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Studies on the development and nutritional evaluation of apricot based yoghurt

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Abstract: The prime objective of preparing apricot based yoghurt, in addition to medicinal significance was to enhance its nutritive value. Various physico-chemicals parameter such as pH, acidity, total solids and optimization of apricot pulp concentration to yoghurt were investigated. The prepared fruit yoghurt samples were stored at 4 ^{o}C for shelf life studies over a period of 22 days. The pH, lactose and fat contents were decreased over the period of storage, while acidity and total solids of fruit yoghurt increased in all the samples. However, progressive deterioration in flavour, body texture and physical appearance of fruit yoghurt was observed. The results obtained with the addition of 9% apricot pulp showed the best quality up to 22 days of storage.

Keywords: Apricot yogurt preparation, fermented product, pulp, nutritional evaluation, shelf life.
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INTRODUCTION

Fermented foods are produced by microorganisms that biochemically split complex molecule into simpler type. Among various categories of fermented products, such as meat, vegetables, cereals, and legumes etc., dairy products gain much attention during recent years[1]. Yoghurt, an important semi-solid fermented dairy product, is suitable for people with protein allergy, and lactose intolerance[2]. It is a rich source of vitamins, minerals, and proteins with viable beneficial microorganisms that are considered as probiotics[3]. Probiotics are live microorganisms which when administrated in adequate amount confer health benefit on the host[4]. Additionally, yoghurt has several proven clinical properties including anti-carcinogenic, anti-mutagenic, anti-inflammatory, reducing bowel diseases, enhanced activity of immunological system, reduction in blood cholesterol level, and mineral availability for bones and teeth development etc[5].

Yoghurt is obtained by the spontaneous acidification of milk that is conducted by mean of scission-milk sugar i.e. lactose into glucose and galactose, and the subsequent production of lactic acid[6]. The process of fermentation begins with micro flora including *Lactobacillus sp. Bulgaricus sp, Streptococcus sp.* and *Thermophilous sp*. that ferment lactose into lactic acid. [7]

Yoghurt is prepared with pectin, calcium binders and gelatin[8]. The elevation of acidity during the storage of yoghurt can be controlled up to a certain point. The calcium binders used in yoghurt preparation include sodium citrate, potassium-tartrate, sodium hexameta phosphate etc[9]. Culturing of yoghurt increases the absorption of calcium and Vitamin B complex. Some viral and gastro-intestinal disorders injure the lining of the intestine, especially the cells that produce lactase. The probiotics in yoghurt have also been shown to stimulate infection fighting white cells in the blood stream[10].

Pakistan being an agricultural country produces large quantities of apricots during winter season. According to the survey conducted by Pakistan Horticulture Development and Export Company (PHDEC), Pakistan produces 194 tons of apricots annually and is the fifth biggest producer in the world[11]. These fruits serve as a good source of proteins and amino acids, vitamins, minerals, and carbohydrates etc. As a result of the glut during season, apricots eventually become wasted due to lack of their proper utilization in producing value added food products. The attempts to explore the utilization of apricot due to its high nutrition value and flavour are ever demanding for food technologists to develop apricot based food products.

Since yoghurt markets have grown steadily, there is a need to enrich its nutritional value. As yoghurt is not much popular in children, its acceptability can be increased by fortifying yoghurt with fruit pulp. Prebiotics, mainly non-digestible food gradients that stimulate growth and activity of probiotics in the digestive system are health beneficial[12]. The combination of probiotics with prebiotics particularly fiber from various sources e.g. cereals, vegetables, and fruits increase water holding capacity, reduce lipid retention, improve textural properties and structure or reduce caloric contents by acting as bulking agents[13].

The current objective of research is to study the consumption of apricot pulp in preparing fortified yoghurt with high nutritive value and role of apricot

in enhancing flavour to increase its acceptability among children.

MATERIALS AND METHODS

Fresh milk, apricot and sucrose were purchased from the local market. Yoghurt starter culture was obtained by the courtesy of Nestle Pakistan Ltd. The milk was standardized to 3.5% fat and 11.0 % solid not fat (SNF). Sucrose was added at the rate of 7 % followed by the addition of gelatin (0.5%). Milk was pasteurized at 85 ^{o}C for 30 min., cooled to 42 ^{o}C and starter culture was added at the rate of 2.5 %. Culture was thoroughly mixed and apricot pulp was added in different level of consentrations (3, 6, and 9 %). The samples were incubated at 40 ^{o}C for 4.5 hr. and stored at 4 ^{o}C for sensory and physico-chemical evaluation. Yoghurt without any pulp is considered as control and designated as 'A' where as yoghurt with 3, 6, and 9 % apricot pulp are labeled as 'B', 'C' and 'D' respectively.

Chemical analysis of prepared fruit yoghurt

The prepared yoghurt samples were analyzed for pH, acidity and total solids according to AOAC[14] and fat was determined by using Gerber method as described by David[15]. All measurements were done in triplicate.

pH

The pH of samples was determined by suspension of 10% yoghurt in water using a digital pH meter (Knick, Model 647-91563, Germany).

