World Journal of Dairy & Food Sciences 12 (1): 01-12, 2017
ISSN 1817-308X

DOI: 10.5829/idosi.wjdfs.2017.01.12

Evaluation of Yogurt and Soft Cheese Fortified with Chia Seeds

Safaa Moustapha Abd El Fatah Faid

Home Economics Department, Faculty of Specific Education,
Ain Shams University, Cairo - Egypt

Abstract: Chia (*Salvia hispanica*L.) constitutes a potential alternative raw material and ingredient in dairy industry applications due to its high nutrition value content. Therefore, this investigation was carried out to use chia flour as a fortified of soft cheese and yoghurt at different levels 4, 8, 12 and 16% fortified soft cheese and 3, 6, 9 and 12% suspended yoghurt, respectively and compared with control soft cheese and yoghurt free addition chia flour. Different parameters were determined and evaluation in soft cheese and yoghurt at different levels during storage period. The results during storage period (30 days) showed that the total solids ash and crude fiber were increased and fat was decreased in soft chasse and its formulae when increasing chia flour were added and also titratable acidity (as lactic acid) was slightly increased and pH slightly decreased, the antioxidants (ß-carotene, vitamin A, total phenols and total flavonoids) of soft cheese were the highest with adding chia flour at level 16% (7.38 µg/100g, 88.6mg RAE, 18.2mgGAE/100gm, 1.96quarstine/100gm and 2.85%). It could be noticed that adding chia flour to the soft cheese reduced the number of microbes during the storage period. The producer of soft cheese good organoleptic characteristics preferred adding at level 8% chia flour.Chemical and physical properties of yoghurt as control and yoghurt fortified with chia flour were determined at different levels during storage period (15 days). From these results it might be noted that the total solids was increased 50.8% from control yoghurt at zero time to yoghurt suspended with 16% chia flour at the end of storage period and also, fat, total protein, ash content, acidity and pH value showed that no changes during storage period**.** The acetaldehyde gradually decreased and diacetyl gradually increased when chia flour increased during storage period.The panelists highly accepted the yoghurt made by addition of chia flour at 12% levels to the milk and the yoghurt products were preference to the panelists.From the obviously results it could be recommended that the producer of soft cheese good organoleptic characteristics prefers adding at level 16% chia flour and the panelists highly accepted the yoghurt made by addition of chia flour at 12% levels to the milk and the yoghurt products were preference to the panelists.

Key words: Chia (*Salvia hispanica L.*) · Yogurt · Soft Cheese · Buffalos' Milk

INTRODUCTION

Chia (*Salvia hispanica L.*), a biannually cultivated plant, is categorized under the mint family (*Labiatae*), superdivision of *Spermatophyta* and kingdom of Plantae, prominently grown for its seeds. Chia seed is composed of protein (15-25%), fats (30-33%), carbohydrates (26-41%), high dietary fiber (18-30%), ash (4-5%), minerals, vitamins and dry matter (90-93%). The seed also contains a high amount of antioxidants [1]. The seed contains 25 to 40% oil with 60% of it comprising (Omega) ω-3 α-linolenic acid and 20% of (Omega) ω-6 linoleic acid. Both essential fatty acids are required by the human body for good health and they cannot be artificially synthesized [2]. Furthermore, an omega-6/omega-3 ratio of 4:1 or less is recommended. A high ratio of omega-6/omega-3 is detrimental to health and may lead to the development of chronic diseases. Improving the dietary ratio by increasing the omega-3 fatty acids is essential for brain functioning and for the management of cardiovascular disease, arthritis and cancer [3]. Therefore, the incorporation of seeds such as chia in the diet, which contain high contents of these fatty acids, is particularly desirable. Chia flour is rich in protein and is complete with all eight essential amino acids. It is also rich in calcium, iron, vitamin C, omega-3-fatty acidsand antioxidants, so

Corresponding Author: Safaa Moustapha, Home Economics Department, Faculty of Specific Education, Ain Shams University, Cairo - Egypt. E-mail: dr_safaa2010@yahoo.com.

called as a food for healthy skin, hair and nail. However, a major challenge to the development of enriched food products is presented by the multiple acceptance criteria: product freshness, sensory characteristics, appearance, storage conditions, ease of preparation and safety standards, which must be achieved, despite the addition of an active ingredient [4] and nutritional benefits.

Yogurt has long been known as a product with many desirable effects for health. The excellent sensory properties and the health benefits of yogurt can be credited to the action of yogurt bacteria and their metabolites [5].

A product is called yogurt if live bacteria are present in the final product [5]. Yoghurt to be considered as a probiotic product, the *Streptococcus thermophilus* and L. *delbrueckii*s sp. *bulgaricus,* as starter cultures, must be at a daily dose of 10^9 cfu/g and several authors have indicated that a minimal concentration of 10^6 cfu/g of a product is required for a probiotic effect [6]. Bee pollen and chia seeds are not only selected as a supplement for its technological and sensory properties, but also for its nutritional benefits. Indeed, a noteworthy trend in recent times is the addition of prebiotics for the improvement of the nutritional properties of yogurt and fermented dairy products [7].

Approximately a third of the world's milk production is used for cheese manufacturing [8]. Cheese plays an important role in the people diet; most of the cheese is consumed either directly or with bread. The soft cheese is the most type consumed in Egypt.

In recent years, in the cheese industry the applications have focused on the study of the relationship between microstructure, texture and sensory properties that constitute a parameter of interest for optimizing manufacturing practices. The challenge is how to reduce or remove cholesterol from these products, without completely eliminating fat, which provides vitamin A and D, essential fatty acids and textural properties. For this reason, in this work the microstructure of spreadable cheese reduced in fat type and cholesterol, with added chia seed meal, using the digital image analysis was assessed. Comparing the microstructure as a function of varying fat content but equal percentage of chia flour, it was concluded that the cheeses with higher fat content (10 % fat) showed free cavities larger and more heterogeneous matrix than cheeses with lower fat content (6 % fat). When comparing the texture parameters of the images it was observed, for the same content of chia, the grey scale entropy increased and the uniformity decreased with fat content, which may be related with a greater variability in the size of the cavities. This is related to the data obtained previously by texture profile analysis, where it was observed that while it was increasedthe fat % it was also increasing the hardness parameter and the consistency value [9].

