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Composition and quality of stirred yoghurt supplemented with apricot kernels powder

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Abstract

The object of this study was to improve the quality of stirred yoghurt. Apricot kernels powder (AKP) was used as a source of dietary protein as well as minerals and fibers. Cow's milk was supplemented with 1% (w/v) of the resultant AKP powder which was soaked its kernels in four portions: water, ascorbic acid solution (1%), citric acid solution (1%) and sodium chloride solution (1%). Carboxy methyl cellulose (0.1%) was used as a trial to improve body and texture of the product, whereas sugar (5%) was used as a sweetner. The chemical compositions of fresh and stored stirred yoghurt was determined. The results showed that addition of AKP increased the total solid, protein and ash contents in fresh and stored stirred yoghurt. However, the content of minerals changed, the titratable acidity decreased. Generally, it could be recommended that, supplemented stirred yoghurt with apricot kernels powder which soaked its kernels in 1% citric acid solution can be applied for stirred yoghurt making.

Keywords: stirred yoghurt - apricot kernels powder

1. Introduction

Yoghurt is one of the most popular fermented milk product in Egypt and throughout the world for it's-at least in part-various health claims and therapeutic benefits added to its nutritional impact. The uniqueness of yoghurt attributes in the synbiotic fermentation involved in its making. However, flavour and texture of the final product are the most pronounced factors that influence the quality and consumer acceptance of yoghurt. So, it is well known that the marketability of any food product depends upon four factors, body, texture, flavour and keeping quality or shelf – life [3].

Yoghurt is an increasingly prominent cultured dairy product in many countries. This is partly because of an increased awareness of the consumer regarding possible health benefits of yoghurt. Yoghurt is easily digested, has high nutritional value, and is a rich source of carbohydrates, protein, fat, vitamins, calcium, and phosphorus. Because milk protein, fat, and lactose components undergo to partial hydrolysis during fermentation, yoghurt is an easily digested product of milk [18].

Nowadays, a lot of fruit seeds are disposed of yearly at preparing plants. This not only wastes a potentially valuable resource but also aggravates an already serious disposal problem. To be monetarily suitable, however, both oil and meal from these fruit seeds could be used [12]. Also, these by-products contain large amounts of oil, starches and protein which could be utilized as nourishment and food source. Plant proteins are utilized in food as functional ingredients to enhance stability and texture as well as to improve the nutritional quality of the product [14]. Plant proteins to be for all intents, purposes and effectively used in various sustenance applications, are usually referred to as functional properties of proteins may influence shape and conformation. The isolation method and

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condition of fat was also reported to affect the functional properties of protein [9].

Apricot contains high amount of non- essential, polar, acidic, sulphur and aromatic amino acids. On the other side, the essential, non-polar and basic amino acids are low in apricot powder. Apricot kernel powder has higher contents of tyrosine, cysteine, methionine, aspartic acid, glutamic acid, serine, proline and alanine. In generally, apricot kernel powder is a good source of the most amino acids of important and is required for human and animal nutrition. And by blending with other vegetable materials, it will produce a very well balanced diets [17].

In Egypt, large amounts of apricot kernels representing the by-products, accumulating after processing of apricot juice, nectar, jam, pulp in brine or in syrup and sheets or utilized fresh. Apricot kernels represent up to 16% of the weight of the whole fruits. Several studies were carried out in order to utilize apricot kernels in food industry as ice cream. Apricot kernels cake contained 41.5 and 50% total protein and oil, respectively which could be utilized as rich source of fixed oil, protein and macaroni paste production [2]. Thus, the objective of this study was to investigate the possibility of utilization of defatted apricot kernels in supplementation of stirred yoghurt.

2. Materials and Methods

2.1. Materials:

Fresh cow's milk was obtained from the herd of Sakha Experimental Stations, Animal Production Research Institute, Ministry of Agriculture. Skim milk was prepared using cream separator. The apricot kernels (*prunus armeniaca* variety baladi) was obtained from the factory of the Food Technology Research Institute, Agricultural Research Center, Giza, Egypt. Yoghurt starter culture which consists of *Streptococcus thermophiles* & *Lactobacillus delbrueckii* subsp. *bulgaricus* (Freeze-Dried Redy-Set) was obtained from Chr. Hansen Laboratories, Copenhagen, Denmark.CMC (food grade) was purchased from central drug house (p) LTD New Delhi-110002 .

