J. of Food and Dairy Sci., Mansoura Univ., Vol 10 (9)303-308:, 2019

Journal of Food and Dairy Sciences

Journal homepage: www.jfds.mans.edu.eg
Available online at: www. jfds.journals.ekb.eg

A Study on Supplementation of Non-Fat Yoghurt with Psyllium

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ABSTRACT

Skim buffalo's milk supplemented with psyllium husks (PSH) or seeds (PSS) was used for making stirred yoghurt. Milk was heated at 90^{o}C /10 min and quickly cooled to 42^{o}C (control, without psyllium) and to 60^{o}C for supplementation with PSH at ratios of 0.5, 1.0 and 1.5%, w/v (A1, A2 and A3) and with PSS at ratios of 0.5, 1.0 and 1.5% w/v (B1, B2 and B3) and then cooled (42^{o}C) to be ready for fermentation. The resultant yoghurt was analyzed when fresh and during cold storage (4^{o}C) for 7 and 15 days for chemical, physiochemical and sensory properties. The obtained results for the different treatments with psyllium indicated almost significant increase ($P \leq 0.05$) on total solids, total protein and ash content. Generally, titratable acidity gradually increased through storage period and pH decreased with different rates due to type and amount of supplement. PSH and PSS enhanced formation of acetaldehyde and increased carbohydrate at different storage periods and subsequently increaseD the energy of the treated yoghurt. Water holding capacity and viscosity were almost significantly increased by supplement and by amount of both PSH and PSS and with advancing storage period. The control yoghurt had the lowest values of both of them. Organoleptically, the use of PSH or PSS at level of 1.5% (w/v) gave improved body and texture without any adverse impact on the flavour of the prepared product.

Keywords: Psyllium, husks or seeds, non-fat yoghurt.

INTRODUCTION

Yoghurt defines as composite gel that constitutes three-dimensional casein network aggregated through isoelectric precipitation due to action of lactic acid bacteria and act as basic structure of yoghurt, containing denatured serum proteins and fat globules (Weerathilake *et al.,* 2014). Reduction or elimination of fat from yoghurt milk, starter culture and manufacture condition of yoghurt (LAl *et al.*, 2006), hardly affect its physical and textural properties. Such properties are quite important for yoghurt quality and consumer satisfying (Crion *et al.*, 2012). However, in recent years consumers are more conscious than ever before to modify their eating habits for many health benefits especially avoiding too much fat. Low-fat dairy products have gained popularity in Egypt, while non-fat yoghurt is manufactured to meet the increasing demand for low-calorie dairy products.

In the literature, a lot of studies were carried out aiming to improve quality of non- or low-fat yoghurt by means of using pectin and different hydrocolloids (Alakali *et al.*, 2008, Sahan *et al.*, 2008 ; Razmkhah Sharabiani *et al.*, 2010 ; Mohamed, 2012 ; Mehanna *et al.*, 2013a) and transglutaminase (Ozer *et al.*, 2007 and Mehanna *et al.*, 2013b), while fortification with dairy powders were studied (Amatayakul *et al.*, 2006 and Marafon *et al.*, 2011) and their impacts on texture properties and the sensorial attributes of yoghurt – in general – were reviewed by Karam *et al.* (2013).

Husks and seeds from Plantago ovata (*Plantaginis ovatae*) are commonly also referred to as psyllium, psyllium has a long history for use as a dietary fiber supplement and primarily as a gentle bulk-forming laxative to promote the regulation of large bowel function. Dietary supplementation with psyllium has been shown to lower blood cholesterol levels, and especially LDL cholesterol (Anderson *et al.*, 2000) as well as to maintain blood glucose homeostasis, which together are the most effective preventive measures against diabetes and cardiovascular diseases. Moreover, Psyllium fiber is widely used as a supplement for the treatment of constipation and has in clinical trials repeatedly reported significantly increased levels of stool moisture in healthy subjects (Marlett *et al.*, 2000) and in patients with gastrointestinal disease (McRorie *et al.*, 1998). On the opposite of the desired effect against constipation, and because of its great ability to retain water, psyllium has also been shown to slow down the gastric emptying time and colon transit, this being of benefit for individuals with fecal incontinence from liquid stools or diarrhea (Bliss *et al.*, 2001).

The objective of this study was to develop functional non-fat stirred yoghurt using psyllium husk (PSH) or seeds (PSS) and to add more health benefits to the product. Chemical analysis and some physico-chemical properties as well as the sensorial properties of the product were taken into consideration. The changes – on storage – related to the prementioned properties were also followed during 15 days of cold storage.

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DOI: 10.21608/jfds.2019.54524

MATERIALS AND METHODS

Materials:

Fresh buffalo's milk used in the present study was collected from the herd of Mehallet Moussa Animal Production Research Station, Animal Production Research Institute. Skim milk was prepared using cream separator.

