Physical, Chemical, Microbiological and Sensory Characteristics of Some Fruit-Flavored Yoghurt

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SUMMARY

Yoghurt with different fruit-flavors(Cornelian, Morello Chery and Rose hip marmalade, grape molasses, date pulp, and control (without additive)) was prepared and stored up to 10 days at 5°C. The fruit flavors were added at the rate of 7 % w/w. Yoghurt samples were analyzed for some physical, chemical, microbiological and sensory some characteristics. The total aerobic mesophilic bacterial count, coliform count, and yeast and mold counts were determined in yoghurt samples at 1, 6 and 10 days interval. There were significantly differences in the fat, ash, protein, total solids (TS) content and titratable acidity (TA) for samples amonts 1d of storage. There were marked differences in the protein and dry matter due to different flavor additives. Syneresis and TA increased over the storage period. The yoghurt containing Grape molasses and Morello had higher flavor scores than using other flavoring. The total mesopilic bacterial count was significantly higher in the yoghurt sample contained grape molasses. Yeast and mould count increased significantly during storage at 5°C .

***Key words**: Furit-flavored yoghurt, sensory quality, storage, physical, chemical properties, microbial quality.*

Bazı Meyve Aromalı Yoğurtların Fiziksel, Kimyasal, Mikrobiyolojik ve Duyusal Özellikleri

ÖZET

Kızılcık, kuş burnu, vişne marmelatları, üzüm pekmezi, hurma pulpu içeren yoğurtlarla kontrol grubu (meyve ilavesiz) yoğurt hazırlandı ve 10 gün süreyle 5°C'de depolandı. Meyve aromaları ağırlık oranına göre % 7 oranında yoğurtlara katıldı. Yoğurt örneklerinde bazı fiziksel, kimyasal, mikrobiyolojik ve duyusal özellikleri belirlendi. Örneklerde 1. 6. ve 10. günlerde aerobik mezofilik bakteri sayısı, koliform bakteri ve maya ve küf sayıları tespit edildi. Örnekler arasında depolamanın 1. günde yağ, kül, protein, toplam kuru madde ve titrasyon asitliğinde önemli farklar bulundu. Farklı aromalardan dolayı yoğurtlarda protein ve kuru madde içeriğinde iz bırakacak farklılıklar gözlemlendi. Depolama periyodunda serum ve titrasyon asitliği arttı. Vişne ve üzüm pekmezli örneklerin, diğerlerine göre, daha fazla tat ve aroma puanı almıştır. Aerobik mezofilik bakteri üzüm pekmezli yoğurtlarda önemli bir şekilde daha yüksek bulundu. Maya ve küf sayısı 5°C'de depolama süresince önemli olarak artış gösterdi.

***Anahtar kelimeler**: Meyveli aromalı yoğurt, duyusal kalite, fiziksel, kimyasal özellikler, mikrobiyal kalite.*

INTRODUCTION

The use of yogurt dates back many centuries, although there is no accurate record of the date when it was first made. According to legend, yogurt was first made by the ancient Turkish people in Asia (1). Yogurt is one of the most unique dairy product, yet a universal one. The uniqueness of yogurt is attributable to the symbiotic fermentation involved in its manufacturing. Yogurt in different forms with appropriate local names is made throughout the world.

The manufacture of yogurt in Turkey today is mainly based upon traditional technologies. In Turkey, usually 1 day old yogurt is used as a starter culture for production of yogurt. In principle, world wide, there is not any differences between manufacturing of home-made and factory-made yogurt (2,3). Yogurt is being enjoyed everywhere in the world for its beneficial properties. It is easily digestible, has high nutritional value, (4,5,6) and has also therapeutic properties (7,8).

The chemical composition and microbial quality of yogurt was reported by several workers. According to Yaygın and Kılıç (9) yogurt commercially sold in different
regions of Turkey contained some bacteria and yeast.

Dayısoylu (10) reported that yogurt sold in the markets in Van, Turkey had average coliform bacteria count of 5.0 x 10^2 cfu/g and yeast and mold count of 2.2 x 10^5 cfu/g.

