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Sensory quality of whey beverage prepared with different fruit juices and it's shelf-life

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Abstract

The resent investigation was conducted at the Department of Animal Husbandry and Dairying, C.S. Azad University of Agriculture and Technology, Kanpur. This study evaluated the effect of three types of fruit juice *viz*., Pineapple (A_1), Pomegranate (A_2) and Sweet lime (A_3) on the sensory properties of whey beverages with different fruit juices. The impact of four juice concentration levels (15%, 20%, 25%, and 30%), three sugar levels (6%, 8%, and 10%), and five storage periods (0, 7, 14, 21, and 28 days) was systematically assessed. The sensory evaluation revealed that Pineapple juice-based beverages (A_1) achieved the highest flavour score (7.60), followed by sweet lime (A_3) with 7.45, and pomegranate (A_2) with 7.39. Beverages with 25% fruit juice (B_3) recorded the best flavour score (8.18), and those with 10% sugar (C_3) were preferred with a mean score of 8.00. Fresh samples (D_1) exhibited the highest sensory appeal with a flavour score of 8.02, which significantly declined by the 28th days (D_5) to 5.30, indicating storage-related sensory deterioration.

Keywords: Whey, fruit juices, sensory evaluation, & shelf-life etc.

Introduction

Milk is considered as the most satisfactory, ideal and almost completes food, endowed by nature, which is also referred as 'Bank of nutrients'. Milk plays an important role in meeting the requirements of many essential nutrients, and hence milk is considered as a protective food. Also, it is essential food for the newly born young ones and equally important to the expectants mother for supply of most essential major and minor substance. Dairy technologists are engaged to see that each and every constituents of milk are properly utilized. (Anonymous, 2023) [5].

Whey is the largest and highly nutritious important product of the dairy industry, it is obtained during the manufacture of casein, cheese, paneer, chhana and shrikhand. Whey protein comprises of four major protein fractions and six minor protein fractions. Major protein fractions include beta-lactoglobulin (65%), alpha-lactalbumin (25%), bovine serum albumin (8%) and immune globulins (2%) (Ramos *et. al*., 2016) [15]. Minor fractions include lactoferrin, lysozyme, lactoperoxidase and glyco macro peptides.

Prepared soft drinks from the clarified and deproteinized whey by addition of cane sugar, citric acid, flavour and final preparation was subjected to pasteurization and carbonation. Among four flavours tried in whey soft drink, orange flavour was highly acceptable. No off- flavours or signs of spoilage were observed in all the stored soft drink samples.

Materials and Methods

Materials: Materials mainly included the ingredients required for optimization of compositional and processing parameters of Whey beverage with different fruit juices. The following material ware used for the present investigation.

Collection of cow milk: Requisite amount of cow milk was obtained from Experimental Dairy C.S. Azad University of Agriculture & Technology, Kanpur, whey which was required for the preparation of whey beverage with different fruit juices.

Sugar: Good quality, clean, crystalline, white cane sugar was purchased from local market.

Muslin cloth: Clean, suitable size muslin cloth piece was used for straining of whey.

Chemicals: Citric acid @ 1.5 per cent and analytical reagents (AR) were used in the physico-chemical analysis.

Equipment: The equipment used for the preparation and packaging of Whey beverage with different fruit juices was as under:

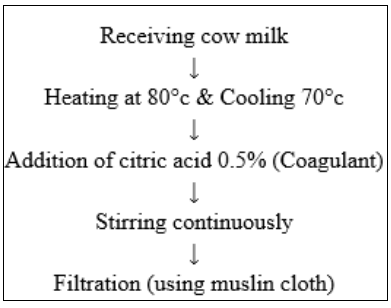
- Gas stove as heating media
- Stainless steel vessel for milk heating.
- Stainless steel ladle.
- A centigrade scalethermometer.
- Hoop for whey straining.
- Electronic weighing machine
- Hand juicer machine
- Stainless steel knife.
- Transparent glass bottles of 200 ml capacity for packaging

Preparation technique

Extraction of paneer whey

Paneer whey was prepared as per the method given by **Shewfelt (1997).** Good quality fresh cow milk was strained through muslin cloth. At that point milk was transferred to stainless steel vessel and brought to boil by warming at temperature 800C. The vessel was expelled from the fire and permits to cool at temperature 750C. The coagulant i.e. citric acid @ 0.5 per cent was added slowly and blended so that it was blended properly. The coagulated milk was pouredover piece of clean muslin cloth extended over another vessel to deplete the whey. The clear milked whey was collected in vessel. The whey was once more heated to a temperature of 100^0C for 5 minutes, so as to remove the traces of fat and curd particles. The clear yellowish green whey was at that point used for the preparation of whey beverage with different fruit juices.

