Quality Characteristics of Banana based Milk Smoothies Developed from Milk of Hariana, Sahiwal and Cross Breed Cows

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ABSTRACT
A study was undertaken to assess the quality characteristics and suitability of milk of Hariana (H), Cross breed (CB) and Sahiwal (S) cows for development of milk smoothies. The 125 g milk of each breed, 75 g of banana, three variants of sugar and 0.1 percent sodium alginate were used in formulation. Prepared smoothies were analyzed for different physico-chemical and sensory characteristics. In general, non-significant (P<0.05) differences were observed in physico-chemical characteristics among different smoothies. But mean values of water, protein and solid-not-fat showed significantly (P<0.05) different values. Water was significantly (P<0.05) lower while solid-not-fat was significantly (P<0.05) higher in Cross breed milk smoothies as compared to the smoothies of other breeds of cows. The sensory profile of all the smoothies were no significant (P>0.05) differences with each other. Finally Sahiwal milk smoothies were selected based on higher scores of sweetness, acidity, consistency and overall acceptability scores than others.

Key words: Banana, Cross breed, Hariana, Nutritional quality, Sahiwal, Sensorial quality, Smoothie.

INTRODUCTION
Today consumers are seeking convenient, ready to eat, healthy food with correct nutrition. It is directly reflected in the food industry in form of higher nutritional value products and redevelopment of products aiming to meet healthiness trend. Milk is considered as vessel to provide nutrients in right proportion required for human well-being. It is dense in most of the nutrients except iron, vitamin-c, fiber etc. Milk can also be utilized in production of various nutritious and convenient products that are accepted by most of the population, especially in India where milk is the only source of animal protein for vegetarians. Similarly minimally processed fruits and vegetables is one of the major growing sectors in the food industry (Patrignani *et al.*, 2015**)**. Moreover, beverages, concentrated juices and purees are vital food products, due to the massive demand of the global market (Tumpanuvatr and Jittanit, 2012). The importance of minimally processed foods with an increased shelf life and better nutritional properties is increasing day by day (Mohideen *et al.*, 2015).

Bananas are rich in mineral called potassium. This mineral is important as it helps to maintain fluid levels in the body and regulates the movement of nutrients and waste products in and out of cells. Potassium also helps muscles to contract and nerve cells to respond. It keeps the heart beating regularly and can reduce the effect of sodium on blood pressure. Banana pulp is an excellent source of iron, vitamin-B_6 and moderate source of vitamin-C, manganese and dietary fiber (Jothi *et al.*, 2014). So it is an excellent fruit for making milk based products like smoothies and could be helpful in production of complete food.

MATERIALS AND METHODS
The 125 g milk of Hariana, Cross breed and Sahiwal breeds of cow were taken separately for preparation of milk

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smoothies. Smoothies were prepared using 75 g of banana in each formulation. The sugar was standardized for all three variants of milk smoothies and finally two percent sugar was used in subsequent experiments. At last sodium alginate @0.1 percent was added to the formulation to make the desired consistency. For smoothie development, milk after proper filtration was pasteurized at 72°C for 15 sec. Good quality banana of desired quantity were peeled, figured, pieced and added with sugar and other ingredients. After cooling prepared smoothies were packaged in PVC cups under refrigeration.

The pH of prepared smoothies was measured using digital pH meter. The titrable acidity of samples was measured following the procedure of Caric *et al.* (2000) while specific gravity, moisture, fat, protein, ash, crude fiber, total solids, solid-not-fat were measured by AOAC, (2000) standard procedures. The level of sugar was estimated by following the procedure of Pandya *et al.* (2013) and Vitamin-C by Hassan *et al.* (2016). The sensory quality of samples was evaluated using 8 point descriptive scale (Keeton *et al.*,

1984). Data obtained in the study were analyzed statistically in SPSS (version 16.0) software following the procedure of Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Banana based milk smoothies were prepared using the milk of Hariana (H), Cross breed (CB) and Sahiwal (S) cows individually. The prepared smoothies were assessed for physico-chemical characteristics and sensory attributes. The mean values of physico-chemical characteristics in terms of percent moisture, fat, protein, ash, fibre, sugar, total solids, Solids-not-fat, titratable acidity pH, specific gravity and Viamin-C (mg/100g) are presented in Table 1. The best variant of smoothie prepared from milk of different breed was selected based on sensory scores given in Table 2.