Çon et al. (11) found that the addition of fruit flavor had no significant effect on the total bacteria and coliform counts. They also stated that fruit-flavored yogurts, made using 1-day old yogurt as a starter culture, could be stored for up to 7 days without losing its desired flavor qualities. Few studies have been reported on the influence of alternative sweeteners on the quality of yogurt. McGREGOR and White (12) concluded that high fructose corn syrup (HFCS) did not adversely affect yogurt quality and may have increased its acceptability.

The use of different fruit-flavor in yogurt manufacture has been attempted increasingly. The aim of this study was to utilize some fruit flavors in developing a yogurt of high acceptability. Another objective of this study was to evaluate the effect of flavor additives on physical, chemical, sensory and microbiological properties of yogurt.

MATERIAL and METHOD

Yoghurt production

Cow's milk (milk fat 3%, protein 3.5%, TS 12% and acidity 8.0 SH) was used (50 kg) for yogurt production and to increase solids of milk 2% NFDM (skim milk powder) was added. The mix was heated to 60°C and homogenized. The mix was pasteurized at 85°C for 30 min. and then rapidly cooled to 45°C. 2 % (w/v) yogurt (containing *Streptococcus thermophilus and Lactobacillus delbrueckii* subsp. *bulgaricus*) has added as a starter culture. The inoculated yogurt mixes were filled into 1.7 kg plastic cups and incubated at 43°C. Incubation was terminated at pH 4.5. At this point, the yogurt was stored in a refrigerator (5°C) overnight. Yogurt was prepared in a pilot plant.

Cornelian marmalade, Rose hip marmalade, Date pulp, Morello Cherry preserve, Grape molasses and one without additive (control) were used in production of fruit-flavored yogurt. The additives were added at a ratio of 7% w/w rate. Next day, the yogurt samples were stirred and filled in 250 g plastic cups along with the fruit additives at the desired rates. The yogurt samples were stored in the refrigerator at 5°C for 10 days. The yogurt samples were analyzed at 1, 6, and 10 days interval.

Compositional Analyses

The samples were mixed and analyzed in duplicate for acidity, fat, protein, ash, and TS content. The micro-Kjeldahl method was used to determine total protein content of yogurt (13). Fat content was measured by the Gerber method (14) and ash by heating a 5g sample in a muffle furnace at 100°C for 1 hour, 200°C for 2 hours and 550°C overnight (15). TS was determined using a drying oven (13). Titratable acidity was expressed in terms of % lactic acid (13). The pH was measured with a (Hanna Instruments 8521) pH meter.

Syneresis

One hundred grams of yogurt sample was placed on a filter paper resting on a top of a funnel. After 2 h of drainage at 7°C, the quantity of whey collected in a 50 ml graduated cylinder was used as an index of syneresis (16).

Microbial Analyses

Testing for Coliforms, Yeast and Mold was according to Standard Methods for the Examination of Dairy Products (15), using the Violet Red Bile Agar (VRB) and acidified Potato Dextrose Agar (PDA) respectively. Lactic bacteria count was done according to the method described in Compendium of Methods for the Microbiological Examination of Food (17).

Sensory Evaluation

The flavor, appearance, body and texture of all yogurt samples were evaluated sensorial by a trained panel of five members using a five-point score system (5 excellent, 1 unacceptable). The sensory profiles were conducted on coded samples after 1, 6, and 10 d of storage, inviting comments on rate of flavour addition also (18).

Statistical Analysis

The results were submitted to the analysis of variance (ANOVA) using the general linear model (GLM) procedure of the statistical Analysis System (SAS) (19). The means were separated by use the least significant difference (LSD) test. Significance differences was determined at α=0.05 (20). The values of yeast and mold counts and the total bacterial count were transformed to log values. Since the coliform count was <1 cfu/g in all yogurt samples no statistical test was performed in this case.

RESULT and DISCUSSION

Compositional analyses

Yogurt samples containing different fruit-flavors were analyzed at day 1 (Table 1). The effect of different fruit flavors on the fat, protein, TS, TA, and ash content is shown in Table 1. There were significant differences in the TS, fat, protein and ash contents ($P<0.05$) of yogurt samples. Yogurt containing grape molasses had significantly higher TS. Yogurt containing grape molasses had significantly higher protein and ash content than others. Yogurt containing morello cherry and cornelian marmalade had lower ash content than others. FDM was highest in the yogurt samples added with rosehip marmalade. In the case of MNFS there were no differences in yogurt samples, except for the one containing rosehip.

