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Study on sensory quality evaluation of whey based fruit juice beverages

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Abstract

Experiment was conducted to evaluate the sensory quality of Whey Based fruit beverages. The beverage was prepared from whey, water, fruit juice (pineapple and orange), citric acid and sugar, and to suggest the optimal blend formulation and waste product utilization (dairy), 15 blends for each fruit were prepared and their quality was estimated by sensor analysis. The whey based fruit beverage prepared with whey & water (70:30) and 20 % fruit juice (T_3P_3 & T_3O_3) was found to be more acceptable in terms of sensory analysis.

Keywords: ATMA, Constraints and Suggestions, Participation, Farmer friends

Introduction

Whey is the milk serum that is produce during the manufacture of *paneer*, *channa*, *chakka*, cheese, casein, etc., that result from acid or proteolytic enzyme mediated coagulation of milk. It is major by-product of dairy industry. In the manufacturing of these products, about 10- 20 per cent portion of milk is recovered as the desired end product and remaining 80-90 per cent liquid portion is the whey. It is considered to be reliable source of number of high quality and biological active proteins, carbohydrates and minerals. Whey constituent 45-50% of total milk solid, 70% of milk sugar (lactose), 20% of milk protein and 70-90% of milk minerals and almost all the water soluble vitamins present in the milk (Horton, 1995) [6]. Whey is the source of calcium, phosphorus and essential amino acid. The presence of all these ingredients makes whey a highly nutritious product (Savarana *et al.*, 2005) [11].

In India, nearly 5 million tones whey is produced of which *channa* and *paneer* whey contribute around 80 per cent of total whey (Gupta, 2008) [5] and majority of it is disposed off as a waste. Biological oxygen demand (BOD) of whey varies from 39,000 to 48,000 ppm, which is roughly 200 times more as treat the whey before disposal, which is found to be uneconomical. The high biochemical oxygen demand (BOD) of whey poses a major worldwide disposal and pollution problem for the dairy industry, for which an effective and permanent solution is urgently needed. Biological waste water treatment technologies can assist in the safe disposal of whey or whey permeates within the federal environment specifications, but only at substantial cost. Regulations for preventing disposal of untreated whey and recognition of the value of whey components accelerated in the late twentieth century. It resulted in increase in people attention towards whey and whey proteins and other components and established a sound basis for their nutritional and functional value.

One alternative is use of whey rich in lactose and protein, in processes in which saleable products contribute wholly or partially to the costs. (Marwaha *et.al*, 2007) [9]. Development of any process for its economical utilization would be of great benefit to the dairy industry. Whey has been tried in the past to utilize in the formulation of a nutritious beverage, but this has not been successful because the results have not been satisfactory because of its high acidity rate, resulting in its poor taste characteristics. Therefore, the beverage must contain other ingredients also at high extent to develop a beverage of a good taste. (Ahmed Eltayeb *et.al* 2011) [1].

At this stage, product diversification using whey as an infrastructure replacer of water without much change in the existing infrastructure is quite feasible. Market demand for beverages is growing all over the world and India is no exception to it. Whey beverages have been recognized as a genuine thirst quencher, light, refreshing, healthful and nutritious (Prendergast, 1985) [10]. A value-added functional beverage is formulated utilizing unprocessed liquid whey. Whey has excellent nutritional qualities and bland flavors; it is easy to digest and has a unique

functionality in a beverage system. The ready-to-drink beverages are formulated with liquid whey and fruit juice (pineapple and orange) along with an adequate amount of sugar and citric acid. The acidic flavor of whey is compatible with citrus flavors and particularly pineapple and orange. The health and nutritional benefits of pineapple and orange further imparts the value to the formulated beverages.

Pineapple [*Ananascomosus* (L.)Merr. Family: Bromeliaceae] is one of the most important commercial fruit crops in the world. Due to its excellent flavour and taste, it is known as the queen of fruits (Baruwa, O.I. 2013) [3]. Pineapple is the third most important tropical fruit in the world after Banana and Citrus (Bartholomew et.al. 2003) [2]. Mature fruit contains 14% of sugar; a protein digesting enzyme, bromelin, and good amount of citric acid, malic acid, vitamin A and B (Joy, P.P. 2010) [7] Pineapple contains 81.2 to 86.2% moisture, and 13-19% total solids, of which sucrose, glucose and fructose are the main components. Carbohydrates represent up to 85% of total solids whereas fibre makes up for 2-3%. Of the organic acids, citric acid is the most abundant in it. The pulp has very low ash content, nitrogenous compounds and lipids (0.1%). From 25-30% of nitrogenous compounds are true proteins. Out of this proportion, Ca. 80% has proteolytic activity due to a protease known as Bromelin. Fresh pineapple contains minerals as Calcium, Chlorine, Potassium, Phosphorus and Sodium (Dull, G. G. 1971) [4].

