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RESEARCH PAPER

OPEN ACCESS

AN INVESTIGATION OF SENSORY EVALUATION OF FLAVOURED YOGHURTS MADE WITH DIFFERENT STARTER CULTURE DURING STORAGE

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ABSTRACT

Six different yoghurts were prepared with mango pulp and pineapple essence and sugar combination with *Lactobacillus bulgaricus*, *Streptococcus thermophilus*, *Lactobacillus acidophilus*, *Lactobacillus sporogens*, *Bifido bifidum*, *Bifido longum*, and *Bifido infantis* as starter culture. Three types of yoghurts were developed under each flavours, with different combination of probiotics and termed as A1, B1, C1, A2, B2 and C2. A1, B1, C1 were mango yoghurts and A2, B2 and C2 were pineapple yoghurts. Mean scores of Mango and Pineapple yoghurts were significantly different from each other only in one sensory attribute i.e., flavor ($P < 0.001$). Mango yoghurt had a higher scores for flavor and overall acceptability compared to pineapple yoghurts. The mango yoghurt B1 i.e., yoghurt fermented with *Lactobacillus bulgaricus*, *Streptococcus thermophilus* and *Lactobacillus sporogenes* was found to be highly acceptable.

KEY WORDS:

(ANOVA) analysis of variance, (CRD) complete randomized design

A-*Lactobacillus bulgaricus*, *Streptococcus thermophilus*, B- *Lactobacillus bulgaricus*, *Streptococcus thermophilus*, *Lactobacillus sporogens*, C-*Lactobacillus bulgaricus*, *Streptococcus thermophilus*, *Lactobacillus acidophilus*, *Bifido bifidum*, *Bifido longum*, and *Bifido infantis*

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INTRODUCTION

Milk is a complete food, gifted by God to human being. Yogurt is a product of the lactic acid fermentation of milk by addition of a starter culture containing *Streptococcus thermophilus* and *Lactobacillus delbrueckii ssp. bulgaricus*. In some countries less traditional microorganisms, such as *Lactobacillus helveticus* and *Lactobacillus delbrueckii ssp. lactis*, are sometimes mixed with the starter culture (McKinley, 2005). Yoghurt is a fermented milk product with custard like consistency. Fruit yogurt, a popular type of yogurt is liked by masses and is known as fruit stirred yogurt. Yogurt prepared by adding seasonal fruits are very attractive. Fruit stirred yogurt is popular among masses and particularly children who dislike the flavour of plain yogurt. This modification has made the yogurt flavor attractive for them. Addition of fruit makes the yogurt more delicious. The product contains both the nutritive effect of yogurt and refreshing taste of fruit. Fruit stirred yogurt has more sweetness and pleasing flavor (Hursit and Temiz, 1999). The types of flavouring material used in the yoghurt industry are fruits, fruits preserves, canned fruit, frozen fruits and miscellaneous fruit products (Tamime and Robinson, 1985). The aim of the study was to investigate the changes in microbiological properties in mango and pineapple yoghurts made with different probiotic cultures during storage. The aim of the study was to investigate the changes in sensory properties in mango and pineapple yoghurts made with different probiotic cultures during storage.

MATERIALS AND METHODS

The raw material viz Double toned milk, powdered sugar, milk powder, pineapple essence, food color, pasturised mango pulp, and plastic sterile cups used for preparation of yoghurts were purchased from the local market.

The probiotic stock cultures required for the study i.e., *Lactobacillus bulgaricus*, *Streptococcus thermophilus*, *Lactobacillus acidophilus*, *Lactobacillus sporogens*, *Bifido bifidum*, *Bifido longum*, and *Bifido infantis* in powder form were obtained from National Institute of Nutrition, Hyderabad. The two different flavoured yoghurt i.e., mango and pineapple was prepared by using standard technique as described below in the form of flow chart (flowchart 1):

Acceptability of yoghurt on different periods of storage, the six types of yoghurts developed were stored at 4°C in refrigerator for a period of 1 month and they were assessed for sensory characteristics. The sensory evaluation of developed products was conducted using structured schedule at 0, 1, 2, 3 and 4 weeks of storage. The organoleptic qualities i.e., aroma, appearance, texture, flavor, acidity, mouthfeel and overall acceptability of the yoghurts developed were evaluated by trained panel of 10 members using five –point hedonic scale scoring system(5 excellent, 1 poor) (Anonymous 1989). The results obtained from 10 replications of all organoleptic qualities scores were analysed by analysis of variance (ANOVA), using complete randomized design (CRD) and Tukey HSD Test for Post-ANOVA Pair-Wise Comparisons.