Syneresis

Syneresis increased in all of the samples during storages, which was significant after 6 d of storage (Table 3). Yogurt containing date pulp had significantly lower syneresis ($P>0.05$) (Table 2). The syneresis values were similar to the results of Farooq and Haque (16). TA increased from 1.31 to 1.50 in 10 d (Table 3). The TA values were similar to the results obtained by O'Neil et al. (21) who observed an increase during storage.

Table 1. Chemical Composition of Fruit-flavored Yoghurt at the Beginning of Storage

Samples	Total Solids (%)	Fat (%)	Protein (%)	TA[1](%A)	Ash (%)	FDM[2] (%)	MNFS[3](%)
Fruit flavors (%7)							
Cornnelian marmalade	16.48^{c}	2.90^{c}	4.09^{b}	1.36^{a}	0.85^{c}	17.60^{b}	13.58^{d}
Rosehip marmalade	15.11^{e}	3.03^{bc}	3.60^{d}	1.34^{a}	0.90^{b}	20.03^{a}	12.09^{e}
Morello cherry	17.39^{c}	3.15^{ab}	3.73^{cd}	1.30^{b}	0.82^{c}	18.12^{ab}	14.24^{c}
Grape molasses	17.69^{b}	3.03^{bc}	4.26^{a}	1.29^{b}	1.00^{a}	17.10^{b}	14.67^{b}
Date pulp	18.25^{a}	3.00^{c}	3.58^{d}	1.28^{b}	0.90^{b}	16.44^{b}	15.25^{a}
Control	14.58^{f}	3.18^{a}	3.80^{c}	1.27^{b}	1.09^{a}	21.79^{ab}	11.40^{f}

^{abcde} Values in the Same column with the same alphabet do not differ significantly ($p> 0.05$).

[1]TA= Titratable acidity, [2]FDM= Fat-in-dry-matter, [3]MNFS= Moisture - in- non fat - substance

The pH of yoghurts decreased from 4.15 to 3.90 (Table 3). The decrease in pH was accompanied by an increase in the alcoholic aroma and acidic taste of yogurt samples resulting in decreased flavor scores (Table 2). Laye et al. (22) reported lower TA values than the present result. However, the pH values were almost similar.

Sensory Characteristics

The yogurt samples containing each of grape molasses and morello cherry had significantly higher flavor score, than the one containing Rose hip marmalade. Rose hip marmalade if incorporated along with some sugar would improve the flavor of yogurt. The appearance score decreased during storage period. The flavor score decreased during storage from 4.01 to 3.73 (Table 3). The body and texture score were ranged 3.88 to 4.28 . Overall, with prolonged storage the body and texture scores decreased. The findings of Farooq and Haque (16) are in agreement with the current finding. Yogurt samples containing Morello cherry, Cornelian marmalade and control had higher body and texture score then the other three samples. In contrast, Keating and White (23) found that prolonged storage led to an increase in the body and texture score.

Table 2. Effect of Some Fruit Flavorings on Syneresis, pH, TA , and sensory qualities of Yogurt Samples (During storage at 1, 6, 10 days).

Samples	Syneresis (%)	pH	TA (%)	Flavor (Out of 5)	Body and Texture (Out of 5)
Added fruit flavors					
Cornnelian marmalade	25.60^{b}	3.93^{d}	1.50^{a}	3.53^{c}	4.45^{a}
Rosehip marmalade	24.66^{c}	3.98^{bcd}	1.40^{c}	3.77^{b}	3.92^{c}
Morello cherry	27.20^{a}	3.95^{cd}	1.47^{b}	4.10^{a}	4.17^{b}
Grape molasses	27.07^{a}	4.07^{a}	1.39^{cd}	4.02^{a}	3.87^{c}
Date pulp	23.23^{d}	4.00^{bc}	1.38^{d}	3.73^{b}	3.88^{c}
Control	24.83^{c}	4.01^{b}	1.30^{e}	4.10^{a}	4.28^{b}

^{abcde} Values in the Same column with the same alphabet do not differ significantly ($p > 0.05$).

