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Development, chemical analysis and sensory evaluation of whey based pineapple juice beverages

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Abstract
Whey based pineapple fruit juice beverages were prepared using different ratio of whey and water (90:10, 80:20, 70:30, 60:40 & 50:50), fruit juice percent (10%, 15% & 20%), sugar 10% and Citric acid 0.2% were kept constant in all the treatments. 15 treatments were prepared for chemical and sensory evaluation on an average the whey based pineapple juice beverages of treatment T_1P_1, T_1P_2, T_1P_3, T_2P_1, T_2P_3, T_3P_1, T_3P_2, T_3P_3, T_4P_1, T_4P_2, T_4P_3, T_5P_1, T_5P_2 and T_5P_3 contained moisture85.42,85.39,84.29,85.9285.87,84.76,86.43,85.31,85.28,86.98,86.94,85.88,87.51,87.47 and86.42 percent, Ash 0.32,0.32, 0.32,0.31, 0.32, 0.32, 0.28, 0.28, 0.29,0.26, 0.26, 0.27, 0.22, 0.22 and 0.23 percent, Protein 0.43,0.46,0.48,0.39, 0.42, 0.44, 0.35, 0.38, 0.40,0.31, 0.34,0.36, 0.27, 0.30 and 0.32 percent, Fat 0.40,0.41, 0.41, 0.36,0.37, 0.37,0.32, 0.33, 0.33, 0.28, 0.29, 0.29, 0.24, 0.25 and0.25 percent, Carbohydrate 13.42, 13.42,14.5, 13.01, 13.01, 14.11,12.59, 12.59, 13.7,12.17,12.17,13.2,11.76, 11.76 and 12.80 percent, Total Solid14.56, 14.61, 15.72, 14.06,14.11, 15.23,13.51,14.70,14.71,13.03,13.05,14.11,12.48,12.51 and 13.58 percent, respectively. Colour and Appearance 5.33, 5.66, 6.00, 6.33, 6.33, 5.66, 6.00, 5.33, 6.00, 6.33, 6.33, 6.33, 6.66, 6.66 and T_5P_3 7.00, Consistency 6.00, 6.00, 6.33, 6.00, 5.66, 7.00, 7.00, 6.66, 7.00, 7.00, 6.66, 7.00, 6.00,6.66 and 7.00, Flavour and Taste 5.66,6.00, 60.66, 6.00, 6.33, 7.00, 6.00, 6.66, 7.66, 7.00, 6.00, 6.66, 6.00, 6.00 and 6.00, overall acceptability 6.00, 5.66, 6.33, 5.00, 6.00, 6.00, 5.66, 6.66, 7.666, 6.66, 7.00,7.00, 6.66,6.33 and 7.00. Whey based Pineapple fruit juice beverage prepared by using whey :water (70:30) and 20 % fruit juice T_3P_3 was found to be more acceptable as compared to sample prepared by using different combination of whey, water and fruit juice concentration, as it gave good Flavour & Taste and Overall acceptability.

Keywords: organoleptic evaluation, chemical analysis and pineapple

1. Introduction
Whey is the milk serum, yellowish liquid portion of milk left after the formation of curd / coagulated products that result from acid or proteolytic enzyme. It is the main by-product, left after the manufacture of paneer, channa, chakka, cheese, casein, etc. About 80-90 percent whey is obtained during the manufacturing of these products and only 10- 20 per cent portion of milk is recovered as an end product. Depending on the types of coagulant used whey is defined as Acid whey or Sweet whey. Acid whey is the milk serum obtained after the production of rennet cheese (hard cheese), whereas Sweet whey is the milk serum results from the production of cottage cheese. Another type of whey is the Industrial grade whey, which is obtained when protein coagulation is done with acids other than lactic acid, e.g, hydrochloric acid, sulphuric acid or acetic acid.

Whey contain 45-50 percent of total milk solid, 70 percent of milk sugar(lactose), 20 percent of milk protein and 70-90 percent of milk minerals and almost all the water soluble vitamins present in the milk (Horton, 1995). The protein present in the whey comprises about 50 per cent ß lactoglobulin, 25 percent of a – lactalbulmin and 25 percent other proteins.

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). Currently, it is estimated about 165 million tones of whey is produce in the world of which European produce 68 per cent and North America 24 per cent (Anonymous, 2010) [2].

In India, about 5 million tones whey is produced of which 80 per cent of total whey is from channa and paneer whey (Gupta, 2008) [7] and large portion of it is disposed of as a waste. It is reported by Divya and Kumari, 2009 [5] that the Biological oxygen demand (BOD) of whey varies from 39,000- 48,000 pm and it if found to be uneconomic to treat the whey before disposal. An effective and permanent solution is needed to treat the biological waste water which is within the federal environment specification and also only at minimal cost. It is only at the late twentieth century that the regulations for preventing disposal of untreated whey and recognition of the value of whey components were know. It resulted in increase in people attention towards whey and whey product.

