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DEVELOPMENT OF FRUIT ENRICHED BUTTERMILK BEVERAGE

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ABSTRACT

The investigation was aimed at developing nutritious health beverage by utilising buttermilk along with incorporation of fruit juices such as pineapple and orange juice. Buttermilk was blended with various levels of fruit juices and also along with addition of 10 per cent sugar. The study reveals that blending pineapple juice at 30 per cent and orange juice at 25 per cent resulted in most acceptable beverage. Out of that buttermilk blended with 30 per cent of pineapple juice level was optimised. The most acceptable beverage was stored in glass bottles at 4ºC±1 ºC and it was observed that the beverage prepared as above stored for period of 12 days as revealed by physico chemical and microbiological attribute studies during period of storage.

1. KEYWORDS: Buttermilk, Pineapple and orange juice.

2. INTRODUCTION

Buttermilk obtained during the manufacture of butter is an important by-product. A large quantity of milk produced in India is utilized for conversion into ghee (30%), curd (6%) and butter (10%). It is estimated that 1,50,000 million tonnes of ghee and butter, respectively was produced in India. It is further estimated that 30,708 million tonnes of buttermilk has been produced in the country (Bhushan *et al.*, 2015).

Buttermilk (BM) is an important dairy by product left behind after removal of butter during churning of cream or curd. It has a composition similar to that of skim milk, and is predominantly made up of protein, lactose, and minerals. Buttermilk is a unique product due to its concentration of milk fat globule membrane (MFGM) components (proteins, phospholipids, and sphingolipids) that have been associated with very promising health

properties ranging from anti-viral to anti-cancer. In recognition of the immense therapeutic and nutritional value of BM, it has been mentioned as one of the best amongst various milk products (Anon 2003).

According to Ayurveda, BM is an assortment of three tastes i.e. sweet, sour and astringent. It is a highly acclaimed medicine for diarrhoea, dysentery, chronic-specific and nonspecific colitis, piles and jaundice. It has been used to treat gastrointestinal upsets since time immemorial (Anon 2003). Buttermilk has been reported to exert a hypo-cholesteromic (Pearce 1996) and an anti-carcinogenic effect (Astaire *et al*., 2003).

Increased awareness in health issues leads to increase the consumption of fruit juices and vegetable juice and other natural products as an alternate to the traditional caffeine containing beverages such as tea, coffee or other soft drinks.

Fruit juices are well recognized for their nutritive value, mineral and vitamin content. They are beverages that are consumed for their nutritional value, thirst-quenching properties and stimulating effect or for their medicinal values (Fawole and Osho, 2002).

At present bulk of the beverages are generally synthetic flavoured, that are made available in market. If this could be substituted with fruit juice and dairy by product, results in beneficial contribution to the consumer, dairy industries and beverage manufacturers as well as fruit growers.

With the above considerations the present investigation has been taken up, keeping in view- To optimize blending of buttermilk with fruit/vegetable juice on the quality of buttermilk-based health beverage.

3. MATERIALS AND METHODS

The following materials and ingredients were used in this investigation for the preparation of dairy by product-based beverage. Milk: Fresh cow milk was procured from the Student's Experimental Dairy Plant (SEDP) for the preparation of paneer and the resultant whey was used for the research work. Whey - Panner whey procured obtained from Students Experimental Dairy Plant (SEDP), Dairy Science College, Hebbal, Bengaluru, was used in this investigation. Buttermilk was procured from the Mother Dairy, Yelahanka, Bengaluru. Fruit/ vegetable juice - The fruits (Pineapple and Orange) and vegetables (Tomato and

Carrot) were procured from local market and juice was extracted in an hygienic condition. Sugar - Good quality cane sugar was procured from the local market.

Chemicals

All the chemicals used for chemical analysis were of analytical grade.

Media used for microbiological study

Standard Plate Count Agar (SPCA) was used for enumeration of total count. Whereas Violet Red Bile Agar (VRBA) and Malt Extract Agar (MEA) for enumeration of coli forms and yeast and mold respectively.