Physico-chemical characteristics

Water

Banana based milk smoothies prepared from milk of H, CB and S were showing the percent water in the range of 82.62±0.01 to 82.97±0.04. The significantly (P<0.05) higher water content was noticed in S compared to CB. However, no significant (P>0.05) differences were observed in smoothies of H and S. the reason might be of similar composition.

Fat

The percent fat values in different smoothies were in the range of 2.27±0.04 to 2.30±0.17. There was no significant (P>0.05) differences were observed in fat values among smoothies prepared from milk of different breeds. Highest fat value was noticed in CB smoothies which could be due to variation in milk composition and suitability for preparation of banana smmothies.

Protein

Percent protein values in different milk smoothies were in the range of 2.52±0.01 to 2.83±0.02. The protein values overall showed significant (P<0.05) differences among the smoothies made from milk of H, CB and S. Significantly (P<0.05) higher protein value was observed in smoothies prepared with S milk and lowest in CB milk smmothies. These variations in milk proteins could be due to the corresponding differences in protein content in different milk.

Ash

The range of percent ash values in smoothies was 0.91±0.01 to 0.93±0.02. There was no significant (P>0.05) variations observed in smoothies made from H, CB and S milk. However, highest percent ash was noticed in H milk smoothies. It could be due to the compatibility and compositional variations the components used for preparation of smoothies.

Fiber

Percent fibre in milk smoothies prepared using banana and milk of H, CB and S were in the range of 0.92±0.03 to 0.98±0.01. There was no significant (P>0.05) differences were observed in fibre values of different smoothies.

However, non-significantly (p>0.05) higher fibre value was in S smoothies. The reason may be compatibility retention of fibres and suitability of milk for banana smoothies.

Sugar

The percent sugar values were in the range of 10.04±0.12 to 10.71±0.11 in milk smoothies. The values were non-significantly (P>0.05) different with each other. The highest value of sugar was reported in CB milk based smoothies and lowest in S based smoothies. It could be due to compositional variation and compatibility of added sugar in smoothies.

Total solids

The percent total solids in all smoothies were showing the range of 17.03±0.12 to 17.38±0.21. There was no significant

Table 1: Physico-chemical characteristics of banana based milk smoothies (Means±SE).

Parameters	Banana based milk smoothies		
	H	CB	S
Water (%)	82.87ᵃ±0.04	82.62ᵇ±0.01	82.97ᵃ±0.04
Fat (%)	2.27±0.04	2.27±0.16	2.30±0.17
Protein (%)	2.68ᵇ±0.05	2.52ᶜ±0.01	2.83ᵃ±0.02
Ash (%)	0.93±0.02	0.91±0.01	0.91±0.01
Fibre (%)	0.92±0.03	0.94±0.02	0.98±0.01
Sugar (%)	10.33ᵃᵇ±0.19	10.71ᵃ±0.11	10.04ᵃ±0.12
Total Solids (%)	17.13±0.08	17.38±0.21	17.03±0.12
Solids-not-fat (%)	14.86ᵇ±0.12	15.08ᵃ±0.05	14.76ᵇ±0.13

- Means bearing different superscripts (a, b, c) within row differ significantly (P<0.05)
- Where: H=Hariana milk smoothie
  CB=Cross breed milk smoothie
  S=Sahiwal milk smoothie
- No. of replicates were n=6, one way ANOVA and Duncan multiple range test was used to draw the inferences

Table 2: Sensory profile of banana based milk smoothies (Means ±SE).