2.2. Methods:

2.2.1. Preparation of apricot kernels powder:

Apricot kernels were cleaned and washed twice with tap water, then left to dry in the air. The dried apricot kernels were cracked to release the kernels, after that soaking in warm water (40±2ºC) for 10-15 minutes, then divided in to: control and three portions of soaking solutions (A_1); 1% of ascorbic acid solution (A_2); 1% citric acid solution (A_3); 1% NaCl solution for 6, 12, 18 and 24 hr at room temperature. The kernels/solvent ratio was 1:12 (W/V), and the soaking solutions were changed every 6 hr by fresh solutions. The soaked kernels were dried at 50^0C for 18 hr in an electric air drought oven. The ground kernels were used for lipid extraction by n-hexane in soxhelt apparatus for 24 hr. After that drying and crushing in blender was conducted. The defatted powder was air dried at room temperature and ground to pass through a 60 mash sieve. The resulted defatted AKP was kept at 4^0C until use. All treatments were dehydrated according to the method of [6, 23].

2.2.2 Preparation of stirred yoghurt with apricot kernels powder:

Full fat and skim cow`s milk were used for yoghurt production. Milk was heated to 90˚C for 10 min. and then rapidly cooled to 60˚C after that CMC (0.1%) was added and then quickly cooled to 42±0.5ºC and incubated with active working starter culture 2%. Fermentation was carried out at the same temperature to pH 4.6. The produced yoghurt gel was stirred and divided in to five parts. The first part with full milk was with no additives served as a control (C1). The second part with skim milk was with no additives served as a control (C2), other treatments were manufactured with skim milk and then divided into 3 equal portion: T1; sucrose 5% + 1% of defatted AKP which soaked in ascorbic acid solution, T2 sucrose 5% + 1% defatted AKP which soaked in citric acid solution and T3 sucrose 5% + 1% defatted AKP which soaked in NaCl solution were added. The resultant stirred yoghurt samples were stored in refrigerator at 4±1°C for 10 days. The samples were analyzed when fresh and after 10 days of cold storage. All experiments were carried out in triplicates.

2.2.3. Chemical analysis:

Ash, true protein, total carbohydrates, fibers and titratable acidity were determined according to the method of [1]. The pH of samples was determined using pocket pH meter (IQ Scientific USA, Model IQ 125). Viscosity was measured using Brookfield viscometer (Model RVDVII, Brookfield Engineering Laboratories, INC., MA, USA) according to the method of [16]. For each parameter, samples were analyzed in three

replicates. The fresh and stored samples were analyzed for total solids, fat, acidity and total nitrogen (TN) as described by [13].

2.2.4. Minerals analysis:

Mg, Zn and Fe were determined by Atomic Absorption according to the methods described by [19].

2.2.5. Sensory evaluation:

The organoleptic properties included flavour (60 points) ; body & texture (40 points) were evaluated [7, 15]. The organoleptic properties were done by 10 staff members.

2.3. Statistical analysis:

Analysis of variance and Duncan's test as well as average and standard deviation (SD) were carried out using SPSS computer program [20].

3.Resultus and Disscussion

3.1. Chemical composition of apricot kernels powder:

The chemical composition of defatted AKP is shown in Table (1). The results indicated that defatted powder (control) had the higher crude protein, ash and moisture contents (55.12 , 3.96 and 11.01%, respectively). Soaking the apricot kernels in ascorbic acid, citric acid and sodium chloride had significantly effect on chemical composition ($P<0.05$), which caused decreasing in moisture, protein and ash content, while fat, fibers and carbohydrate contents increased. Meanwhile, A_1 had 33.82, 9.50 and 4.16% of carbohydrates, fibers and fat content. Also, A_2 had 50.22, 3.40, 9.99, 34.43, 10.60 and 5.32% of protein content, total ash, moisture, carbohydrates, fibers and fat contents, respectively. A_2 recorded the highest fat content (5.32%), while A_3 had the highest fibers (11.20%) and carbohydrates content (34.78%). These results are in accordance with the findings of Abd El-Aal *et al.* [2] &Radi [17].

3.2.Minerals content :

Results in Table (2) show that microelements contents of AKP proved to be a good source of some minerals such as Fe, Mg, and Zn. These values are slightly lower than that reported by [2].