Whey has been tried in the past to utilize in the manufacturing 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].

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) [4]. Pineapple is the third most important tropical fruit in the world after Banana and

Citrus (Bartholomew et.al. 2003) [3]. In India, the pineapple is grown on a commercial scale along the Costal area of Andhra Pradesh, Kerala and to certain extent in Bengal, Assam, Mizoram and Manipur. Pineapple juice's composition varies depending on geography, season, process and time of harvest. Its balance of sugar and acid contributes to the fruit's refreshing flavor (http://livewell.jillianmichaels.com/acids-pineapple-juice-5081.html).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) [8]. 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) [6].

The present study was undertaken to focus on development of whey based pineapple juice beverage with addition of whey, water, pineapple juice, citric acid and sugar, and to suggest the optimal blend formulation and waste product utilization (dairy). At present fruit beverages are generally synthetic flavored, bottled are sold in the market. If this could be substituted with fruit juice and dairy whey, it will be more beneficial to the consumer, dairy industries and beverage manufacturers and fruit growers. Beverages based on whey continue to receive a considerable amount of attention reflecting a growing awareness of the potential of these products in the market place. 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. In order to find the optimal products, 15 blends were prepared and their quality was estimated by sensor analysis. The results of quality estimation are presented graphically. On the basis of the analysis of the quality estimation, optimal formulations for whey based fruit beverages were determined and the best product was suggested.

2. 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) 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) 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.

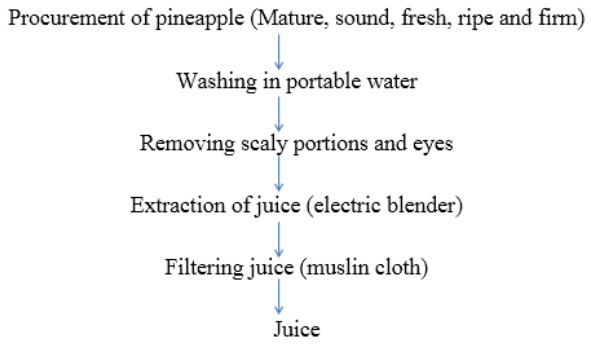

Fig 1: Flow chart for preparation of pineapple juice

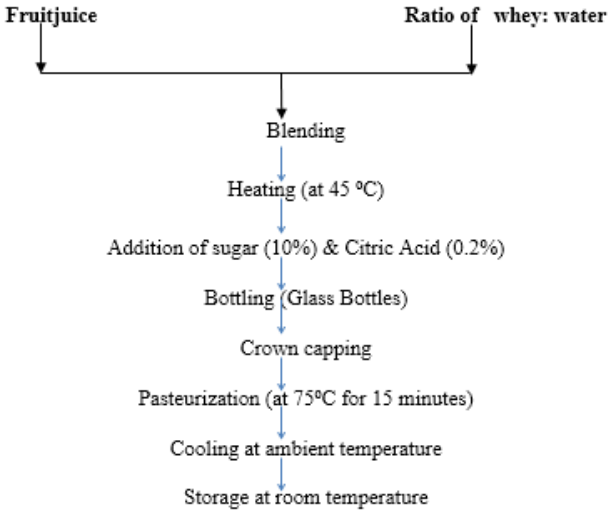

Fig 2: Process flow sheet for the preparation of whey- based fruit juice beverage.

Chemical Analysis

The samples prepared were analyzed for chemical constituents using standard procedure: (Moisture, Fat, Protein, Ash, Total Solid and Carbohydrate)

Organoleptic Evaluation

The prepared beverages were evaluated using 9 point hedonic scale

Statistical Method

The data was subjected to statistical analysis using Two Way Classification Analysis of Variance with three observations per cell. The value of critical differences at 5% probability level where also calculated.

3. Result and Discussion

The whey based pineapple juice beverages were analyzed for Moisture, Fat, Protein, Ash, Total solid and Carbohydrate.

Table 1, indicate that the average moisture content was significantly influenced by the ratio of whey and water and also due to juice percentage. The highest average value of moisture content was obtained in the treatment T_5P_1 (87.51) and the lowest average value of moisture content was obtained in the treatment T_1P_3 (84.29). The moisture content increased when whey and water ratio decreased and moisture content

decreased when juice percent increased.