Actual cheese yield is simply expressed as a percent yield (kg cheese/ 100 kg milk) and it is important of economic destination. Compounds of milk (e.g. protein and fat) or the additives play an important role in the cheese yield [10].

Syneresis can be described as the course by which the coagulum is concentrated by the elimination of water and soluble constituents. Syneresis is one of the most important processes in cheese making because it directly affects cheese yield and quality through its effect on moisture, mineral and lactose content of curd. Surprisingly, syneresis is one of the less understood processes in cheese manufacturing. This process can occur spontaneously but it is very limited with enzymatic coagulation. Thus usually two mechanisms are used to promoting syneresis, cutting and stirring [11].

The aim of the present study was to investigate the possibilities of making benefit healthy soft cheese and yoghurt from chia flour at different levels to buffalo's milk.

MATERIALS AND METHODS

Materials: Chia seeds (*Salvia hispanica L.*), was obtained from Field Crops Research Inst., Agric. Res. Center, Giza-Egypt. Buffalos' milk, fat, salt and French origin skim milk powder was purchased from local market at Cairo.

Culture of *Lactococcuslactis subsp. lactis*, *Streptococcus salivarius subsp. Thermophilus TCC-3* and *Lactobacillus bulgaricus* powder calf rennet (Ha-LA) were obtained from Chr. Hansen's Laboratory, Copenhagen, Denmark. All other chemicals used were purchased from Algomhorya Company, Giza- Egypt.

Methods

Preparation of Chia Flour: Seeds of chia were laboratory milled to give a very fine powder following by grinding into flour and sieving through 40 mesh screens using a hammer mill. The chia flour was packed in a plastic container and kept at refrigerator temperature until used.

Manufacture of Soft Cheese: The soft cheese was manufactured according to Fahmi and Shrara [12] with some modifications by El-Safty *et al.*[13]. Table (1) showed that the different mixtures contained of

Table 1: Total solids content of soft cheese and its formulae

	Soft cheese				
		% of chia flour			
Materials	Control (%)	4%	8%	12%	16%
Chia flour	0.00	4	8	12	16
Fat content	2.00	2.00	2.00	2.00	2.00
Buffalos' milk	14.0	14.0	14.0	14.0	14.0
Skim milk powder	17.0	13.0	9.00	5.00	1.00
Salt	2.00	2.00	2.00	2.00	2.00
Total	35.0	35.0	35.0	35.0	35.0

buffaloes' milk 14, Fat 2, salt 2, skim milk powder 17 and chia powder at different ratios (4, 8, 12 and 16%) were used to prepare soft cheese contained total solid 35%. The different mixtures were pasteurized at 63°C for 30 min, immediately cold to 42°C, after that, salt 2% was added. Then, an active culture of *Lactococcuslactis subsp. lactis* 2%, was added, 3gm/100 kg of rennet was added to the different mixtures at pH 6.2±0.2. After that the mixtures were poured in cubs and incubated to complete coagulation at 42°C for 3hrs. The obtained cheese samples were stored at in refrigerator at 5±2 °C.

Chemical Analysis and Physical Properties of Soft Cheese and its Formulae: Chemical analyses and physical properties which include crude fiber, ash content, total solids, total nitrogen, soluble nitrogen, salt and titratable acidity were determined in soft cheese as considerable control and its formulae according to AOAC [14]. Moreover, pH meter value was measured using Jenway pH- meter (Jenway Limited, Gransmore green, Felsted, Dunmow, England). The ß-carotene analysis was performed on samples by means of HPLC according to Pupin *et al*. [15].

Vitamin A value calculation was performed based on vitamin A activity of the ß-carotenes according to the conversion factor provided by theFood and Nutrition Board [16]. Vitamin A value was expressed in retinol activity equivalents (RAE), which represents vitamin A activity as retinol. Where, 12 µg of ß-carotene from foods are required to provide the body with 1 µg of retinol, giving dietary ß-carotene an RAE ratio of 12:1. Mean while, total phenolic acids and total flavonoids compounds were determined according to AOAC (14).

Syneresis and Yield: Syneresis of experimental soft cheese was determined according to Farooq and Haque [17].Actual cheese yield was determined according to Fox *et al.*[10].

Microbiological Assay: The empiricist soft cheese samples were taken periodically after one day, 2, 3 and 4 weeks. The samples were microbiologically analyzed for total bacterial count, yeast andmoulds and spore-forming bacteria as described byAPHA[18]. Lactic acid bacterial counts were determined according to Harrigan and McCance [19]. The results were expressed as log counts.

Sensory Evaluation: The experimentalsoft cheese was organoleptically assessed by 20 trained panelists for flavor [20] body and texture [21] and appearance color [15] according toPappas *et al.* [22] where the total score was 100 degrees.

Manufacture of Yoghurt: Buffalos' milk (100 ml) was pasteurized at 90°C for 10 min and cooled to 45°C at room temperature then incubated with 3% active subculture *Streptococcus Salvarious subsp. Thermophilus TCC-3* and *Lactobacillus bulgaricus* at 45°C for 3 hours according to the method described by Lee and Lucey [23] to give control yoghurt**.** Whereas, the formulae were prepared from the obvious recipe mixed separately with chia flour at 3, 6, 9 and 12% levels to give 4 formulae.

Chemical analyses and physical properties which include ash content, acidity, total solids (TS) and titratable acidity (TP), fat and total carbohydrates were determined in soft cheese as considerable control and its formulae during storage period (Zero time, after 5, 10 and 15 days) according toAOAC[14]. Moreover, pH meter value was measured using Jenway pH- meter (Jenway Limited, Gransmore green, Felsted, Dunmow, England). Acetaldehyde and diacetyl were determined in the yoghurt chia flour during storage period according to Lees and Jago [24, 25].

The organoleptic evaluation for the yoghurt and its formulae were judged by 20 experiences panelists according to Abdel Moneim *et al.*[26].

Statistical Analysis: The data obtained in the present study was analyzed by ANOVA. For all analyses, when a significant difference (p b 0.05) was detected in some variable, the data means test was applied to evaluate the difference between the samples. The results were analyzed with the aid of the software SAS System for Windows [27].

