along the storage period as recorded by **Saad and Abd-Salam (2015)** presented in **Table [6].** The increase in Ash/DM is also due to the increase of salt content of the cheese **Abd EL-Halim (2007). Table [6]**

Table (5) Salt and Salt -in moisture content of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during cold storge at 5±1ºC up to 90 days.

Treatments		Storage Period (days) 5±1ºC					
		0	15	30	45	60	90
		%Salt					
C		4.06^{Fd}	4.30^{Ef}	4.46^{Df}	4.61^{Cf}	4.77^{Bf}	4.97^{Ad}
25% Oil	R25	4.20^{Fabc}	4.52^{Ebc}	4.69^{Dbc}	4.78^{Cbc}	4.88^{Bcd}	5.11^{Ac}
	S25	4.13^{Fc}	4.35^{Eed}	4.56^{Ddef}	4.71^{Ced}	4.81^{Bdef}	5.08^{Ac}
50% Oil	R50	4.25^{Eab}	4.60^{Dab}	4.77^{Cab}	4.84^{Cab}	4.96^{Bb}	5.19^{Ab}
	S50	4.16^{Fbcd}	4.40^{Eed}	4.61^{Dcde}	4.75^{Ccd}	4.86^{Bcde}	5.13^{Abc}
75% Oil	R75	4.29^{Ea}	4.65^{Da}	4.82^{Ca}	4.90^{Ca}	5.04^{Ba}	5.30^{Aa}
	S75	4.20^{Fabc}	4.45^{Ecd}	4.65^{Dbcd}	4.81^{Cbc}	4.91^{Bbc}	5.18^{Ab}
		%Salt -in- moisture					
C		6.11^{Fab}	6.69^{Ebc}	7.03^{Dab}	7.41^{Cab}	7.75^{Bab}	8.19^{Abc}
25% Oil	R25	6.27^{Ea}	6.96^{Dab}	7.37^{Ca}	7.62^{BC}	7.86^{Bab}	8.33^{Aab}
	S25	6.15^{Eab}	6.67^{Dbc}	7.09^{Cab}	7.44^{Bab}	7.72^{Bab}	8.25^{Abc}
50% Oil	R50	6.30^{Ea}	7.03^{Da}	7.42^{Ca}	7.68^{BCa}	7.95^{Bab}	8.43^{Aab}
	S50	6.17^{Eab}	6.70^{Dbc}	7.13^{Cab}	7.47^{BCab}	7.75^{Bab}	8.29^{Aab}
75% Oil	R75	6.33^{Ea}	7.06^{Da}	7.48^{Ca}	7.70^{BCa}	8.06^{Ba}	8.57^{Aa}
	S75	6.20^{Eab}	6.76^{Dabc}	7.17^{Ca}	7.53^{Bab}	7.79^{Bab}	8.34^{Aab}

$^{A, B, C}$, ….: Means with same letter for same treatment during storage period are not significantly different (P<0.05). $^{a, b, c,}$ …....: Means with same letter among treatments in the same storage period are not significantly different (P<0.05).

Table (6) Ash and Ash/DM content of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during cold storge at 5±1ºC up to 90 days.

Treatments		Storage Period (days) 5±1ºC					
		0	15	30	45	60	90
		%Ash					
C		3.83^{Fa}	4.08^{Ea}	4.21^{Db}	4.39^{Ca}	4.57^{Ba}	4.65^{Aa}
25% Oil	R25	3.74^{Fb}	3.99^{Eb}	4.15^{Dbc}	4.32^{Cb}	4.44^{Bb}	4.60^{Aab}
	S25	3.64^{Fcd}	3.81^{Ed}	4.03^{Dde}	4.20^{Cbc}	4.36^{Bbcd}	4.50^{Acd}
50% Oil	R50	3.69^{Fbc}	3.93^{Ebc}	4.08^{Dcd}	4.26^{Cbc}	4.39^{Bbc}	4.56^{Aabc}
	S50	3.58^{Fde}	3.82^{Ede}	3.98^{De}	4.15^{Cc}	4.30^{Bcd}	4.46^{Ad}
75% Oil	R75	3.64^{Fbcd}	3.87^{Ecd}	4.04^{Dcde}	4.23^{Cbc}	4.35^{Bcd}	4.55^{Abcd}
	S75	3.52^{Fe}	3.75^{Ee}	3.94^{Df}	4.10^{Cd}	4.26^{Bd}	4.41^{Ad}
		%Ash/DM					
C		11.37^{Fa}	11.41^{Ea}	11.49^{Da}	11.63^{Ca}	11.88^{Ba}	11.93^{Aa}
25% Oil	R25	11.34^{Fb}	11.40^{Ea}	11.47^{Da}	11.60^{Cb}	11.69^{Bb}	11.89^{Ab}
	S25	11.07^{Fcd}	11.18^{Ec}	11.27^{Dde}	11.43^{Cc}	11.55^{Bd}	11.70^{Ad}
50% Oil	R50	11.32^{Fbc}	11.37^{Eb}	11.42^{Db}	11.57^{Cbc}	11.67^{Bb}	11.85^{Abc}
	S50	10.99^{Fde}	11.11^{Ed}	11.23^{Dd}	11.39^{Ccd}	11.53^{Bd}	11.68^{Ad}
75% Oil	R75	11.29^{Fbcd}	11.35^{Eb}	11.38^{Dc}	11.54^{Cbc}	11.62^{Bc}	11.83^{Ac}
	S75	10.90^{Fe}	10.99^{Ee}	11.21^{Dd}	11.35^{Cd}	11.48^{Be}	11.64^{Ae}