METHODS

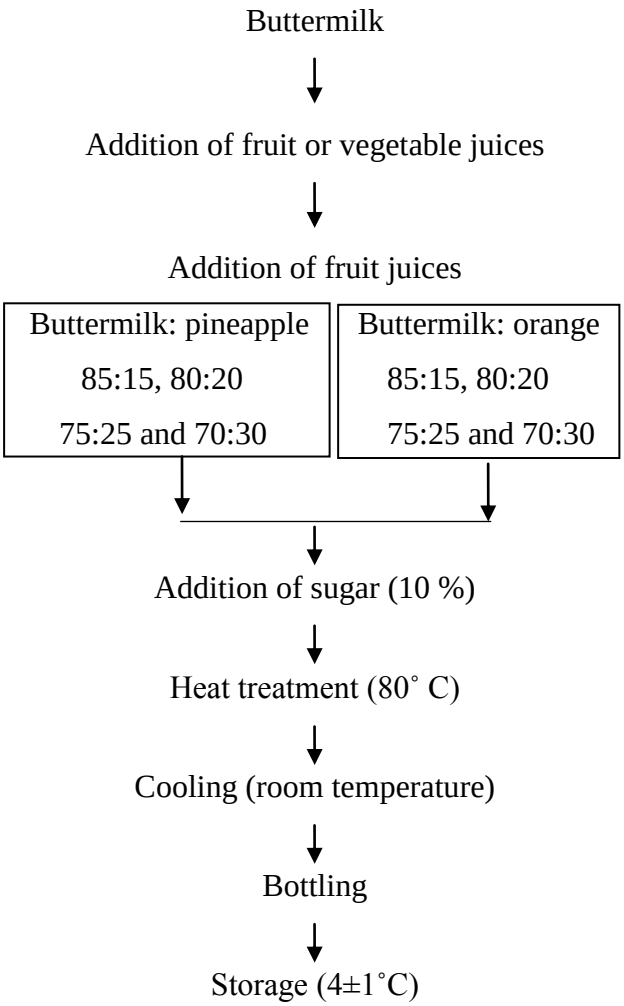
3.1 Preparation of fruit juices

Fresh ripened and matured pineapple of medium size was selected for extraction of juice. The outer skin was removed with the help of a stainless steel knife and the fruit was washed with, clean water and cut into small pieces. The pieces were then grinded in a blender and the juice was extracted. The extracted juice was filtered through a muslin cloth to remove musts and to get clear juice.

Similarly well ripened oranges of good quality were procured from the market for the extraction of juice. The outer skin was peeled off and only inner juicy portion of the fruit was utilized for juice extraction. The juicy portion was placed into blender and the juice was extracted. The extracted juice was filtered through a muslin cloth to remove musts and to get clear juice.

3.2 Process optimization for preparation of beverage with its admixture of buttermilk with fruit juice based beverage.

The optimization of Butter milk based beverage is carried out by blending fruit(Orange, pineapple) and vegetable (carrot, tomato) juices at 15, 20, 25, 30 per cent concentration, followed by addition of sugar (10%), heat treatment, cooling and bottling. The beverage thus prepared were subjected to various physico-chemical and sensory attribute studies to adjudge the optimum level of blending fruit juices/ vegetable juices to butter milk.



Flow chart for Preparation of fruit/vegetable juice buttermilk based beverage.'

4. RESULT AND DISCUSSION

4.1 Effect of blending fruit juices to buttermilk on physico –chemical and sensory characteristics of formulated buttermilk beverage.

In this study, various blends of buttermilk and pineapple and orange juice were tried. The effect of blending pineapple/orange juice on various physico-chemicals and sensory properties of beverage was evaluated and the results are delineated in the following sections:

4.1.1 Effect of blending fruit juices to buttermilk on Physical characteristics of formulated buttermilk beverage.

Pineapple and orange juice was blended with buttermilk at various proportions. The effect of blending fruit juice on pH, acidity, specific gravity and viscosity of the beverage is presented table 1.

