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Effect of Stabilizer on Sensory Characteristics and Microbial Analysis of Low-fat Frozen Yoghurt Incoporated with Carrot Pulp

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Abstract

Frozen yoghurt has been the fastest growing product in the frozen dessert market in recent years. Consumer's interest in frozen yoghurt stems from the desirable nutritional properties attributed to the product. Yoghurt contains substantial amounts of live lactic acid bacteria and the beneficial effects of yoghurt are postulated to be due to its probiotic contents. The present study was carried out with different levels (2%, 3%, 4% and 5%) of carrot pulp. Frozen yoghurt mix was standardisation to 12 % sugar, 12 % SNF, @ 2% culture, Fat (1.5%) and Stabilizer (0.3%, 0.4% and 0.5%) adjusted to 26% total solids for frozen yoghurt. The low fat frozen yoghurt samples of different treatments were analyzed for organoleptic characteristics (flavour & taste, body & texture, Colour & appearance and overall acceptability), nutritional characteristics (acidity and pH) and microbial analysis (yeast and mould & coliform test). The data obtained on various parameters were statistically analyzed. Based on the results, it was concluded that the low fat frozen flavoured yoghurt with 3% carrot pulp, 0.5% Stabilizer (T_3S_3) and 4% carrot pulp, 0.5% Stabilizer (T_4S_3) are high as comparable with other treatments in the organoleptic characteristics (Flavour & taste, Body & texture, Colour & appearance and Overall acceptability) and nutritional characteristics (acidity, pH). The average value of yeast and mould count of different treatment of yoghurt was not more than 10/g. It means that all yoghurt samples were very good in quality. There was no contamination in different

treatments. This was possible due to strict sanitary conditions followed during each step of manufacture and use of sterilized equipments for this purpose.

Keywords: Yoghurt, frozen yoghurt, sensory quality, carrot pulp, microbial quality.

1. Introduction

The nutritional and potentially therapeutic value of food is a key characteristic in the development of new value–added products manufactured for health conscious consumers **(Garcia *et al.* 1998).** Yoghurt is one of the most popular fermented milk products worldwide and has gained widespread consumer acceptance as a healthy food **(Mckinley 2005).** Frozen yoghurt has been the fastest growing product in the frozen dessert market in recent years **(Opdahl and Baer, 1991, Guinard *et al.*, 1994).** Yoghurt is more nutritious than several other fermented milks because of its higher milk solids content. Yoghurt is valued for its therapeutic value being known to have antibiotic and curative properties. Yogurt is also useful for controlling the growth of harmful bacteria and in curing intestinal disease like constipation, diarrhoea, dysentery **(Shahani and Chandan, 1979).** Anticarcinogenic effect of yoghurt has been demonstrated by **Ayebo and Sahani, (1980).**

Yoghurt is coagulated milk product obtained by lactic acid fermentation through the action of *Lactobacillus Bulgaricus* and *Streptococcuc Thermophillus,* form milk and milk products (pasteurized or concentrated milk) with or without optional additions (milk powder, skim milk powder, whey powder etc.). The micro organisms in the final products must be viable and abundant (**F.A.O/W.H.O, 1977).**

Carrot (Dascus carota L.) is rich in Vitamin A, B_1, B_2, C, E, Folic acid, beta carotene, carbohydrate, calcium, phosphorous, iron, potassium, magnesium, copper, manganese and sulphur, besides having potent antioxidant property , but lacks in protein and fat. Thus, carrot juice was found to be suitable for incorporation in the production of nutritionally rich yoghurt food. This study aimed at development and Optimization of low fat frozen flavoured yogurt and to evaluate the organoleptic and microbial characteristics of low fat frozen flavoured yogurt.

2. Materials and Methods

The experimental work was carried out in the research laboratory of Warner School of Food and Dairy Technology, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad.

3. Raw Materials

Milk: Milk was procured from Students Training Dairy, Sam Higgionbottom Institute of Agriculture, Technology and Sciences, Allahabad. Skimmed milk powder was purchased from the local market of Allahabad.