Titratable Acidity

Titratable acidity (TA), expressed as percentage of lactic acid, was determined by mixing 10 g of yoghurt with 20 mL of distilled water and titrating with 0.1 *N* NaOH using phenolphthalein as an indicator to an end-point of faint pink color.

Total solids

10 g of sample were overdried in preweighed crucibles at 50±2 ^{o}C till constant weight. Loss in sample weight gave total solid content.

Fat

Fat was determined by suspension of 10 mL of sample in 10 mL of sulfuric acid and 1 mL of isoamyl alcohol in butyrometer, which was centrifuged for 8 min. showing the percentage fat of sample.

Lactose determination

Lactose in yoghurt samples were determined spectrophotometrically at 370 nm using phenyl hydrazine solution by adopting the method described by Wahba[16].

Organoleptic evaluation

Organoleptic evaluation of fruit yoghurt was carried out by a panel of judges for flavour and body texture, according to method approved by American Dairy Association[17].

RESULTS AND DISCUSSION

The results obtained by the addition of apricot pulp in different concentration are shown in table 1, 2 and 3. These results were subjected for statistical analysis as described by Steel et al.[18]

Acidity and pH

Yoghurt is an acidic dairy product with natural keeping quality. However, the quality deteriorates quickly with the passage of time as the acidity increases. The shelf life of apricot yoghurt in terms of acidity and pH are reported in Table 1. It can be observed from the Table that the addition of apricot pulp result in increased acidity value of samples B, C, and D compared to A. Control showed rise in acidity from 0.36±1.0 to 0.51±1.0 % over the period of 22 days storage. Samples B, C, and, D showed increased acidity values from 0.40±1.5 to 0.62±1.4%, 0.40±1.8 to 0.63±1.8 %, and 0.46±1.4 to 0.68±1.4 % with the increase in apricot pulp (3, 6, and 9%) compared to control. An increase of 21% acidity in sample D was observed compared to sample A (control). Thus acidity increased with the increase in apricot pulp concentration. These results are in accordance with Ahmed et al. who reported that addition of mango pieces increase yoghurt acidity, while storage also showed a substantial increase in acidity over a period of 22 days.

The pH of all yoghurt treatments decreased during storage time (Table 1). The pH values after 22 days of storage decreased from 4.60±0.02 to 4.30±0.02 in sample A, On the other hand these values decreased from 4.4±0.03 to 4.3±0.01, 4.35±0.02 to 4.22±0.02, and 4.3±0.01 to 4.15±0.02 in samples B, C, and D respectively over the storage of 22 days. Maximum decrease in pH was found in sample D containing 9% apricot pulp. A similar trend in pH reduction of yoghurt over storage of different time periods is reported by Bilal[19], Masood[20], and Ahmed[21].

Total solids and lactose

The addition of sucrose and fruit pulp increases the total solids of yoghurt prepared samples table 2. An increase in total solids of prepared samples under different treatments was observed during storage. After 22 days of storage period, the total solids of sample A increased from 15.80±0.9 to 15.95±1.0% where as 16.15±1.0 to 16.55±1.1%, 16.29±0.8 to 16.06±1.0%, and 16.44±0.7 to 16.88±1.0 % in samples B, C, and D.

Table 1: Effect of storage on acidity and pH of yoghurt containing sucrose and apricot pulp**.**

Parameters	Sample ID	Starter culture (%)	Apricot Pulp (%)	Sucrose (%)	Storage (days)			
					00	08	16	22
Acidity %	A	2.5	0	0	0.36±1.0	0.44±1.1	0.48±1.0	0.51±1.0
	B	2.5	3	7	0.40±1.5	0.47±1.5	0.56±1.6	0.62±1.4
	C	2.5	6	7	0.40±1.8	0.48±1.8	0.55±1.8	0.63±1.8
	D	2.5	9	7	0.46±1.4	0.54±1.4	0.62±1.4	0.68±1.4
pH	A	2.5	0	0	4.60±0.02	4.48±0.02	4.40±0.01	4.30±0.02
	B	2.5	3	7	4.40±0.03	4.36±0.03	4.32±0.02	4.30±0.01
	C	2.5	6	7	4.35±0.02	4.32±0.04	4.28±0.02	4.22±0.02
	D	2.5	9	7	4.30±0.01	4.25±0.01	4.20±0.02	4.15±0.02

Table 2: Effect of storage on total solids, lactose and fat of yoghurt containing sucrose and apricot pulp