Psyllium husks (PSH) and seeds (PSS) were obtained from Imtenan Health Section, Food Additives Company, Egypt. The chemical analysis of both of them was done (AOAC, 2000) and the results were as follows:

	Moisture %	Crude protein%	Oil %	Fiber %	Ash %
Psyllium husks	88.87	2.0	1.6	81.95	2.5
Psyllium seeds	86.86	6.4	5.1	71.26	2.1

Yoghurt starter culture consisting of *Streptococcus thermophilus* & *Lactobacillus delbrueckii* ssp. bulgaricus was obtained from Chr. Hansen's Laboratories, Copenhagen, Denmark.

Methods:

The skim buffalo's milk used contained 3.46% protein, 9.77% total solids and 0.66% ash. Stirred yoghurt was made as mainly described by Tamime and Robinson (1999).

Milk was heated at 90^{o}C /10 min and quickly cooled to 42^{o}C (control, without psyllium) and to 60^{o}C for addition of PSH at ratios of 0.5, 1.0 and 1.5% w/v (A1, A2 and A3) and PSS at ratios of 0.5, 1.0 and 1.5% w/v (B1, B2 and B3) and then cooled to 42^{o}C. Milk from the different treatments were inoculated with yoghurt starter culture and incubated at the same temperature to rich pH 4.6. The prepared samples were stirred and filled into 100 ml plastic cups and then cooled to 4^{o}C. Three replicates were done from each treatment. The resultant yoghurt was analyzed when fresh and during storage at 4^{o}C for 15 days for: total solids, total protein, ash and titratable acidity according to the methodology mentioned by A.O.A.C. (2000), while pH value was measured using a pH meter JENCO Model 1671, USA. Carbohydrate was calculated using the following equation:

Carbohydrate = TS - (protein + fat + ash)

The concentration of acetaldehyde (μ mol /100 g yoghurt) was measured using spectrophotometer (Shimadzu, 240 UV, Vis., Japan) as described by Lees and Jago (1970).

Water holding capacity (WHC) of yoghurt was measured by centrifugation of 5 g yoghurt sample at 4500 rpm for 30 min at 10^{o}C (Jouan, MR1822, France). The WHC was calculated as follows according to Isanga and Zhang (2009):

$$\text{WHC (\%)} = 1 - \frac{W1}{W2} \times 100$$

Where: W1 = weight (g) of whey after centrifugation,
W2 = yoghurt initial weight (g)

The apparent viscosity was evaluated using a digital Brookfield viscometer (Model LVD-E, Brookfield Engineering Laboratories, Inc., USA) with ultra low adapter (ULA) unit which attached to viscometer as described by Khalifa and Ghanimah (2013). Samples were tested in triplicate at 5±1^{o}C with spindle No. 64. The viscosity reading was recorded as centipoises (cP).

Calculation of the energy value:

The energy (kcal /100 g) was calculated using energy conversion factors for protein (4), lactose or carbohydrate (4) and fat (9) (Barrantes *et al.*, 1994).

Sensory evaluation:

It was assessed according to El-Shibiny *et al.* (1979) taking into consideration the maximum attainable scores for body and texture were 40 points (10 points for each of appearance, smoothness, viscosity and wheying-off) and were 60 points for flavours (10 points for each of acid, bitterness, flat, foreign, cooked and unclean).

Statistical analysis:

Analysis of variance and Duncan's test were carried out using SPSS computer program (SPSS, 1999). Averages were recorded±SE.

RESULTS AND DISCUSSION

The data with respect to assessing the use of psyllium husks (PSH) or seeds (PSS) on chemical composition of yoghurt are presented in Table (1). The total solids (TS) of fresh yoghurt was noted to be in increasing order with increasing the amount of PSH from 9.79% in control sample (without psyllium) to 10.39, 10.69 and 11.75% when PSH was added at 0.5, 1.0 and 1.5% in order, and to 10.48, 10.96 and 11.81% when PSS was used at levels of 0.5, 1.0 and 1.5%, respectively. The corresponding values of total protein content were 3.46% for control and 3.50, 3.49 and 3.52% for PSH and 3.66, 3.62 and 3.73% for PSS treatments. Ash content increased significantly due to PSH and PSS. Such changes in chemical composition of yoghurt due to the use of PSH or PSS are mainly due to the used husks and seeds contained solids, protein and ash as prementioned elsewhere in the present study. However, the changes during storage could be attributed to loss of some moisture via evaporation since no hot sealing for the lids was applied (Mehanna *et al.*, 2013a). The attained changes –on storage- are in agreement with the trends given by El-Shibiny *et al.* (1979), Mehanna *et al.* (1999) and Mehanna *et al.* (2013a).