Table 3. Effect of Storage on Some Properties of Flavored Yoghurt

Storage time days)	Syneresis (%)	pH	TA (%A)	Flavor (Out of 5)	Body and Texture (Out of 5)
1	24.35^{c}	4.15^{a}	1.31^{c}	4.01^{a}	4.21^{a}
6	25.08^{b}	3.92^{b}	1.41^{b}	3.88^{b}	4.10^{ab}
10	27.32^{a}	3.90^{b}	1.5^{a}	3.73^{c}	3.99^{b}

^{abc} Values in the Same column with the same alphabet do not differ significantly ($p > 0.05$).

Microbiological quality

It can be seen from Table 4 and 5 that all of the yogurt samples had <1.0 cfu/g coliform bacteria and remained so even after 10 d storage. According to the Turkish Standards Institute (TS 1330) (24) a maximum count of 10 cfu/g of coliform is allowed in yogurt. However, some workers (10) reported that yogurt sold commercially had much higher coliform count than that mentioned in TS 1330.

All the yogurt samples showed significant increases in yeast and mold count (Table 4,5). Yeast and mold count of yogurt samples ranged from 2.10 to 2.89 cfu/g. At the beginning yogurt containing grape molasses and control had the lowest yeast and mould count, but at 10 d had almost similar count as observed in others (Table 4). It can be seen clearly from Table 5 that yeast and mold counts increased progressively during storage. The fruit flavor addition increased the yeast and mold counts (Table 4). Çon et al. (11) found much higher yeast and mold count in their yogurt samples. The high yeast and mold count could be attributed to contamination from air, the fruit marmalade, molasses and the 1 day old culture used for yogurt manufacture.

Arnott et al. (25) showed that 26.3 % of the yogurt produced and sold commercially in Ontario, Canada had mold count > 1 cfu/ g . According to TS 1330, Yogurt Standards a maximum of 100 cfu/ g of mold is allowed in yogurt. Salji et al. (26) found that initial count of yeast and mold 1 cfu/ml which increased to 3x 10^{3} cfu/ml at 10 d of storage. Yaygın and Kılıç (9) found that yogurt made using only pure culture showed no growth of yeast and mold up to 4 d of storage.

The aerobic mesophilic bacteria count was significantly affected by the type of flavor additives used in yogurt. The aerobic mesophilic counts were ranged from 5.29 to 5.87 log cfu/g in day 1 samples (Table 4). However, the toplam bacteria count increased marginally during storage. Çon et al. (11) found that the flavor additives had no effect on the aerobic mesophilic count in yogurt. At the end of storage (10 d), Yogurt samples containing grape molases and morello cherry had the highest (5.94, 6.06 log cfu/g) and lowest date pulp (5.47 log cfu/g) aerobic mesophilic bacteria count respectively. It can be seen clearly from Table 5 that total bacteria count increased from 5.47 to 5.70 (log cfu/g) during storage.

Table 4. Effect of Flavor Addition on Microbial Count of Fresh Yoghurt

Samples	Coliform bacteria (cfu/g)	Aerobic mesophilic bacteria (log cfu/g)	Yeast and mold (log cfu/g)
Fruit flavors			
Cornelian marmalade	<1	5.70 [b]	2.89 [a]
Rose hip marmalade	<1	5.56 [c]	2.65 [b]
Morello cherry	<1	5.50 [c]	2.69 [ab]
Grape molasses	<1	5.87 [a]	2.27 [c]
Date pulp	<1	5.55 [c]	2.82 [ab]
Control	<1	5.29[d]	2.10[c]

[abc] Values in the Same column with the same alphabet do not differ significantly (p> 0.05).

Table 5. Effect of storage period on microbial counts of yogurt samples.

Storage time (days)	Coliform bacteria (cfu/g)	Aerobic mesophilic bacteria (log cfu/g)	Yeast and mold (log cfu/g)
1	<1	5.47 [c]	2.21 [c]
6	<1	5.55 [b]	2.64 [b]
10	<1	5.70[a]	2.87 [a]

[abc] Values in the Same column with the same alphabet do not differ significantly (p> 0.05).

Conclusion

Grape molasses and Morello cherry as fruit flavor for yogurt preferred over other fruit flavoring. Cornelian marmalade containing yogurt not preferred much because it had high level of acidity. The flavor, body and texture of the fruit flavored yogurt tended to decrease during storage. Storage had a marked effect on yeast and mold counts. All the panelists recommended that fruit addition level could increase the flavor scores of the yogurt samples.