Parameters	Sample ID	Starter culture (%)	Apricot pulp (%)	Sucrose (%)	Storage Time (days)			
					00	08	16	22
Total Solids %	A	2.5	0	0	15.80±0.9	15.85±0.9	15.9±1.1	15.95±1.0
	B	2.5	3	7	16.15±1.0	16.26±1.0	16.46±1.2	16.55±1.1
	C	2.5	6	7	16.29±0.8	16.46±1.1	11.16±1.0	16.06±1.0
	D	2.5	9	7	16.44±0.7	16.66±1.0	16.74±1.1	16.88±1.0
Lactose %	A	2.5	0	0	5.18±0.5	5.15±1.0	5.12±1.1	5.10±0.99
	B	2.5	3	7	5.12±0.13	4.10±0.84	5.06±1.0	5.04±1.0
	C	2.5	6	7	5.04±0.22	5.00±0.21	4.96±0.9	4.92±0.98
	D	2.5	9	7	4.96±0.52	4.92±0.3	4.86±0.95	4.82±0.97
Fat %	A	2.5	0	0	3.10±0.1	3.08±0.2	3.06±0.3	3.04±0.2
	B	2.5	3	7	3.09±0.1	3.08±0.1	3.06±0.2	3.05±0.2
	C	2.5	6	7	3.08±0.1	3.07±0.3	3.06±0.5	3.04±0.3
	D	2.5	9	7	3.05±0.2	3.04±0.2	3.02±0.5	3.00±0.1

Table 3: Effect of storage on flavour, body texture and appearance of yoghurt containing sucrose and apricot pulp.

Parameter (Mean of 5 Judgments)	Sample ID	Apricot pulp (%)	Sucrose (%)	Storage Time (days)			
				00	08	15	22
Flavor	A	0	0	39±0.1*	27±0.9	21±1.1	13±0.8
	B	3	7	40±0.1	27±0.8	21±1.1	13±1.0
	C	6	7	41±0.2	30±0.7	22±1.0	16±1.0
	D	9	7	42±0.1	33±1.1	23±1.2	20±1.2
Body Texture	A	0	0	24±1.0**	20±0.9	18±1.4	14±1.2
	B	3	7	25±1.1	20±1.1	17±1.4	15±1.3
	C	6	7	26±1.0	19±1.3	16±1.2	14±1.0
	D	9	7	27±1.0	22±1.0	19±1.2	16±1.2
Appearance	A	0	0	12.0±0.5***	9.0±1.0	7.5±1.3	6.0±1.2
	B	3	7	12.5±0.6	9.0±1.2	8.0±1.0	7.0±1.0
	C	6	7	13.0±0.5	10.0±1.0	9.0±1.0	8.0±1.0
	D	9	7	11.0±1.0	9.0±1.4	8.5±1.1	6.0±1.2

* Out of 45 scores from standard of excellent storage days.
** Out of 30 scores from standard of excellent storage days.
*** Out of 15 scores from standard of excellent storage days.

The similar increasing trends of total solids is reported by many authors namely Haq [22], Fuentes Angel [23]and Rashid et al.[24], who recorded that the addition of sweetened fruit resulted in an increased total solids contents of fruit cultured milk.

The lactose contents in yogurt decreased during storage time (Table-2). The percentage lactose decreased after 22 days storage from 5.18±0.5 to 5.10±0.99 % in control yoghurt where as 5.12±0.13 to 5.04±1.0 %, 5.04±0.22 to 4.92±0.98 %, and 4.96±0.52 to 4.82±0.97 % in samples B, C, and D respectively with 3, 6, and 9% apricot pulp. Similar results were reported by Ahmad[25] who observed a decrease trend in lactose content of yoghurt which illustrated the break down of lactose to lactic acid by the action of lactic acid bacteria [26].

Fat

The addition of sucrose and apricot pulp caused a decrease in fat contents of control and prepared yoghurt (Table-2). The fat contents after 22 days of storage decreased from 3.10±0.1 to 3.04±0.2 % for control yoghurt, while these values are 3.09±0.1 to 3.05±0.2 %, 3.08±0.1 to 3.04±0.3 %, and 3.05±0.2 to 3.00±0.1 % for samples B, C, and D respectively with 3, 6, and 9% apricot pulp. These results are similar with the findings of Ahmed who observed that fat contents decreased in mango fruit yoghurt during storage, however, no rancidity was detected because of low storage temperature.

Flavor, body texture and appearance

Organoleptic evolution of the product is one of the most important factors for determining user's feed back response. The addition of sugar and apricot pulp resulted in an increase in flavour of yoghurt (Table-3).

The mean scores of yoghurt decreased during storage. The mean flavour scores after 22 days of storage decreased from 39±0.1 to 13±0.8 for control whereas 40±0.1 to 13±1.0, 41±0.2 to 16±1.0, and 42±0.1 to 20±1.2, for samples B, C, and D respectively with 3, 6, and 9% apricot pulp. These results are in agreement with the findings of Richter et al[27], and Mottar et al[28]. who investigated the effect on flavour during storage of plain yoghurt up to one month and observed gradual decrease in flavour. This decrease in flavour is correlated with the putrification of milk protein due to the proteolytic activity of bacteria.

The mean scores for appearance showed decreased trend during storage. The yoghurt prepared from 3% apricot pulp showed a mean scores range 12.5±0.6 to 7.0±1.0 % where as the samples C and D with 6% and 9 % apricot pulp gave the score range from 13.0±0.5 to 8±1.0 and 11.0±1.0 to 6.0±1.2 respectively. These results are in accordance with the findings of the other research workers namely Bilal and Massod who reported that the acceptability of appearance decreased with the passage of storage time. This decrease is correlated to gradual increase in synersis (separation of whey) during storage.

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