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DEVELOPMENT OF PASTEURIZED BANANA MILK-BASED BEVERAGES USING COW AND BUFFALO MILK

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By using cow and buffalo milks 24 different formulations of banana milk beverages were prepared. The amount of banana pulp and stabilizers was varied, beverages were pasteurized at 80°, bottled, and cold stored at 4-8°. After preliminary sensory evaluation, the first-higher eight formulations were again manufactured for further study, and to determine shelf life under cold storage conditions. On comparison, it was found that buffalo milk based beverages were liked more by the people of Pakistan. The reason seemed to be the palate and taste of the people of the subcontinent for the buffalo milk rather than the cow milk. For manufacturing such beverages, Grindsted's Mexpectin RS-450 as well as Grindsted's Gelodan S.M. can be used @ 0.15 or 0.20% but more viscous beverages secured higher scores, and Mexpectin had an edge over the Gelodan. Due to the use of potassium sorbate in the formulations and cold storage, the bottled beverages gave shelf life of one month.

Key words: Banana milk beverages, Cow and buffalo milk.

Introduction

Banana is liked amongst millions of people all over the world for its organoleptic, nutritive and therapeutic values. Ripe banana is not only essentially a sugary and easily digestible fruit, but it is also one of the most easily assimilated fruits. Over the past thirty years or so it has been widely used as an important element in the nutrition of the people suffering from various intestinal disorders, e.g., the coeliac disease in children [10].

Flavoured milk drinks containing fruits are among the most popular drinks in the Western World, and one of their major uses is their supply as "School-milk". The principal advantage for dairies of supplying school milk is that it gets young people used to drinking milk, which should increase the consumption of milk products in the long run. Henrequiz *et al.* [5] reported about a low cost milk drink, providing a suitable alternative to whole milk particularly for nursing and pregnant mothers and infants of 0-2 years.

Milk drinks have been developed by several researchers using different kinds of fruits. Guleria and Jain [3] manufactured fruit milk beverages by mixing apple, banana and orange juice with buffalo's and cow's milk. Similarly, Nguen and Taduler [7] prepared milk drinks with banana or pawpaw nectar by mixing cow's milk pasteurized at 80° with nectar, fruit juice and pulp, blended with sugar syrup.

The fact that people take milk drinks excessively during summer in Pakistan can be utilized for introducing milk based beverages containing such fruits as are locally found in abundance, e.g., mango, banana and apple. A research was, therefore, undertaken to develop pasteurized banana milk-based beverages. Different formulations were employed by varying milk types, banana pulp content, and stabilizers of various levels. An effort was made in the process to assess whether, organoleptically and otherwise, the products prepared by using buffalo milk or cow milk yielded a superior quality of drink or not. An attempt was also made to determine the shelf life of pasteurized banana milk beverages under cold storage conditions.

Materials and Methods

Banana fruit and other ingredients were purchased from the local market, and the study was conducted in the Fruits and Vegetables Laboratory, Department of Food Technology, University of Agriculture, Faisalabad, during 1988-89. It was divided into two parts. The first part pertained to the manufacture of different quality beverages by varying the levels of banana pulp content, milk types, two stabilizers and their levels (Table 1). The Grindsted's Mexpectin RS-450 and Grindsted's Gelodan S.M. stabilizers were tested at the rate of 0.10, 0.15 and 0.20%. The banana pulp was maintained at 5 and 6% level and both buffalo's and cow's milk was used @ 6%. Other ingredients were added in the following ratio:

(a) Cane-sugar 13.00%, (b) Sodium citrate 0.02%, (c) Potassium sorbate 0.01%, (d) Citric acid 0.20%, (e) Water to make 100%.

For higher colour appeal, food grade green colour manufactured by Standard Manufacturing Company (SMC), Lahore, was added @ 0.02%.