$^{A, B, C}$, ….: Means with same letter for same treatment during storage period are not significantly different (P<0.05). $^{a, b, c,}$ …....: Means with same letter among treatments in the same storage period are not significantly different (P<0.05).

Cheese ripening indices:

According to the ripening indices and the produced compounds, the cheese can be classified according to their content of such components, *i.e*., soluble nitrogen (SN), soluble nitrogen/total nitrogen (SN/TN), total volatile fatty acids (TVFA) and Shilovish ripening index.

Soluble nitrogen content and its proportion to the total nitrogen of substituted soft cheese fat with soybean or rice bran oil, when fresh and throughout the storage period. The ratios of SN and SN/TN significantly increased in all cheese treatments during storage (P<0.05) presented in **Table [7]**. SN increased by increasing the soft cheese substitution rate of rice bran and soybean oil as recorded by **Ramadan *et al.*, (2014).**

Rice bran oil treatments recorded slightly significant higher SN and SN/TN content than the Soybean oil treatments (P<0.05). The remarkable increase of SN and SN/TN for both oils content could be due to the activity of proteases and peptidases released by the starter culture, which markedly increase proteolysis of cheese treatments and hence will be reflected on the cheese quality and the sensory properties of the produced cheese **(EL-Alfy *et al.*, 2004) & (Nasr, *et al* 2020). Table [7]**

The obtained results in **Table [8]** indicated that the Shilovish ripening index was higher in fresh cheese treatments than the control full fat cheese, then there was gradual significant increase in Shilovish ripening index along the storage period up to 90 days for both control and cheese treatments (P<0.05). Moreover, cheese treatments recorded the highest values of Shilovich ripening index than the control. This mainly due to the effect of proteases elaborated by the added probiotic starter culture to the experimental cheeses, and the production of peptides and amino acids as a result of protein hydrolysis and hence reflects the significant increase of Shilovich ripening index (P<0.05), which is correlated together with flavour of cheese treatments as reported by **Mehanna *et al.*, (2009).**

Table (7) Soluble Nitrogen and S.N/TN content of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during cold storge at 5±1ºC up to 90 days.

