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Effect of phyto-protein enrichment on organoleptic evaluation of mango RTS beverages

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Abstract
The investigation was conducted to develop the protein fortified mango RTS. Various proportions of soya protein isolate (SPI), peanut protein isolates (PPI) and rice bran protein concentrate (RBPC) were added to the mango pulp to fortify mango RTS. It was observed that there was progressive decrease in the sensory scores of the beverage with increase in proportion of protein concentrate in it. The overall acceptability scores w.r.t. control were lower for protein fortified RTS, however, the RTS fortified with protein from different sources were not showing significant difference among themselves. Throughout the storage period, the RTS prepared with fructose scored more in flavor, taste, mouth feel and overall acceptability scores than prepared from sucrose. The organoleptic scores of all the variants of protein fortified RTS remained acceptable at room temperature upto 90 days of storage.

Keywords: Phyto-protein, organoleptic, RTS beverages

Introduction
India is the second largest producer of fruits and vegetables in the world. Fruits and vegetables are important constituents of our diet and provide significant quantity of nutrients, especially vitamins, minerals, fiber and sugars. Mango (*Mangifera indica* L.) belongs to family Anacardiaceae (Nakesone, 1998) [6]. Ripe fruit of mango are soft with a pleasant aroma and has a flavour often described as a peach-pineapple combination (Lalel *et al*., 2003) [5]. It has an excellent flavor, attractive fragrance, delicious taste and high nutritional value that have made it one of the best fruits. It is a good source of vitamin A, B and C and minerals.

Consumers of the present day are becoming increasingly conscious of the health and nutritional aspects of their food. Their tendency is to avoid chemical and synthetic food and choose therapy and nutrition through natural resources. Fruits ready to serve beverages (RTS), which are acidic and non-alcoholic in nature, have been increasingly gaining popularity throughout the world due to their nutritional, refreshing and easily digestible properties. However, these beverages are traditionally poor in protein due to inherent low protein content in fruits and the technological difficulties in its protein fortification of acidic beverages.

The rapidly growing world protein requirement has directed major attention to plant proteins. Oilseeds are valuable sources of lipid and basically processed for their edible oils leaving behind a lot of protein-rich meal. Proteins are usually recovered from the meals and marketed as food ingredients in developed countries. The most produced oilseeds worldwide are, in decreasing order, soybean, rapeseed, cotton, groundnut and sunflowers, amongst others (FAO 2009) [4]. The major challenge to develop a protein fortified fruit beverage is to preserve protein functional properties and to prevent its sedimentation. The flavor challenges include overcoming the bitter/brothy flavor of protein and coagulation during pasteurization. Proteins undergo denaturation and discoloration due to disruption of food systems by heating and/or blending during processing. Temperature also affects food protein deterioration, which can affect storage time, sedimentation, pH, objectionable odors and off-flavors development. The protein enriched fruit-whey beverages have been reported to suffer from the problem of astringency also (Beecher *et al.*, 2008) [1]. Thus, keeping in mind the popularity of mango beverages and the need of its fortification with protein from plant sources.

Materials and methods
The present research work entitled, "Effect of Phyto-protein enrichment on Organoleptic Evaluation of mango ready to serve beverages" was carried out in Centre of Food Science and Technology, CCS HAU, Hisar during.