The method of manufacture is shown in Fig. 1. Before addition of citric acid a stability time of 15 mins. was given for the milk proteins to stabilize as it protect milk curdling. For

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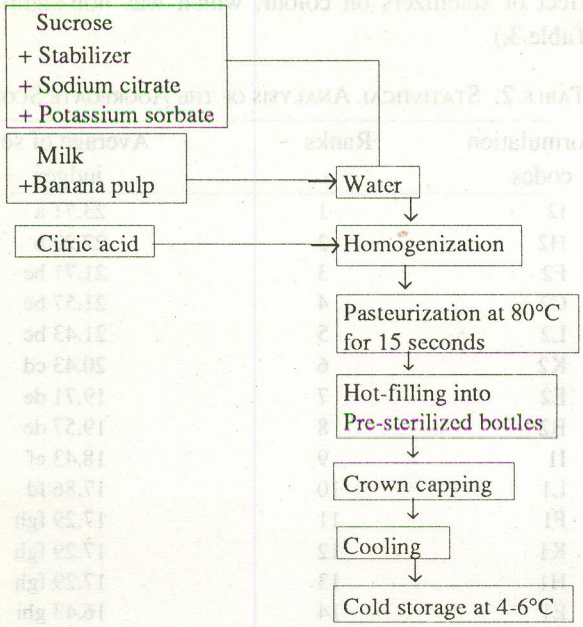

Fig. 1. Scheme of manufacturing the products.

pasteurization, the formulation were heated to 80° in batches and holding time of 15 sec. was given at that temperatures.

Twenty-four formulations were prepared, and after one day's cold storage they were organoleptically evaluated by a sensory panel of seven judges, who used 9-point Hedonic scale as described by Larmond [6] to judge and rank the different formulations. The numerical values were equivalent to:

1 = Dislike extremely, 2 =Dislike very much, 3 = Dislike moderately, 4 = Dislike slightly, 5 = Neither dislike nor like, 6 = Like slightly, 7 = Like moderately, 8 = Like very much and 9 = Like extremely.

Samples of 12 formulations were presented at one sitting to the panel of expert judges. Throughout the study the products were served chilled. The readings were taken on 0, 7, 14, 21 and 28th day's of preparation for colour, taste and flavour attributes. Averages for each parameter were calculated and then these were added for every beverage, and these aggregate scores were used to rank the formulations. All data were subjected to statistical analysis as described by Steel and Torrie [11]. The treatment means were analyzed by using Duncan's New Multiple Range Test (DMRT).

In the second part of the study, the eight high-ranking formulations, from the first part of the study, were prepared once again by using the same methodology. To determine the shelf-life these were cold stored at 4-5° until the panelists declared them unfit for human consumption. The scores were also statistically analyzed by the same methods to assess the best formulation(s).

Results and Discussion

First part of the study. The statistical analysis of the aggregate scores for the 24 formulations prepared in the first part of the study are shown in Table 2. Highly significant differences were observed for the various treatments employed in the preparation. The average scores revealed that

(a) Five in the "like moderately" group, which were I-2, H2, F2, C2 and L2
(b) Four (K2, E2, B2, and I-1) in the "like slightly" group;
(c) Seven (L1, F1, K1, H1, E1, B1, and C1) in the "neither-like-nor-dislike: group;
(d) Two (A2 and D2) in "dislike slightly" group; and
(e) Six treatments (G2, J2, J1, G1, D1, and A1) fell in the "dislike moderately" group.

It is evident from Table 1 that the two top-ranking formulations (I-2 and H2) were manufactured by using buffalo's milk and Mexpectin RS-450 stabilizer. This fact reflected that the panelists liked buffalo milk more than cow milk.

TABLE 1. VARIOUS CONSTITUENTS AND THEIR LEVELS USED IN BANANA FRUIT MILK BEVERAGES.

Formulation Codes	Milk type	Stabilizer's levels (%)	Banana pulp contents (%)
Mexpectin RS-450-stabilized beverages			
A1		0.01	5
A2		0.10	6
B1	Cow	0.15	5
B2		0.15	6
C1		0.20	5
C2		0.20	6
Gelodan-stabilized beverages			
D1		0.10	5
D2		0.10	6
E1	Cow	0.15	5
E2		0.15	6
F1		0.20	5
F2		0.20	6
Mexpectin RS-450-stabilized beverages			
G1		0.10	5
G2		0.10	6
H1	Buffalo	0.15	5
H2		0.15	6
I-1		0.20	5
I-2		0.20	6
Gelodan-stabilized beverages			
J1		0.10	5
J2		0.10	6
K1	Buffalo	0.15	5
K2		0.15	6
L1		0.20	5
L2		0.20	6

The next three formulations (F2, C2 and L2) obtained very close scores, i.e., from 21.71 – 21.43 (Table 2). The treatment which was ranked third (C2) contained cow milk with a combination of Mexpectin RS-450 indicating that amongst 24 formulations the top three contained this stabilizer and hence proved to be the best stabilizer for manufacturing banana milk beverage.