Treatments		Storage Period (days) 5±1ºC					
		0	15	30	45	60	90
		%SN					
C		0.22^{Fde}	0.31^{Ede}	0.38^{Dde}	0.44^{Ccd}	0.53^{Bbc}	0.62^{Aed}
25% Oil	R25	0.26^{Ebcd}	0.34^{Dcd}	0.42^{Ccd}	0.50^{Babc}	0.55^{Babc}	0.67^{Abcd}
	S25	0.23^{Ecde}	0.32^{Dd}	0.39^{Ced}	0.48^{Bbcd}	0.53^{Bbc}	0.64^{Acde}
50% Oil	R50	0.29^{Eab}	0.38^{Db}	0.48^{Cab}	0.54^{Bab}	0.59^{Babc}	0.69^{Abc}
	S50	0.27^{Ebc}	0.36^{Dbc}	0.45^{Cbc}	0.51^{BCabc}	0.56^{Babc}	0.67^{Abcd}
75% Oil	R75	0.32^{Ea}	0.42^{Da}	0.52^{Ca}	0.57^{Ca}	0.63^{Ba}	0.75^{Aa}
	S75	0.30^{Fab}	0.39^{Eb}	0.49^{Dab}	0.56^{Cab}	0.60^{Bab}	0.71^{Aab}
		%SN/TN					
C		12.58^{Fed}	16.08^{Ee}	19.34^{De}	21.52^{Cd}	24.78^{Bcd}	28.29^{Ae}
25% Oil	R25	14.75^{Fcd}	17.93^{Ec}	21.56^{Dc}	24.34^{Cc}	26.15^{Bc}	30.81^{Ac}
	S25	13.40^{Fde}	16.89^{Ed}	20.15^{Dd}	23.57^{Cc}	25.27^{Bcd}	29.50^{Ad}
50% Oil	R50	16.53^{Fb}	20.52^{Eb}	24.48^{Db}	26.63^{Cb}	28.20^{Bb}	32.29^{Ab}
	S50	15.47^{Fbc}	20.17^{Eb}	24.58^{Db}	26.43^{Cb}	28.70^{Bab}	32.19^{Ab}
75% Oil	R75	18.33^{Fa}	22.78^{Ea}	26.86^{Da}	28.17^{Ca}	29.90^{Ba}	34.91^{Aa}
	S75	16.75^{Fb}	20.26^{Eb}	24.68^{Db}	26.51^{Cb}	28.82^{Bab}	32.97^{Ab}

$^{A, B, C}$, ….: Means with same letter for same treatment during storage period are not significantly different (P<0.05). $^{a, b, c,}$ …....: Means with same letter among treatments in the same storage period are not significantly different (P<0.05).

Table (8) Shilovish ripening index content of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during cold storge at 5±1ºC up to 90 days.

Treatments		Storage Period (days) 5±1ºC					
		0	15	30	45	60	90
		%Shilovish Ripening Index					
C		16.37^{Fcd}	21.35^{Ecd}	26.75^{Dde}	30.45^{Cbc}	33.25^{Be}	39.25^{Acd}
25% Oil	R25	18.75^{Eabc}	23.30^{Dabc}	28.20^{Ccd}	31.91^{Bb}	35.50^{Bcde}	40.50^{Abcd}
	S25	17.60^{Ebc}	22.00^{Dbc}	27.85^{Ccd}	31.10^{BCb}	34.45^{Bde}	39.25^{Acd}
50% Oil	R50	20.50^{Eab}	25.25^{Dab}	31.25^{Cabc}	35.60^{Ba}	37.20^{Bbc}	43.65^{Aab}
	S50	19.00^{Eabc}	24.65^{Dabc}	30.25^{Cbc}	34.75^{Ba}	36.30^{Bbcd}	42.45^{Aabc}
75% Oil	R75	21.80^{Ea}	26.70^{Da}	33.90^{Ca}	37.35^{Ba}	39.60^{Ba}	45.90^{Aa}
	S75	20.75^{Eab}	25.95^{Dab}	33.00^{Cab}	36.70^{Ba}	38.10^{Bab}	44.70^{Aa}

$^{A, B, C}$, ….: Means with same letter for same treatment during storage period are not significantly different (P<0.05). $^{a, b, c,}$ …...: Means with same letter among treatments in the same storage period are not significantly different (P<0.05).

The total volatile fatty acids (TVFA) of control full fat fresh cheese were lower than that of other cheese treatments. Rice bran oil treatments recorded slightly significant higher values of TVFA than soybean oil cheese treatments (P<0.05) presented in **Table (9)**. And the TVFA content followed the same trend of other ripening indices, as TVFA values of fresh cheese treatments significantly increased all over the storage period and recorded the highest values at the end of storage at 90 days (P<0.05). This could be attributed to the lipolytic degradation and not the difference effect of replacing milk fat with rice bran oil as reported by **Halida *et al.*, (2020).** The present data confirmed the sensory evaluation of both cheese treatments either by rice bran or soyabean oil substituted, as TVFA consider to be the most volatile organic compounds in dairy products associated with odor and taste and play important role for the consumer acceptance. The TVFA content of rice bran oil was slightly significant higher than the soybean oil cheese treatment, and both of them were significant higher than the control cheese. The present results confirmed by **Abd EL-Aziz *et al.*, (2012) and Nasr *et al.*, (2020). Table (9)**

Microbiological analysis

Microbiological properties of substituted fat soft cheese with rice bran and soybean oil at levels of 25, 50 and 75% are presented in **Table [10**]. The obtained results show that, total viable bacterial count increased among the first storage period (15 days), followed by gradual decrease in all cheese treatments up to the end of storage, this could be due to increasing of acidity, salt and low temperature which control the rate of growth and bactericidal agents. As recorded by **EL-Alfy *et al.*, (2010). Table [10]**

Table (9) TVFA content of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during cold storge at 5±1ºC up to 90 days.