RESULTS AND DISCUSSION

The Results and discussion of the present study are described under the following heads:

4.1. ACCEPTABILITY OF MANGO AND PINEAPPLE YOGHURTS DEVELOPED.

4.1.1. Acceptability of Mango yoghurt and pineapple yoghurt on the day of preparation.

The sensory characteristics studied were Aroma, appearance, texture, flavour, acidity, mouthfeel and overall acceptability. Hedonic 5- point scale was followed to obtain the scores.

The mean sensory attribute scores for yoghurt samples of mango and pineapple on the day of preparation are presented in Table 1.

The Mango yoghurt samples had an aroma scores of 4.3, 4.3 and 4.2 for A1, B1 and C1 products respectively. The scores were similar for A2, B2 and C2 also, which ranged from 4.2 to 4.3, in 5 point hedonic scale. This indicated that aroma of all the yoghurts developed were highly acceptable. The product A1, A2, B1, B2 got similar and higher scores compared to C1 and C2. It might be due to the reason that *Lactobacillus bulgaricus*, *Streptococcus thermophilus* and *Lactobacillus sporogenes* imparted good aroma to yoghurts. The aroma compounds that were identified in typical yoghurts were acetaldehyde, acetone, ethyl acetate, butanone, diacetyl and ethanol (Tamime & Robinson, 1999).

Balow et al. (1991) reported that while fermenting milk, *Lactobacillus bulgaricus* produces acetaldehyde, which is one of the main yogurt aroma components. C1 and C2 yoghurt i.e., *Lactobacillus bulgaricus*, *Streptococcus thermophilus*, *Lactobacillus acidophilus*, *Bifido bifidum*, *Bifido longum*, and *Bifido infantis* blend of bacteria, imparted less aroma in C1 and C2 yoghurt. However, the probiotics used did not have adverse effects on the aroma of the products developed.

The appearance scores of mango yoghurt samples were 3.7, 4.0 and 3.8 for A1, B1 and C1 and pineapple yoghurt samples had appearance scores of 4.2, 3.6 and 3.8 for A2, B2 and C2. Pineapple yoghurts were more appealing compared to mango yoghurt, which however, is not significant. B2 had least score in all yoghurts. Earlier Osundahunsi et al. (2007) prepared different fruit flavoured soy-yoghurt with artificially flavoured strawberry, vanilla, orange and naturally orange, pineapple and pawpaw (fruit chunks) added to yoghurt and reported that the appearance has shown no significant difference between the artificial flavour and natural fruit chunks soy-yoghurts.

Mango yoghurt samples had texture score of 3.4, 3.9 and 3.6 for A1, B1 and C1. All the three pineapple yoghurts had similar scores of 3.9. As mango pulp could not be miscible properly in yoghurt, the texture score were lower compared to pineapple. EPS (exopolysaccharide) materials produced by *S. thermophilus* and *L. delbrueckii* subsp. *bulgaricus* have important role in the consistency and texture of yoghurt (Tamime & Robinson 1999). Osundahunsi et al. (2007) reported that the decrease in

consistency of fruit –flavoured yoghurt might be due to the diluting effect of the flavouring agent during stirring. As Pineapple essence was a liquid and could be easily mixed with every particle of yoghurt, Pineapple yoghurts might have obtained higher scores for texture than mango.