Table 1. Chemical composition (%) of AKP prepared with different treatments

Property	*defatted AKP (control)	A_1	A_2	A_3
Moisture	11.01 ± 0.2^a	10.91 ± 0.3^a	9.99 ± 0.2^c	10.33 ± 0.3^b
Crude protein	55.12 ± 0.12^a	51.11 ± 0.08^b	$50.22^c\pm0.13$	49.80 ± 0.12^c
Crude fat	4.09 ± 0.01^d	4.16 ± 0.02^c	5.32 ± 0.02^a	5.09 ± 0.00^b
Total ash	3.96 ± 0.00^a	3.81 ± 0.00^a	3.40 ± 0.01^b	3.20 ± 0.00^c
Crude fibers	5.18 ± 0.04^d	9.50 ± 0.03^c	10.60 ± 0.03^b	11.20 ± 0.01^a
Total carbohydrates	29.78 ± 0.04^c	33.82 ± 0.05^b	34.43 ± 0.03^a	34.78 ± 0.03^a

*: soaking apricot kernels in only water without soaking in any solutions.
A_1: soaking apricot kernels in ascorbic acid solution.
A_2: soaking apricot kernels in citric acid solution.
A_3: soaking apricot kernels in NaCl solution.
** ^{abcd}letters indicate significantly differences between apricot kernels powder treatments.
*** Results are mean of three determinations ± standard deviation.

Table 2. Minerals content (mg/100g) of AKP prepared with different treatments.

Minerals (mg/100g)	defatted AKP Control	A_1	A_2	A_3
Fe	15.05	14.11	13.66	12.34
Mg	159	148	147	143
Zn	7.12	6.90	6.33	6.49

*see legend to Table (1) for details.

3.3. The chemical composition of stirred yoghurt:

The chemical composition of the control (not supplemented with AKP) and stirred yoghurt supplemented with different treatments of AKP is presented in Table (3) for fresh and stored stirred yoghurt. The data show that treatment T2 had the higher total solids, protein and ash contents being 16.84, 4.13% and 4.57%, respectively. The mean averages of total solids and protein contents of all stirred yoghurt samples increased with advancing storage period. These results are in agreement with Hassan and Imran [10], which may be due to evaporation of water and loss of moisture during storage period.

In the same Table (3) the data show that titratable acidity increased and pH values decreased with added amount of AKP to yoghurt. These results are in line with the findings gives by Hassanein *et al.* [11]. The above results due to fermented samples which were higher in acidity and lower in pH values. This could be clearly observed that, higher bacterial load produces acids in the medium.

Table 3. Chemical composition, pH and acidity of fresh and stored stirred yoghurt.

Treatments	C1	C2	T1	T2	T3
Fresh stirred yoghurt					
TP%	2.78±0.01^{c}	2.69±0.05^{d}	4.06±0.03^{b}	4.13±0.02^{a}	3.38±0.01^{b}
Ash%	0.57±0.03^{c}	0.56±0.01^{c}	0.83±0.02^{b}	0.92±0.01^{a}	0.82±0.01^{b}
TS%	10.63±0.03^{c}	9.83±0.02^{e}	16.77±0.02^{b}	16.84±0.02^{a}	16.19±0.03^{b}
pH	4.65±0.02^{a}	4.65±0.01^{a}	4.55±0.01^{b}	4.57±0.01^{a}	4.59±0.01^{a}
Acidity%	0.61±0.006^{c}	0.59±0.006^{c}	0.75±0.01^{a}	0.74±0.008^{b}	0.65±0.008^{b}
Stored stirred yoghurt (after 10 days)					
TP%	3.31±0.01^{c}	3.09±0.05^{d}	4.49±0.01^{b}	4.54±0.01^{a}	3.98±0.01^{b}
Ash%	0.66±0.01^{c}	0.62±0.01^{c}	0.92±0.02^{b}	0.96±0.03^{a}	0.90±0.02^{a}
TS%	11.15±0.02^{d}	10.36±0.05^{e}	17.08±0.03^{b}	17.32±0.04^{a}	16.63±0.02^{c}
pH	3.31±0.01^{c}	3.09±0.05^{d}	4.49±0.01^{b}	4.54±0.01^{a}	4.44±0.003^{b}
Acidity%	0.78±0.01^{c}	0.75±0.006^{d}	0.89±0.003^{a}	0.88±0.01^{b}	0.84±0.008^{b}

*C1: control yoghurt manufactured using full fat milk.
C2: control yoghurt with skim milk.
T1: yoghurt supplemented with AKP (soaked in 1% ascorbic acid solution).
T2: yoghurt supplemented with AKP (soaked in 1% citric acid solution).
T3: yoghurt supplemented with AKP (soaked in 1% sodium chloride solution).
**^{abcd} letters indicate significant differences between treatments.
*** Results are average of three determinations ± standard deviation.