RESULTS AND DISCUSSION

Chemical Compositionand Physical Properties of Soft Cheeseand its Formulae from Chia Flour During Storage Periods: The chemical composition of soft cheese and its formulae containing different percentages of chia flour during storage period are shown in Table (2) indicated that, total solids in control soft cheese increased

Table 2: Chemical composition and physical propertiesof soft cheese added with chia flourand its formulae during storage periods

Storage periods	T.S %	F/DM %	Crude fiber %	Ash %	S/M %	TN/DM %	SN/DM %	Titratable acidity	pH
Zero time									
Control	35.7	23.1	0.00	2.62	3.06	6.92	1.63	0.63	5.23
4 %	36.2	22.6	0.23	2.32	3.06	6.65	1.58	0.66	5.10
8 %	36.6	22.5	0.43	2.81	3.07	6.38	1.46	0.68	4.82
12%	36.9	22.5	0.61	2.95	3.06	6.14	1.37	0.71	4.76
16%	37.1	22.4	0.82	3.11	3.08	6.02	1.28	0.75	4.71
After seventh days									
Control	37.2	21.8	0.00	2.97	3.16	6.82	2.23	0.78	4.38
4 %	37.4	21.7	0.31	3.11	3.18	6.41	2.18	0.82	4.35
8 %	37.8	21.6	0.52	3.17	3.17	6.23	2.12	0.86	4.32
12%	38.1	21.5	0.73	3.22	3.18	6.18	2.18	0.89	4.30
16%	38.4	21.4	0.88	3.32	3.20	6.14	2.08	0.91	4.26
After fifteen days									
Control	39.3	20.7	0.00	3.12	3.27	6.52	2.96	0.94	4.18
4 %	40.1	20.3	0.37	3.29	3.29	6.21	2.74	0.96	4.15
8 %	40.2	20.2	0.56	3.64	3.27	6.09	2.51	1.06	3.97
12%	40.7	20.2	0.78	3.73	3.28	5.91	2.42	1.08	3.97
16%	40.8	20.1	0.91	3.81	3.30	5.78	2.29	1.13	3.88
After thirty days									
Control	40.3	20.2	0.00	3.41	3.35	6.12	3.32	1.17	3.81
4 %	41.3	19.8	0.39	3.59	3.39	6.02	3.17	1.21	3.75
8 %	41.7	19.7	0.61	3.78	3.41	5.87	3.05	1.23	3.72
12%	41.9	19.6	0.80	3.85	3.45	5.76	3.01	1.26	3.68
16%	42.1	19.5	0.93	3.98	3.51	5.34	2.82	1.28	3.64

T.S: Total solids, F/DM: Fat/dry matter, T.N/DM: Total nitrogen/dry matter,
S.N/DM: Soluble nitrogen/dry matter S/M: Salt/Moisture

from 35.7 at zero time to reach 40.3 % after 30 days. Whereas, the addition of chia flour for buffaloes' milk at range 4, 8, 12 and 16 % caused increase in total solids (T.S) and gave 41.3, 41.7, 41.9 % and 42.1 %, respectively,during storage period. These results are in accordance with those reported by Hassanein [28] who found the total solids were increased in soft chasse and its formulae when increasing chia flour were added.

Fat/dry matter (F/DM) percentage in control soft cheese made from buffaloes' milk was higher than soft cheese adding chia flour at different levels during storage periods. It was also observed that the fat content of all cheese formulae gradually decreased during storage periods, the last results obtained about F/DM in different treatments are in agreement with data obtained by Ibrahim *et al.* [29].

The results in the same table indicated that the crude fiber in the control soft cheese was not detected, whilst, the all formulae recorded gradually increase in crude fiber during storage periods. Moreover, the ash content of control soft cheese slightly increased, ash content ranged from 2.62 to 3.41% at zero time, while soft cheese at 16% from chia flour ranged from 3.11to 3.98% during the storage periods. Surely, the gradually increases of ash back for adding chia flour.

Form the over results it could be notice that the salt content in control soft cheese and its formulae have slightly increased in salt/moisture percent when chia flour increased. This may be due to the lowest moisture content of fortified cheese and/or the effect scattering salt throughout ladling according to Fayed [30]. Salt/moisture percentage recorded the highest value of control cheese 3.51% in 16% addition after 30days, but the lowest value was found in level control soft cheese and addition 4% at zero time.

Concerning total nitrogen on dry matter (TN/DM) as percent slightly decreased of formulae soft cheese and control, this decrease may be due to protein degradation and formation of water-soluble compounds [31]. Soluble nitrogen on dry matter as percent was increased in soft cheese made from chia flour at different ratio during storage. This may be due to the higher present of chia flour in formulae soft cheese which caused higher protein decomposition than control [32].

Data listed in the same Table appeared that the titratable acidity (as lactic acid) was slightly increased between first day and 30 days. The trend of the change in pH- values of all treatments was opposite to the acidity which may be led to more lactic acid production as a result of microorganism's metabolism [33].

Table 3: ß-carotene (µg/100g), vitamin A (µg RAE)*, total phenols mg GAE/100gmand total flavonoids mg quarstine/100gm of soft cheese and with adding chia flourduring storage periods.

Formulae	ß-carotene	Vitamin A	Total phenols	Total flavonoids
Control	0.05	0.60	0.00	0.00
4 %	1.94	23.3	5.43	0.59
8 %	3.78	45.4	9.72	1.12
12%	5.62	67.4	14.6	1.57
16%	7.38	88.6	18.2	1.96

*RAE Retinol Activity Equivalent.1 RAE = 1 µg retinol, 12 µg â-carotene, whereas the RAE for preformed vitamin A is the same as Retinol Equivalent (RE).

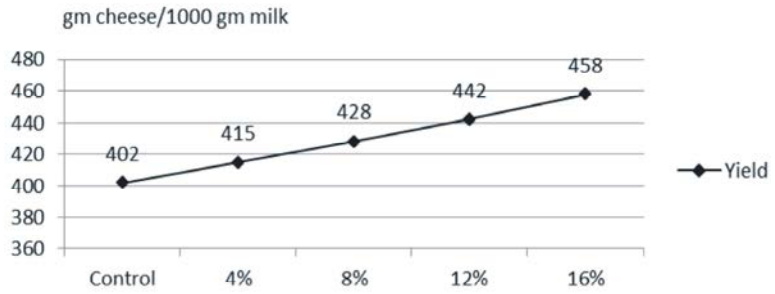

Fig. 1: Yield of soft cheese and with adding chia flour

From the results, it could be noticed that the soft cheese made from chia flour at 4, 8, 12 and 16% fortified buffaloes' milk gave a good product and nutrition value. This may be due to chia had contained highest protein, fat, carbohydrate and antioxidants.