The flavour scores of mango yoghurt samples were 4.7, 4.5 and 4.2 for A1 ,B1 and C1 and pineapple yoghurt samples had scores of 3.4, 3.6 and 3.3 for A2 ,B2 and C2 respectively. The product A1 got higher score for flavour because *Lactobacillus bulgaricus* and *Streptococcus thermophilus* imparts good flavour in fermented products. The typical flavour of natural or plain yoghurt is directly associated with the presence of carbonyl compounds, mainly acetaldehyde, in the product. Tamime & Robinson, 1999 and Tamime (1977). Balow et al.(1991) reported that *Lactobacillus bulgaricus* has the ability to contribute flavours and modify taste. Mango has natural taste and smell which was highly liked and preferred by the panelists, when compared to the pineapple essence. *Lactobacillus bulgaricus* has complex nutritional requirements, including the inability to ferment any sugar except lactose, from which it produces lactic acid, which gives tart flavour to yogurt. The C2 received the least score. This could be due to C2 contain pineapple essence and a blend of *Lactobacillus bulgaricus*, *Streptococcus thermophilus*, *Lactobacillus acidophilus*, *Bifido bifidum*, *Bifido longum* and *Bifido infantis* as a starter culture which decrease the taste due to production of more acetic acid by Bifidobacteria. Mahdi et al. (1990) and Torre et al. (2003) reported that *Bifidobacterium* spp., when present in high number, produce a noticeable amount of

acetic acid during long fermentation time and decrease the flavour. Similar results were reported by Osundahunsi et al. (2007) who also reported significant difference in flavour of fruits and artificial flavoured yoghurts .

Mango yoghurt samples had an acidity score of 3.7, 3.8 and 3.8 for A1 ,B1 and C1 and pineapple yoghurt samples had slightly lower scores i.e., 3.3, 3.2 and 3.6 for A2 ,B2 and C2 respectively.

The mouthfeel scores of mango yoghurt samples were 3.7, 3.7 and 4.0 for A1 ,B1 and C1 respectively and pineapple yoghurt samples had slightly higher scores of 4.1, 3.9 and 3.9 for A2 ,B2 and C2 .The mouthfeel of pineapple yoghurt A2 was the highest . This may be due to the probiotic *Streptococcus thermophilus*, which produces pyruvic and formic acid and *Lactobacillus bulgaricus* which produces peptides and aminoacids. This might enhance the taste and aroma of yoghurt and increase the mouthfeel intensity as stated by Awad et al.2005. The physiology of *S. thermophilus* is, polysaccharide production, and flavour generation which might imparts good mouthfeel in yoghurt as reported by Almiron et al. (2000). Another reason could be that the pineapple essence is being volatile could have retained in the mouth for longer time .

Mango yoghurt samples had an overall acceptability score of 4.0, 4.2 and 3.9 for A1, B1 and C1 respectively and pineapple yoghurts had scores of 3.9, 3.8 and 3.7 for A2, B2 and C2 respectively (shown in table 2). Mean scores of Mango and Pineapple yoghurts were significantly different from each other only in one sensory attribute i.e., flavour ($P < 0.001$), but not in other quality

attributes i.e., aroma, appearance, texture, acidity, mouthfeel and overall acceptability. In terms of overall acceptability, the mango yoghurt B1 was highly preferred, among the 3 mango yoghurts where the starter culture used was a combination of *Lactobacillus bulgaricus*, *Streptococcus thermophilus* and *Lactobacillus sporogenes*. This could be due to *Lactobacillus sporogenes* have nice flavour in comparison to other probiotics and with mango it enhanced the acceptability of yoghurt. Anderson (1984) reported that *Lactobacillus sporogenes* are facultative anaerobes which produce acids but no gas from fermentation of maltose, mannitol, raffinose, sucrose and trehalose, which favour, taste and aroma and increase acceptability of products. Pineapple yoghurt C2 received the lowest mean scores for overall acceptability. This could be due to C2 contain six different types of probiotics in which *Bifidobacteria* spp. produce more acid which may decrease the acceptability. *Bifidobacteria* spp. when present in high number, produce a noticeable amount of acetic acid during long fermentation time as reported by Mahdi et al.(1990) and Torre et al.(2003) whilst *Lb. acidophilus* will produce acetaldehyde and lactic acid, and contribute to the characteristic 'bio' yoghurt flavour (Rasic & Kumann, 1983).