With the increasing in the level of blending from 0 to 30 per cent, there was study decrease in pH of both pineapple and orange juice blended buttermilk beverage. The pH of control was 6.86, whereas pineapple juice blended buttermilk beverage was found to be 6.46, 6.42, 6.40 and 6.30 at 15, 20, 25 and 30 per cent blending respectively and whereas for orange juice blended buttermilk beverage the descriptive pH was followed to be 6.48, 6.44, 6.38 and 6.35.With the increase in the incorporation of pineapple or orange juice in buttermilk, there was significant increase in acidity. The acidity of control was 0.12 per cent whereas for pineapple juice blended with buttermilk beverage it was 0.162, 0.165, 0.17 and 0.175 at 15, 20, 25 and 30 per cent blending. The respective acidity for orange juice blended buttermilk beverage was 0.173, 0.179, 0.186 and 0.189 per cent at the same level of blending. It is evident from the results that with increasing level of blending of pineapple/orange juice to buttermilk there was significant increase in specific gravity of blends. The specific gravity of control was 1.035 whereas pineapple juice blended buttermilk beverage recorded specific gravity was 1.041, 1.043, 1.045, and 1.046 at 15, 20, 25 and 30 per cent blending whereas for orange juice blended buttermilk the respective specific gravity was observed to be 1.038, 1.040, 1.041 and 1.042 at the above level of blending.

With increase in the incorporation of pineapple and orange juice to buttermilk, there was significant increase in viscosity. The viscosity of control was 1.80cP whereas pineapple juice blended with buttermilk beverage the viscosity was found to be 1.82, 1.83, 1.84 and 1.85cP at 15, 20, 25 and 30 per cent blending, respectively whereas for orange juice blended buttermilk beverage it was 1.81, 1.82, 1.83, and 1.84cP at the similar level of blending.

4.1.2 Effect of blending fruit juices to buttermilk on chemical composition of formulated buttermilk beverage

The chemical composition of pineapple or orange juice blended formulated buttermilk beverage is presented in table -2.

In the formulated buttermilk beverage the level fat significantly decreased with the increase in the level of pineapple juice and orange juice. At 30 per cent of blending the fat content of pineapple juice blended buttermilk was 0.41 per cent where as for orange juice blended buttermilk beverage it was 0.42 per cent as against the control which had fat content of 0.59 per cent.

Protein content of pineapple juice based beverage was 3.24, 3.08, 2.91 and 2.74 at 15, 20, 25, and 30 per cent blending. The values for orange juice blended buttermilk beverage was 3.33, 3.20, 3.06 and 2.92 per cent at the same level of blending where as protein content in control was 3.73 per cent.

Similarly the ash content in pineapple juice blended buttermilk beverage significantly increased with the increase in the level of pineapple juice and orange juice. The ash content at 30 per cent level was found to be 0.79 and 0.78 per cent respectively for pineapple and orange juice blended buttermilk beverages as against the control (0.75 %).

Table 1: Effect of blending fruit juices to buttermilk on Physical characteristics of formulated buttermilk beverage.

Parameter	Control (100:0)	Proportion of blending								CD (P≤0.05)
		Buttermilk: Pineapple juice				Buttermilk: Orange juice				
		(85:15)	(80:20)	(75:25)	(70:30)	(85:15)	(80:20)	(75:25)	(70:30)	
Acidity %LA	0.12[a]	0.162[b]	0.165[b]	0.17[b]	0.175[b]	0.173[b]	0.179[b]	0.186[b]	0.189[b]	0.024
pH	6.86[a]	6.46[b]	6.42[b]	6.40[b]	6.30[b]	6.48[b]	6.44[b]	6.38[b]	6.35[b]	0.30
Specific gravity	1.035[a]	1.041[b]	1.043[c]	1.045[d]	1.046[d]	1.038[b]	1.040[c]	1.041[c]	1.042[c]	0.001
Viscosity (cP)	1.80[a]	1.82[b]	1.83[b]	1.84[b]	1.85[b]	1.81[b]	1.82[b]	1.83[b]	1.84[b]	0.004

*10% sugar level is maintained for all the samples

**Average of three trials

Total carbohydrate content in control was 14.23 per cent whereas in pineapple juice blended buttermilk beverage it was 15.65, 16.18, 16.64 and 17.12 at 15, 20, 25, and 30 per cent blending. Increase in the blend of pineapple juice from 15 to 30 per cent there was significant increase in the carbohydrate content even in orange juice blended buttermilk beverage with carbohydrate content of 15.10, 15.44, 15.72, 16.01 at the above level of blending respectively.