ß-Carotene, Vitamin A, Total Phenols and Total Flavonoids of Soft Cheese and with Adding Chia Flourduring Storage Periods: The results in Table (3) indicated that adding of chia flour for soft cheese gradually increased antioxidants. Data in the same Table revealed that antioxidants (ß-carotene, vitamin A, total phenols and total flavonoids) of soft cheese were the highest with adding chia flour at level 16% (7.38 µg/100g, 88.6mg RAE, 18.2mgGAE/100gm, 1.96quarstine/100gm and 2.85%) with compared its other treatments, respectively.

Chia seeds oils are protected by natural, endogenous polyphenolic antioxidants. These antioxidants exert a marked protective effect on plant lipids even though the natural oils contain high concentrations of polyunsaturated fatty acids (PUFA) that are usually very susceptible to oxidation. Polyphenols responsible for this protective action are most commonly flavonoids and cinnamic acid derivatives that occur abundantly throughout the plant kingdom [34].

Natural antioxidants protect the human body against free radicals, inhibit many chronic diseases and prevent lipid oxidation in food. Phenolic compounds are important components of many edible plants, including soybean, canola, flaxseed and olive, which are used as food or food ingredient sources [35]. Synthetic antioxidants are widely used for its performance; however, they present different toxicological problems [36]. The legislation on food safety has gradually become more rigorous, requiring the use of toxicity tests for synthetic antioxidants. Additionally, consumers tend to use natural products as antioxidants, as these appear safe and do not require pre-testing [21].Chia seeds are a promising source of antioxidants due to the presence of polyphenols, chlorogenic and caffeic acids, myricetin, quercetin and kaempferol [37] which protect consumers against adverse conditions such as cardiovascular diseases and certain cancers [38].

Yield of Soft Cheese and with Adding Chia Flour: The results in Fig. (1) cleared that different levels of chia flour gradually increased the cheese yield and the highest quantity of cheese yield found in chia flour level 16% compared to its other treatments which recorded the lowest quantity of cheese yield, due to chia flour contained large amount of the protein and fiber were maintained absorbed water.Paolo *et al.*[39] reported that cheese yield is defined as the quantity of cheese expressed in kilograms obtained from 100 kg of milk. It is very important parameters: The higher the recovered percentage solids the greater is the amount of cheese obtained and therefore again in economic terms. It is therefore obvious how to elaborate a rapid method that allows for an estimate before transformation of the final cheese yield on the basis of the composition of the raw material.

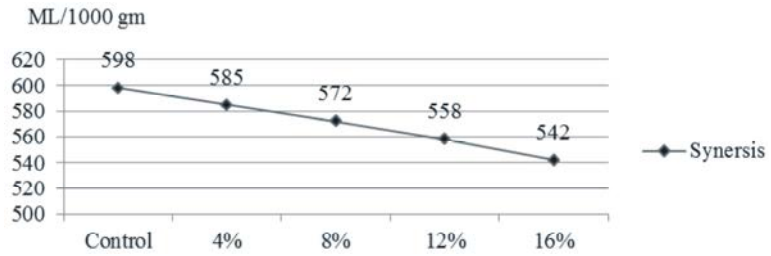

Fig. 2: Syneresis of soft cheese and with adding chia flour.

Table 4: Microbiological analysis of soft cheese and with adding chia flour during storage periods (Log CFU/ml)

	Storage periods (Log CFU/ml) / day			
Cheese formulae	Zero Time	After seventh	After fifteen	After thirty
Total bacterial count				
Control	3.62	4.82	5.52	6.40
4 %	3.76	4.98	5.36	6.18
8 %	3.88	4.75	5.22	6.11
12%	3.91	4.45	5.13	5.02
16%	3.87	4.42	4.18	4.00
Lactic acid bacterial				
Control	3.86	4.23	4.48	4.67
4 %	3.73	3.97	4.38	4.43
8 %	3.87	4.12	3.67	3.72
12%	3.68	3.91	3.61	3.68
16%	3.65	3.94	3.59	3.45
Yeasts and moulds				
Control	ND	2.3	3.6	4.8
4 %	ND	ND	2.1	3.7
8 %	ND	ND	ND	ND
12%	ND	ND	ND	ND
16%	ND	ND	ND	ND
Spore forming bacteria				
Control	1.30	2.12	2.41	2.98
4 %	1.41	1.98	2.16	2.76
8 %	1.32	1.73	1.97	1.58
12%	1.37	1.55	1.82	1.49
16%	1.63	1.58	1.79	1.45

ND: not detected

Many factors involving milk composition, amount and genetic variants of casein, milk quality, milk pasteurization, coagulant type, vat design, curd firmness at cutting and manufacturing parameters influence on cheese yield [40].

Syneresis of Soft Cheese and with Adding Chia Flour: Data in Fig. (2) indicate that the Syneresis gradually decreased at the level of 16% to 542 (ml/1000gm) compared to control soft cheese 598 (ml/1000gm), due to add LSP because at the end of storage period the water was lost.

The rate and extent of syneresis depend on a number of factors including coagulation conditions, the resulting gel propertiesand cutting/stirring conditions [41]. Syneresis is considered to be one of the most important steps in cheese making as a result of its effect on moisture, mineral and lactose content of curd. Syneresis control influences cheese homogeneity, quality and yield and also has an impact on protein and fat losses in whey. In essence, the flow of whey must be controlled during cheese manufacturing to minimize losses of solids in whey and to obtain the desired cheese moisture content in order to decrease the production of downgraded cheese. Thus better control of the syneresis process would result in an improvement of the homogeneity and quality of dairy products [42].