Culture: Freeze dried culture of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* were obtained from the Dairy Microbiology Division of N.D.R.I Karnal (Haryana).

Other materials: Fresh carrot and sugar were purchased from the local market of Allahabad. Plastic cups of 100ml capacity also purchased from the local market of Allahabad. Stabilizer (Sodium alginate) was obtained from dairy technology.

Culture propagation

Mixed Culture: Mixed culture of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* were propagated in sterile skim milk test tubes by inoculation and incubation at 37^0C.After incubation the culture were stored at 50^0C.

Bulk culture: Bulk culture was routinely propagated in sterile skimmed milk for this purpose 2% of the active culture was introduced into skimmed milk and incubated at 37^0C. After setting the culture were transferred and stored at 5^0C until further use.

4. Analysis of Milk

Determination of milk Fat: Fat percentage of milk was determined by Gerber method as per procedure given in ISI: 1224 part I (1977).

Determination of Solid Not Fat: The SNF content of milk was determined by Richmond's formula as per the procedure laid down by Indian Standard: 2311(1973) Hand Book of Food Analysis.

5. Standardization of Milk

SNF: Milk SNF 12%was standardized by using skimmed milk powder.

6. Preparation of Carrot Pulp

Carrots were washed with warm water after removing top, bottom and surface layers to avoid surface contamination and blanched in hot water for 5 min to inactivate pectinase and peroxidise enzymes and also to tenderize it. Carrot was blended by using a food processor for carrot pulp (INALSA, INDIA) and evaluated for total solids (AOAC, 1990) and titratable acidity (Ranganna, 1979). The pH of the samples was measured by using digital pH meter (Century Digital pH meter, India). The carrot juice had 6.82% total solids, 2.67 (% of citric acid) titratable acidity and a pH of 5.79.

7. Preparation of Low-fat Frozen Yoghurt (LFFY)

Mix was prepared by using skim milk with standardization of fat 1.5% and 12% milk solid not fat. With the addition of 12% sweetening agent and 0.3% (S_1), 0.4% (S_2) and 0.5% (F_3) stabilizer in different concentration. The mix was standardized to a total solid content of up to 12% by addition of skim milk powder. The mix was homogenized and then pasteurized and cooled to 42°C. Yogurt starter culture was added at the rate of 2% and carrot pulp was added in 2% (T_1), 3% (T_2), 4% (T_3) and 5% (T_4) concentration. The mix was incubated at 42°C till we achieve an acidity of 0.45%. The mix was aged at 5°C and frozen in a batch freezer to overrun of 70%.