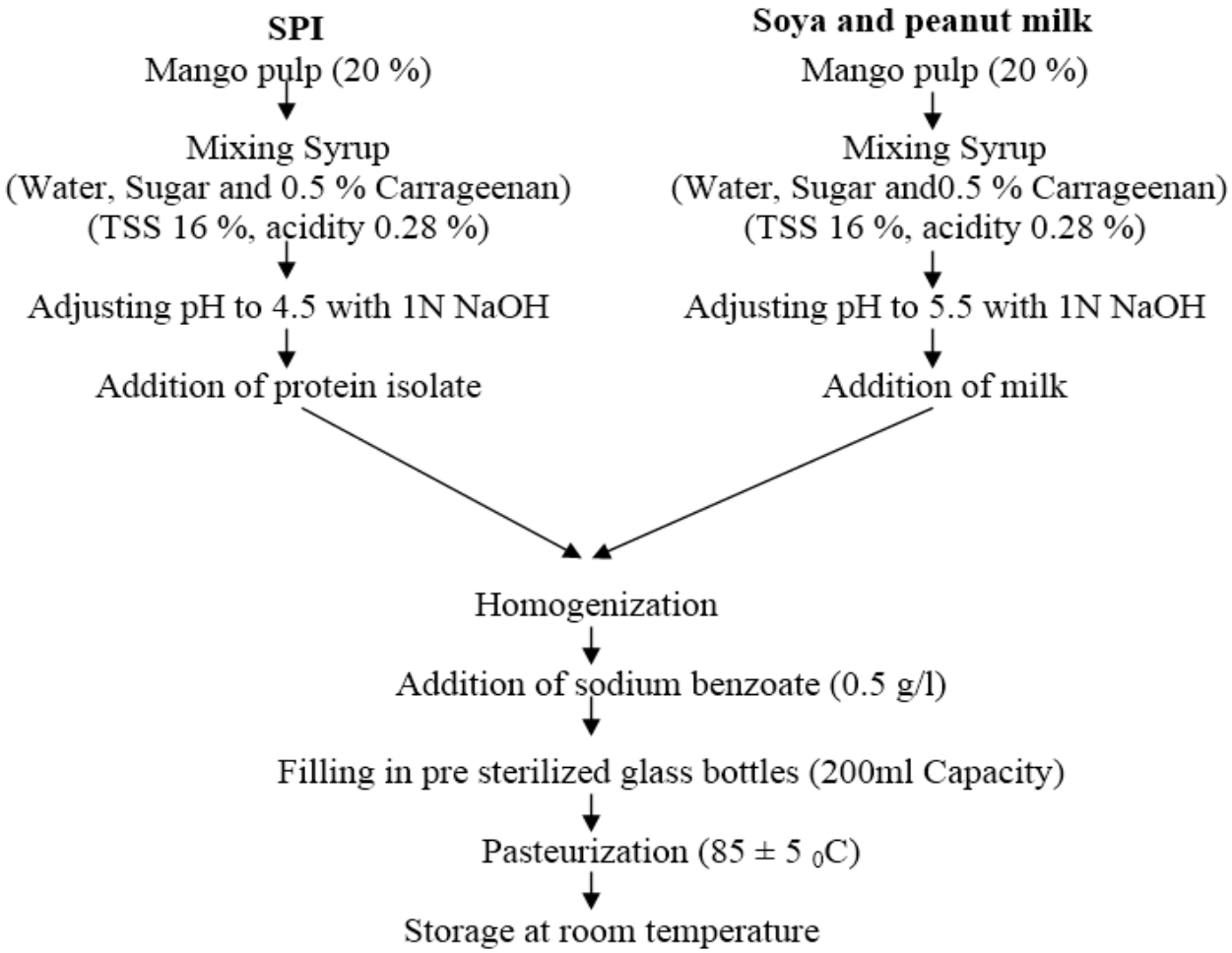
The recipe for RTS drink was standardized using 20% pulp, adjusting 16 % TSS and 0.20 to 0.30 % acidity. The squash recipe was standardized using 40% pulp, adjusting 50% TSS and 1.0 to 1.5 % acidity.

For development of plant protein fortified beverages, following treatments were tried:

Soya, peanut protein isolates and rice bran protein concentrates @ 1, 2, 3, and 4 % for RTS and @ 2, 3 and 4 % for squash were added to the mango beverage. These protein isolates were mixed properly in water before adding in the beverages. The pH of the beverage was adjusted to 4.5 with 1 N NaOH before addition of protein source. The beverages prepared from various concentrations of protein sources were organoleptic ally evaluated to obtain the most acceptable treatment each for RTS and Squash. This treatment was only for RTS and not for squash. Soya and peanut milk blended with mango pulp in the ratio of 40, 50 and 60 %. For both soya and peanut milk blend with mango, sodium benzoate 0.5 percent was added and pH of pulp was adjusted to 5.5 with 1 N NaOH before mixing the pulp with milk in order to stabilize the beverage. The RTS prepared from various concentrations of milk were organoleptic ally evaluated to obtain the most acceptable treatment. In the best blend above obtained, to prevent browning during pasteurization and storage, the cane sugar (sucrose) was replaced with 0, 50 and 100 % keto group sugar fructose. The beverage blend with various proportions of fructose was then analyzed to obtain best treatment showing maximum organoleptic acceptability and minimum browning during storage upto 90 days at room temperature. The best combination of above prepared beverages with isolate and milk with replacement of sugar with or without fructose were separately bottled in 200 ml bottles, pasteurized, capped and stored at room temperature (35±5°C) for further analysis and compared with control.

For preparing beverages, total soluble solids and acidity were first analyzed in mango pulp. On the basis of this analysis, requisite quantities of sugar and citric acid dissolved in water by heating were added to pulp for the adjustment of TSS and acidity in beverages (w/w basis). The beverages were homogenized in colloid mill, strained, filled in pre-sterilized glass bottles (200 ml capacity) leaving 2.5 cm headspace and sealed with crown corks. The sealed bottles were processed in boiling water for 20 minutes. The bottles were then cooled in air, labelled and stored at room temperature for analysis during storage.