4.1.2. SENSORY EVALUATION OF YOGHURT AT DIFFERENT PERIODS OF STORAGE.

During storage, the aroma, appearance, texture, flavour, acidity, mouthfeel and overall acceptability scores decreased in all yoghurts during 0, 7th, 14th, 21st and 30th day respectively (shown in Figure 1, 2, 3, 4 and 5). The different storage period of

yoghurts are significantly affected the scores for all attributes. The scores for aroma, appearance, flavor and overall acceptability were not significantly different from 0 day to 7th day after that significant difference were found, whereas in texture, acidity, and mouthfeel scores were significantly different ($P < 0.05$) from 0 day to 7th day in all yoghurts

CONCLUSION

The demand for fruit flavoured yoghurts is increasing in the recent years. Hence there is a great scope to develop & popularize fruit yoghurts in India. The yoghurts developed were subjected to sensory evaluation. The organoleptic qualities i.e., aroma, appearance, texture, flavor, acidity, mouthfeel and overall acceptability were assessed by a panel of experts using five point hedonic scale scoring system. The sensory evaluation was carried out using structured schedule at 0, 7th, 14th, 21st day 30th day of storage. The overall acceptability of all the yoghurt samples was found to be good. However, the mango yoghurts obtained slightly higher scores than the pineapple yoghurts. Mango yoghurt samples had an overall acceptability score of 4.0, 4.2 and 3.9 for A1, B1 and C1 respectively and pineapple yoghurts had scores of 3.9, 3.8 and 3.7 for A2, B2 and C2 respectively. Mean scores of Mango and Pineapple yoghurts were significantly different from each other only in one sensory attribute i.e., flavor ($P < 0.001$), but not in other quality attributes.

In terms of overall acceptability, the mango yoghurt B1 was highly preferred, among the six yoghurts developed, where the starter culture used was a combination of *Lactobacillus bulgaricus*, *Streptococcus*

thermophilus and *Lactobacillus sporogenes*. This could be due to *Lactobacillus sporogenes*, which imparts good flavor, in comparison to other probiotics. Addition of mango pulp might have also enhanced the acceptability of yoghurt. Out of the three Pineapple yoghurts, A2 (*Lactobacillus bulgaricus* & *Streptococcus thermophilus*) had higher acceptability. *Lactobacillus bulgaricus* has complex nutritional requirements, including the inability to ferment any sugar except lactose, from which it produces lactic acid, which gives tart flavor to yogurt.

During storage day by day there was significant decrease in all the sensory attribute scores. The results indicated that yoghurt with mango pulp could be stored upto 7th day and upto 14th in case of pineapple yoghurts without loss of sensory characteristics at refrigerated temperature of 4°C. From 7th day to 14th day and 14th day to 21 day, significant differences were observed in all yoghurts.

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Flowchart1 : The two different flavoured yoghurt i.e., mango and pineapple was prepared by using standard technique