Treatments		Storage Period (days) 5±1ºC					
		0	15	30	45	60	90
		TVFA (0.1N NaoH/100g)					
C		10.40^{Fd}	14.95^{Eef}	22.55^{De}	29.10^{Cd}	36.25^{Bc}	45.55^{Ae}
25% Oil	R25	12.75^{Fbc}	16.45^{Ecde}	24.40^{Dcd}	32.30^{Cc}	40.70^{Bb}	47.50^{Ad}
	S25	11.90^{Fc}	15.40^{Edef}	23.50^{Dde}	31.80^{Cc}	39.75^{Bb}	46.00^{Ade}
50% Oil	R50	13.60^{Fab}	18.80^{Eabc}	26.00^{Dbc}	33.35^{Cbc}	44.25^{Ba}	52.60^{Abc}
	S50	12.95^{Fbc}	17.35^{Ebcd}	25.25^{Dbcd}	32.70^{Cbc}	43.65^{Ba}	50.95^{Ac}
75% Oil	R75	14.75^{Fa}	20.75^{Ea}	28.75^{Da}	35.85^{Ca}	45.35^{Ba}	54.70^{Aa}
	S75	13.70^{Fab}	19.05^{Eab}	26.50^{Db}	34.80^{Cab}	44.25^{Ba}	52.75^{Ab}

$^{A, B, C}$, ….: Means with same letter for same treatment during storage period are not significantly different (P<0.05). $^{a, b, c,}$ …...: Means with same letter among treatments in the same storage period are not significantly different (P<0.05).

Table (10) Total bacterial count content of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during cold storge at 5±1ºC up to 90 days.

Treatments		Storage Period (days) 5±1ºC					
		0	15	30	45	60	90
		Total bacterial count (Log/cfu/g)					
C		8.26	8.37	8.29	8.26	8.11	7.93
25% Oil	R25	8.24	8.35	8.25	8.15	8.06	7.90
	S25	8.24	8.32	8.20	8.09	8.00	7.86
50% Oil	R50	8.18	8.29	8.19	8.07	7.95	7.81
	S50	8.12	8.25	8.17	8.05	7.93	7.77
75% Oil	R75	8.08	8.22	8.15	8.01	7.90	7.71
	S75	8.05	8.20	8.13	7.98	7.85	7.63

C: Control full-fat cheese milk 5% fat + Yoghurt starter (2%) ,**R25**: substituted 25% of milk fat by Rice bran oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **S25**: substituted 25% of milk fat by Soyabean oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **R50**: substituted 50% of milk fat by Rice bran oil + Yoghurt starter+ *Lactobacillus plantarum* (1:1), **S50**: substituted 50% of milk fat by Soyabean oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **R75**: substituted 75% of milk fat by Rice bran oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **S75**: substituted 75% of milk fat by Soyabean oil + Yoghurt starter + *Lactobacillus plantarum* (1:1).

Probiotic bacterial counts showed that lactobacilli counts were increased during the first period of storage presented in **Table [11]**. By advancing of storage, there was a decrease in lactobacilli counts caused also by adverse conditions of temperature, acid development and salt content, along the storage period as described by **Tiwari *et al.*, (2019).** However, cheese shows great advantage over fermented dairy products like yoghurt as a good vehicle for incorporating of probiotic bacteria to diet because they have a higher pH and buffer capacity, higher consistency and more acceptability, which would be able to offer more protection to probiotic bacteria during storage and transit in the gastrointestinal tract **(Gardiner *et al.*,1998). Table [11]**

The results of microbiological analysis reflect that yeast and mold were not detected in all treatments when fresh and during storage up to 60 days of storage, this could be attributed the high quality of cheese milk and followed the good hygienic sanitary precautions during cheese making and storage. At the end of storage there were some counts of molds and yeast were only detected in the control and cheese treatments at 60 days which not affected the cheese quality and acceptability.