Titratable acidity (TA) values expressed as percentage of lactic acid and pH are listed in Table (2). Insignificant differences were observed in fresh samples between the PSH-treated samples and the control, whereas the TA values were significantly higher in case of using higher amount of PSS (Treatments B2 and B3). In case of 7 days old samples, the differences between all treatments –with except A1- and the control were insignificant ($P>0.05$), while after 15 days of storage the control had the highest acidity (0.95%) with insignificant differences with B2 (0.91%) and B3 (0.92%) and with significant differences with the rest treatments ($P\leq0.05$). A gradual increase in acidity was recorded during storage all samples reaching significant higher values ($P\leq0.05$) at the end of storage period. The increase of acidity during storage is mainly due to more fermentation of lactose while the rate of increase agrees with the trend given by Mehanna and Gonc (1988) who mentioned that the rate of developing TA was lower within the first five days of storage and then increased after that.

The pH (Table 2) had an opposite trend of acidity since the lowest significant values were recorded at the end of storage period. Concerning impact of the treatments, the addition of PSH increased the pH of fresh and stored yoghurt while A2 had more impact in this respect. The opposite impact was noticed when PSS was used in fresh and 7 days old yoghurt since the pH of the control was relatively higher than those of B1, B2 and B3.

Decourcelle *et al.* (2003) found that modified starch increased pH reduction in fat-free stirred yoghurt. The gradual decrease in pH during storage agrees with the trend given by Mehanna and Gonc (1988), Sahan *et al.* (2008) and Mehanna *et al.* (2013a), while Hassan *et al.* (2015) mentioned that during storage period all yoghurt samples showed continued decrease in pH until day 10, the differences being significant only at day 10. Thereafter, no significant changes were observed at 15 days compared with day 10. This was true in control yoghurt and yoghurt containing cress seed mucilage or guar gum.

Table 1. Changes in total solids, total protein and ash of non-fat stirred yoghurt when fresh and at 7 and 15 days of cold storage as affected by psyllium husks or seeds. (Average±SE of 3 replicates)*.

Storage	C,	psyllium husks			psyllium seeds		
period(days)	control	A1	A2	A3	B1	B2	B3
Total solids (%)							
Fresh	9.79±0.16^{Cd}	10.39±0.01^{Cc}	10.69±0.10^{Cbc}	11.75±0.18^{Ca}	10.48±0.05^{Cc}	10.96±0.02^{Cb}	11.81±0.02^{Ca}
7	10.93±0.03^{Bd}	11.07±0.07^{Bd}	11.51±0.05^{ABbc}	12.42±0.21^{ABa}	11.24±0.06^{Bcd}	11.67±0.11^{Bb}	12.61±0.07^{Ba}
15	11.42±0.08^{Ad}	11.51±0.08^{Ade}	11.93±0.02^{Ac}	12.94±0.04^{Aa}	11.69±0.03^{Acd}	12.41±0.08^{Ab}	13.01±0.14^{Aa}
Total protein (%)							
Fresh	3.46±0.22^{Cc}	3.50±0.04^{Cc}	3.49±0.01^{Cc}	3.52±0.11^{Cc}	3.66±0.01^{Cb}	3.62±0.03^{Cb}	3.73±0.04^{Ca}
7	3.82±0.11^{Bc}	4.08±0.04^{Bbc}	4.13±0.01^{Bb}	4.19±0.02^{Bb}	4.36±0.04^{ABab}	4.41±0.07^{ABa}	4.33±0.17^{Bab}
15	4.21±0.09^{Ac}	4.41±0.81^{Abc}	4.54±0.02^{Abc}	4.60±0.05^{Aabc}	4.77±0.05^{Aab}	4.75±0.16^{Aab}	4.80±0.08^{Aa}
Ash (%)							
Fresh	0.66±0.02^{Bd}	0.83±0.04^{Bc}	0.89±0.01^{Bb}	0.94±0.01^{Ba}	0.84±0.01^{Bc}	0.93±0.08^{Ba}	0.96±0.01^{ABa}
7	0.75±0.02^{Ad}	0.90±0.04^{Ac}	0.95±0.01^{Abc}	0.96±0.01^{ABb}	0.93±0.02^{ABbc}	0.95±0.07^{ABbc}	1.03±0.03^{Aa}
15	0.79±0.01^{Ae}	0.93±0.01^{Ad}	0.97±0.01^{Acd}	1.03±0.03^{Abc}	0.99±0.01^{Abcd}	1.04±0.02^{Aab}	1.09±0.01^{Aa}

*** A1, A2, A3 (0.5, 1.0 and 1.5% of psyllium husks) and B1, B2 and B3 (0.5, 1.0 and 1.5% of psyllium seeds).**
A, B.. etc Means within columns with different superscripts are significantly different (p≤0.05).
A, b..etc Means within rows with different superscripts are significantly different (p≤0.05) .