Total solids content in pineapple juice blended buttermilk beverage was significantly higher with a values of 20.15, 20.51, 20.77 and 21.06 per cent at 15, 20, 25 and 30 per cent blending respectively where as in orange juice blended buttermilk beverages, total solids was recorded to be 19.692, 19.89, 20.00 and 20.13 per cent respectively at the above blending level as against the control which had 19.30 per cent total solids.

4.1.3 Effect of blending fruit juices to buttermilk on sensory characteristics of formulated buttermilk beverage.

Pineapple and orange juice were blended with buttermilk at various proportions. The effect of pineapple and orange juice blending to buttermilk on the sensory characteristics of the beverage is presented in Table 3 and Fig1.

Table 2: Effect of blending fruit juices to buttermilk on Chemical composition of formulated buttermilk beverage.

Parameter (%)	Control (100:0)	Proportion of blending								CD (P≤0.05)
		Buttermilk : Pineapple juice				Buttermilk : Orange juice				
		(85:15)	(80:20)	(75:25)	(70:30)	(85:15)	(80:20)	(75:25)	(70:30)	
Fat	0.59[a]	0.50[b]	0.48[b]	0.44[b]	0.41[b]	0.51[b]	0.49[b]	0.45[b]	0.42[b]	0.043
Protein	3.73[a]	3.24[b]	3.08[b]	2.91[b]	2.74[b]	3.33[b]	3.2[b]	3.06[b]	2.92[b]	0.28
Ash	0.75[a]	0.76[b]	0.77[b]	0.78[b]	0.79[b]	0.752[b]	0.76[c]	0.77[c]	0.78[c]	0.001
Total carbohydrate	14.23[a]	15.65[b]	16.18[c]	16.64[d]	17.12[c]	15.1[b]	15.44[c]	15.72[d]	16.01[c]	0.14
Total solids	19.30[a]	20.15[b]	20.51[c]	20.77[d]	21.06[e]	19.69[b]	19.89[c]	20.0[c]	20.13[d]	0.12

*10% sugar level is maintained for all the samples

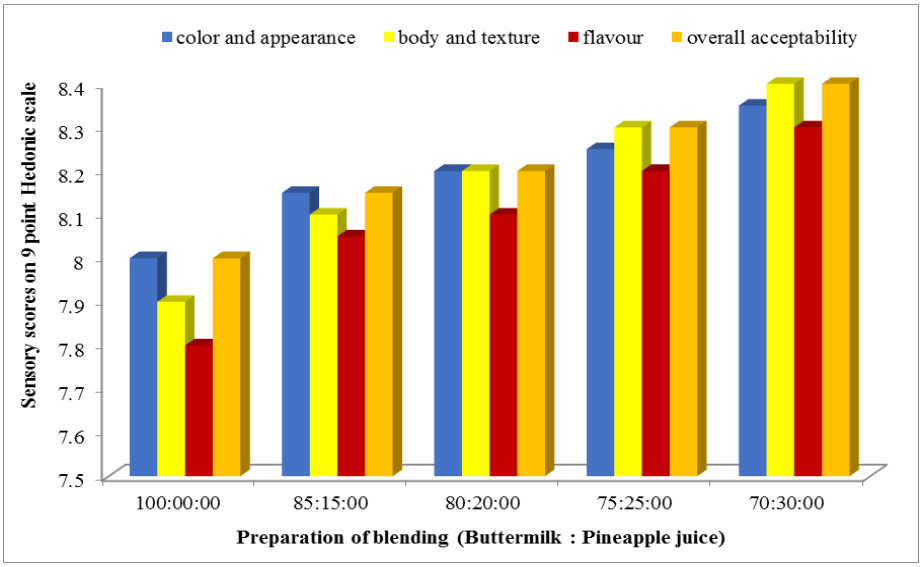
**Average of three trials

Table 3: Effect of blending fruit juices to buttermilk on sensory characteristics of formulated buttermilk beverage.