Sensory attributes	Banana based milk smoothies		
	H	CB	S
Colour and Appearance	7.08±0.13	7.08±0.13	7.08±0.13
Flavour	7.20±0.17	7.20±0.17	7.20±0.17
Body and Texture	6.87±0.05	7.08±0.17	7.08±0.17
Sweetness	6.33±0.35	6.33±0.35	6.50±0.34
Acidity	6.87±0.20	6.87±0.20	6.95±0.22
Consistency	6.25±0.20	6.33±0.20	6.33±0.20
Mouthfeel	6.70±0.23	6.70±0.23	6.70±0.23
Overall acceptability	6.79±0.19	6.79±0.19	6.87±0.23

- Means bearing different superscripts (a, b, c) within row differ significantly (P<0.05)
- Where: H=Hariana milk smoothie
  CB=Cross breed milk smoothie
  S=Sahiwal milk smoothie
- No. of replicates were n=21, one way ANOVA and Duncan multiple range test was used to draw the inferences

(P>0.05) differences in total solids was observed among all smoothies. However, highest percent total solid was CB based smoothies and lowest in S based smoothies. The reason may be variation in milk composition and components compatibility in smoothie preparations.

Solids-not-fat (SNF)

The percent SNF in smoothies prepared from banana and milk of H, CB and S was in the range of 14.76±0.13 to 15.08^a±0.05. The significantly (P<0.05) higher SNF was in CB milk smoothies as compared to other smoothies. It could be due to higher SNF in milk and suitability of other components used in preparation of banana based milk smoothies.

pH

The pH is a good indicative of milk and milk products quality. The range of pH observed in preparation of H, CB and S milk based smoothies was 6.06±0.03 to of 6.33±0.19. Overall no significant (P>0.05) variation was observed in milk smoothies of H, CB and S. The higher pH in S milk smoothies may be indicative of better taste.

Titrable acidity

The titrable acidity is the indication of handling conditions and formation of lactic acid in the milk products. It also indicates the storage conditions of milk products. The range of titrable acidity in milk smoothies was almost invariable and 0.23±0.01 or ±0.02. So it indicates the constant of storage and handling conditions of the products and other components used in milk smoothies preparations.

Specific gravity

The specific gravity of milk indicates the adulteration and components of milk and milk products. The range of specific gravity observed in H, CB and S smoothies was 1.061±0.01 to 1.069±0.05 (Fig 1). These values were non-significantly (P>0.05) different with each other. It could be due to almost similar smoothies components and milk compatibility with these constituents.

Vitamin C

Vitamin-C is naturally deficit in milk but addition of banana and other components contributed the Vitamin-C. The range of Vitamin-C in H, CB and S milk based banana smoothies was 3.55±0.03 to3.59±0.05. No significant (P>0.05) differences were observed in Vitamin-C values of all smoothies.

The variations in sugar compatibility on various ingredients used in milk products preparations were noticed in present study. The similar findings were advocated by Bhardwaj and Pandey (2011) in continuous basundi making process standardization. The compatibility and saturation level of sugar was also suggested by Patel and Bhadama (2013) during mechanized production of value added traditional Indian Dairy Products (TIDP) for organized Sector. The variations in milk product composition and ingredients used for product preparation were noticed in smoothies preparation. These findings were supported by Kumar and Das (2007) during performance evaluation of single screw vented extruder for production of sandesh and Khurana (2006) during development of technology for extended shelf life fruit *lassi*. The pattern of protein in sugar added banana milk smoothies was variable and mostly dependant on the composition of milk and availability of proteins from other sources as suggested by Jain (2010) in preparation of indigenous milk products from milks of different cow's breeds.

Sensory profile

On the basis of sensory evaluation it was observed that all variants of smoothies were very well liked by the panelists. But S milk based banana smoothie was choice product of the sensory panelists.

Colour and appearance

The colour and appearance is primary acceptability criteria of selecting any product because it gives the first impression of food quality. All three variants of smoothies were showing similar colour and appearance scores and no significant (P>0.05) differences were observed among them.
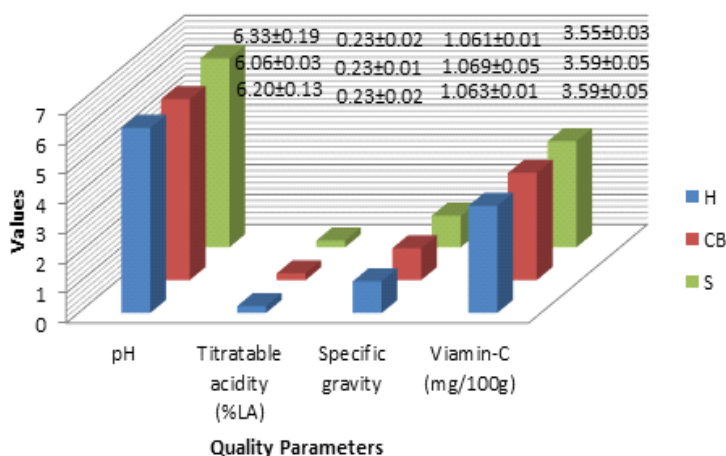