The highest average value of ash content was obtained in the treatment T_1P_3 (0.32) and the lowest average value of ash content was obtained in the treatment T_5P_1 (0.22) and T_5P_2 (0.22). The ash content increased with increased in whey and water ration and also with increased in fruit juice percent.

It is observed from the table 1 that the highest average value of protein content was obtained in the treatment T_1P_3 (0.48) and the lowest average value of protein content was obtained in the treatment T_5P_1 (0.27). The Protein content in whey based pineapple juice beverage decreased with decreased in whey and water ratio and also with decreased in fruit juice percent.

Table 1 indicates that the highest average value of fat content was obtained in the treatment T_1P_2 (0.41) & T_1P_3 (0.41) and the lowest average value of fat content was obtained in the treatment T_5P_1 (0.24). The Fat content in the whey based pineapple juice beverages decreased with decreased in whey and water ratio but there are no significant changes due to fruit juice percent.

From the table 1, the highest average value of Carbohydrates content was obtained in the treatment T_1P_3 (14.5) and the lowest average value of Carbohydrates content was obtained in the treatment T_5P_1 (11.76) and T_5P_2 (11.76). The carbohydrate content of whey based pineapple juice beverages increased with increased in the ratio of whey and water and also with increased in fruit juice percent.

The highest average value of Total solid content according to table 1, was obtained in the treatment T_1P_3 (15.71) and the lowest average value of Total solid content was obtained in the treatment T_5P_1 (12.48). The Total solid content of whey based pineapple juice beverages increased with increased in whey and water ratio and also with increased in fruit juice percent.

Sensory Evaluation

- **Colour and appearance:** The highest average value of Colour and appearance was obtained in the treatment T_3O_3 (8.66) and the lowest average value of Colour and appearance was obtained in the treatment T_2O_1 (6.33)
- **Consistency:** The highest average value of Consistency was obtained in the treatment T_3O_3 (8.00) and the lowest average value of Consistency was obtained in the treatment T_1O_1 (5.00)
- **Flavour and Taste:** The highest average value of Flavour and Taste was obtained in the treatment T_3O_3 (8.00) and the lowest average value of Flavour and Taste was obtained in the treatment T_1O_1 (5.66) and T_2O_1 (5.66)
- **Overall Acceptability:** The highest average value of Overall acceptability was obtained in the treatment T_3O_3 (8.66) and the lowest average value of Overall acceptability was obtained in the treatment T_1O_1 (6.00)

4. Conclusion

Organoleptic evaluation showed that whey based Pineapple fruit juice beverage prepared by using whey & water (70:30) and 20 % fruit juice T_3P_3 was found to be more acceptable as compared to sample prepared by using different combination of whey, water and fruit juice concentration, as it gave good Flavour& Taste and Overall acceptability. It is therefore concluded that whey was found excellent for development of whey based pineapple juice beverage. 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.

Table 1: Whey based pineapple juice beverage

Treatments	T_1P_1	T_1P_2	T_1P_3	T_2P_1	T_2P_2	T_2P_3	T_3P_1	T_3P_2	T_3P_3	T_4P_1	T_4P_2	T_4P_3	T_5P_1	T_5P_2	T_5P_3
Chemical parameters															
Moisture (%)	86	85.60	85.20	86.9	86.45	86.19	87.55	87.21	86.91	87.98	87.00	86.75	88.21	87.80	87.39
Ash (%)	0.4	0.43	0.43	0.39	0.41	0.41	0.38	0.39	0.4	0.38	0.39	0.39	0.36	0.36	0.37
Protein (%)	0.53	0.54	0.55	0.52	0.53	0.53	0.5	0.52	0.53	0.48	0.5	0.51	0.44	0.45	0.46
Fat (%)	0.45	0.45	0.45	0.43	0.44	0.42	0.42	0.42	0.42	0.4	0.4	0.4	0.39	0.38	0.38
Total Carbohydrates (%)	12.62	12.98	13.37	11.76	12.17	12.45	11.15	11.46	11.74	10.76	11.71	11.95	10.6	12.69	11.4
Total solid (%)	14	14.4	14.8	13.1	13.55	13.81	12.45	12.79	13.09	12.02	13.00	13.25	11.79	11.01	12.61
Sensory evaluation															
Colour and appearance	6.33	6.66	6.99	6.33	6.75	7	6	6.33	6.66	6.33	6.33	6.33	6.66	6.66	6.99
Consistency	6	6	6.33	6	6.66	7	7	6.66	7	7	6.66	7	6	6.66	7
Flavour and Taste	5.66	6	6.66	6	6.33	7	6	6.66	7.66	7	6	5.66	6	6	6
Overall acceptability	6	5.66	6.33	5	6	6	5.66	6.66	7.66	6.66	7	7	6.66	6.33	7

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