Flow diagram showing preparation of paneer whey from milk

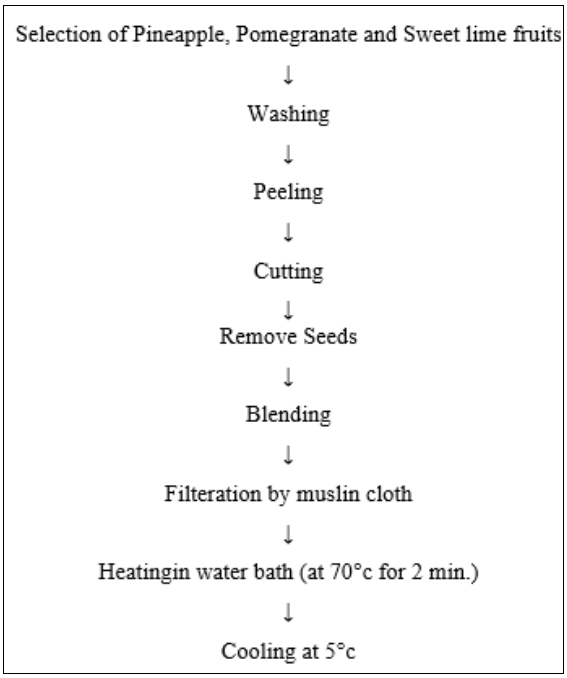


Selection of Pineapple, Pomegranate and Sweet Lime Fruits

Pineapple, Pomegranate and Sweet Lime Fruits were collected from nearest fruit market, Kalyanpur Kanpur Nagar. During the course of present study while selecting the both fruits, stage of ripening, size, colour and taste were considered so that there should not be any variation in the quality of juice to be extracted from the natural product.

Preparation of Pineapple, Pomegranate and Sweet Lime Juice

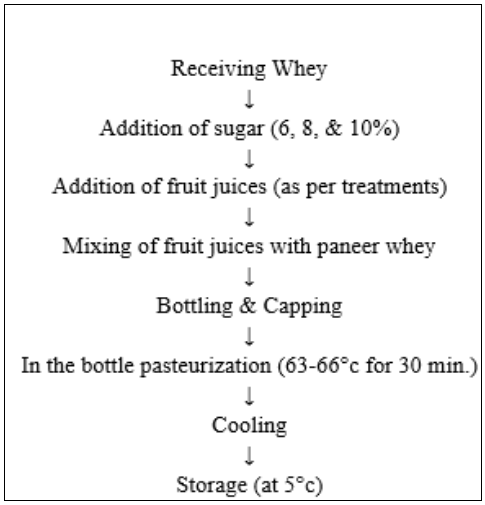
Flow diagram: showing preparation of Pineapple Juice, Pomegranate Juice and Sweet Lime Juice.



Preparation of whey beverage with different fruit juices

Flow diagram for whey beverage with different fruit juices given by Reddy *et al.* (1987) [25] was used with following modifications. The paneer whey obtained from cow milk, cool to room temperature and then it passed through the hand cream separator machine for removal of residual fat. After getting this defatted, sugar and (15, 20, 25 and 30 percent) fruit juices were added. The products were filled in sterilized bottles and then cooled and stored in refrigerator at 5-7 °C.

Flow diagram of Whey beverage with different fruit juices



(Reddy *et al.*, 1987) [25]

Results and Discussion

Sensory tests were utilized to decide the sensory quality of whey beverage with different fruit juices by a board of five judges from the department of Animal Husbandry and Dairy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The judges considered flavour, colour and appearance, sweetness and overall acceptability of whey

beverage with different fruit juices when assessing the test. The samples of whey beverage with different fruit juices were subjected to organoleptic assessment on 9-Point Hedonic scale as endorsed in IS: 6273 (Part-II) 1971 [8]. A board of five semi prepared judges were given the treated samples of the whey beverage with different fruit juices for sensory assessment. The results and discussion of this inquiry have been displayed beneath the taking after headings.

Table 1 Flavour

The flavour of whey beverage with different fruit juices is the most critical quality attribute, determining its acceptability. It must be free from any off-flavour, bitterness, excessive acidity, or curdling. The effect of various factors on the flavour score is presented in Table 4.1.1 (A & B), and the analysis of variance is shown in Table 1 (C). These tables reveal the following observations.

Table 1: (A) The effect of Fruit juices (A), Levels of fruit juices (B), Levels of sugar (C) and Storage period (D) on flavour score of Whey beverage with different fruit juices.