Fig 1: Quality parameters of banana based milk smoothies.

Flavour

The mean flavour was also showing the same trend as in colour and appearance scores. There was no significant variation noticed in flavour scores smoothies among the breeds of milk.

Body and texture

The range of body and texture mean scores was 6.87±0.05 to 7.08±0.17. Body and texture of all smoothies showed no significant (P>0.05) variations in scores of all smoothies. But body and texture score of H based smoothies was non significantly (P>0.05) lower than other smoothies. It could be due to compatibility status and choice of panelists.

Sweetness

The range of sweetness mean scores was 6.33±0.35 to 6.50±0.34. Sweetness of all smoothies showed no significant (P>0.05) differences in scores of all smoothies. However, sweetness score of S based smoothies was non-significantly (P>0.05) higher than other smoothies. It could be due to compatibility status and choice of panelists.

Acidity

The range of acidity mean scores was 6.87±0.20 to 6.95±0.34. The acidity scores of all smoothies showed no significant (P>0.05) differences among each other. However, acidity score of S based smoothies was non-significantly (P>0.05) higher than other smoothies. It could be due to stability of products against environmental factors.

Consistency

The range of consistency mean scores was 6.25±0.20 to 6.33±0.20. The consistency scores of all smoothies showed no significant (P>0.05) differences among each other. However, consistency score of H based smoothies was non-significantly (P>0.05) lower than other smoothies. It could be compatibility of ingredients used in preparation of smoothies.

Mouthfeel

The mouthfeel is impression of product after its taste and decides the products quality. All three variants of smoothies were showing similar mouthfeel scores and no significant (P>0.05) differences were observed among them.

Overall acceptability (OA)

The range of OA mean scores was 6.79±0.19 to 6.87±0.23. The OA scores of all smoothies showed no significant (P>0.05) differences among each other. However, consistency score of S based smoothies was non-significantly (P>0.05) higher than other smoothies. It could be compatibility of ingredients used in preparation of smoothies and their acceptability by the sensory panelists.

The S milk based smoothies was product of choice which could be due to lower sugar taste and better compatibility with the ingredients used in smoothies preparations. The same pattern of acceptance was noticed by Adebayo-Oyetoro *et al*. (2016) during evaluation of pawpaw juice milk blends but higher sugar level was suggested by Baljeet *et al*. (2013) for whey based pineapple beverages which could be due to acidic nature of whey. Colour and appearance, flavour, body and texture and overall acceptability were the key sensory attributes in selecting the products. The similar kind of selection criteria was also suggested by Shukla *et al*. (2003) for beverages using fruit juice/pulp in separated milk and reconstituted skim milk and Hassan *et al*. (2015) for fruit flavoured milk based beverages.

CONCLUSION

In general all the formulations and recipes were liked by the panelists and showed more or less similar nutrient status. On physico-chemical characteristics basis, non-significant (P<0.05) differences were observed in the smoothies of Hariana, Cross breed and Sahiwal milk smoothies except in mean values of water, protein and solid-not-fat. The percent mean values of water was significantly (P<0.05) lower while solid-not-fat was significantly (P<0.05) higher in Cross breed milk smoothies as compared to the smoothies of other breeds of cows. However, protein values in all smoothiess were significantly (P<0.05) different from each other. The sensory profile showed very well acceptance of all smoothies but banana and Sahiwal milk based smoothies was selected because of nonsignificantly (P>0.05) higher scores of sweetness, acidity, consistency and overall acceptability scores than others.

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