Table 2. Changes in acidity, pH and acetaldehyde of non-fat stirred yoghurt when fresh and at 7 and 15 days of cold storage as affected by Psyllium husk or seeds. (Average±SE of 3 replicates).*

Storage	C,	psyllium husks			psyllium seeds		
period(days)	control	A1	A2	A3	B1	B2	B3
Titratable Acidity (%)							
Fresh	0.69±0.01^{Cb}	0.69±0.01^{Bb}	0.69±0.01^{Bb}	0.70±0.01^{Cb}	0.68±0.01^{Bb}	0.71±0.01^{Cab}	0.74±0.05^{Ca}
7	0.85±0.01^{Ba}	0.70±0.01^{Bb}	0.82±0.01^{Aa}	0.85±0.01^{Ba}	0.82±0.02^{Aa}	0.84±0.02^{Ba}	0.86±0.01^{Ba}
15	0.95±0.01^{Aa}	0.79±0.03^{Ac}	0.83±0.01^{Abc}	0.91±0.01^{Aa}	0.86±0.01^{Ab}	0.91±0.01^{Aa}	0.92±0.01^{Aa}
pH value							
Fresh	4.91±0.15^{Abc}	5.09±0.04^{Aab}	5.14±0.04^{Aa}	4.97±0.02^{Aabc}	4.89±0.04^{Abc}	4.75±0.03^{Ac}	4.80±0.03^{Ac}
7	4.84±0.07^{Aab}	4.89±0.05^{ABab}	4.98±0.10^{ABa}	4.85±0.06^{Aab}	4.74±0.01^{ABbc}	4.46±0.01^{ABc}	4.57±0.05^{Bc}
15	4.43±0.03^{Bc}	4.67±0.07^{Bab}	4.75±0.03^{Ba}	4.55±0.03^{Bbc}	4.55±0.02^{Bbc}	4.55±0.02^{Bbc}	4.46±0.02^{BCc}
Acetaldehyde (µ mol /100 g yoghurt)							
Fresh	18.14±0.59^{Cd}	20.94±0.24^{Bd}	35.83±0.90^{Bb}	40.42±0.92^{ca}	19.81±0.32^{cd}	21.13±0.12^{Cd}	30.53±0.96^{Cc}
7	21.64±0.86^{ABe}	25.36±0.58^{Ad}	39.23±0.61^{Ab}	43.37±0.95^{Ba}	23.91±0.33^{Bde}	28.87±0.95^{Bc}	37.30±0.80^{Bb}
15	23.11±0.96^{Ad}	26.19±0.60^{Ad}	39.86±0.75^{Ab}	46.32±0.92^{Aa}	26.13±0.70^{Ad}	31.11±0.16^{Ac}	41.72±0.95^{Ab}

*** See legend on Table (1) for details.**

Acetaldehyde content (Tale 2) seems to be affected by the applied treatments and advancing storage period. Supplementation with PSH or PSS increased acetaldehyde content and the increase was proportional with the amount of supplement added. The control had always the lowest content, while the contents were always higher in case of using PSH compared with PSS. This was true in the fresh and stored samples. In general, acetaldehyde content gradually increased during storage and the samples of 15 days old had almost the highest significant value. This was true in control and all treated samples which agrees with the results given by Mehanna *et al.* (1999 and 2000) and disagrees with the trend given by Sahan *et al.* (2008). The effect of psyllium and storage period on the carbohydrate content of yoghurt is shown in Table (3). It seems that the psyllium had a better performance in keeping higher carbohydrate content and that might be explained by the fact that psyllium has higher carbohydrate precursors (Rizk, 1986). In fresh yoghurt all PSH and PSS supplemented samples had higher carbohydrate compared to the control and the higher were the amounts of them added, the higher were the carbohydrate contents. In the stored samples, A3 and B3 treatments caused the highest carbohydrate content than the other treatments or the control. The content of carbohydrate at different storage periods showed significant differences, the highest (P≤0.05) content was reported for day 15 being 7.29, 7.27 and 7.30% for 0.5, 1.0 and 1.5% PSH in order and 7.11, 7.11 and 7.12% for 0.5, 1.0 and 1.5% PSS respectively.

Table 3. Changes in carbohydrate (%) and energy (kcal/100 g) of non-fat stirred yoghurt when fresh and at 7 and 15 days of cold storage as affected by Psyllium husk or seeds. (Average±SE of 3 replicates).*

Storage period(days)	C, control	psyllium husks			psyllium seeds		
		A1	A2	A3	B1	B2	B3
Fresh	$5.68±0.13^{Bc}$	$6.07±0.04^{ABb}$	$6.31±0.10^{Ab}$	$7.29±0.18^{Aa}$	$6.04±0.06^{Abc}$	$6.41±0.13^{Ab}$	$7.11±0.17^{Aa}$
7	$6.35±0.12^{Abc}$	$6.08±0.10^{ABcd}$	$6.46±0.02^{Ab}$	$7.27±0.19^{Aa}$	$5.94±0.04^{Ad}$	$6.30±0.03^{ABbc}$	$7.11±0.05^{Aa}$
15	$6.42±0.02^{Abc}$	$6.17±0.07^{Acd}$	$6.44±0.02^{Abc}$	$7.30±0.04^{Aa}$	$5.94±0.04^{Ad}$	$6.12±0.16^{Bb}$	$7.1 2±0.19^{Aa}$
Fresh	$36.54±0.62^{Cd}$	$38.28±0.02^{Cc}$	$39.20±0.44^{Cbc}$	$43.25±0.71^{Ba}$	$38.56±0.76^{Cbc}$	$40.11±0.08^{Cb}$	$43.37±0.86^{Aa}$
7	$40.69±0.02^{Bd}$	$40.70±0.26^{Bd}$	$42.22±0.23^{Bbc}$	$45.84±0.82^{Aa}$	$41.20±0.22^{Bed}$	$42.85±0.44^{Bb}$	$46.31±0.38^{Aa}$
15	$42.51±0.30^{Ad}$	$42.30±0.30^{Ad}$	$43.95±0.02^{Acd}$	$47.51±0.19^{Aa}$	$42.83±0.11^{Ad}$	$45.47±0.42^{Abc}$	$46.36±0.95^{Aab}$