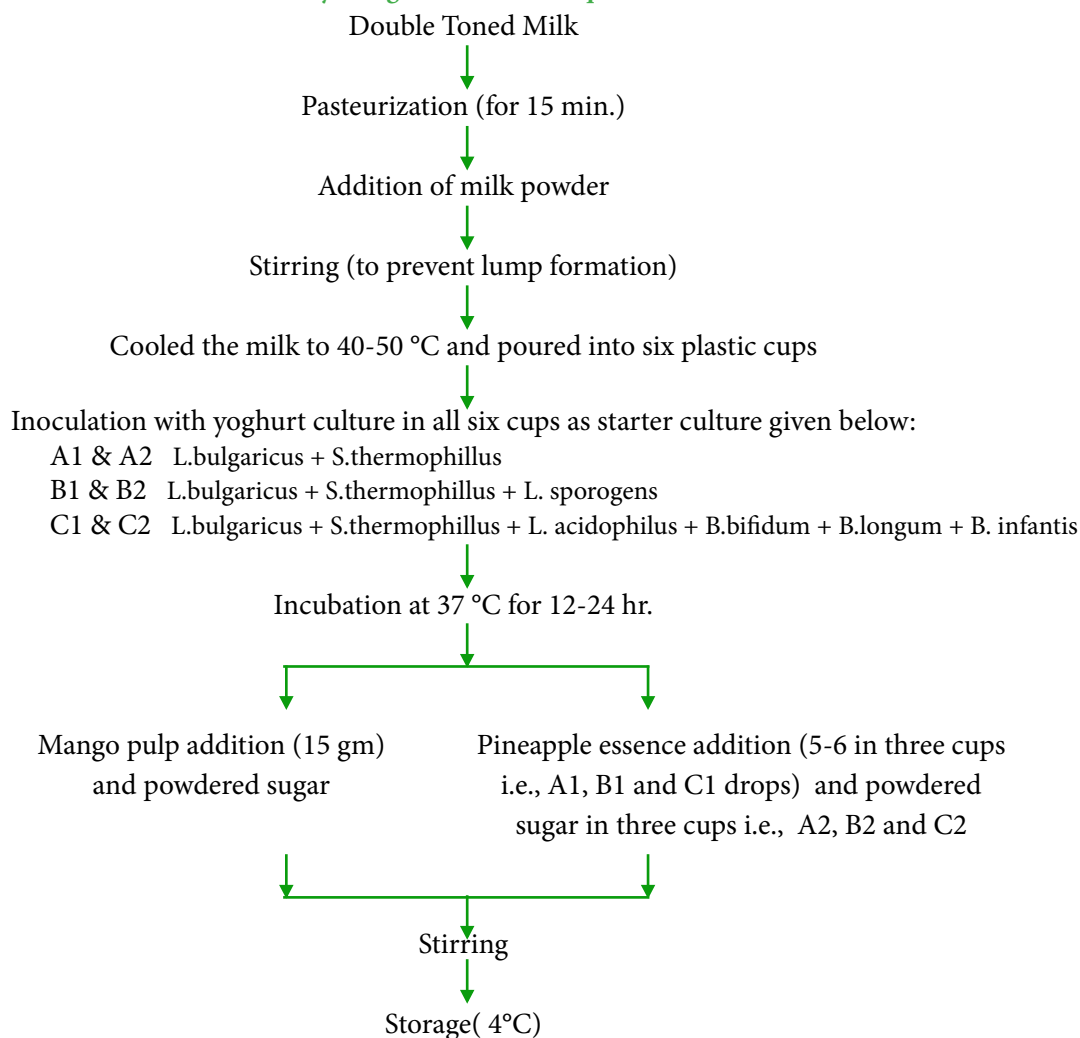


Table 1: Sensory attribute scores of mango and pineapple yoghurts on the day of preparation (Mean ± S.E.).

Attributes	A1	B1	C1	A2	B2	C2
Aroma	4.30 ±0.21 _a	4.30 ±0.21 _a	4.20 ±0.20 _a	4.30 ± 0.21 _a	4.30±0.21 _a	4.20 ±0.20 _a
Appearance	3.70 ±0.21 _a	4.00 ± 0.25 _a	3.80± 0.24 _a	4.20 ±0.24 _a	3.60 ±0.84 _a	3.80± 0.20 _a
Texture	3.40 ±0.16 _a	3.90 ± 0.18 _a	3.60± 0.16 _a	3.90 ± 0.18 _a	3.90± 0.18 _a	3.90± 0.23 _a
Flavour	4.70 ±0.15 _a	4.50 ± 0.22 _a	4.20 ± 0.13 _a	3.40 ±0.30 _a	3.60 ±0.26 _a	3.30±0.26 _a
Acidity	3.70 ± 0.15 _a	3.80 ± 0.20 _a	3.80 ± 0.20 _a	3.30 ±0.36 _a	3.20 ±0.29 _a	3.60± 0.22 _a
Mouthfeel	3.70 ± 0.21 _a	3.70 ± 0.21 _a	4.00 ± 0.25 _a	4.10 ±0.23 _a	3.90 ±0.27 _a	3.90± 0.34 _a
Overall acceptability	4.00 ± 0.14 _a	4.20 ± 0.20 _a	3.90± 0.23 _a	3.90 ±0.73 _a	3.80 ±0.78 _a	3.70± 0.82 _a

Means with same subscripts in rows are not significantly different.

