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Influence of Different Fruit Additives on Some Properties of Stirred Yoghurt During Storage

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Abstract: In this study, stirred type yoghurt with cornelian, rosehip, morello cherry (marmalades), grape (molasses), date (pulp) added and control (without additive) set type yoghurt were produced and stored up to 10 days at 4±1°C. Physico-chemical, microbiological properties and sensory quality of yoghurt samples were determined at 1. 6. and 10 days at storage. During storage period according to analysis results, the total solids between 14.58-20.51%, fat 2.95-3.10%, protein 3.61-4.34%, ash content 0.82-1.08%, titratable acidity (TA) 1.27-1.62, and pH 3.93-4.29 were found. Syneresis and TA increased over the storage period. The results showed that total mesophilic bacteria count were significantly different among yoghurt samples (P<0.05). Moreover Mold and yeast count showed significant increase during storage period. Sensory evaluation results showed that there was no any statistical differences among the yoghurt samples.

Key words: Fruit yoghurt, physico-chemical properties, sensory quality

Depolama Süresince Stirred Yoğurdun Bazı özelliklerine Farklı Meyve Katkılarının Etkisi

Özet: Bu çalışmada, kızılcık, kuşburnu, vişne (marmelatları), üzüm (pekmez) ve hurma (pulp) ilave edilmiş ve sade (kontrol) meyveli yoğurtlar üretilmiş ve 4±1°C'de 10 gün depolanmıştır. Yoğurtlarda fiziko-kimyasal, mikrobiyolojik ve duyusal nitelikler 1. 6. ve 10. günlerde belirlenmiştir. Yoğurtlarda yapılan analiz sonuçlarına göre toplam kuru madde %14.58-20.51, yağ %2.95-3.10, protein %3.61-4.34, kül %0.82-1.08, toplam asitlik 1.27-1.62 ve pH 3.93-4.29 arasında değiştiği saptanmıştır. Serum ve asitlik tüm yoğurtlarda depolama süresince artmıştır. Toplam mezofilik bakteri sayısı yoğurt örnekleri arasında farklılık göstermiştir (P<0.05). Depolama periyodunca maya ve küf sayısında artış gözlenmiştir. Yapılan analiz sonucunda yoğurt örnekleri arasında duyusal yönden önemli bir farklılık görülmemiştir (P<0.05).

Anahtar kelimeler: Meyveli yoğurt, fiziko-kimyasal özellikler, duyusal kalite

Introduction

Yoghurt is an increasingly popular cultured dairy product in most countries. This is partly because of an increased awareness of the consumers 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 partial hydrolysis during fermentation, yoghurt is an easily digested product of milk (Rasic and Kurman, 1978; Tamime and Rabinson, 1985; Lee et al., 1988; Sanchez-Segarra et al., 2000).

Physical properties of yoghurt are influenced by milk composition and manufacturing conditions, variables affecting physical properties include heat treatment applied to milk, protein content, acidity, culture, additives, homogenization mechanical handling of coagulum and presence of stabilizers (Nielson, 1975; Rasic and Kurman, 1978; Parnell et al., 1986).

The increase in the per capita annual consumption of yoghurt in the majority of the countries has been attributed to both the ever-increasing availability of fruit or flavored yoghurt, and to the diversity of presentations of the product. A variety of different flavoring ingredient (fruits, natural flavors or synthetic flavors) are currently added to yoghurt. It can be observed that the flavors, which are in regular demand, are surprisingly few in number, and the rest are introduced by the yoghurt manufacturers merely to encourage a wider popularity for the product. The types of flavoring material used in the yoghurt industry are fruits, fruits preserves, canned fruit, frozen fruits and miscellaneous fruit products (Tamime and Robinson, 1985).

The flavorings and their dosage is usually regulated according to the regulations say by each country. The FAO/ WHO recommendations for fruit yoghurt are a fruit content between 5 and 15 %. In addition, Turkish Food Codex (for fermented milk) suggested for fruit yoghurt fruit contend was 6% (Anonymous, 2001). Added flavoring usually refers to sweetened or unsweetened chunks or concentrated, natural fruit substances.

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Results of recent studies indicated that fruit addition levels plays a significant role in acceptability of fruit added yoghurt. A study of the higher level of fruit addition into yoghurt would be increase sensory quality of the fruit yoghurts (Tarakçı and Küçüköner, 2003).