The RTS were evaluated organoleptic ally at the regular monthly interval during three months storage. The organoleptic evaluation was done by a panel of ten semi trained judges following the hedonic rating scale as described by Ranganna (2003) [7]. The products were evaluated for colour and appearance, flavour, taste, mouth feel and overall acceptability.



Flow sheet for preparation of plant protein fortified mango RTS drink

Results and discussion

Organoleptic evaluation

A gradual decrease in sensory scores for overall acceptability and its various attributes was observed in RTS during storage. In the present investigation, the overall acceptability of scores w.r.t. control were lower for protein fortified RTS, however, the RTS fortified with protein from different sources were not showing significant difference among themselves.There was significant decrease in colour and appearance scores of RTS with increasing storage period. The average colour and appearance score of RTS at 0-day was 7.7, which decreased to 7.1 by 90 days of storage (Tables 1).

Table 1: Effect of different treatments and storage period on colour and appearance score (9-point hedonic scale) of protein fortified mango RTS

Treatments	Storage period (days)				
	0	**30**	**60**	**90**	**Mean**
T_0	7.7	7.6	7.5	7.1	**7.5**
T_1	8.3	8.2	8.2	7.4	**8.0**
T_2	7.3	7.2	7.0	6.8	**7.1**
T_3	7.6	7.5	7.3	7.2	**7.4**
T_4	7.7	7.3	6.9	6.8	**7.2**
T_5	7.8	7.4	7.4	7.3	**7.5**
T_6	7.3	7.2	7.1	6.9	**7.1**
T_7	8.1	7.9	7.8	7.3	**7.8**
Mean	**7.7**	**7.5**	**7.4**	**7.1**	
CD at 5 % Treatment = 0.21; Storage = 0.18; Treatment × Storage = NS					

T_0 (Control with Sucrose); T_1 (Control with Fructose); T_2= T_0+ SPI; T_3= T_1 + SPI; T_4=T_0 + PM; T_5= T_1+PM; T_6= T_0+SM; T_7= T_1+SM; SPI= Soya Protein isolate: PM= Peanut milk: SM= Soya milk;: NS= Non- significant

In RTS colour and appearance score decreased with the time due to degradation of carotenoids, increased sedimentation and NEB, as observed also by Dutta *et al*., (2005) [3]. The decrease in colour and appearance scores of squash and RTS during storage has been reported by other workers also (Sirohi *et al*., 2010) [10].

In the present investigation, the organoleptic scores for flavor, taste, mouth feel and overall acceptability were significantly higher in the RTS prepared with fructose than sucrose. There was a significant decrease in taste scores of RTS with increasing storage period. The average taste score of RTS at 0-day was 7.8, which decreased to 7.3 by 90 days of storage (Tables 2).

Table 2: Effect of different treatments and storage period on taste score (9-point hedonic scale) of protein fortified mango RTS

Treatments	Storage period (days)				
	0	**30**	**60**	**90**	**Mean**
T_0	8.3	8.1	7.9	7.7	8.0
T_1	8.5	8.4	8.3	8.2	8.4
T_2	7.3	6.9	6.7	6.5	6.9
T_3	7.7	7.6	7.4	7.4	7.5
T_4	7.6	7.0	6.5	6.4	6.9
T_5	7.5	7.4	7.3	7.2	7.4
T_6	7.3	7.1	7.0	7.1	7.1
T_7	7.9	7.6	7.4	7.5	7.6
Mean	7.8	7.5	7.3	7.3	
CD at 5 % Treatment = 0.24; Storage = 0.29; Treatment × Storage = 0.41					

T_0 (Control with Sucrose); T_1 (Control with Fructose); T_2= T_0+ SPI; T_3= T_1 + SPI; T_4=T_0 + PM; T_5= T_1+PM; T_6= T_0+SM; T_7= T_1+SM; SPI= Soya Protein isolate: PM= Peanut milk: SM= Soya milk

The average aroma score of RTS at 0-day was 7.6, which decreased to 7.2 by 90 days of storage. Among the various treatments, aroma scores were lower than control for protein fortified RTS, however, the RTS fortified with protein from different sources showing significant differences among themselves (Tables 3). There was significant improvement in aroma scores of variants of RTS where sucrose was replaced by fructose. The interaction between treatments and storage was found to be significant.