*** See legend on Table (1) for details.**

The data (Table 3) revealed that the energy of control yoghurt was 36.54, 40.69 and 42.51 kcal/100 g on the day of preparation and at 7 and 15 days of storage, respectively. This trend of results was observed in all treated samples. A3 had the maximum corresponding values when PSH was used, while B3 had the same when PSS was added. In both cases, the higher was the amount of supplement added, the higher were energy values. The control of any age had almost lower values compared to the treated samples suggesting PSH and PSS had almost significant impact on increasing energy of yoghurt.

Water holding capacity (WHC) is defined as drainage occurs during apply stress and indicates protein network resistance against shear stress. WHC (Table 4) ranged in fresh yoghurt from 35.55% for the control to 53.53, 63.57 and 80.37% for 0.5, 1.0 and 1.5% for PSH treatments and to 50.72, 60.57 and 62.11% for 0.5, 1.0 and 1.5% of PSS treatments respectively. Such values gradually increased during storage reaching the maximum corresponding values of 51.37%, and 62.71, 80.86, 95.76, 61.69, 65.27 and 73.89%, respectively at the end of storage.

Table 4. Changes in water holding capacity (%) and viscosity (cP) of non-fat stirred yoghurt when fresh and at 7 and 15 days of cold storage as affected by Psyllium husk or seeds. (Average±SE of 3 replicates).*

Storage period(days)	C, control	psyllium husks			psyllium seeds		
		A1	A2	A3	B1	B2	B3
Water holding capacity (WHC)							
Fresh	$35.55±0.94^{Cd}$	$53.53±0.96^{Bc}$	$63.57±0.90^{Bb}$	$80.37±0.98^{Ca}$	$50.72±0.11^{Bc}$	$60.57±0.75^{Bb}$	$62.11±0.18^{Bb}$
7	$43.20±0.26^{Be}$	$56.03±0.06^{Bd}$	$69.88±0.34^{Bb}$	$86.37±0.35^{Ba}$	$56.82±0.90^{ABd}$	$63.71±0.75^{Ac}$	$66.99±0.80^{Bbc}$
15	$51.37±0.70^{Ae}$	$62.71±0.90^{Ad}$	$80.86±0.81^{Ab}$	$95.76±0.41^{Aa}$	$61.69±0.63^{Ad}$	$65.27±0.81^{Ad}$	$73.89±0.28^{Ac}$
Viscosity							
Fresh	$2050±3.59^{Bd}$	$3885±4.60^{Bbc}$	$4800±6.7^{Bb}$	$8746±9.30^{Aa}$	$2300±15.2^{Bd}$	$2746±13.8^{Bd}$	$3020±4.0^{Bcd}$
7	$2320±5.48^{Bd}$	$4100±6.88^{Bc}$	$6880±24.5^{Ab}$	$9852±6.29^{Aa}$	$2516±31.7^{Bdf}$	$3070±31.2^{AB}$	$3666±32.9^{Bd}$
15	$2799±6.29^{Af}$	$4903±9.24^{Ac}$	$7236±31.16^{Ab}$	$10026±28.93^{Aa}$	$3096±29.7^{Adf}$	$3523±32.44^{Ae}$	$4060±15.27^{Ad}$

*** See legend on Table (1) for details.**

All concentrations of the used psyllium significantly increased WHC. Evertt *et al.* (2005) reported that in high levels of psyllium (husks or seeds) the flow units of network are decreasingly covered by fibre and the aggregates are partially statically stabilized. This leads to decrease syneresis and increased WHC. Other stabilizers and thickness connect the granules and chains of milk proteins and provide continues and homogeneous doubled network structure with minimum free ends. This more interconnected network would binding aqueous phase more efficiently. Our results agree with those of Gonçalvez *et al.* (2003) ; Sahan *et al.* (2008) and Razmkhah sharabiani (2010) who reported the effects of thickeners on syneresis reduction.