The next four high ranking formulation (L2, K2, E2, and B2), will fall under slightly like group, were manufactured by using Gelodan stabilizer (Table 1) indicating that Grindsted's Gelodan could also be used for this purpose, but Mexpectin RS-450 yielded the best results.

The formulation ranked No. 9(I1) needs special attention, as it was the only one amongst the "like slightly" group formulations, which contained 5% banana pulp, while all others contained 6% banana pulp. Because as it had Mexpectin RS-450, the panelists probably judged it very close to the other better ranking formulations. This fact also supports our first conclusion that Mexpectin RS-450 stabilizer was the best for banana milk beverages.

The remaining formulations prepared by using 0.10% level of either Mexpectin or Gelodan, were completely eliminated by the panelists from their estimation.

It also appeared that 0.15 and 0.20% Mexpectin RS-450 and Gelodan both tended to check coagulation of casein and separation of constituents, thereby giving a better-quality product. Anonymous [2] reported that Grindsted's Mexpectin RS-450 was almost twice as effective against serum separation and sediment formation in drinking Yoghurt as a conventional pectin.

Thus, the conclusions of the first part of the study can be summarized that the formulations having 6% banana pulp with 0.15 or 0.20% stabilizers were the best; that those of 5% banana pulp with 0.15 or 0.20% stabilizer were acceptable, and that the formulations containing 5% pulp with 0.10% stabilizer were unacceptable. The reason for this conclusion was perhaps the fact that the people in Pakistan consider more viscous beverages, containing a liberal quantity of fruit contents, as superior.

Second part of the study. It is interesting to note that out of the 24 formulations, the first eight formulations had a common factor, that all of them contained 6% banana pulp and either 0.15 or 0.20% level of stabilizers. Therefore, these eight high-ranking formulations were again manufactured to study the shelf life when kept at 4-5° by using the sensory attributes of colour, taste, and flavour. The results of the second part of the study are described below.

The statistical analysis of the data revealed that the milk (cow or buffalo) type, levels of stabilizers and storage time had a highly significant effect on the beverages, except for the effect of stabilizers on colour, which was non-significant (Table 3.)

TABLE 2. STATISTICAL ANALYSIS OF THE AGGREGATE SCORES.

Formulation codes	Ranks	Average of seven judges
I2	1	23.71 a
H2	2	22.29 b
F2	3	21.71 bc
C2	4	21.57 bc
L2	5	21.43 bc
K2	6	20.43 cd
E2	7	19.71 de
B2	8	19.57 de
I1	9	18.43 ef
L1	10	17.86 fd
F1	11	17.29 fgh
K1	12	17.29 fgh
H1	13	17.29 fgh
E1	14	16.43 ghi
B1	15	15.86 hi
C1	16	15.71 i
A2	17	12.86 j
D2	18	12.29 jk
G2	19	11.00 kl
J2	20	11.00 kl
J1	21	10.00 lm
G1	22	9.57 lm
D1	23	9.29 m
A1	24	9.14 m

Note: Values followed by similar letters do not differ at P=0.05 percent probability level by DMR test.

TABLE 3. STATISTICAL SIGNIFICANCY OF THE EIGHT TREATMENTS STUDIES IN THE SECOND PART OF THE STUDY.

Source of varience	Colour	Taste	Flavour
Milk types	**	**	**
Stabilizer types	ns	**	**
Stabilizer's levels	**	**	**
Storage time	**	**	**

ns = non significant ** = Significant at P = 0.01%

TABLE 4. STORAGE MEANS FOR COLOUR, TASTE AND FLAVOUR.

Storage time (days)	Colour	Taste	Flavour
0	6.07 b	6.52 b	6.75 b
7	6.32 a	6.91 a	7.02 a
14	5.64 c	6.46 b	6.50 c
21	4.75 d	5.27 c	5.34 d
28	3.61 e	4.00 d	3.84 e

Note. Values followed by similar letters do not differ at P = 0.05 percent probability level by DMR test.

Colour. The panelists gave low scores for colour to the formulations in their first day evaluation, gave the highest scores during 7 days evaluation, and thereafter the scores declined up to the end of the research (Table 4). The reason for the initial low score could possibly be the effect of high processing temperature and protein and lactose contents, as the initial phase of heating causes a slight shift in the colour towards a blusih-green hue, accompanied by an increase in brightness due to deterioration of why proteins and breakdown of casein micelles [9].