Orange (*Citrus sinensis*L.) is a deciduous tree which belongs to family Rutaceae. Sweet orange is the most commonly grown fruit in the world and widely cultivated in tropical and sub-tropical climates.

Oranges constitute a significant source of antioxidants (mainly vitamin C), polyphenol compounds (hydroxyl cinnamic acid and flavanones), phyto-chemicals (hesperidins and narigenin) and various vitamins and minerals. These components exhibit therapeutic properties such as anti-inflammatory, antihypertensive, diuretic, analgesic and hypolipidemic activities (Klimczak *et al.*, 2007) [8].

Materials and methods

The experimental studies were carried out in the Department of Food Science and Technology, Warner school of Food and Dairy Technology, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad. Whey was collected from the student training center SHUATS. Fresh and fully ripe fruit (Pineapple & Orange) were purchased from local market and the fruit were washed and rinsed thoroughly with potable water. After the removal of outer cover, the fruit is ready for extraction of juice. The extracted juice was filtered by passing through a sterile muslin cloth into a clean transparent plastic bowl (juice extraction flow chart in fig. 1 and 2) The beverages were prepared using five ratio of whey and water (90:10, 80:20, 70:30, 60:40 & 50:50), three level of fruit juice (10%, 15 % & 20%) and the amount of sugar and citric acid (10% & 0.2%) respectively were constant in all treatments. After the beverage got ready it was packed in sterilized glass bottles and sealed with the help of crown capper. Then this beverage was stored at room temperature and used for further investigation. The details regarding preparation of whey beverage is given in figure 3. The product was evaluated for its sensory quality by a panel of 5 judges selected from the staff of Department of Food Science & Technology, Warner school of Food and Dairy Technology, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad.