The objectives of this study were to evaluate the physico-chemical, microbiological and sensory quality of different fruit added yoghurt during storage and to relate these characters to different fruit additives addition.

Material and Methods

Material

Raw cow's milk used for the production of yoghurt was obtained from the herd of Van Özel İdare dairy farm. Experimental yoghurts were made in the pilot plant of Food Engineering Department, Faculty of Agriculture at Yüzüncü Yıl University. Cornelian and rosehip marmalades (contained % 55 fruit pulp) were obtained from Gümüş suyu food company (Gümüşhane). Morello cherry was obtained from Tamek food company (Bursa). Grape molasses obtained from Gesaş company (Konya). Date was purchased from a local food market. Non fat dry milk powder was obtained from Pınar company (İzmir). A commercial mixed stain concentrated freze-dried yoghurt starter culture (Yoghurt Culture, YC-180) was obtained from Christina Hansens Company (Denmark). The starter was a blend of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus* at a rate 1:1.

Methods

Yoghurt production

Cow's milk (milk fat 3%, protein 3.60%, total solids 12.1% and acidity 8.0 SH) was used for yoghurt production and to increase solids of milk 2% non fat dry matter was added. The mix was heated to 60^{o}C and homogenized. The mix was pasteurized at 85^{o}C for 30 min. and then rapidly cooled to 45^{o}C. *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus* added at the rate of 2% (w/v) served as starter culture into the mix. The inoculated mix was filled into 1.7 kg plastic cups and incubated at 43^{o}C. Incubation was terminated at pH 4.5. At this point, the yoghurt was stored in a refrigerator (4±1^{o}C) overnight. Yoghurt was prepared in a pilot plant.

Cornelian marmalade, rosehip marmalade, morella cherry preserve, grape molasses, date pulp were used in production of fruit yoghurt. The additives were added 10 % w/w rate. The yoghurt samples were stirred and filled in 250g plastic cups along with the fruit additives at the % 10 rates. The yoghurt samples were stored in the refrigerator for 10 days. The yoghurt samples were analyzed at 1, 6, and 10 days interval. Two replicate yoghurts were made.

Compositional Analyses

The samples were mixed and analyzed in duplicate for acidity, fat, protein, ash, and total solids (TS). The micro-Kjeldahl method was used to determine total protein content of yoghurt (AOAC, 1990). Fat content was measured by the Gerber method (Kurt et al., 1996) and ash by heating a 5g sample in a muffle furnace at 100^{o}C for 1 hour, 200^{o}C for 2 hours and 550^{o}C overnight (Marth, 1978). TS was determined using a drying oven (AOAC, 1990). Titratable acidity was expressed in terms of % lactic acid (Anonymous, 1989). The pH was measured with a (Hanna Instruments 8521) pH meter.

Syneresis

One hundred grams of yoghurt sample was placed on a filter paper resting on a top of a funnel. After 2 h of drainage at 7^{o}C, the quantity of whey collected in a 50 ml graduated cylinder was used as an index of syneresis (Farooq and Haque, 1992).

Microbial analyses

Testing for Coliform, Yeast and Mold was according to Standard Methods for the Examination of Dairy Products (Marth, 1978), using the Violet Red Bile Agar (VRB) and acidified Potato Dextrose Agar (PDA) respectively. Mesophilic bacterial count was done according to the method described in Compendium of Methods for the Microbiological Examination of Food (Speck, 1976). Plate count agar (PCA) medium (Difco) was used to detect non lactic acid bacteria and *L. delbrueckii* subsp*. bulgaricus*.

Sensory Evaluation

The appearance, body -texture and flavor of all yoghurt samples were evaluated sensorily by a trained panel of five members using a five-point scoring system (5 excellent, 1 unacceptable) (Anonymous, 1989). The sensory profiles were conducted on coded samples at 1, 6, and 10 d of storage, inviting comments on rate of flavour addition also (Larmond, 1987).

Statistical Analysis

Data were analyzed by analysis of variance (ANOVA) using the general linear model (GLM) procedure of the Statistical Analysis System (SAS, 1995). The means were separated by use of the least significant difference (LSD) test. Significant differences were determined at α=0.05 (Steel and Torrie, 1980).