Table (4) depicts that control fresh and stored yoghurt exhibited lower viscosity than the PSH or PSS treated yoghurt. The value in fresh control yoghurt was 2050 cP, whereas those of PSH with 0.5, 1.0 and 1.5% were 3885, 4800 and 8746 cP respectively and those due supplementation with 0.5, 1.0 and 1.5% PSS were 2300, 2746 and 3020 cP in order. This trend of results continued with higher values during storage reaching the maximum values of 2799, 4903, 7236, 10026, 3096, 3523 and 4060 cP for the control, A1, A2, A3, B1, B2 and B3 treatments respectively. Such trend during storage could be due to gel viscosity often decreases during mixing, and also recovers a part of the original structure and increase after cessation of shearing (Chengcheng Li *et al.*, 2014). On the other hand, apparent viscosity had a direct correlation with psyllium concentration. Its thickeners assumed due to binding more free water and trap it in casein network thus increase viscosity of sample (Sahan *et al.*, 2008).

Organoleptic characteristics scores of control and psyllium supplemented yoghurt based on body and texture are shown in Table (5). The scores of control fresh and stored yoghurt were significantly less than the corresponding scores of the other two test yoghurt samples prepared with PSH or PSS. Probably it was due to very thin consistency low viscosity and separation of whey on the surface of control yoghurt especially during storage. However, PSH and PSS had improving impact in this respect. Scores of all tested yoghurt samples declined at the end of storage period.

Table 5. Organoleptic scoring of non-fat stirred yoghurt when fresh and at 7 and 15 days of cold storage as affected by Psyllium husk or seeds. (Average±SE of 15 evaluations from 3 replicates).*

Property	C, control	psyllium husks			psyllium seeds		
		A1	A2	A3	B1	B2	B3
Fresh							
Body texture (40)	30.12±0.02[c]	38.81±0.18[a]	38.46±0.03[a]	38.23±0.33[a]	35.00±0.13[b]	37.20±0.66[b]	37.60±0.31[ab]
Flavour (60)	45.11±0.33[d]	50.11±0.66[c]	50.36±0.12[c]	45.61±0.12[d]	55.22±0.33[b]	57.34±0.36[a]	54.94±0.33[b]
Total score (100)	75.23±0.18[d]	88.92±0.11[b]	88.82±0.33[b]	83.84±0.02[c]	90.22±0.12[b]	94.54±0.11[a]	92.57±0.20[a]
7 days							
Body texture (40)	32.33±0.18[c]	37.24±0.11[ab]	38.50±0.12[a]	37.36±0.33[ab]	36.03±0.33[b]	39.35±0.33[a]	36.36±0.6[b]
Flavour (60)	47.36±0.33[d]	52.36±0.12[c]	52.64±0.21[c]	48.23±0.33[d]	55.63±0.26[b]	58.23±0.18[a]	56.52±0.6[b]
Total score (100)	79.69±0.11[d]	89.50±0.66[c]	91.14±0.18[b]	85.59±0.12[cd]	91.66±0.33[b]	97.58±0.11[a]	92.88±0.21[b]
15 days							
Body texture (40)	32.11±0.12[b]	36.32±0.21[ab]	36.61±0.18[a]	37.15±0.18[a]	35.22±0.12[ab]	36.67±0.12[a]	31.20±0.10[a]
Flavour (60)	47.60±0.36[bc]	51.36±0.21[b]	50.42±0.11[b]	45.23±0.33[c]	53.20±0.18[a]	55.33±0.66[a]	52.32±0.15[a]
Total score (100)	79.71±0.18[c]	87.68±0.12[ab]	87.03±0.11[b]	82.38±0.31[c]	88.42±0.22[ab]	92.00±0.11[a]	83.52±0.31[a]

*** See legend on Table (1) for details.**

Various strategies exist to improve the gel stability of set-yoghurt, such as increase total solids of milk, etc., stabilizers are common added to control textural defects and increase consistency. This study indicated that the level of 1.5% psyllium (husks or seeds) gave firmer network and smoother texture. Flavour scores of the control and psyllium supplemented yoghurt are depicted in Table (5). Flavour score of control yoghurt was less (45.11, 47.36 and 47.60) when fresh or after 7 and 15 days of storage than scores obtained for PSH supplemented yoghurt with 0.5% (50.11, 52.36 and 51.36), with 1% (50.36, 52.64 and 50.42) and with 1.5% (45.61, 48.23 and 45.23) throughout the storage time.

In conclusion, the use of PSH or PSS at certain levels may be recommended to improve some properties and organoleptic attributes of the non-fat stirred yoghurt.

REFERENCES

Alakali, J. S. ; Okonkoo, T. W. and Brdye, E. M. (2008). Effect of stabilizer on the physico-chemical and sensory attributes of thermized yoghurt. African J. Biotechnol. 7: 158.

Amatayakul, T., Sherkat, F. and Shah, N. P. (2006). Physical characteristics of set yoghurt made with altered casein to whey protein ratios and EPS-producing starter cultures at 9 and 14% total solids. Food hydrocoll. 20: 314.

Anderson, J. W. ; Allgood, L.D. ; Lawrence, A. ; Altringer, L.A. ; Jerdack G.R. ; Hengehold, D.A. and Morel, J.G. (2000). Cholesterol-lowering effects of psyllium intake adjunctive to diet therapy in men and women with hypercholesterolemia: Meta-analysis of 8 controlled trials. American J. Clin.l Nutr. 71: 472.