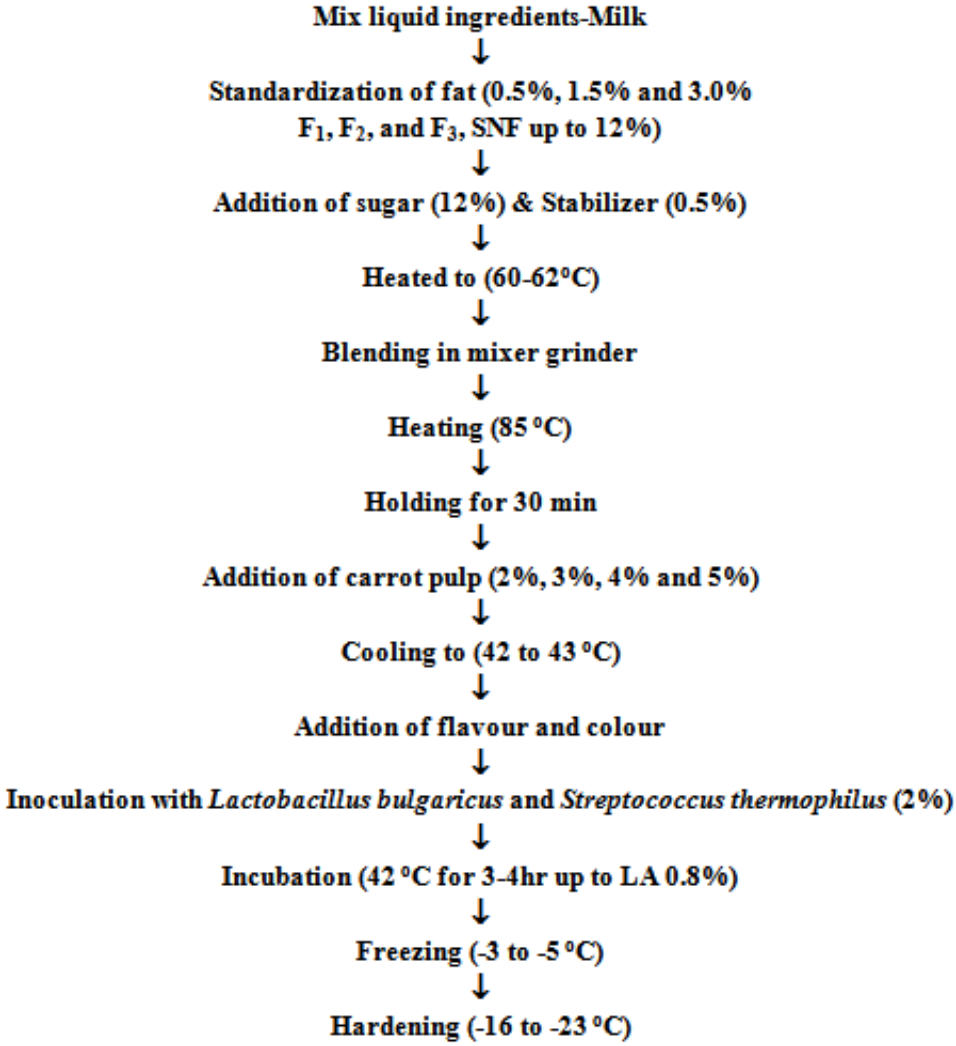

Fig. 1: Flow diagram for the preparation of Low-fat frozen yoghurt incorporated with carrot pulp.

8. Treatments

8.1 Carrot Pulp –

T_1: Addition of 2 percent of carrot pulp
T_2: Addition of 3 percent of carrot pulp
T_3: Addition of 4 percent of carrot pulp
T_4: Addition of 5 percent of carrot pulp

8.2 Stabilizer –

S_1: 0.5 percent Stabilizer
S_2: 1.5 percent Stabilizer
S_3: 3.0 percent Stabilizer

9. Microbial Analysis

Yeast and mould count: Yeast and mould count in yoghurt were determined as per the procedure laid down in IS: 1479 (Part-III), 1962 and Manual in Dairy Bacteriology, I.C.A.R publication.

Presumptive coliform test: The presumption coliform test was determined as per the procedure laid in IS: 1479, (Part-III), 1962 and Manual in Dairy Bacteriology I.C.A.R publication.

10.Nutritional Analysis of Prepared Yoghurt

Titartable acidity and pH of the samples were determined as per BIS (1989). The pH of samples was determined by using a digital pH meter.

11.Sensory Evaluation

The yoghurt sample was evaluated for the sensory attributes of colour and appearance, body and texture, flavour and over all acceptability by a panel of 5 judges selected from the Halina School of Home Science and Warner School of Food and Dairy Technology. 9 point Hedonic Scale score card was used for the purpose.(Srilaksmi, 2003)

12.Statistical Analysis

The data obtained for different parameters was analysed statistically using Factorial randomized block design (ANOVA) and critical difference technique with three replications. **(Imran and Coover, 1983)**

13.Results and Discussion

Table 1: Yeast and mould count of stabilizer and carrot juice incorporated in low fat frozen yoghurt.

a) Yeast and mould					
Level of Stabilizer	**Level of Carrot pulp**				
	T_1	**T_2**	**T_3**	**T_4**	**Mean**
S_1	11	8	7	9	8.75
S_2	12	9	12	11	11
S_3	14	10	12	8	11.75
Mean	12.33	9	11	9.33	10.41
$CD_{0.05}$ Carrot pulp : 0.84 : S, Stabilizer : 0.73 : S					

Yeast and mould count: PDA medium contained chloramphenichole is specified for yeast and mould. The results of current trial are shown in Table 1, and it is clear that the initial counts of 8/g (T_4S_3) which is often quoted as the "therapeutic minimum". The average value of yeast and mould count for different levels of stabilizer and carrot pulp were differed significantly. According to PFA (2004) the acceptable value of yeast and mould count in yoghurt and dahi should not be more than 100/g.