Microbiological Characteristics: Data in Table (4) showed the total bacterial count in soft cheese control and its formulae made from buffaloes' milk with adding different levels of chia flour. From the resultant it could be observed that the total bacterial count of control soft cheese was3.62 CFU/ml and the soft cheese at 4, 8, 12 and 16% chia flour treatments increased at zero time were 3.76, 3.88, 3.91 and 3.87 CFU/ml. Whilst, the total bacterial counts in the soft cheese at the second week were slightly decreased gradually until the end of storage period. As well as, the 16 % chia flour treatment showed the lowest total bacterial count. Generally the total bacterial counts were decreased with increasing of chia flour treatment to 16%. This may be due to the chia flour had contained the phytochemical caused inhibition of microbial growth.

From the results in Table 4, it could be noticed that the control soft cheese and its formula 4 and 8% chia flour had the highest lactic acid bacteria count compared to the other treatments during storage period. Also, the lactic acid bacteria counts were decreased through three weeks for the formulae 12 and 16% treatment which added chia flour, were declined through the last week of soft cheese during storage period.

Table 5: Organoleptic properties of soft cheese with adding chia flourduring storage period:

		Organoleptic properties			
Treatments	Storage periods	Flavor (50)	*B and T (35)	**A and C (15)	Total Score (100)
Control	Zero Time	41±1.24[a]	31±0.95[a]	13±0.95[a]	85
	7 days	43±1,56[a]	31±1.02[a]	13±0.98[a]	87
	15 days	47±1.58[a]	32±[1.05a]	13±0.91[a]	92
	30 days	48±1.35[a]	33±1.12[a]	14±1.00[a]	95
4 %	Zero Time	41±1.28[a]	30±1.13[a]	12±1.02[a]	83
	7 days	43±1.35[a]	30±1.24[a]	12±0.96[a]	85
	15 days	45±1.48[a]	31±1.21[a]	12±0.86[a]	86
	30 days	47±1.39[a]	32±1.15[a]	13±0.89[a]	92
8 %	Zero Time	42±1.27[a]	30±1.08[a]	12±0.91[a]	84
	7 days	45±1.77[a]	31±1.04[a]	12±0.94[a]	88
	15 days	46±1.64[a]	32±1.24[a]	13±0.73[a]	91
	30 days	47±1.22[a]	33±0.98[a]	14±0.54[a]	94
12%	Zero Time	40±1.49[a]	27±1.01[b]	10±0.24[a]	77
	7 days	42±1.28[a]	27±1.08[b]	11±0.35[a]	80
	15 days	43±0.98[a]	28±1.07[b]	11±0.28[a]	82
	30 days	43±0.97[a]	29±1.16[b]	12±0.46[a]	84
16%	Zero Time	35±1.18[b]	25±1.56[b]	8±0.73[b]	68
	7 days	36±1.27[b]	26±1.43[b]	8±0.27[b]	70
	15 days	36±0.98[b]	27±1.08[b]	9±0.61[b]	72
	30 days	37±1.01[b]	27±1.22[b]	9±0.58[b]	73

Means within a column with different letters are significantly different at (P= 0.05)

* B and T. Body and Texture, **A and C. Appearance and Color

Counts of moulds and yeast were recorded in control soft cheese and its formulae from chia flour (Table 4). The results illustrated the yeast and moulds growth inhibition in the soft cheese during storage period. Meanwhile, the yeast and moulds were detected at control soft cheese in the second week and increased gradually in the formula at 4% chia flour in the third week during storage periods. The increased in control soft cheese may be due to the acidity development and accumulation of lactic acid. Yeasts consumelactate formed by lactic acid bacteria as source for carbon for their growth and energy requirements [43]. Moulds and yeast failed to grow in the presence of chia flour because of antioxidants such as beta carotene, total phenol and total flavonoids as the presence these compounds in chia flour have a harmful effect on those microorganisms. The results in the same table indicated that the spore forming bacteria counts in control soft cheese and its formulae fromchia flour gradually increased till the end of storage period.

Generally, it could be noticed that adding chia flour to the soft cheese reduces the number of microbes during the storage period and this leads to improved product quality. This may be due to chia flour had contained amount of antioxidants as ß-carotene, total phenols and total flavonoids.

Organoleptic Properties of Soft Cheese with Adding Chia Flour During Storage Period: The results in Table (5) indicated that significant differences of organoleptic characteristics (Flavor, body and texture and appearance and color) of soft cheese sample control and other treatment manufactured by adding chia flour at percentage 16%. The control sample and all treatments showed improved sensory evaluation during storage for 30 days. Soft cheese at level 8% addition chia flour gained the highest total score organoleptic properties for other treatments compared to the sample control. The producer of soft cheese good organoleptic characteristics prefers adding at level 16% chia flour.

Cheese is an excellent source of protein and minerals such as calcium and phosphorus and essential amino acids; therefore it is an important food product for both young and old people [44].

Chemical Composition and Physical Properties of Yoghurt from Chia Flour and its Formulae During Storage Periods: Table (6) indicated that the chemical and physical properties of yoghurt as control and yoghurt fortified with chia flour at 3, 6, 9 and 12% levels were added separately to buffalo's milk during storage period. From these results it may be noted that the total solids was increased 50.8% from control yoghurt at zero time to

Table 6: Chemical composition and physical propertiesof yoghurt added with chia seed flourand its formulae during storage periods:

Storage periods	Acidity	pH	Ash %	Fat %	Titratable acidity	Total solids	Total carbohydrates
Zero time							
Control	0.90	4.51	0.83	6.50	4.17	15.32	4.50
3%	0.85	4.47	0.90	6.40	4.38	17.54	6.50
6%	0.98	4.41	0.96	6.30	4.55	19.05	7.70
9%	1.02	4.38	1.02	6.20	4.70	20.52	8.90
12%	1.13	4.34	1.10	6.10	4.93	22.83	10.80
After fifth days							
Control	0.96	4.47	0.89	6.50	4.29	15.34	4.42
3%	0.98	4.43	0.93	6.40	4.48	17.64	6.45
6%	1.03	4.39	0.99	6.30	4.63	19.16	7.63
9%	1.03	4.35	1.10	6.20	4.82	20.71	8.78
12%	1.15	4.31	1.22	6.10	4.98	22.91	10.93
After ten days							
Control	1.11	4.43	0.97	6.40	4.35	15.43	4.37
3%	1.13	4.38	0.98	6.30	4.55	17.75	6.93
6%	1.16	4.35	1.07	6.20	4.68	19.27	7.58
9%	1.18	4.32	1.19	6.10	4.89	20.88	8.71
12%	1.20	4.29	1.38	6.00	5.05	22.97	10.77
After fifteen days							
Control	1.27	4.39	0.96	6.40	4.40	15.50	4.35
3%	1.29	4.27	0.97	6.30	4.61	17.86	6.37
6%	1.30	4.24	1.04	6.20	4.79	19.75	7.52
9%	1.33	4.21	1.15	6.10	4.99	21.01	8.65
12%	1.36	4.18	1.36	6.00	5.16	23.11	10.71