AOAC (2000). Official Methods of Analysis of AOAC International, 17th Ed. Vol. 11 Gaithersburg, MD.

Barrantes, E. ; Tamime, A. Y. ; Davis, G. and Barclay, M. N. I. (1994). Production of low-calorie yoghurt using skim milk powder and fat substitutes. 2. Compositional quality. Milchwissen-schaft, 49: 135.

Bliss, D.Z. ; Jung, H.J. ; Savik, K. ; Lowry, A. ; LeMoine, M. ; Jensen, L. ; Werner, C. and Schaffer, K. (2001). Supplementation with dietary fiber improves fecal incontinence. Nursing Res. 50:203.

Chengcheng, Li ; Wei Li ; Xiaohong Chen ; Meiqin Feng ; Xin Rui , Mei Jiang and Mingsheng Dong (2014). Microbiological, physicochemical and rheological properties of fermented soymilk produced with exopolysaccharide (EPS) producing lactic acid bacteria strains LWT. Food Sci. Tech., 57: 477.

Crion, C. I. E. ; Gee, V. L. ; Kelly, A. L. and Auty, M. A. E. (2012). Modifying the microstructure of low-fat yoghurt by microfluidisation of milk at different pressures to enhance rheological and sensory properties. Food Chem., 130: 510.

Decourcelle, N. ; Lubbers, S. ; Vallet, N. ; Rondeau, P. and Guichard, E. (2003). Effect of thickeners and sweeteners on the release of blended aroma compounds in fat-free stirred yoghurt during shear conditions. Inter. Dairy J. 14: 783.

El-Shibiny, S. ; El-Dien, H. F. and Hofi, A. A. (1979). Effect of storage on the chemical composition of Zabady. Egyptian J. Dairy Sci. 7:1.

Everett, D. W. and McLeod, R. E. (2005). Interactions of polysaccharide stabilizers with casein aggregates in stirred skim-milk yoghurt. Inter. Dairy J. 15: 1175.

Gonçalvez, D. ; Pérez, M. C. ; Reolon, G. ; Segura, N. ; Lema, P. ; Gámbaro, A. ; Varela, P. and Ares, G. (2003). Effect of thickeners on the texture of stirred yoghurt. Alimentos e Nutrição Araraquara, 16: 207.

Hassan, L. K. ; Haggag, H. F. ; Elkalyoubi, M. H. ; Abd El-Aziz, M. ; El-Sayed, M. M. and Sayed, A. F. (2015). Physico-chemical properties of yoghurt containing cress seed mucilage or guar gum: Annals Agric. Sci., Fac. Agric., Ain Shams Univ., http://dx.doi.org/10.1016 /j.aoas2014.11.021.

Isanga, J. and Zhang , G. (2009). Production evaluation of some physiochemical parameters of peanut milk yoghurt. LWT-Food Sci. Technol. 42: 1132.

Karam, N. C. ; Gaiani, C. ; Hosri, C. ; Burgain, J. and Scher, J. (2013). Effect of dairy powders fortification on yoghurt texture and sensorial properties. A review. J. Dairy Res. 80:400.

Khalifa, M. Y. and Ghanimah, M. A. (2013). Studies on fluid milk viscosity as affected by some factors. J. Biol. Chem. Environ. Sci. 8: 57.

Lal, S. N. D. ; Connor, C. J. O. and Eyres, L. (2006). Application of emulsifiers / stabilizers in dairy products of high rheology. Advances in Colloid and Interface Sci. 123-126: 433.

Lees, G. J. and Jago, G. R. (1970). The estimation of diacetyl in the presence of other carbonyl compounds. J. Dairy Res. 37:129.

Marafon, A. P. ; Sumi, A. ; Alcântara, M. R. ; Tamime, A. Y. and de Oliveira, M. N. (2011). Optimization of the rheological properties of probiotic yoghurts supplemented with milk proteins. Food Sci. Tech., 44:511.

Marlett, J.A. ; Kajs, T. M. and Fischer, M. H. (2000). An unfermented gel component of psyllium seed husk promotes laxation as a lubricant in humans. American J. Clin. Nutr.72: 784.

McRorie, J.W.; Daggy, B.P. ; Morel, J.G. ; Diersing, P.S. ; Miner, P. B. and Robinson M. (1998). Psyllium is superior to docusate sodium for treatment of chronic constipation. Aliment. Pharmacol. Therapeut. 12: 491.

Mehanna, N. M. ad Gonc, S. (1988). Manufacture of yoghurt from milk fortified with whey powder. Egyptian J. Dairy Sci. 16: 239.

Mehanna N. M. ; Ibrahim, E. M. and El-Nawasany, L. I. (2013a). Impact of some hydrocolloids on the physical characteristics and quality of non-fat yoghurt. Egyptian J. Dairy Sci. 41:163.