Yeast and mould count indicates contamination with these organisms; partially with fruit yoghurt yeast and mould problems are likely to arise (Kroger, 1976). Yeast and mould count can also come from the environment where proper air control system is not in place. The results indicated that proper care was taken to avoid contamination throughout the process and there was no post processing contamination. According to the Turkish Standards Institute (TS 1330), 1989 yoghurt standards a maximum of 100cfu/g of mould is allowed in yoghurt. Salji *et al.* 1987 found that initial count of yeast and mould 1 cfu/ml which increased to 3×10^3 cfu/ml at 10 days of storage.

13.1 Coliform count in Low-fat frozen yoghurt incorporated with carrot pulp

All the treatments were subjected to coliform test and it is found to be negative coliform test. This indicated that the yoghurt treatments were free from gas producing organisms. This was possible due to strict due to sanitary condition observed between during each step of manufacture.

According to PFA (2004) the acceptable value of coliform count in yoghurt and dahi should not be more than 10/g. Contamination with the coliform organism is a common problem is the industry and they are completely undesirable in any products. These organisms are killed during pasteurization and if they are present in the product they are the result of post pasteurization contamination (Kroger, 1976). The absence of coliform organism indicates that proper care was taken during processing to avoid post processing contamination and product is of food quality.

Table 2: Effect of nutritional analysis of stabilizer and carrot juice incorporated in low fat frozen yoghurt.

b) Titartable Acidity					
Level of Stabilizer	**Level of Carrot pulp**				
	T_1	**T_2**	**T_3**	**T_4**	**Mean**
S_1	0.16	0.12	0.16	0.15	0.147
S_2	0.13	0.17	0.16	0.18	0.16
S_3	0.11	0.15	0.19	0.17	0.15
Mean	0.13	0.14	0.17	0.16	0.15
$CD_{0.05}$ Carrot pulp : 0.0034 : S, Stabilizer : NS					

Titartable Acidity and pH: Titartable acidity of (T_3S_3) was observed to be 0.19 percent. The finding is in accordance with the minimum level of 0.11 percent. According to ISI (1974), the maximum lactic acid acidity should be 0.8 percent. The significant difference in acidity (0.11-0.19 % L.A) due to addition of carrot pulp. Titratable acidity found increased and pH decreased with increased levels of carrot pulp is mainly due to sugar fermentation and conversion of lactose to lactic acid. Similar findings were reported O'Neil *et al.*1979; Tamine and Robinson, 1985; Shin *et al.* 1991 and Salwa *et al.* 2001 for yoghurt.

Table 3: Influence of stabilizer and Carrot pulp on organoleptic quality of yoghurt.

a) General appearance					
Level of Stabilizer	**Level of Carrot pulp**				
	T_1	**T_2**	**T_3**	**T_4**	**Mean**
S_1	6.4	6.7	7.2	7.2	6.87
S_2	6.6	7.4	7.9	7.6	7.37
S_3	7.0	7.8	8.6	8.6	8.0
Mean	6.66	7.3	7.9	7.8	7.4
$CD_{0.05}$ Carrot pulp : 0.137 : S, Stabilizer : 0.119 :S					
b) Flavour					
Level of Stabilizer	**Level of Carrot pulp**				
	T_1	T_2	T_3	T_4	Mean
S_1	6.7	7.0	7.2	7.2	7.02
S_2	6.7	6.9	7.8	7.6	7.25
S_3	6.9	7.4	8.7	7.5	7.62
Mean	6.76	7.1	7.9	7.43	7.29
$CD_{0.05}$ Carrot pulp : 0.143 :S, Stabilizer :0.124 :S					