Coliform group detection revealed that they were not detection in all experimental cheese when fresh and all over the storage period. The obtained results of mold & yeast and coliform are confirmable by those of **EL-Kholy *et al.*, (2016).and AL-Dubai *et al.*, (2020).**

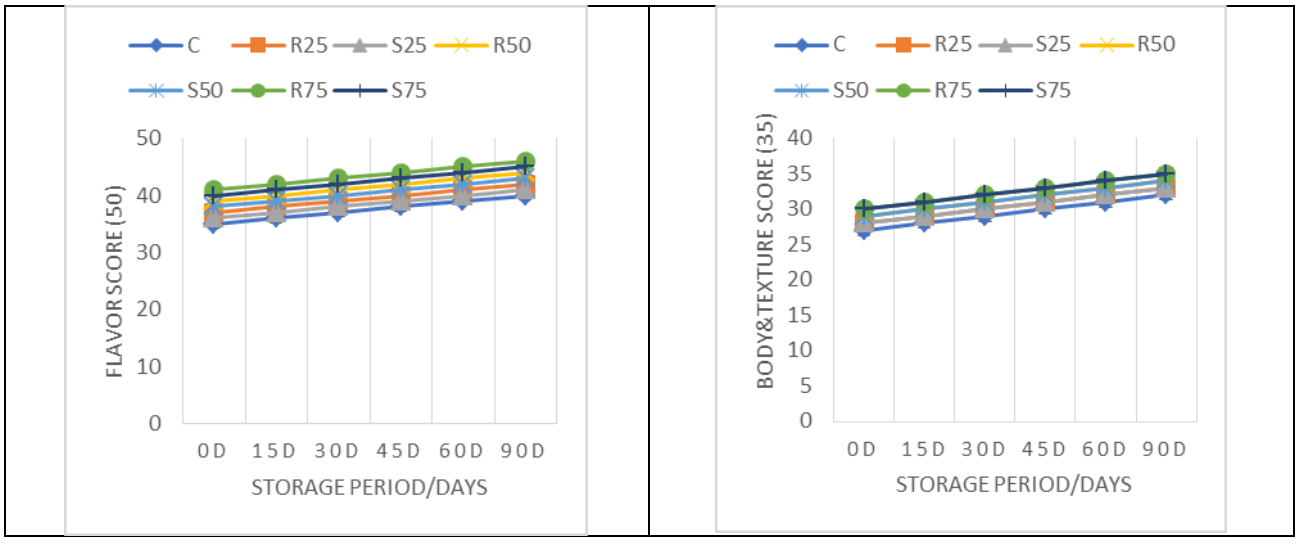
The sensory evaluation

The sensory evaluation of the fat substituted soft cheese with rice bran or soybean oils revealed that the rice bran oil cheese treatment at level of 75% had the highest total score along the storge period followed by soybean oil 75%, rice bran oil 50%, soybean oil 50%, rice bran oil 25%, and 25% soybean oil cheese treatments respectively illustrated in **Fig. [2]**. The obtained results are in accordance to those obtained by **Weimer, (2007) and Nasr, *et al.*, (2020).**

The sensory evaluation values confirmed the results obtained for ripening indices as S.N, SN/TN, TVFA, and Shilovich ripening indices of the cheese treatments during the storage period up to 90 days as a result of protein hydrolysis and lipolysis by the action of proteolytic and lipolytic enzymes elaborated by added probiotic starter culture (*Lactobacillus plantarum*) to the experimental cheese **AL-Dubai *et al.*, (2020).**

Table (11) Lactobacilli count content of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during cold storge at 5±1ºC up to 90 days.

Treatments		Storage Period (days) 5±1ºC					
		0	15	30	45	60	90
		Lactobacilli count (Log/cfu/g)					
C		7.86	7.99	7.78	7.60	7.44	7.11
25% Oil	R25	8.04	8.19	8.12	8.04	8.00	7.83
	S25	8.01	8.16	8.10	7.99	7.93	7.79
50% Oil	R50	8.01	8.15	8.09	8.00	7.87	7.69
	S50	7.99	8.12	8.06	7.96	7.84	7.62
75% Oil	R75	7.96	8.11	8.05	7.95	7.85	7.64
	S75	7.93	8.09	8.02	7.92	7.83	7.49