Mehanna N. M. ; Ibrahim, E. M. and El-Nawasany, L. I. (2013b). Minimzing whey separation from non-fat yoghurt. Egyptian J. Dairy Sci. 41: 59.

Mehanna, N. M. ; Mehanna, A. S. ; Saleh, T. M. and El-Asfory S. M. A. (1999). Manufacture of low-calori zabady by means of decreasing fat content. J. Agric. Sci. Mansoura Univ., 24: 6757.

Mehanna, N. M. ; Saleh, T. Mehanna, A. S. and El-Asfory, S. M. A. (2000). The quality of low-calori buffalo zabady. Egyptian J. Dairy Sci. 28: 59.

Mohmed, S. S. A. (2012). Impact of pectin types on the physical and rheological properties of milk and yoghurt gel. Ph. D. Thesis, Fac. Agric. Kafrelsheikh Univ., Egypt.

Ozer, B.; Kirmaci, H. Oztekin, S. ; Hayaloglu, A. and Atamer, M. (2007). Incorporation of microbial transglutaminase into non-fat yoghurt products. Inter. Dairy J. 17: 199.

Razmkhah Sharabiani, S. ; Razavi, S. M. A. ; Behzad, Kh. and Mazaheri Tehrani, M. (2010). The effect of pectin, sage seed gum and basil seed gum on physicochemical and sensory characteristics of non fat concentrated yoghurt. Iran Food Sci. Tech. Res. J. 13: 27.

Rizk, A. M. (1986). The phytochemistry of the flora of Qatar. Published by Kingprint of Richmond and the Scientific and Applied Research Centre, Qatar.

Sahan, N. ; Yasar K. and Hayaloglu A. (2008). Physical, chemical and flavour quality of non-fat yogurt as affected by a β-glucan hydrocolloidal composite during storage. Food Hydrocoll 22: 1291.

SPSS (1999). SPSS for Windows. Release 10 (Oct., 1999). Standard Version. Copyright SPSS Inc., 1989-1999.

Tamime, A.Y. and Robinson, R. K. (1999). Yoghurt Science and Technology. Wood head Publishing limited, England.

Weerathilake, W. A. D. V. ; Rasika, D. M. A. ; Ruwanmali, J. K. U. and Munasinghe, M. A. D. D. (2014). The evolution, processing, varieties and health benefits of yoghurt. Int. J. Sci. Res. Pub. 4:1.

دراسة اضافة قشور أو بذور السيلليوم فى اليوغورت المقلب منزوع الدسم

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استخدم لبن فرز جاموسى مع اضافة قشور او بذور السيلليوم فى تصنيع يوجورت مقلب منزوع الدسم. تم تسخين اللبن على ٩٠°م /١٠ دقائق ثم التبريد السريع حتى ٤٢°م (المعاملة الضابطة بدون سيلليوم) وحتى ٦٠°م لاضافة قشور السيلليوم بمعدل ٠.٥ ، ١.٠ ، ١.٥% وزن/حجم (أ١ ، أ٢ ، أ٣) وبذور السيلليوم بمعدل ٠.٥ ، ١.٠ ، ١.٥% وزن/حجم (ب١ ، ب٢، ب٣) ثم التبريد على ٤٢°م . لقح اللبن فى كل المعاملات ببادىء اليوجورت وتم التحضين على نفس درجة الحرارة لاتمام التخمر ثم تحليل المنتج الطازج والمخزن مبرداً حتى ٧ ، ١٥ يوم. أوضحت النتائج المتحصل عليها وجود زيادة معنوية نتيجة المعاملة بالسيلليوم فى الجوامد الصلبة والمحتوى من البروتين والرماد مقارنة بالعينات الضابطة بدون سيلليوم. وبصفة عامة زاد التقدم فى الحموضة خلال فترة التخزين وتناقص الرقم الهيدروجينى بمعدلات مختلفة وفقا للمعاملات. كانت الاختلافات معنوية واعلى فى المحتوى من الكربوهيدرات والاستيالدهيد نتيجة اضافة السيلليوم وايضا اثناء التخزين وكانت قيم السعرات الحرارية فى عينات اليوجورت ٣٦.٥٤ ، ٤٠.٦٩ و ٤٢.٥١ كيلوكالورى/ ١٠٠ جم يوجورت طازج غير معامل وعند ٧ ، ١٥ يوم من التخزين على التوالى وكانت القيم المقابلة اعلى فى حالة استخدام السيلليوم . زادت قيم اللزوجة تدريجيا بالتقدم فى التخزين فى عينات اليوجورت وبدرجات مختلفة نتيجة المعاملات . وأدى اضافة السيلليوم الى تحسنا واضحا فى منع تشريش اليوجورت حيث زادت خاصية مسك الماء. أوضحت نتائج التحكيم الحسى ان استخدام قشور او بذور السيلليوم بنسبة ١.٥% (وزن/حجم) حسن كثيرا من قوام تركيب المنتج دون اى تأثير غير مرغوب على النكهة.