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REFERENCES

1.Kurt A (1981): Süt Teknolojisi. Atatürk Üniversitesi Yayınları, No: 573. Atatürk Üniversitesi Basım Evi.

2. Akın N, Rice P, (1994): Main yogurt and related products in Turkey. Cult. Dairy Prod. J. 29:23-29.

3. White C H (1995): Manufacture of high quality yogurt. Cult. Dairy Prod. J. 30 :18-24.

4. Hewitt D, Bancroft H J (1985): Nutritional value of yogurt. J. Dairy Res. 52:197-207.

5. Tamime AY, Robinson R K (1985): Yogurt Science and Technology. Pergamon Press Ltd., Oxford.

6. Çakmakci S, Çağlar A, Türkoğlu H (1993): Importance of yogurt in human nutrition. Standard 32:29-38.

7. Blanc B (1986): The nutritional value of yogurt. Int. J. Immunotherapy. Suppl. 11:25-32.

8. Gilliland S E (1991): Properties of yogurt. In "Therapeutic Properties of Fermented Milks". R.K. Robinson (Ed). p 65 Elsevier Applied Science, London.

9. Yaygın H, Kılıç M (1980): A study on properties of yogurt produced using starter culture and carryover culture techniques. 7th. Scientific Congress, Agriculture and Research Group, 6-10 October, Adana, Turkey.

10.Dayisoylu K S (1993): A Study of the physical, chemical, microbiological and flavor characteristics of yogurt commercially produced and sold in Van, Turkey. Master Thesis. Yuzuncu Yil University, Food Science and Technology Department, Van, Turkey.

11. Çon A H, Çakmakcı S, Çağlar A, Gökalp H Y (1996): Effects of different fruits and storage periods on microbiological qualities of fruit-flavored yogurt produced in Turkey. J. Food Prot. 59 :402-406.

12. McGregor J U, White C H (1986): Effect of sweeteners on the quality and acceptability of yogurt. J. Dairy Sci. 69:698-703.

13. AOAC (1990): "Official Methods of Analysis". 15 th ed. AOAC, Arlington,VA.

14. Kurt A, Çakmakcı S, Çağlar A (1996): Standard methods for analysis of milk and milk products. Atatürk University Publication Center. Publication number 252/d.

15. Marth E H (1978): "Standard Methods for the Examination of Dairy Products". 14th ed. American Public Health Association, Washington, D.C.

16. Farooq H, Haque Z U (1992): Effect of sugar esters on the textural properties of nonfat low calorie yogurt. J. Dairy Sci. 75:2676-2680.

17. Speck M L (1976): "Compendium of Methods for the Microbiological Examination of Foods". American Public Health Association, Washington, D.C.

18. Tekinşen O C, Keleş A (1994): Besinlerin Duyusal Muayenesi. Selçuk Üniv. Veteriner Fak. Yayın Ünitesi, Konya.77sayfa.

19. SAS Inst. (1995): SAS User's Guide: Statistics, Version 6.0 Edition. SAS., Inc., Cary, NC.

20. Steel R D G, Torrie J H (1980): "Principles and Procedures of Statistics- A biometrical Approach". 2nd ed. McGraw-Hill, New York.

21. O'Neil J M, Kleyn D H, Hare L B (1979): Consistency and compositional characteristics of commercial yogurts. J. Dairy Sci. 62:1032-1036.

22. Laye I, Karleskind D, Morr C V (1993): Chemical microbiological and sensory properties of plain nonfat yogurt. Food. Sci. 58 :991-1000.

23. Keating K R, White C H (1990): Effect of alternative sweeteners in plain and fruit-flavored yogurts. J. Dairy Sci.73:54-62.

24. Anonymous (1989): Yogurt standard. (TS 1330). Turkish Standards Institute. Necatibey Cad. 112. Bakanlıklar, Ankara, Turkey.

25. Arnott D R, Duitschaever C L, Bullock D (1974): Microbiological evaluation of yogurt produced commercially in Ontario. J. Milk Food Technol. 37:11-13.

26. Salji J P, Saadi S R, Mashhadi A (1987): Shelf life of plain liquid yogurt manufactured in Saudi Arabia. J. Food Prot. 50 : 123-126.