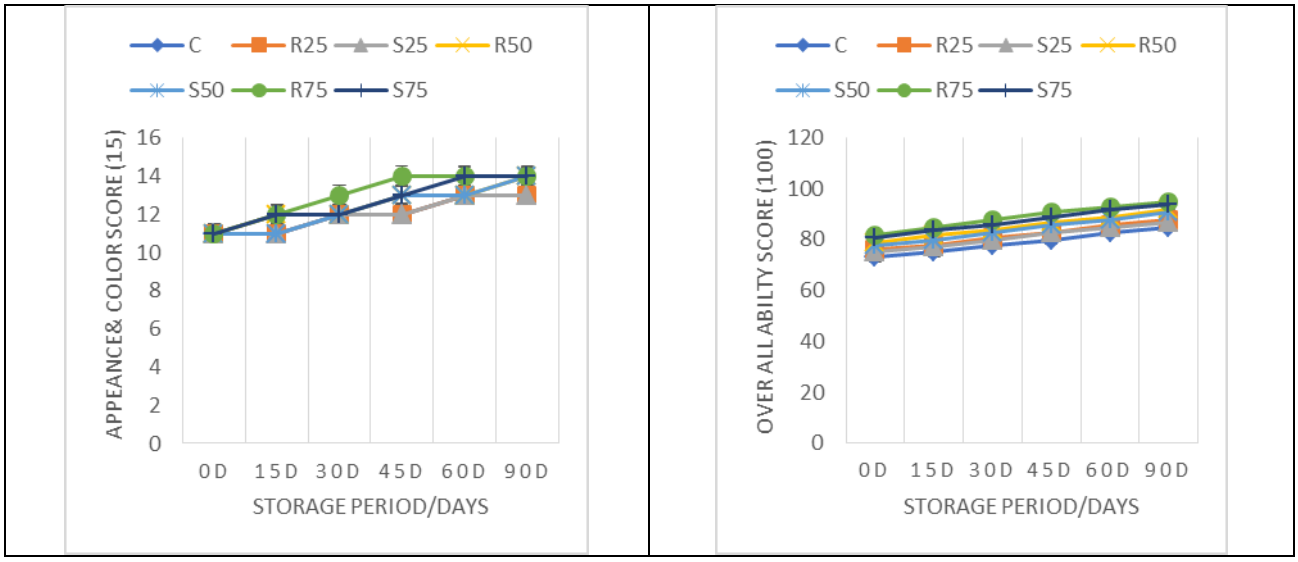


Fig. (2) Sensory evaluation scores of substituted probiotic soft cheese fat with Rice bran or Soybean oil when fresh and during cold storge at 5±1ºC up to 90 days. C: Control full-fat cheese milk 5% fat + Yoghurt starter (2%) ,**R25**: substituted 25% of milk fat by Rice bran oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **S25**: substituted 25% of milk fat by Soyabean oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **R50**: substituted 50% of milk fat by Rice bran oil + Yoghurt starter+ *Lactobacillus plantarum* (1:1), **S50**: substituted 50% of milk fat by Soyabean oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **R75**: substituted 75% of milk fat by Rice bran oil + Yoghurt starter + *Lactobacillus plantarum* (1:1), **S75**: substituted 75% of milk fat by Soyabean oil + Yoghurt starter + *Lactobacillus plantarum* (1:1).

Conclusions

In this study, it was possible to substitute cheese milk fat by soybean oil for reducing costs of probiotic soft cheese analogues with high nutritional appeal at lower costs, comparing with the same levels of rice bran oil at significantly higher costs. Both soybean and rice bran oil substituted soft cheese fat, represent the shift toward reduced-fat or cholesterol-free, higher antioxidants, dietary fiber and phytoconstituents which meet consumer preferences.

References

[1] **Abd El-Aziz, M.; Mohamed, H.S.S. and Seleet, F.L. (2012).** Production and evaluation of soft cheese fortified with Ginger extract as functional dairy food. Poi. J. Food Nut. Sci., 62 (2): 77-83.

[2] **Abd El-Halim, S. E. (2007).** Improvement of Domiati cheese quality produced from heat-treated buffaloٍs milk using different starter cultures. M.Sc. Thesis, Fac. Agric., Ain Shams Univ., Egypt.

[3] **Abd El-Halim, S. E.; EL-Nawawy, M.; Essawy, E. A. and Hassan, Z. M. R. (2007).** Effect of various starters on the quality of Domiati cheese produced from heat-treated buffalo milk.J. Biol. Chem. Environ. Sci., 2(2):119–136.

[4] **Abdel-Salam, M. H., &Alichanidis. E. (2004).** Cheese Varieties Ripened in Brine. In P. F. Fox, P. L. H. McSweeney, T. M. Cogan, and T. P. Guinee (Eds.), Chemistry, Physics, and Microbiology (3rd ed, pp. 227–249, Vol.

[5] **Abdel-Tawab, G. H. and Hofi, A. A. (1966).** Testing cheese ripening, rapid chemical techniques. Indian J. Dairy Sci., 19: 39-41.