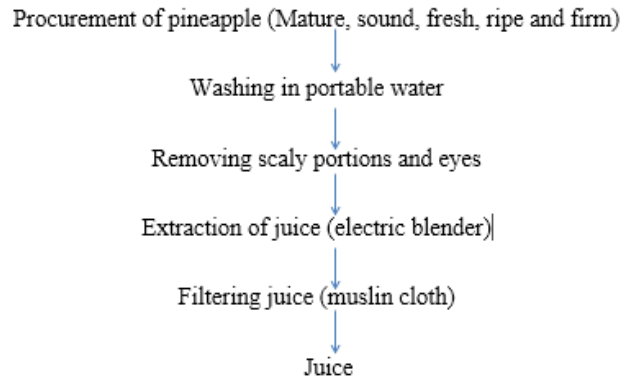


Fig 1: Flow chart for preparation of pineapple juice

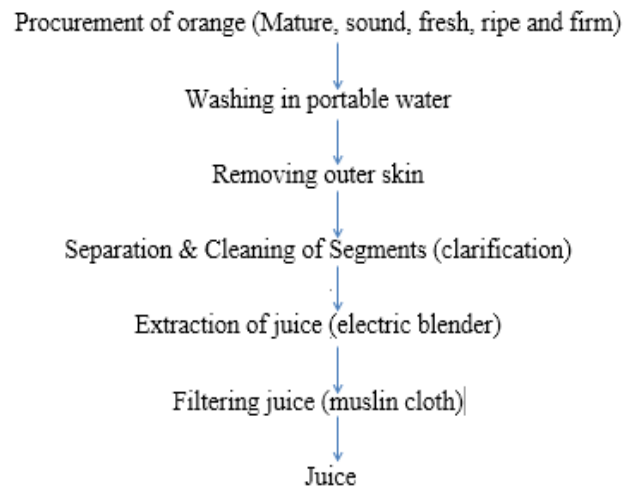


Fig 2: Flow chart for preparation of orange juice

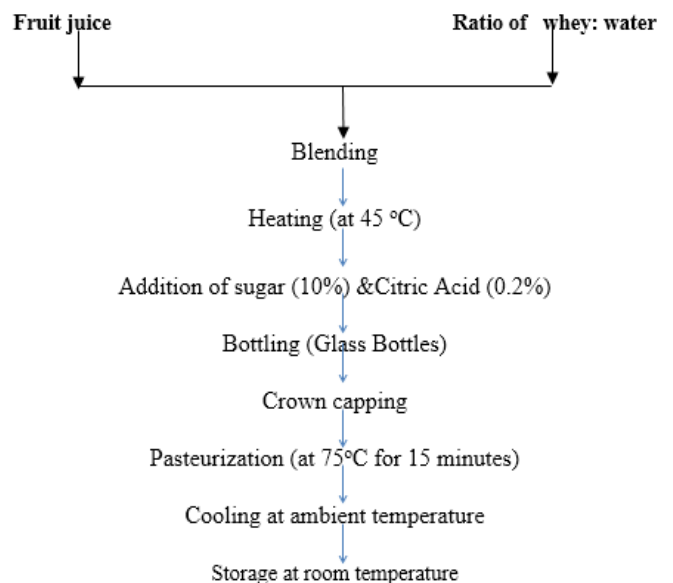


Fig 3: Process flow sheet for the preparation of whey- based fruit juice beverage.

Results and discussion

It is observed that the mean value of P₃ 20(%) Juice) was observed to be highest compare to the mean value of P₁10 (%) Juice & P₂ 15(%) Juice, hence P₃ could be regarded as most effective. Similarly the average Colour and appearance due to T₅ (50:50) Whey + water is highest, so this ratio may be considered as most effective. It is evident from the table 1 that the highest average value of Colour and appearance was obtained in the treatment T₅P₃ (7.00).

Table 1: Colour and appearance percent in experimental sample whey based pineapple juice beverage.

Juice (%)	Whey + water					Mean
	T ₁ (90:10)	T ₂ (80:20)	T ₃ (70:30)	T ₄ (60:40)	T ₅ (50:50)	
P ₁ (10%) Juice	5.33	5.66	5.00	5.33	5.33	5.33
P ₂ 15 (%) Juice	5.66	6.00	5.33	6.00	6.33	5.86
P ₃ 20 (%) Juice	6.33	6.33	6.66	6.66	7.00	6.60
Mean	5.44	5.66	5.66	6.00	6.22	
			C.D. at 5%	F-Test		
Due to juice (%)			0.36	S		
Due to Whey + water			0.47	S		
Int. (juice) x (Whey + water)			0.82	S		

It is evident from the table 2 that the highest average value of Consistency was obtained in the treatment T₂P₃, T₃P₁, T₃P₃, T₄P₁, T₄P₃, and T₅P₃ (7.00) respectively. It is observed that the mean value of P₂ 15(%) Juice) was observed to be highest compare to the mean value of P₁ 10(%) Juice and P₃ 20(%)

Juice, hence P₂ could be regarded as most effective. Similarly the average consistency due to T₄ (60:40) Whey + water and T₅ (50:50) Whey + water is highest, so this ratio may be considered as most effective.

Table 2: Consistency percent in experimental sample whey based pineapple juice beverages.

Juice (%)	Whey + water					Mean
	T ₁ (90:10)	T ₂ (80:20)	T ₃ (70:30)	T ₄ (60:40)	T ₅ (50:50)	
P ₁ (10%) Juice	5.00	5.00	5.33	6.00	5.66	5.40
P ₂ 15 (%) Juice	7.00	7.00	6.66	7.00	7.00	6.93
P ₃ 20 (%) Juice	6.66	7.00	6.00	6.66	7.00	6.66
Mean	6.22	6.33	6.00	6.55	6.55	
			C.D. at 5%	F-Test		
Due to juice (%)			0.25	S		
Due to Whey + water			0.32	S		
Int. (juice) x (Whey + water)			0.56	S		

It is observed that the mean value of P₂ 15(%) Juice) was observed to be highest compare to the mean value of P₁ 10(%) Juice and P₃ 20(%) Juice hence P₂ could be regarded as most effective. Similarly the average flavour and taste due to T₄

(60:40) Whey + water is highest, so this ratio may be considered as most effective. It is evident from the table 3 that the highest average value of Flavour and Taste was obtained in the treatment T₃P₃ (7.66).

Table 3: Flavour and Taste percent in experimental sample whey based pineapple juice beverages

Juice (%)	Whey + water					Mean
	T ₁ (90:10)	T ₂ (80:20)	T ₃ (70:30)	T ₄ (60:40)	T ₅ (50:50)	
P ₁ (10%) Juice	5.66	6.00	6.66	6.00	6.33	6.13
P ₂ 15 (%) Juice	7.00	6.00	6.66	7.66	7.00	6.86
P ₃ 20 (%) Juice	6.00	5.66	6.00	6.00	6.00	5.93
Mean	6.22	5.88	6.44	6.55	6.44	
			C.D. at 5%	F-Test		
Due to juice (%)			0.25	S		
Due to Whey + water			0.33	S		
Int. (juice) x (Whey + water)			0.57	S		

It is evident from the table 4 that the highest average value of Overall acceptability was obtained in the treatment T₃P₃ (7.66) respectively. It is observed that the mean value of P₃ 20(%) Juice was observed to be highest compare to the mean value of P₁ 10(%) Juice and P₂ 15(%) Juice hence, P₃ could be

regarded as most effective. Similarly the average overall acceptability due to T₃ (70:30) Whey + water and T₅ (50:50) Whey + water is highest, so this ratio may be considered as most effective.