Table 2: Overall acceptability scores of yoghurts at different periods of storage (Mean \pm S.E.).

Flavours	Products	0 d	7 d	14 d	21 d	30 d
Mango	A1	4.00 \pm 0.47a	4.30 \pm 0.48 a	3.30 \pm 0.48b	1.70 \pm 0.48c	Unacce- -ptable
	B1	4.20 \pm 0.63a	3.70 \pm 0.52 ab	3.20 \pm 0.63 b	1.50 \pm 0.52 c	
	C1	3.90 \pm 0.73 a	3.30 \pm 0.42 a-	2.50 \pm 0.52 b	1.30 \pm 0.48 b	
Pineapple	A2	3.90 \pm 0.73 a	3.50 \pm 0.52 ab	3.00 \pm 0.66 b	1.70 \pm 0.48 c	
	B2	3.80 \pm 0.78 a	3.40 \pm 0.51 ab	2.80 \pm 0.83 b	1.50 \pm 0.52 c	
	C2	3.70 \pm 0.82 a	3.40 \pm 0.48 a	2.50 \pm 0.52 b	1.30 \pm 0.48 b	

Means with different subscripts in rows are significantly different $P < 0.05$.

Figure1: The sensory evaluation of all yoghurts on the day of preparation

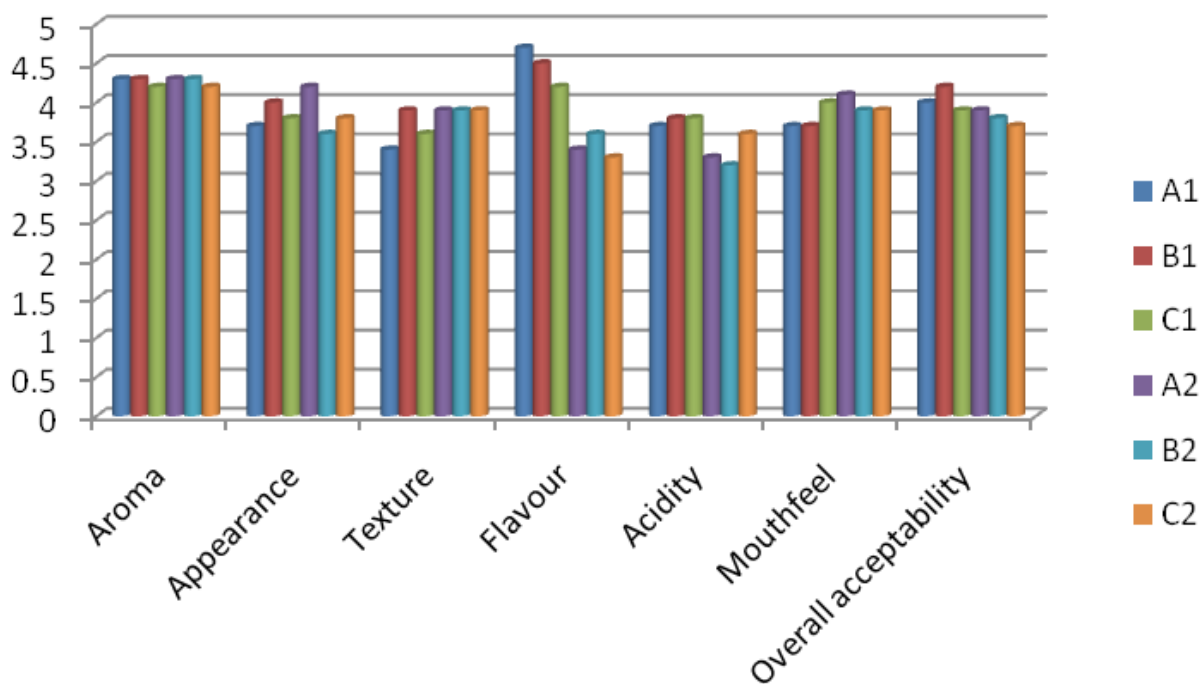