Table 3: Effect of different treatments and storage period on aroma score (9-point hedonic scale) of protein fortified mango RTS

Treatments	Storage period (days)				
	0	**30**	**60**	**90**	**Mean**
T_0	8.3	8.2	8.0	7.8	8.1
T_1	8.6	8.5	8.4	8.3	8.5
T_2	7.0	6.8	6.5	6.3	6.7
T_3	7.5	7.4	7.3	7.2	7.4
T_4	7.1	6.9	6.9	6.8	6.9
T_5	7.7	7.6	7.4	7.3	7.5
T_6	7.1	6.8	6.8	6.7	6.9
T_7	7.8	7.5	7.2	7.1	7.4
Mean	7.6	7.5	7.3	7.2	
CD at 5 % Treatment = 0.32; Storage = 0.20; Treatment × Storage = 0.57					

T_0 (Control with Sucrose); T_1 (Control with Fructose); T_2= T_0+ SPI; T_3= T_1 + SPI; T_4=T_0 + PM; T_5= T_1+PM; T_6= T_0+SM; T_7= T_1+SM; SPI= Soya Protein isolate: PM= Peanut milk: SM= Soya milk

The average mouth feel score of RTS at 0-day was 7.6, which decreased to 7.2 by 90 days of storage. Among the various treatments, mouth feel scores were lower than control for protein fortified RTS, however, the RTS fortified with protein from different sources were not showing significant differences among themselves (Tables 4).

Table 4: Effect of different treatments and storage period on mouth feel (9-point hedonic scale) of protein fortified mango RTS

Treatments	Storage period (days)				
	0	30	60	90	Mean
T_0	8.3	8.1	8.0	7.9	8.1
T_1	8.5	8.4	8.3	8.3	8.4
T_2	7.2	7.1	7.0	6.9	7.1
T_3	7.7	7.4	7.2	6.8	7.3
T_4	7.0	7.0	6.7	6.6	6.8
T_5	7.6	7.4	7.3	7.2	7.4
T_6	7.2	7.0	7.0	6.7	7.0
T_7	7.6	7.3	7.1	7.2	7.3
Mean	7.6	7.5	7.3	7.2	
CD at 5 % Treatment = 0.20; Storage = 0.20; Treatment × Storage = NS					

T_0 (Control with Sucrose); T_1 (Control with Fructose); T_2= T_0+ SPI; T_3= T_1 + SPI; T_4=T_0 + PM; T_5= T_1+PM; T_6= T_0+SM; T_7= T_1+SM; SPI= Soya Protein isolate: PM= Peanut milk: SM= Soya milk;: NS= Non- significant

There was a significant decrease in overall acceptability scores of RTS with increasing storage period. The average overall acceptability score of RTS at 0-day was 7.6, which decreased to 7.2 by 90 days of storage (Tables 5).

Table 5: Effect of different treatments and storage period on overall acceptability (9-point hedonic scale) of protein fortified mango RTS

Treatments	Storage period (days)				
	0	30	60	90	Mean
T_0	8.2	8.0	7.9	7.6	7.9
T_1	8.5	8.4	8.2	7.9	8.3
T_2	7.2	7.0	6.8	6.6	6.9
T_3	7.5	7.4	7.3	7.2	7.4
T_4	7.4	7.1	6.8	6.7	7.0
T_5	7.7	7.5	7.4	7.3	7.5
T_6	7.0	7.0	7.0	6.9	7.0
T_7	7.9	7.6	7.4	7.3	7.6
Mean	7.7	7.5	7.4	7.2	
CD at 5 % Treatment = 0.24; Storage = 0.24; Treatment × Storage = 0.52					

T_0 (Control with Sucrose); T_1 (Control with Fructose); T_2= T_0+ SPI; T_3= T_1 + SPI; T_4=T_0 + PM; T_5= T_1+PM; T_6= T_0+SM; T_7= T_1+SM; SPI= Soya Protein isolate: PM= Peanut milk: SM= Soya milk

Among the various treatments, the overall acceptability of scores were lower than control for protein fortified RTS This could be attributed to lesser NEB, improved colour, flavour and mouth feel due to fructose. Usha and Shikha (2015) [11] reported that the sugar replacement with sucrolose improved the overall acceptability of RTS mango drink.

In the present investigation, fortification of beverage with protein resulted in reduced overall acceptability with respect to control because of decreased colour & appearance scores and increased sedimentation. The beany off flavour of the protein sources was also responsible for the observed decreased flavour and mouth feel scores. The developed protein fortified RTS and squash, however, remained acceptable upto 90 days, the period of storage study. Similar lower acceptability has been reported by other workers for mango beverage fortified with soya protein isolate (Chauhan and Joshi, 1998) [2] and soya milk (Sakhale *et al.*, 2012) [12].

Conclusion

The overall acceptability scores w.r.t. control were lower for protein fortified RTS, however, the RTS fortified with protein from different sources were not showing significant difference among themselves. Throughout the storage period, the RTS and squash prepared with fructose scored more in flavor, taste, mouth feel and overall acceptability scores than prepared from sucrose. The Organoleptic scores of all the variants of protein fortified RTS and squash remained acceptable at room temperature upto 90 days of storage.

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