c) Body and texture					
Level of Stabilizer	**Level of Carrot pulp**				
	T_1	T_2	T_3	T_4	Mean
S_1	6.3	6.2	6.5	6.3	6.32
S_2	6.7	6.6	6.8	7.4	6.87
S_3	7.8	7.5	8.2	8.1	7.9
Mean	6.93	6.76	7.16	7.03	7.22
$CD_{0.05}$ Carrot pulp : 0.15 :S, Stabilizer : 0.13 :S					
d) Overall acceptability					
Level of Stabilizer	**Level of Carrot pulp**				
	T_1	**T_2**	**T_3**	**T_4**	**Mean**
S_1	6.45	6.63	6.96	6.9	6.73
S_2	6.66	6.8	7.66	7.53	7.16
S_3	7.33	7.63	8.57	8.56	8.02
Mean	6.81	7.02	7.73	7.66	7.30
$CD_{0.05}$ Carrot pulp : 0.34 :S, Stabilizer : NS					

General appearance: Good quality yoghurt was a gel like coagulation and porcelain like surface without wheying off. It has natural milk colour and fresh appearance (Ranganadham and Gupta 1987). The frozen yoghurt T_3S_3 recorded highest mean score of 8.6 for general appearance. There was significant variation due to stabilizer and carrot pulp on the general appearance of yoghurt (Table 3).

Flavour: Good quality yoghurt has pleasant milky to slight sour taste with natural yoghurt flavour. Variation in the score for flavour due to different treatments was found to be significant. The data regarding average score for stabilizer and carrot pulp was T_3S_3 (8.7) indicating that flavour of all the samples was good irrespective to treatments (Table 3). The characteristics flavour of yoghurt is due to production of lactic acid, acetaldehyde and other carbonyl compounds during fermentation of lactose by yoghurt culture (Pette and lolkeme, 1950). In another study no "acidic yoghurt taste" was observed in yoghurt ice cream (Caisip and Resubel 2001).

Body & texture: Good quality plain yoghurt should have custard like body with a smooth texture. Variation in the score for body and texture due to different treatments was found to be significant. The average score for carrot pulp and stabilizer level was 8.2 (T_3S_3) indicating that body and texture of all samples was good irrespective of the treatments. Chawla and Balachandran (1994) stated that incorporation of SNF in milk contribute to refinement in taste of yoghurt with improved consistency, viscosity and reduced whey separation.

Stabilizer levels had significant effect on body and texture of yoghurt. The highest score of 8.2 was recorded for 0.5 percent level of stabilizer indicating that the frozen yoghurt at 0.5 percent stabilizer was the best quality product with firm body and smooth texture.

Overall acceptability: The overall acceptability of yoghurt was determined on the basis of the average of the total score obtained for different sensory attributes viz. General appearance, flavour and body and texture.

From the average figures of overall acceptability in Table 2, it is seen that highest overall acceptability score was recorded for yoghurt with 4 percent of carrot pulp and 0.5 percent of stabilizer 8.5 (T_3S_3). The critical examination of data indicates that from all the carrot pulp levels are highly significant.

It is concluded that the low-fat frozen yoghurt containing 0.5% stabilizer and 4% carrot pulp (T_3S_3) was high as comparable with other treatments in organoleptic and nutritional characteristics. T_3S_3 showed significant difference in organoleptic characteristics (flavour and taste, body and texture, colour and appearance & overall acceptability) and nutritional characteristics (pH and acidity), When the highest amount of stabilizer and carrot pulp were added. The low coliform and yeast and mould count indicated that there was no post processing contamination and this probiotic product could be manufactured without having contamination problems and can be stored at room temperature for extended period of time. The quality of sample T_3S_3 (0.5% stabilizer and 4% carrot pulp) is very well comparable to that of the other treatments.

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