Table 4: Overall acceptability percent in experimental sample whey based pineapple juice beverage.

Juice (%)	Whey + water					Mean
	T ₁ (90:10)	T ₂ (80:20)	T ₃ (70:30)	T ₄ (60:40)	T ₅ (50:50)	
P ₁ (10%) Juice	6.00	5.66	6.33	5.00	6.00	5.80
P ₂ 15 (%) Juice	6.00	5.66	6.66	7.66	6.66	6.53
P ₃ 20 (%) Juice	7.00	7.00	6.66	6.33	7.00	6.80
Mean	6.33	6.11	6.55	6.33	6.55	
			C.D. at 5%	F-Test		
Due to juice (%)			0.28	S		
Due to Whey + water			0.36	S		
Int. (juice) x (Whey + water)			0.62	S		

It is observed that the mean value of O₂ 15(%) Juice) was observed to be highest compare to the mean value of O₁ 10(%) Juice & O₃ 20(%) Juice hence O₂ could be regarded as most effective. Similarly the average Colour and appearance due to T₄ (60:40) Whey + water and T₅ (50:50) Whey + water

is highest, so this ratio may be considered as most effective. It is evident from the table 5 that the highest average value of Colour and appearance was obtained in the treatment T₅O₃ (8.00).

Table 5: Colour and appearance percent in experimental sample whey based Orange juice beverage.

Juice (%)	Whey + water					Mean
	T ₁ (90:10)	T ₂ (80:20)	T ₃ (70:30)	T ₄ (60:40)	T ₅ (50:50)	
O ₁ (10%) Juice	6.66	6.66	7.00	6.33	6.66	6.66
O ₂ 15 (%) Juice	7.00	6.66	7.66	8.66	8.00	7.60
O ₃ 20 (%) Juice	7.33	6.66	7.00	7.66	8.00	7.33
Mean	7.00	6.66	7.22	7.55	7.55	
			C.D. at 5%	F-Test		
Due to juice (%)			0.33	S		
Due to Whey + water			0.43	S		
Int. (juice) x (Whey + water)			0.75	S		

It is observed that the mean value of O₃ 20 (%) Juice) was observed to be highest compare to the mean value of O₁ 10(%) & O₂ 15(%) Juice, hence O₃ could be regarded as most effective. Similarly the average Consistency due to T₅ (50:50)

Whey + water is highest, so this ratio may be considered as most effective. It is evident from the table 6 that the highest average value of Consistency was obtained in the treatment T₄O₁ (8.00) respectively.

Table 6: Consistency in experimental sample whey based Orange juice beverage.

Juice (%)	Whey + water					Mean
	T ₁ (90:10)	T ₂ (80:20)	T ₃ (70:30)	T ₄ (60:40)	T ₅ (50:50)	
O ₁ (10%) Juice	5.00	6.00	6.00	6.33	5.66	5.80
O ₂ 15 (%) Juice	6.33	6.66	6.33	7.00	8.00	6.86
O ₃ 20 (%) Juice	7.33	7.00	7.33	7.00	7.66	7.26
Mean	6.22	6.55	6.55	6.77	7.11	
			C.D. at 5%	F-Test		
Due to juice (%)			0.317	S		
Due to Whey + water			0.408	S		
Int. (juice) x (Whey + water)			0.701	S		

It is observed that the mean value of O₃ 20(%) Juice) was observed to be highest compare to the mean value of O₁ 10(%) Juice & O₂ 15(%) Juice hence, O₃ could be regarded as most effective. Similarly the average flavour and taste due to

T₄ (60:40) Whey + water is highest, so this ratio may be considered as most effective. It is evident from the table 7 that the highest average value of Flavour and Taste was obtained in the treatment T₃O₃ (8.00).

Table 7: Flavour and Taste percent in experimental sample whey based fruit beverages.