yoghurt suspended with 12% chia flour at the end of storage period. Whereas, the results from fat, total protein, ash content, acidity and pH value showed that no changes during storage period in the yoghurt as control and yoghurt fortified with chia flour at different levels. Meanwhile, total carbohydrates were increased 2.5 times by increasing the amounts of chia flour to buffalo's milk during storage period.

The physical and sensory properties of yoghurt gels are highly influenced by the protein content and the total solids content of the yoghurt milk. A study on the effect of milk supplementation (Whey, casein hydrolysate and milk protein) on the acidification and microbiological stability of fermented milks showed that acidifying activity was greatly improved with casein hydrolysate, with a reduction of the fermentation time by about 55% by comparison with the other supplementation [45].

Despite of the above results Ozer *et al.* [46] showed that total solids content had no adverse effect on starter activity or coagulation time. Increasing milk total solids from 16 to 23% had significant effect on decreasing rate of pH during fermentation. The incubation time for the milk at 4.6 pH was shorter than thetime of retentate [47]. The Increase in milk fat content influences the growth and activity of starter cultures in samples with 2 levels of total solids (12 and 23%) [48]. The chemical composition of the milk base especially total solids has the major effect on the acceptability of concentrated yoghurt. Concentrated yoghurt containing < 20% total solid was assessed as "Thin and tasteless" and that with > 25% total solid became gummy and bitter [49].

The concentration of lactic acid in milk during fermentation increases, pH decreases, therefore the carboxyl groups dissociate, serine phosphate is ionized and the negative charge between casein micelles is increased. However, the presence of calcium phosphate neutralizes this negative charge, keeping electrostatic repulsion down to a level where attractive forces between the protein molecules are dominant. Due to these attractive forces, the casein micelles aggregate and eventually coagulate into a network of small chains; this is responsible for the increase of viscosity and formation of the yogurt coagulum [50].

Effect of Acetaldehyde and Diacetyl (µg/ml) on Yoghurt from Chia Flour During Storage Period: Table (7) showed that the changes in acetaldehyde and diacetyl content in yoghurt made from chia flour at 3, 6, 9 and 12% levels were added separately to buffalo's milk during storage period. From these results it could be noticed that the acetaldehyde gradually decreased when chia flour increased during storage period. The acetaldehyde was

Table 7: Effect of acetaldehyde and diacetyl (µg/ml) on yoghurt from chia flour during storage period:

Storage periods	Acetaldehyde (µg/ml)	Diacetyl (µg/ml)
Zero time		
Control	181	133
3%	162	121
6%	153	112
9%	120	104
12%	107	98
After fifth days		
Control	209	150
3%	188	136
6%	175	121
9%	138	110
12%	113	102
After ten days		
Control	161	165
3%	158	144
6%	141	137
9%	107	122
12%	99	118
After fifteen days		
Control	113	180
3%	106	169
6%	96	145
9%	88	132
12%	65	124

Table 8: Mean score for sensory evaluation of yoghurt and yoghurt made withusing chia flour during storage period:

		Organoleptic properties			
Treatments	Storage periods	Flavor (45)	*B and T (45)	Appearance (10)	Total Score (100)
Control	Zero Time	44±1.45^{a}	43±1.28^{a}	10±0.71^{a}	97
	5 days	43±1.53^{a}	42±1.51^{a}	10±0.55^{a}	95
	10 days	41±1.24^{a}	40±0.99^{a}	09±0.54^{a}	90
	15 days	40±1.56^{a}	40±1.02^{a}	09±0.45a	89
3 %	Zero Time	43±1.38^{a}	42±1.24^{a}	10±0.74^{a}	95
	5 days	42±1.65^{a}	40±1.55^{a}	10±0.27^{a}	92
	10 days	40±1.19^{a}	38±1.86^{b}	09±0.43^{a}	87
	15 days	39±1.71^{a}	37±0.94^{b}	09±0.73^{a}	85
6 %	Zero Time	42±1.28^{a}	41±1.83^{a}	09±0.62^{a}	92
	5 days	41±1.25^{a}	39±0.91^{b}	09±0.51^{a}	89
	10 days	39±1.43^{b}	36±0.83^{b}	08±0.22^{ab}	83
	15 days	36±1.74^{b}	35±0.72^{b}	08±0.28^{ab}	79
9%	Zero Time	42±1.53^{a}	40±1.59^{a}	08±0.26^{ab}	88
	5 days	40±0.98^{a}	38±0.94^{b}	08±0.43^{ab}	86
	10 days	37±1.01^{a}	35±1.08^{b}	07±0.87^{ab}	79
	15 days	35±1.73^{b}	33±1.01^{b}	06±0.26^{b}	74
12%	Zero Time	36±0.99^{c}	36±0.93^{b}	07±0.43^{ab}	79
	5 days	36±1.83^{b}	34±0.81^{b}	07±0.57^{ab}	77
	10 days	34±1.02^{b}	33±1.00^{b}	06±0.21^{b}	73
	15 days	33±1.28^{b}	30±1.07^{b}	06±0.34^{b}	69

* B and T. Body and Texture

Decreased from 181 µg/ml control yoghurt to 107 µg/ml yoghurt suspended with 12% chia flour and the decreased gradually to end of storage period was 113 µg/ml control yoghurt to 65 µg/ml yoghurt fortified with 12% chia flour. Meanwhile, diacetyl content in yoghurt as control and yoghurt fortified with chia flour at 3, 6, 9 and 12% levels were decreased during cold storage period. The obtained data from these results showed that the fortified yoghurt with chia flour might be giving improved yoghurt.