Figure 2: The sensory evaluation of all yoghurts on the 7th day of preparation

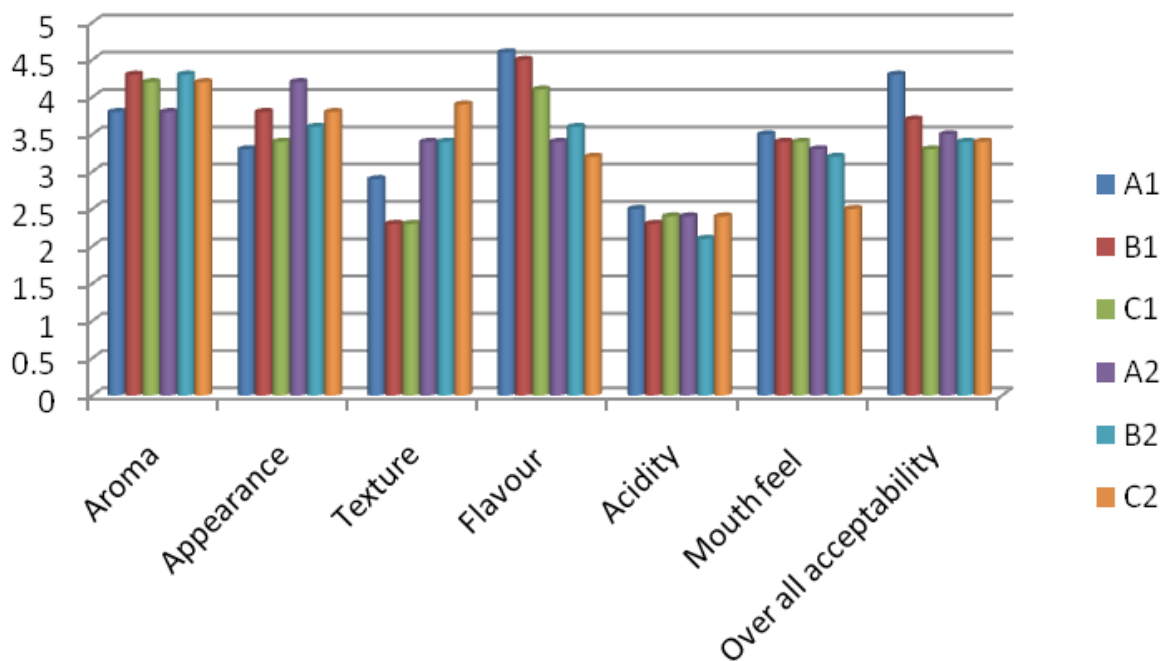


Figure 3: The sensory evaluation of all yoghurts on the 14th day of preparation

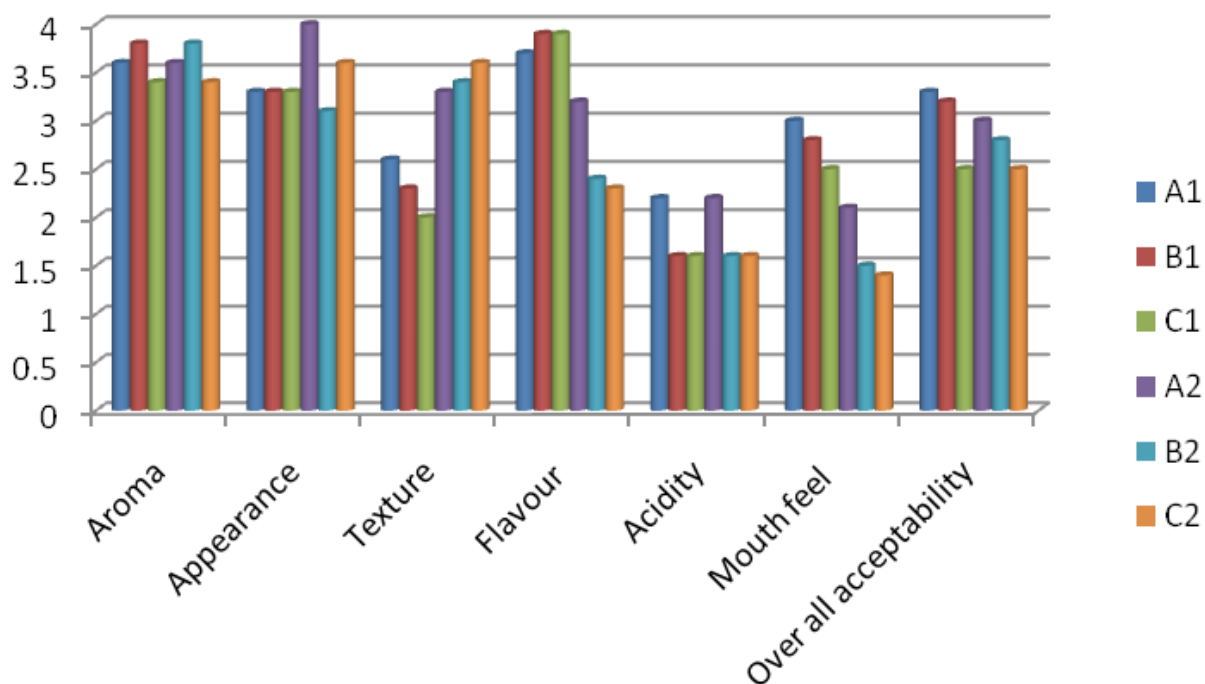


Figure 4: The sensory evaluation of all yoghurts on the 21st day of preparation

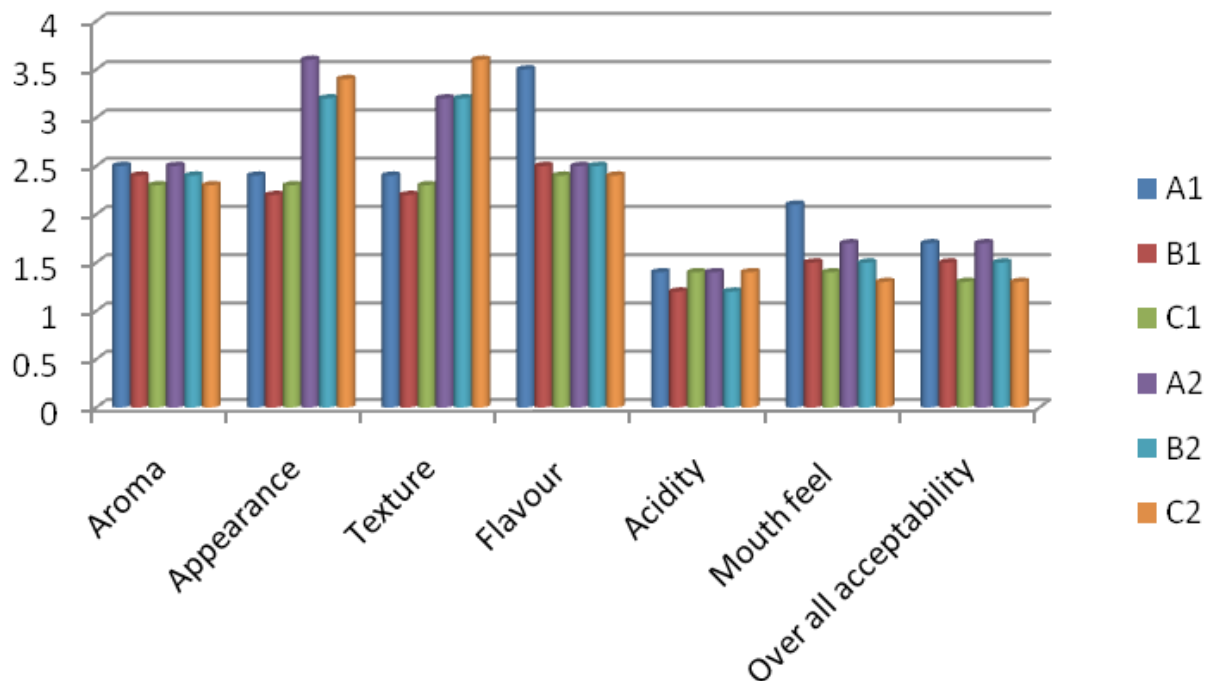


Figure 5: The sensory evaluation of all yoghurts on the 30th day of preparation