	Buttermilk: juice	Color and appearance	Body and texture	Flavor	Overall acceptability
Control	100:0	8.00[a]	7.90[a]	7.80[a]	8.00[a]
Buttermilk : Pineapple juice	85:15	8.15[b]	8.10[b]	8.05[b]	8.15[b]
	80:20	8.20[b]	8.20[b]	8.10[b]	8.20[b]
	75:25	8.25[b]	8.30[b]	8.20[b]	8.30[b]
	70:30	8.35[b]	8.40[b]	8.30[b]	**8.40[c]**
Buttermilk: Orange juice	85:15	8.15[b]	8.08[b]	8.07[b]	8.12[b]
	80:20	8.20[b]	8.10[b]	8.10[b]	8.15[b]
	75:25	8.25[b]	8.20[b]	8.15[b]	8.20[b]
	70:30	7.60[c]	7.70[c]	7.67[b]	7.86[c]
CD(P≤0.05)		0.13	0.17	0.11	0.14

*10% sugar level is maintained for all the samples

**Average of three trial



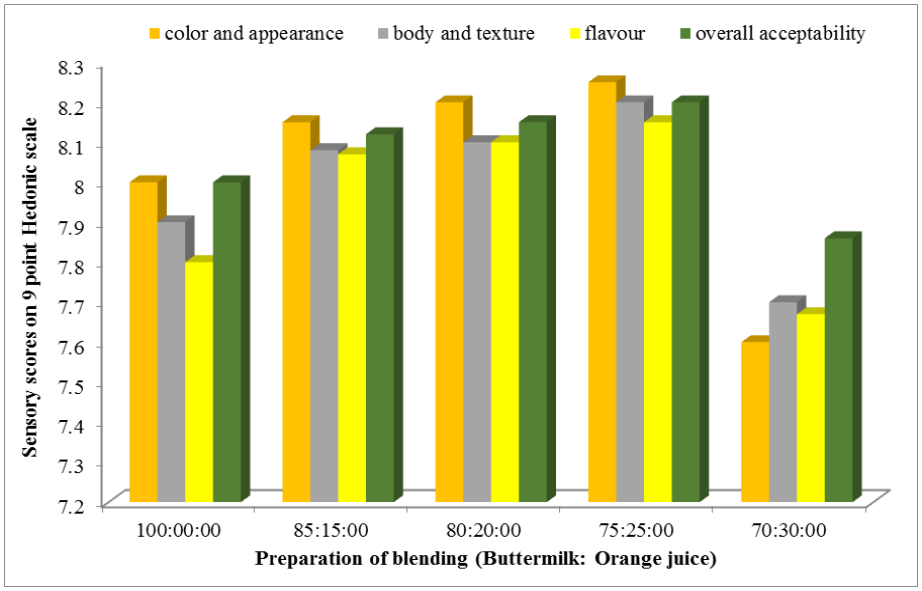


Fig. 1: Effect of blending fruit juices to buttermilk on sensory characteristics of formulated buttermilk beverage.

With the increase in the level of incorporation of pineapple juice from 15 to 30 per cent, there was significant increase in the sensory scores of the beverages whereas with the increase in the level of incorporation of orange juice from 15 to 25 per cent, there was significant increase in the sensory scores of the beverages and further increase in the level up to 30 per cent, there was significant decrease in the sensory scores of the beverages. From the statistical analysis it is evident that blending of pineapple juice at 30 per cent and orange juice at 25 per cent resulted significantly higher overall acceptability scores of 8.40 and 8.20 respectively as compared to other level of blending of fruit juices, and control (8.00).

4.2 Shelf life assessment of optimised buttermilk enriched with pineapple juice

4.2.1. Effect of storage on acidity and pH of Optimised buttermilk enriched with pineapple juice (4±1º C)

The physical quality pH of optimized dairy by product-based health beverage has evaluated in terms of acidity are presented in table 4.

As could be seen from the Table, the acidity and corresponding pH values of sample at 0^{th} day for Pineapple juice enriched buttermilk beverage was observed to be 0.175 and with a corresponding pH of 6.30 respectively. These sample after 4 days of storage as shown acidity of 0.21 with a corresponding pH of 6.25. Similarly after 8^{th} day of storage corresponding acidity and pH for the above samples were found to be 0.29 and 6.20 respectively. With increase in the duration from 0^{th} day to 12^{th} day there was significant increase in the acidity (per cent lactic acid) and corresponding decrease in pH in the beverage samples as could be seen from table 4, there was progressive increase in acidity and decrease in pH in the beverage during storage.