Organoleptic Properties: Table (8) summarized the mean scores for sensory attributes of yoghurt. The results indicated that the panelists mostly preferred white color yoghurt which existed in buffalos' milk, panelists gave high scores of consistencies for yoghurt prepared using chia flour. However, that yoghurt and its yoghurt mixture with chia at different levels (3, 6, 9 and 12%) did not lose their consistency during storage period, unlike the yoghurt as control which lost its consistency during storage. Panelists preferred flavor of yoghurt made by using chia flour at different levels which clearly appeared in yoghurt processed from buffalos' milk compared to control yoghurt which has unacceptable flavor to most people (This unacceptable flavor was tended to disappear after using flavoring compounds beside pure chia flour).

Milk and yogurt are important elements of the human diet, due to their high nutritional value and their appealing sensory properties. During milk processing (Homogenization, pasteurization) and further yogurt manufacture (Fermentation) physicochemical changes occur that affect the flavor and texture of these products while the development of standardized processes contributes to the development of desirable textural and flavor characteristics. The processes that take place during milk processing and yogurt manufacture with conventional industrial methods, as well as with innovative methods currently proposed (Ultra-high pressure, ultrasound, micro fluidization, pulsed electric fields) and their effect on the texture and flavor of the final conventional [20]. Generally, the panelists highly accepted the yoghurt made by addition of chia flour at 12% levels to the milk and the yoghurt products were preference to the panelists.

CONCLUSIONS

Yoghurt and soft cheese are dairy products. It is having several health benefits. The intake of yoghurt and soft cheese can improve lactose maldigestion, it lowers bad cholesterol and is also good for skin.Yoghurt having

several health benefits so, is healthier for consumption. Yoghurt and soft cheese supplies good quality proteins, also an excellent source of calcium, phosphorus and potassium and contains significant quantities of general vitamins. Yoghurt and soft cheese properties by adding different levels from chia flour were affected like on physical, sensory, textural, physiochemical properties and its quality is enhanced.

REFERENCES

1. Ixtaina, V.Y., M.L. Martínez, V. Spotorno, C.M. Mateo, D.M. Maestri and B.W.K. Diehl, 2011. "Characterization of chia seed oils obtained by pressing and solvent extraction". J. Food Comp. Anal., 24(2): 166-174.
2. Mohd, A.N., S.K. Yeap, H.W. Yong, B.K. Beh, T.S. Wei and T.S. Guan, 2012. The Promising Future of Chia, Salvia hispanica L". Journal of Bio-medical and Biotechnology, 171956.
3. Simopoulos, A.P. and L.G. Cleland, 2003. Omega-6/omega-3 essential fatty acid ratio: the scientific evidence. World Review of Nutrition and Dietetics, 92: I-XIII.
4. Drusch, S. and S. Mannino, 2009. Patent-based review on industrial approaches for the microencapsulation of oils rich in polyunsaturated fatty acids. Trends in Food Science and Technology, 20: 237-244.
5. Bakr, S. A. and B. A. Salihin, 2013. "Effects of Inclusion of Allium sativum and Cinnamomumverum in Milk on the Growth and activity of lactic acid bacteria during yogurt fermentation". American-Eurasian J. Agric. & Environ. Sci., 13(11): 1448-1457.
6. Irkin, R. and U.V. Eren, 2008. A Research about Viable Lactobacillus bulgaricus and Streptococcus thermophilus Numbers in the Market Yoghurts. World Journal of Dairy & Food Sciences, 3(1): 25-28.
7. Zare, F., 2011. Microbial, physical and sensory properties of yogurt supplemented with lentil flour. Food Research International, 44: 2482-2488.
8. Farkye, N.Y., 2004. "Cheese Technology". Int. J. Dairy Technol., 57: 91-98.
9. Bortolotto, N., S. Rozycki, H. Castellini and B. Riquelme, 2015. Study of the structure of functional cheese with chia seed added by digital image analysis". Acta Microscopica, 24(1): 1-6.
10. Fox, P.F., T.P. Guinee and P.L.H. McSweeney, 2000. "Fundamentals of cheese science. Gaithersburg, Md.: Gaithersburg, Md.: Aspen Publication.
11. Weber, F., 1987. Curd drainage. In: Cheese making: Science and Technology. Lavoisier, NY.Ed., Eck, A. pp: 22-36.
12. Fahmi, A.H. and H.A. Shrara, 1950. Studies of Egyptian Domiati Cheese. J. Dairy Res., 17(3): 312-328.
13. El-Safty, M.S., A.A. Nofal and A. Hekmat, 1983. The effect of acidic and basic amino acids mixtures on quality and ripening of Domiati cheese made from reconstituted milk. Egyptian J. Food Sci., 11(1-2): 115-122.
14. AOAC, 2010. Official Methods of Analysis of Association of Official Chemists.18thed., Washington, D.C., USA.
15. Pupin, A.M., M.J. Dennis and M.C.F. Toledo, 1999. HPLC analysis of carotenoids in orange juice. Food Chemistry, 64: 269-275.
16. Food and Nutrition Board, Institute of Medicine, 2001. Vitamin A. Dietary Reference intakes for vitamin A, vitamin K, arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium and Zinc. Washington, D.C.: National Academy Press, pp: 82-161.
17. Farooq, H. and Z.U. Haque, 1992. Effect of sugar asters on the texture properties of non fat low caloric yoghurt. J. Dairy Sci., 75: 2676-2680.
18. APHA American Puplic Health Association, 1978. Standard Methods for the Experimental of Dairy Products: Microbiological and Chemical 14th Ed. APHA. NY., USA.
19. Harrigan, W.F. and M.E. McCance, 1976. Laboratory Methods in Food and Microbiology. Academic Press, London and New York.
20. Sfakianakis, P. and C. Tzia, 2014. Conventional and Innovative Processing of Milk for Yogurt Manufacture; Development of Texture and Flavor: A Review. Foods, 3: 176-193.
21. Mason, M.J., D.L. Scammon and X. Fang, 2007. The impact of warnings, disclaimers and product experience on consumers' perceptions of dietary supplements, J. Consum Affairs, 41: 74-99.
22. Pappas, C.P., E. Kanolly and L.P. Voustsinas, 1996. Effect of starter level draining time and aging on the physicochemical, organoleptic and rheological properties of Feta cheese. J. Sci. Dairy Tech., 49: 73-77.
23. Lee, W.J. and J.A. Lucey, 2010. Formation and Physical Properties of Yoghurt. Asian-Australian Journal of Animal Science, 23(9): 1127-1130.