Results and Discussion

Yoghurt samples containing different fruit-additives were analyzed at the beginning of the storage (1th day) and results were given at Table 1. Fat content of yoghurts ranged from 2.95% to 3.10% and total solids from 14.58% to 20.51% (Table 1). There were significant differences in the total solid, protein, TA and ash content ($P<0.05$). Yoghurt containing grape molasses had significantly higher total solid. On the other hand yoghurt used as control had lower TS (14.58%). There were no significant differences in the fat content of the yoghurt contained fruit additives, as shown Table 1. Yoghurt containing cornelian marmalade and grape molasses had significantly higher protein content (4.10, 4.34%) than others. Yoghurt containing morello cherry and cornelian marmalade had lower ash content than others.

Effect of different fruit addition on syneresis, pH, TA and sensory characteristics were shown in Table 2. Morello cherry added yoghurt sample had highest syneresis at the beginning of storage. There was an increase on syneresis of samples during storage. Syneresis of the yoghurt samples ranged from 22.40 to 29.2%. The syneresis values were similar to the results of Farooq and Haque (1992). In addition, the syneresis degrees were lower than results of Katsiari et al., (2002).

The pH of the yoghurts decreased during storage. However, TA of the yoghurt samples were increased during storage. Laye et al., (1993) found lower TA values than our results. The pH values similar the results obtained by O'Neil et al. (1979). When pH decreased alcholic aroma and acidic taste increased on yoghurt samples as result flavor scores were decreased.

Table 1. Chemical composition of fruit added yoghurt at the beginning of storage (n=2)

Fruit Additives	Total Solids (%)	Protein (%)	Fat (%)	Ash (%)
Control	14.58^{f}	3.80^{c}	3.18^{a}	1.09^{a}
Cornelian Marmalade	17.41^{bd}	4.10^{b}	2.95^{b}	0.84^{b}
Rosehip Marmalade	15.50^{e}	3.61^{d}	3.05^{ab}	0.92^{b}
Morello Cherry	19.08^{b}	3.79^{c}	2.95^{b}	0.82^{b}
Grape Molasses	20.51^{a}	4.34^{a}	3.05^{ab}	1.08^{a}
Date Pulp	18.87^{c}	3.74^{c}	3.05^{ab}	0.92^{b}

^{abcd} Means in the same column with the same letter were not significantly different ($P< 0.05$)

Table 2. Effect of Addition of Fruit-Additives on Syneresis, pH, TA, Sensory Characteristics and Microbial Counts of Yoghurt Samples (at 1, 6, 10 days of storage) (n=2)