Juice (%)	Whey + water					Mean
	T ₁ (90:10)	T ₂ (80:20)	T ₃ (70:30)	T ₄ (60:40)	T ₅ (50:50)	
O ₁ (10%) Juice	5.66	6.00	6.00	5.66	6.00	5.86
O ₂ 15 (%) Juice	6.33	6.00	7.00	8.00	6.00	6.80
O ₃ 20 (%) Juice	7.33	7.66	6.33	6.66	7.00	7.00
Mean	6.44	6.55	6.44	6.77	6.55	
			C.D. at 5%	F-Test		
Due to juice (%)			0.301	S		
Due to Whey + water			0.398	S		
Int. (juice) x (Whey + water)			0.681	S		

It is observed that the mean value of O₂ 15(%) Juice) was observed to be highest compare to the mean value of O₁ 10(%) Juice) & O₃ 20(%) Juice, hence O₂ could be regarded as most effective. Similarly the average overall acceptability

due to T₄ (60:40) Whey + water is highest, so this ratio may be considered as most effective. It is evident from the table 8 that the highest average value of Overall acceptability was obtained in the treatment T₃O₃ (8.66) respectively.

Table 8: Overall acceptability in experimental sample whey based Orange juice beverage.

Juice (%)	Whey + water					Mean
	T ₁ (90:10)	T ₂ (80:20)	T ₃ (70:30)	T ₄ (60:40)	T ₅ (50:50)	
O ₁ (10%) Juice	6.00	7.00	7.00	6.66	7.00	6.73
O ₂ 15 (%) Juice	7.66	7.00	8.00	8.66	6.33	7.53
O ₃ 20 (%) Juice	7.00	7.00	6.33	6.66	7.00	6.80
Mean	6.88	7.00	7.11	7.33	6.77	
			C.D. at 5%	F-Test		

Due to juice (%)			0.85	S		
Due to Whey + water			1.11	S		
Int. (juice) x (Whey + water)			1.92	S		

The experiments were conducted to study the preparation and the sensory characteristics viz. Colour and appearance, Consistency, Flavour and Taste and Overall acceptability were done on 9 point hedonic scales. The sensory score obtained with respect to whey based fruit juice beverages (pineapple) and based fruit juice beverages (Orange). It is observed that beverage sample (T₃P₃) and (T₃O₃) prepared by adding whey & water (70:30) and fruit juice (20%) was liked most by the sensory members as compared to the other combinations. The highest average value of Colour and appearance was obtained in the treatment T₅P₃ (7.00) and the lowest average value of Colour and appearance was obtained in the treatment T₁P₁ (4.33). The highest average value of Consistency was obtained in the treatment T₂P₃, T₃P₁, T₃P₃, T₄P₁, T₄P₃, and T₅P₃ (7.00) respectively and the lowest average value of Consistency was obtained in the treatment T₁P₁ (5.00) and T₁P₂ (5.00). The highest average value of Flavour and Taste was obtained in the treatment T₃P₃ (7.66) and lowest average value of Flavour and Taste was obtained in the treatment T₁P₁ (5.66) and T₄P₃ (5.66). The highest average value of Overall acceptability was obtained in the treatment T₃P₃ (7.66) and the lowest average value of Overall acceptability was obtained in the treatment T₂P₁ (5.00). The highest average value of Colour and appearance was obtained in the treatment T₃O₃ (8.66) and the lowest average value of Colour and appearance was obtained in the treatment T₂O₁ (6.33). The highest average value of Consistency was obtained in the treatment T₄O₁ (8.00) and the lowest average value of Consistency was obtained in the treatment T₁O₁ (5.00). The highest average value of Flavour and Taste was obtained in the treatment T₃O₃ (8.00) and the lowest average value of Flavour and Taste was obtained in the treatment T₁O₁ (5.66) and T₂O₁ (5.66). The highest average value of Overall acceptability was obtained in the treatment T₃O₃ (8.66) and the lowest average value of Overall acceptability was obtained in the treatment T₁O₁ (6.00) the result revealed that the decrease in level of fruit juice and increase in level of whey lower down the sensory score of beverages

Conclusion

Organoleptic evaluation showed that whey based fruit beverage prepared by using whey & water (70:30) and 20 % fruit juice both Pineapple and Orange T₃P₃ & T₃O₃ was found to be more acceptable as compared to sample prepared by using different whey, water and fruit juice concentration, as it gave good Flavour & Taste and Overall acceptability. It is therefore concluded that whey based fruit beverage can be prepared by using whey. These beverages have high nutritional quality and increased energy value. These could be particularly useful in place where there is lack of food and improper nutrition leading to deficiencies of certain nutrients.

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