4.2.2 Effect of storage on microbiological quality of Optimised buttermilk enriched with pineapple juice (4±1º C)

The microbiological quality of optimized dairy by product health beverage during storage as the evaluated in terms of total bacterial count, coli form and yeast and mold count are presented in Table 5.

On 0^{th} day of storage the total bacterial count in optimised beverage was were 0.72 log $_{10}$ cfu/ml. whereas coliform, yeast and mold were found to be absent in the fresh samples. On 4^{th} day coliform count was found to be absent in the sample, whereas the total bacterial count for 1.56 log $_{10}$ cfu/ml and yeast and mold count were 0.48 log $_{10}$ cfu/ml. Similarly on 8^{th} day of storage, the total bacterial count was 2.04 log $_{10}$ cfu/ml and coliform count was found to be 0.19, whereas yeast and mold count was 0.72 log $_{10}$ cfu/ml. On Similarly on 12^{th} day of storage, the total bacterial count of beverage optimised with pineapple fruit juice was 2.47 log $_{10}$ cfu/ml and coliform count was found to be 0.24 log $_{10}$ cfu/ml, whereas yeast and mold count was found to be 0.93 log $_{10}$ cfu/ml. Similarly on 16^{th} day, sample finally was not acceptable.

Table 4: Effect of storage on Acidity and pH of optimised pineapple enriched buttermilk beverages (4±1° C).

Types of beverages	Acidity (% LA)					pH				
	0	4	8	12	16	0	4	8	12	16
Pineapple juice enriched buttermilk beverage	0.17	0.21	0.29	0.30	Not accepted	6.30	6.25	6.20	6.10	Not accepted

Table 5: Effect of storage on microbiological quality of formulated dairy by-products based health beverages (4±1° C).

Types of beverages	0th day			4th day			8th day			12th day			16th day		
	TBC	Coli	Y&M	TBC	Coli	Y&M	TBC	Coli	Y&M	TBC	Coli	Y&M	TBC	Coli	Y&M
Pineapple juice enriched buttermilk beverage	0.72	NIL	NIL	1.56	NIL	0.48	2.04	0.19	0.72	2.47	0.24	0.93	Not accepted		

5. DISCUSSION

This investigation was undertaken to develop health beverage by the admixture of dairy by products and fruit/vegetable juices (pineapple, orange, tomato and carrot). The results obtained during the process of product development have been discussed here under along with suitable justification and support of literature.

5.1 Physico – chemical and sensory characteristics of formulated buttermilk beverage with fruit juices

Pineapple and orange juice were blended to buttermilk at 15, 20, 25 or 30 per cent levels. The beverage prepared was subjected to physico- chemical and sensory attributes studies the result are presented in Table 1, 2 and 3.

With the increasing in the proportion of blending tomato and carrot juices to buttermilk, there was proportionate decrease in pH and increase in acidity, due to initial lower pH and higher acidity of pineapple juice (pH-4) and orange juice (pH-4.9) which have been used to blend with buttermilk.

The pH of pineapple blended buttermilk beverage at 30 per cent blend was 6.30 and corresponding acidity was 0.175 per cent, whereas the respective pH and acidity of orange blended buttermilk beverage at 25 per cent blend was 6.38 and 0.186 per cent. As against the control which has depicted pH of 6.86 and acidity 0.12 per cent. With the increasing in the level of blending fruit juices to buttermilk there was increase in specific gravity and viscosity

of both pineapple blended and orange blended beverage, this could be attributed to the higher viscosity of fruit juices.

In the formulated buttermilk beverage the level of fat and protein significantly decreased with the increase in the level of juices from 0 to 30 per cent, which could be attributed to the lower fat and protein content of both pineapple and orange juice as compare to buttermilk. The protein content of buttermilk (control) beverage was 3.73 per cent. Whereas the protein content of pineapple and orange juice was found to be 0.4 and 1per cent respectively.

Whereas with respect to ash, carbohydrate and total solids content, there was significant increase with increasing in the level of blend. This is due to higher ash content of pineapple juice (0.8%) and orange juice (0.9%) as compared to buttermilk which had shown ash content of 0.75 per cent. Similar was the trend in respect of carbohydrate content of pineapple and orange juice blended beverage. As the initial carbohydrate content of pineapple juice and orange juice was found to be higher (13.5% and 10%) respectively, as compared to buttermilk (4.32).