TABLE 5. TREATMENT MEANS FOR COLOUR, TASTE AND FLAVOUR ATTRIBUTES.

Treatment codes	Colour	Taste	Flavour
B2	4.77 e	5.54 c	5.66 d
C2	5.63 a	6.00 b	5.83 cd
E2	4.91 de	5.26 d	5.23 e
F2	5.51 ab	5.97 b	6.17 b
H2	5.20 c	6.17 b	6.29 ba
I-2	5.80 a	6.51 a	6.63 a
K2	5.17 cd	5.34 cd	5.40 e
L2	5.26 bc	5.86 b	5.91 c

Note: Values followed by similar letters do not differ at P = 0.05 percent probability level by DMR test.

At the time of the second evaluation, the colour of milk, banana and the added green colour tended to blend up, and it resulted in the maximum scores for the products (Table 4). Afterwards, the degradation of fruit pigments, the added colour, and the advancement in browning probably resulted in the colour degradation.

Taste. In sensory evaluation, after appearance the taste of the product is the second most important factor. Table5 shows that treatments I-2 and H2, manufactured by adding 0.20% and 0.15% Mexpectin RS-450, respectively, in buffalo milk obtained higher scores for taste. Formulations C2, F2 and L2, prepared by adding 0.20% stabilizer, secured close marks ranging from 5.86 - 6.00, the C2 contained Mexpectin in cow's milk. As B2, E2 and K2 formulations secured the lowest scores, these were excluded from consideration.

Guleria and Jain [3], in India, had manufactured pasteurized milk-based beverages containing different fruits with buffalo's and cow's milk and reported that the beverages prepared with buffalo's milk and higher total solids obtained higher organoleptic scores than those made with cow milk. The most cogent reason for this preference seems the palate and taste of the people of the sub-continent for the buffalo milk rather than the cow's milk. The scores for storage interval observed the same pattern as for colour. The decline in the quality during the later period of storage could, perhaps, be attributed to enzymatic or oxidative activity [9], or the browning caused by the oxidation of ascorbic acid [8].

Flavour. The maximum scores were obtained for formulations I-2 and H2, which were made with buffalo's milk containing 0.20 and 0.15% Mexpectin RS-450, respectively. The beverage prepared by adding Gelodan stabilizer in cow's milk (F2) was rated as the next best (Table 5), followed by L2 and C2, while less securing formulations (B2, K2 and F2) were excludeed from consideration. The pattern of scores obtained by different formulations resembled with colour and taste (Table 4).

Hansen *et al.* [4] had reported that flavour improved with storage interval when the samples were stored at 4°. Similarly in this study, the highest scores were obtained on 7th day of evaluation. After the second evaluation the scores started declining, and the panelists declared, on the 28th day of the preparation of the formulations, that they were unfit for human consumption. The reasons for this were the same as for the declining results in the case of colour and taste, i.e., enzymatic, microbial or oxidative activity. Swartzel *et al.* [12] reported that a number of investigators had correlated the effects of process-heat treatment and storage temperatures with the rate of browning and onset of flavour deterioration.

Hence, it was inferred that the shelf life of bottled pasteurized banana fruit milk, if kept under refrigerated conditions, could be one month. Al-Haq [1] reported that the shelf life of pasteurized mango fruit-flavoured milk-based drinks was 49 days, when kept refrigerated at 4-8°. This better shelf life was secured by manufacturing the product on a milk plant, where, after pasteurization it was homogenized at 2000 psi pressure and then packed in aluminium-foil-coated brick packs. The literature available on the subject also supports this finding, as it is known that both homogenization and use of aluminium foil increase the shelf life of milk products.

Conclusion

1. Buffalo milk is more admired by the people of Pakistan than cow milk, and this predilection proved true when banana milk beverages, were manufactured.

2. The more viscous beverages secured higher scores, as the people feel that such beverages contain higher amounts of fruit pulp.

3. Although Grindsted's Mexpectin RS-450 proved to be the best stabilizer for banana milk beverages, Grindsted's Gelodan S.M. could also be used.

4. Both the stabilizers produced acceptable beverages when used @ 0.15% or 0.20%, but those having 0.10% were completely eliminated by the panelists from their liking.

5. As potassium sorbate-a strong antimicrobial agent-

was used in the formulations, it increased the shelf life of the beverages, which could be as long as one month under 4-5° temperature i.e. refrigerated conditions.

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