24. Lees, G.J. and G.R. Jago, 1969a. Methods for the estimation of acetaldehyde in cultured dairy products. Australian J. Dairy Tech., 24: 181-186.
25. Lees, G.J. and G.R. Jago, 1969b. The estimation of diacetyl in the presence of other carbonyl compounds. J. Dairy Res., 37: 124-130.
26. Abdel Moneim E.S., M.A. Rania and A.S. Zakaria, 2011. "Effects of storage on quality of yoghurt prepared from cows' and goat's milk and pure strains of lactic acid bacteria. J. Sci. Tech., 12(1): 136-143.
27. SAS System for Windows (Statistical Analysis System), 2008. Version 9.2. Cary, USA: SAS Institute Inc. S.
28. Hassanein, A.M., 2003. Study on use of soybean in manufacturing of yoghurt and cheese. Ph. D. Thesis, Fac. of Agric., Suez Canal Univ., Egypt.
29. Ibrahim, F.S., A.M. Darwish and M.B.M. Mostafa, 1999. Assessment the quality of reduced fat Domiati cheese manufactured from skimmilk powder fortified milk. Annals of Agric. Sci. Moshtohor, 37(4): 2589-2603.
30. Fayed, E.O., 1982. Studies on the use of some natural flavor agents on the ripening of picked Domiati cheese. Ph.D. Thesis, Ain Shams Univ.
31. Abou-Donia, S.A., 1986. Egyptian Domiati soft white pickled cheese (Review). New Zeal and J. Dairy Sci. Tech., 21: 167.
32. Moneib, A.F., A. Abo El-Heiba and A.F. Al-Khamy, 1981. Picked soft cheese making from whole and skim milk powder. Egyptian Dairy Sci., 9: 37-44.
33. Abd-Alla, S.A.M., H.M. Abbas, N.H. El-Sayed and N.F. Tawfik, 1993. Effect of substitution of soy milk on some chemical properties, formation of biogenic amines and pr-toxin of blue veined cheese. J. Agric. Sci. Mansoura Univ., 18(7): 2002-2010.
34. Pratt, D.E., 1980. Autoxidation in Food and Biological Systems edited by M.G. Simic and M. Karel, Plenum Press, New York and London, 1980.
35. Alu'datt, M.H., T. Rababah, K. Ereifej and I. Alli, 2013. Distribution, antioxidant and characterisation of phenolic compounds in soybeans, flaxseed and olives, Food Chem, 139(1-4): 93-99.
36. Amarowicz, R., M. Naczk and F. Shahidi, 2000. Antioxidant activity of various fractions of non-tannin phenolics of canola hulls, J. Agric. Food Chem., 48: 2755-2759.
37. Ixtaina, V.Y., S.M. Nolasco and M.C. Tomas, 2008. Physical properties of chia (Salvia hispanica L.) seeds. Industrial Crops and Products, 28(3): 286-293.
38. Craig, R., 2004. Application for approval of whole chia (Salvia hispanica L.) seed and ground whole seed as novel food ingredient". Food Standard Agency, UK. Commission Decision 2009/827/EC Company Representative Mr. D. Amstrong, Northern Ireland, 2004.
39. Paolo, F., S. Andrea, F. Piero, M. Massimo and M. Primo, 2008. Cheese yield: Factors of variation and predictive formulas. A review focused particularly on grana type cheeses. Ann. Fac. Med. Vet. Parma, 28: 211-232.
40. AbouAyana, I.A.A., A.M. El Deeb and A.A. Ibrahim, 2016. Using of Dairy Propionibacteria as Bio-Preservative in Kareish Cheese. Int. J. Dairy Sci., 11(3): 114-123.
41. Fagan, C.C., Leedy M. Castillo, F.A. Payne, C.P. Donnell and D.J. O'Callaghan, 2007. Development of a light scatters sensory technology for on-line monitoring of milk coagulation and whey separation. Journal Dairy Science, 90: 4499-4512.
42. Walstra, P., 1993. The Syneresis of Curd, pp. 141-191. In P. F. Fox (Ed.): Cheese: Chemistry, Physics and Microbiology, Chapman and Hall.
43. Darwish, S.M., S.A. El-Deeb and R.I. Mashaly, 1989. Effect of L. helveticaus cell- free extract at different salt concentration on the acceleration rate of Domiati cheese ripening. Egyptian. J. Dairy Sci., 17: 45.
44. Krupa, H., H. Jana Atanu and H.G. Patel, 2011. "Synergy of dairy with non-dairy ingredients or product: A review. Afr. J. Food Sci., 5(16): 817-832.
45. Oliveria, M.N., I. Sodini, F. Remeuf and G. Corrieu, 2001. Effect of milk supplementation and culture composition on acidification, textural properties and microbiological stability of fermented milks containing probiotic bacteria". International Dairy Journal, 11: 935-942.
46. Ozer, B.H., A.E. Bell, A.S. Grandison and R.K. Robinson, 1998. Rheological properties of concentrated yoghurt Labneh". Journal of Texture Studies, 29: 67-79.
47. Tamime, A.Y., M. Kalab and G. Davies, 1989. Rheology and Microstructure of strained yoghurt (Labneh) made from cow's milk by three different methods. Food Microstructure, 8: 125-135.
48. Mahdian, E. and M.M. Tehrani, 2007. Evaluation the Effect of Milk Total Solids on the Relationship between Growth and Activity of Starter Cultures and Quality of Concentrated Yoghurt. American-Eurasian Journal of Agriculture and Environmental Science, 2: 587-592.

49. Robinson, R.K., 1977. A dairy product for the future: concentrated yogurt. South African Journal of Dairy Technology, 9(2): 59-61.

50. Tamime, A.Y. and R.K. Robisons, 2007. Chapter 2 Backround to manufacturing practice. In Tamime and Robinson's Yogurt: Science and Technology, 3rd ed.; Wood head Publishing LTD: Cambridge, UK, 2007: pp: 11-118.