[6] **Abd-Rabou, H. S., El-Ziney, M. G., Awad, S. M., AlSohaimy, S. A., &Dabour, N. (2016).** Impact of probiotic and symbiotic supplementa-tion on the physiochemical, texture, and sensory characteristics of wheylessDomiati-like cheese. MOJ Food Process Technology, 3(3), 317– 325. https://doi.org/10.15406/ mojfpt.2016.03.002).

[7] **Al Dubai, N. S. Shenana, M., Elalfy, M., & Ismail, E. (2020).** Influence of Some Probiotic Bacteria on the Improvement of Taizzy Soft Cheese Quality. Egyptian Journal of Food Science, 48(2), 229-243.

[8] **Algarni, E.H.A. (2016).** Soft cheese supplemented with thyme, cumin, and turmeric to increase shelf life during storage period. Adv. Environm.Bio., 10(12):227-236.

[9] **AOAC, (2012).** Official methods of Analysis of Association of Official Analytical Chemists 19th ed., Published by AOAC International, Gaithersburg, Maryland 20877-2414, USA.

[10] **APHA (2004)** American Public Health Association. Standard methods for the examination of dairy products. American Publ. Health Assoc. Inc.17th Ed., Washington D.C20001, USA.

[11] **Astawan, M.; Wresdiyati, T.; Suliantari. S.; Arief, I.I. and SeptiawanR.(2012).** Production of symbiotic yoghurt-like using indigenous

lactic acid bacteria as functional food. Media peternakan, 35(1):9-14.

[12] **BSI (1989)** British Standards Institution. Chemical analysis of cheese. BSI, 770. British Standards Institution, London, U.K.

[13] **BSI (1993) British Standards Institution.** Determination of Enterobacteriaceae in microbiological examination of food and animal feeding stuffs. BSI 5763, British Standards Institution, London, U.K.

[14] **El-Alfy M.B.; Shenana M. E;. Ismail E. A; Gafour W.A. and Roshdy A. M. (2010**) Improvementof non-traditional White softcheesemadefromfreshmilkfortifiedwithaddin gskimmilk poder and vegetable oilsusingdifferent ratios of starter culture.

[15] **El-Alfy, M. B.; Abd El-Aty, A. M.; Younis, M. F.; Osman, SH. G. and Gafour, W. A. (2004).** Biological and histopathological changes of rats as affected by feeding on cholesterol–enriched diet containing probiotic Soya Feta like-cheese. Annals of Agric. Sci., Moshtohor, 42(4):1743–1757.

[16] El-Kholy, W., Azzat B. Abd El-Khalek, Sahar H.S. Mohamed, Mohamed T. Fouad and Jihan M. Kassem.(2016). Tallage Cheese as a New Functional Dairy Product. Am. J. Food Technol., 11(5): 182-192,

[17] **European Union (2019).** the Food and Beverage Market Entry Handbook (Egypt). A Practical Guide to the Market in Egypt for European Agri-food Products and Products with Geographical Indications.

[18] **Farrag, A. F., Zahran, H., Al-Okaby, M. F., El- Sheikh, M. M., and Soliman, T. N., (2020).** Physicochemical properties of white soft cheese supplemented with encapsulated olive phenolic compounds. Egypt. J. Chem., 63(8), 8-9.

[19] **Gamage, G.G.A.P.; Adikari, A.M.J.B.; Nayananjalie, W.A.D.; Prasanna, P.H.P.; Jayawardena, N.W.I.A. and Wathsala, R.H.P.; (2016).** Physicochemical, microbiology and sensory properties of probiotic drinkable yoghurt developed with goat milk. Int. J. Scient. &Res.Public., 6(6):203-208.

[20] Gardiner G.E., Ross, R.P., Collins J.K., Fitzgerald, G. and Stanton, G. (1998). Developmentof a probiotic cheddar cheese containing human-derived Lactobacillus para caseistrains. Applied Environmental Microbiolgy 64: 2192-2199.

[21] **Halida, R.; Shunji, K.; Kazue, S.; Chieko, H.; Hiroyuki, H.; Shigeo, N.; Yurika, O.; Junya, I. and Kiyotaka, N. (2020).** Revealing the thermal oxidation stability and its mechanism of rice bran oil. www.nature. com/scientific reports, (2020)10:14091--https:// doi. org /10.1038/s41598-020-71020-y

[22] **Hao, X., Yang, W., Zhu, Q., Zhang, G., Zhang, X., Liu, L., Li, X., Hussain, M. A., Ni, C., & Jiang, X. (2021).** Proteolysis and ACE-inhibitory peptide profile of Cheddar cheese: Effect of digestion treatment and different probiotics. LWT-Food Science and Technology, 145, 111295.