Fruit Additives	Storage days	Syneresis	pH	TA (%LA)	Coliform	TMB[1]	M&Y	App.[2]	Body and texture[2]	Flavour[*]
Control	1	$22.4^{ı}$	4.13^{bcd}	1.27^{h}	<1	$5.21^{ghı}$	1.70^{f}	4.15^{ab}	4.00^{abc}	4.08^{abc}
	6	24.9^{f}	3.97^{fg}	1.31^{gh}	<1	$5.30^{ghı}$	2.38^{de}	4.21^{ab}	$3.88b^{cd}$	4.02^{abc}
	10	27.2^{cd}	3.93^{g}	1.33^{g}	<1	$5.37^{fghı}$	2.22^{e}	4.28^{ab}	4.05^{ab}	4.10^{abc}
Cornelian	1	$22.5^{ı}$	4.10^{cd}	1.38^{ef}	<1	6.09^{ab}	2.51^{de}	4.33^{a}	$3.85b^{cd}$	4.17^{ab}
Marmalade	6	24.3^{fg}	$3.85^{hı}$	1.55^{bc}	<1	5.76^{cd}	2.85^{bcd}	4.15^{ab}	4.20^{a}	4.05^{abc}
	10	28.1^{bc}	$3.82^{ı}$	1.62^{a}	<1	6.26^{a}	3.21^{abc}	3.88^{bc}	3.75^{cd}	4.02^{abc}
Rosehip	1	24.5^{fg}	$4.12b^{cd}$	1.39^{e}	<1	$4.78^{ı}$	2.59^{de}	4.15^{ab}	3.85^{bcd}	3.88^{bc}
Marmalade	6	26.1^{e}	3.93^{g}	1.44^{d}	<1	$5.28^{ghı}$	2.74^{cd}	4.10^{abc}	3.65^{d}	3.70^{c}
	10	26.9^{de}	3.91^{gh}	1.45^{d}	<1	$5.15^{ı}$	3.10^{abc}	4.12^{abc}	4.02^{abc}	3.77^{bc}
Morello Cherry	1	26.8^{de}	4.17^{bc}	1.33^{fg}	<1	5.41^{efg}	2.39^{de}	4.33^{a}	3.73^{d}	4.25^{a}
Marmalade	6	26.7^{de}	$3.81^{ı}$	1.59^{ab}	<1	5.58^{def}	3.20^{abc}	4.15^{ab}	3.88^{bcd}	4.17^{abc}
	10	28.6^{ab}	$3.80^{ı}$	1.60^{a}	<1	5.44^{efg}	3.49^{a}	4.33^{ab}	3.80^{bcd}	4.15^{ab}
Grape Molasses	1	24.5^{fg}	4.29^{a}	1.31^{gh}	<1	5.61^{de}	1.71^{f}	4.35^{a}	3.77^{cd}	4.28^{a}
	6	26.4^{de}	4.06^{de}	1.35^{ef}	<1	$5.19^{hı}$	2.44^{de}	3.88^{bc}	3.88^{bcd}	4.17^{ab}
	10	29.2^{a}	4.01^{ef}	1.54c	<1	$5.22^{ghı}$	3.29^{ab}	3.73^{c}	4.12^{ab}	4.02^{abc}
Date Pulp	1	$22.9^{hı}$	4.19^{b}	1.31^{gh}	<1	5.62^{de}	2.58^{de}	4.05^{abc}	4.17^{a}	4.17^{ab}
	6	$23.1^{hı}$	3.92^{gh}	1.37^{ef}	<1	5.44^{efg}	3.11^{abc}	4.10^{abc}	3.77^{cd}	4.28^{a}
	10	23.7^{gh}	3.98^{fg}	1.46^{d}	<1	5.87^{bc}	3.16^{abc}	4.00^{abc}	4.05^{ab}	4.02^{abc}

^{abcdefgı} Means in the same column with the same letter were not significantly different ($P<0.05$).

[1] Total mesophilic bacteria

[2] Judged by a five member experienced panel using a 5 point scale; 5 is excellent.

The total mesophilic bacteria were significantly affected by the type of fruit additives used in yoghurt. The mesophilic bacteria count were slightly increased during storage period (Table 2). At the end of storage, yoghurt samples containing cornelian marmalade had highest total mesophilic bacteria (6.26 cfu/g). While, yoghurt contained rosehip marmalade had lowest bacteria count. Canganella et al. (1998) found similar results in fruit yoghurts during storage.

All of the yoghurt samples contained Coliform group bacteria of <1.0 cfu/g during storage time. According to the Turkish Standards Institute (TS 1330) (Anonymous, 1989) a maximum count of 10 cfu/g of coliform group bacteria are allowable in yoghurt. The coliform counts determined in this study were acceptable based on TS 1330 limits for coliforms. In this research, all of the yoghurt samples showed significant increase in yeast and mold counts (Table 2). Initial yeast and mold count was lower yoghurt contained morello cherry but later on it was increased. Çon et al. (1996) found similar results. Salji et al., (1987) found that initial counts of yeast and mold not exceeding 1 cfu/ml, but when storage time get longer the yeast and mold counts increased to $2x10^3$ cfu/ml and $3x10^3$ cfu/ml after 5 and 10 d of storage respectively. With prolonged storage time the yeast and mold counts were increased.

The yogurt samples containing each of morello cherry and grape molasse had significantly higher flavor than others. The sensory scores of all the samples were decreased during storage period. The body texture score were 3.65 to 4.20. Overall, with prolonged storage the body and texture scores decreased. The findings of Farooq and Haque (1992)are in agreement with the current finding.

Conclusion

There were differences in physical, chemical and sensory properties of fruit-additives yoghurt compare to control. 10% w/w fruit additives increased acceptability of yoghurt. Panelist preferred morello cherry added yoghurt compare to other samples. Fruit additions have an increasing effect on yoghurt consumption. Also, using different fruit additives give more yoghurt choices to the consumers in the market.

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