As the level of incorporation fruit juices increased, there was corresponding increase in the total solid content of the beverage, which could be attributed to the higher initial total solid content of pineapple juice and orange juice (13 and 12 %) respectively, as compared to buttermilk (9.32%).

The changes in physical and chemical properties as a result of incorporation of fruit juices have been reported by several workers and our results are in agreement with the earlier workers Bhushan, (2015), developed buttermilk based mango, orange and banana beverages. The buttermilk content in the beverage ranged from 62 to 83 per cent and the total solids, fat and protein content in different fruit beverages varied from 11.3 to18.3 per cent, 0.12-0.58 per cent and 1.25-3.68 per cent, respectively.

Amongst various proportions of pineapple and orange juice (15, 20, 25 or 30 per cent) blended with buttermilk, the beverage prepared with 30 per cent pineapple juice blend and 25 per cent orange juice blend secured highest sensory score when compare to all the other combinations. It is in agreement with findings of Shaikh and Rathi (2009), where in buttermilk was blended with orange, mango and pineapple juices with a view to make them more nutritious and acceptable organoleptically. The beverage containing 12 per cent sugar,

24 per cent pineapple juice and processed by ultrafiltration was adjudged the best compared with other combinations.

5.2 Shelf life assessment of optimised buttermilk enriched with pineapple juice

5.2.1 Effect of storage on acidity and pH of Optimised buttermilk enriched with pineapple juice (4±1º C)

Acidity and pH of formulated dairy by-products based health beverage during storage are presented in table 4. The pH of the beverage decreased with the corresponding increase in acidity with the progress and storage.

The decrease in pH and corresponding increase in acidity of formulated dairy by-product based beverage could be attributed to the production of organic acids and amino acids due to action of ascorbic acid on sugar and protein content of beverages. Lactose and proteins are converted into lactic acid and amino acids leading to increase in acidity and decrease in the pH of the beverages. Similar results have also been reported by Sikder *et al.,* (2001), Sirohi *et al*., (2005) and Yadav *et al*. (2010) for mango RTS and banana whey beverage. Garg and Goyal (2006) reported that the increase in acidity of aonla cider was due to the accelerated degradation of pectic substances or due to formation of organic acids by ascorbic acid degradation. Similar observation also recorded by Rashmi, (2011) who reported that acidity increases with corresponding decrease in pH during storage in development of amla whey drink.

5.2.2 Effect of storage on microbiological quality of Optimised buttermilk enriched with pineapple juice (4±1º C)

The results pertaining to the microbiological quality with respect to total bacterial count, coli forms and yeast and mold count of various formulated dairy by-products based health beverages during storage at 4 ± 1˚C are presented in Table 5.

The initial bacterial count for optimized buttermilk enriched with pineapple juice was found to be 0.72 log $_{10}$cfu/ml, and there was no presence of coliform and yeast and mold with the progress of storage period there was increase in total bacterial count, coli forms and yeast and mold count. On 16th day of storage beverage was not acceptable.

The increase in total bacterial count increase may be with regard to acidophilic bacteria. Yeast and mold may be the major contributor due to aciduric nature of them in fruit

formulated dairy by product based health beverage. The results are in agreement with Mandal *et al.*, (1997) who reported that the increase in standard plate count of channa whey beverages on storage. Krishnaiah *et al.*, (1989) reported standard plate count of channa whey beverage stored under refrigeration condition increased from 2 to 7.9 SPC/ml for 30 days. Kumari and Rajorhia, (1998) reported that beverage acidification preserve the product from microbial growth and hence the product had shelf life as high as 12 days.

CONCLUSION

The investigation was aimed at developing nutritious health beverage by utilising buttermilk along with incorporation of fruit juices such as pineapple and orange juice. Buttermilk was blended with various levels of fruit juices along with addition of 10 per cent sugar. The study reveals that blending pineapple juice at 30 per cent and orange juice at 25 per cent resulted in most acceptable beverage. This investigation, a technology has been developed for effective utilization of dairy by products such as buttermilk in the preparation of nutritive beverage by utilizing fruit juices (pineapple juice and orange juice).

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