[23] **IDF (1987) International Dairy Federation**, Skimmed milk, whey, and butter milk. Determination of fat content. Rose gottieb Gravimetric Methods. IDF.22B.

[24] **IDF (1991) International Dairy Federation.** Milk and milk products. Enumeration of microorganisms. Colony count technique at 30ºC, IDF: 100B.

[25] **IDF (1996) International Dairy Federation**. Milk. Determination of Fat Content.00ID.

[26] **IDF (1997). International Dairy Federation.** Sensory evaluation of dairy products by scoring reference method. Standard 99 C.

[27] **Katsiari, M. C., Voutsinas, L. P., &Kondyli,E.(2002).** Improvement of sensory quality of low-fat Kefalograviera-type cheese with commercial adjunct cultures. *International Dairy Journal*, *12*(9), 757-764.

[28] **Khalifa, S. A.; Omar, A.A. and Mohamed A. H. (2017).** The effect of substituting milk fat by peanut oil on the quality of white soft cheese. Int. J. Dairy Sci., 12(1):28-40.

[29] Khalil, N., Kheadr, E., El-Ziney, M., &Dabour, N. (2022). Lactobacillus plantarum protective cultures to improve safety and quality of whey less Domiati-like cheese. *Journal of Food Processing and Preservation*, *46*(4), e16416.

[30] **Kosikowski, F. V. (1978).** Cheese and fermented milk foods. Published by the Author. Camell, Univ., Ithaca, New York, USA.

[31] **Mehanna, N. M. Mousa, M. A. and Abd EL - Khair, A. A. (2009).** Improvement of Ras cheese made from pasteurized milk using slurry from ewe's milk cheese. Egypt J. Dairy Sci. p. 37.

[32] **Milani, E.; Shahidi, F.; Mortazavi, S.A; Vakili, S.A and Ghoddusi, H.B. (2014).** Microbiological and rheological change throughout ripening of Kurdish cheese. J. Food Saf., 34(2):168-175.

[33] Nasr, W. I. A., Shahein, N. M., Hassan, M. A., & Abd-Rabou, N. S. (2020). Characterization of Soft Cheese Supplemented with Rice Bran Oil. *Journal of Food and Dairy Sciences*, *11*(12), 337-341.

[34] Naz, S., Siddiqi, R., Sheikh, H. & Sayeed, S.A. (2005). Deterioration of olive, corn and soybean oils due to air, light, heat and deep frying. Food Res Int, 38, 127–134.

[35] Nikolic, N.C., Cakic, S.M., Novakovic, S.M., Cvetkovic, M.D., Stankovic, M.Z. (2009). Effect of extraction techniques on yield and composition of soybean oil. Macedonian Journal

of Chemical and Chemical Engineering, 28, 173–179.

[36] **Olguin, M. C., Hisano, N., D'Ottavio, A. E., Zingale, M. I., Revelant, G. C., & Calderari, S. A. (2003).** Nutritional and antinutritional aspects of an Argentinian soy flour assessed on weanling rats. Journal of Food Composition and Analysis, 16(4), 441-449.

[37] **Ramadan, M.F.; Mahgoub, S.A. and El-Zahar, K.M. (2014).** Soft cheese supplemented with black cumin oil: Impact on food borne pathogens and quality during storage. Saudi J. Biol. Sci., 21: 280-288.

[38] **Saad, M.F. and Abdel-Salam, A.B. (2015).** Improvement of some parameters of white soft cheese by adding cinnamon and thyme. Global Veterinaria, 14(6):830-836.

[39] **SAS, Institute. (2004).** The SAS/STAT 9.1 User's Guide Vol.1-7. SAS Institute Cary, NC.

[40] **Silvia, F.G.; Tonia, T.I. and Debora, F. (2020).** A short review of green extraction technologies for rice bran oil. Biomass Conversion and Biorefinery. Https:// doi.org/10.1007/s13399-020-00846-3.

[41] Tiwari, P.K.; Asgar, S.; Uprit, Chauhan, M.; Sandey, K.K. and Shinde, N.W. (2019). Effect of oat flour addition on the viability of drink. Int. J. Livestock Res., 9(1):66-73.

[42] **Weimer, B. C. (Ed.), (2007).** Improving the flavour of cheese,Cambridge, Woodhead Publishing Limited.