3.4. Minerals content of stirred yoghurt:

Results in Table (4) show that using AKP caused increasing in minerals content of fresh and stored stirred yoghurt proved to be a good source of some minerals such as iron (Fe), magnesium (Mg) and Zinc (Zn) contents. It is clearly observed that the fermentation process resulted in slightly increasing of most elements of fresh and stored stirred yoghurt, Steinkraus [21].

3.5. Viscosity of stirred yoghurt:

The results in Table (5) show that adding AKP increased viscosity values. This is may be related to the increase of total solids and the higher content of fibers in the powder. Also, it is characterized by its high water hydration capacity, Ahmedna et al. [5]. These results are in agreement with El-Nagar and Kuri [8], and impacted on the aggregation of casein network in yoghurts via electrostatic interaction, and on the resistance for the yoghurt matrix to flow, Tamime and Robinson [22].

Table 4. Minerals content (mg /100g) in fresh and stored stirred yoghurt (mg/100g).

Minerals	C1	C2	T1	T2	T3
Fresh stirred yoghurt mg /100g					
Fe	0.891	0.749	1.863	1.632	1.037
Mg	13.79	12.624	18.127	16.870	16.960
Zn	0.493	0.377	0.585	0.578	0.564
Stored stirred yoghurt (after 10 days) mg /100g					
Fe	0.898	0.773	1.903	1.687	1.054
Mg	14.00	12.711	18.187	17.121	17.121
Zn	0.498	0.389	0.599	0.581	0.571

*see legend to Table (3).

Table 5.Viscosity of stirred yoghurt when fresh and after storage as affected by the applied treatments

Viscosity (mpas)	C1	C2	T1	T2	T3
Fresh	183.05±17.45^{e}	166.0±3.0^{e}	707.5±7.5^{b}	848±8.5^{a}	352.5±6.5^{c}
Stored (after 10 days)	247.00±3.0^{d}	199.5±0.5^{e}	762.0±8.0^{b}	876±14.0^{a}	395.5±5.5^{c}

*see legend to Table (3).

Table 6. Sensory evaluation of fresh and stored stirred yoghurt products.

Property	C1	C2	T1	T2	T3
Fresh stirred yoghurt					
Flavour (60)	55.0±0.00^{a}	51.0±1.0^{b}	47.0±1.0^{d}	55.5±0.5^{a}	40.5±1.0^{c}
Body and texture (40)	38.0±0.5^{a}	35.5±0.5^{a}	35.0±1.0^{b}	38.5±1.0^{a}	34.0±1.0^{b}
Total scores (100)	93.0±1.4^{a}	86.5±0.5^{ab}	82.0±1.90^{c}	93.5±0.5^{a}	74.5±0.5^{d}
Stored stirred yoghurt (after 10 days)					
Flavour (60)	56.0 ±0.05^{a}	53.5±1.0^{b}	47.0±1.0^{c}	55.5±0.00^{a}	42.0±1.0^{d}
Body and texture (40)	38.5 ±0.5^{a}	35.0±0.5^{a}	36.0±1.0^{b}	39.0±1.0^{a}	45.0±0.5^{b}
Total scores (100)	94.5±1.2^{a}	90.0±1.5^{ab}	83.0±1.90^{c}	94.5±0.5^{a}	77.0±0.5^{d}

*see legend to Table (3).

3.6. Sensory properties:

Scores of sensory properties of stirred yoghurt samples are given in Table (6). Sensory properties were evaluated in fresh and after 10 days of storage period. Higher values were given by the panelists for the flavour, texture and appearance of fresh control yoghurt than stored yoghurt. At fresh stirred yoghurt, T2 and C1 had recorded the highest total scores (93.5 and 93.0) followed by treatment C2 (86.5), T1 (82.0) and T3 (74.5). The same trend also recorded after storage period (10 days). T2 achieved the best values than other treatments when fresh or after storage. These results are in agreement with those reported by Aghajani *et al.* [4]. On the other hand, cold storage improved the quality of yoghurt through 10 days. This may be due to formation of the flavour compounds (*e.g.* acetaldehyde, some acids) which found in AKP and produced by starter cultures.

4. Conclusions

Finally, it could be concluded through this study, that it is possible production of yoghurt supplemented with apricot kernel powder rich in many important nutritional components such as protein, carbohydrates and fibers. This would help to exploit the apricot wastes (kernels) after apricot processing to different products. It could be recommended that 1% supplementation with AKP which soaked its kernels in 1% citric acid solution was acceptable and had good quality in the resultant stirred yoghurt.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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