	B1	B2	B3	B4	C1	C2	C3	D1	D2	D3	D4	D5	Mean
A1	7.91	8.00	8.11	8.20	8.29	8.29	8.22	8.01	7.41	7.11	6.37	5.33	7.60
A2	7.38	7.68	8.34	8.07	7.75	7.94	7.90	7.98	7.22	7.13	6.21	5.20	7.39
A3	7.32	7.64	8.10	7.98	7.69	7.69	7.90	8.19	7.28	7.64	6.45	5.61	7.45
B1					7.42	7.50	7.70	7.50	7.23	6.95	6.14	5.19	6.95
B2					7.74	7.85	7.99	8.23	7.42	7.16	6.29	5.22	7.23
B3					8.02	8.38	8.28	8.16	7.37	7.23	6.36	5.33	7.39
B4					8.32	8.16	8.02	8.06	7.24	7.11	6.36	5.30	7.31
C1								8.02	7.24	7.07	6.30	5.25	6.77
C2								8.11	7.42	7.21	6.38	5.36	6.89
C3								7.96	7.35	7.14	6.27	5.24	6.79
Mean	7.53	7.77	8.18	8.08	7.89	7.97	8.00	8.02	7.31	7.17	6.31	5.30	

	A	B	C	D	AB	AC	AD	BC	BD	CD
SE(d)	0.37	0.43	0.37	0.48	0.74	0.64	0.83	0.74	0.96	0.83
SE(M)	0.26	0.30	0.26	0.34	0.53	0.46	0.59	0.53	0.68	0.59
CD at 5%	0.73	0.96	0.84	0.94	1.24	1.46	1.64	2.15	1.46	1.64

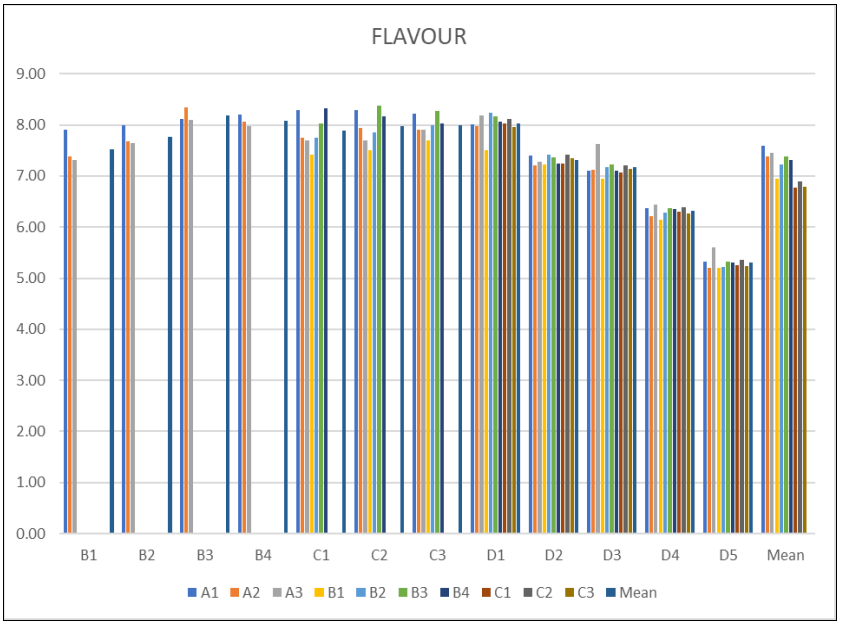


Fig 1: The effect of Fruit juices (A), Levels of fruit juices (B), Levels of sugar (C) and Storage period (D) on flavour score of Whey beverage with different fruit juices

From Table 1 (A), the following observations regarding the effect of fruit juices (A), levels of fruit juice (B), sugar levels (C), and storage periods (D) on the flavour score were made. Among the types of fruit juices, the highest mean flavour score (7.60) was recorded for beverages prepared with Pineapple juice (A1), followed by Sweet Lime juice (A3) with a score of 7.45, while Pomegranate juice (A2) had the lowest score of 7.39. This suggests that Pineapple whey beverages with different fruit juices were most preferred in terms of flavour.

For the levels of fruit juice (B), the 25% juice level (B3) yielded the highest mean score of 8.18, closely followed by the 30% juice level (B4) with 8.08. In contrast, the 15% juice level (B1) had the lowest score of 7.53, indicating that higher fruit juice levels enhanced the flavour profile.

Regarding the effect of sugar levels (C), beverages with 10% sugar (C3) achieved the highest mean score of 8.00, followed by 8% sugar (C2) with 7.97. The lowest flavour

score was observed for 6% sugar (C1) with a score of 7.89. These results suggest that higher sugar levels contributed positively to the flavour perception.

The storage period (D) had a significant impact on the flavour scores. The highest mean score of 8.02 was observed in fresh samples (D1), followed by D2 (7.31). However, the flavour deteriorated over time, with the lowest score recorded on the 28th day (D5) at 5.30. This indicates a gradual decline in sensory quality over the storage period.

The interaction of fruit juices and juice levels (AB) revealed that the combination of Pineapple juice (A1) with 25% juice (B3) scored the highest (8.11). Similarly, among sugar levels and storage periods (CD), the highest score (8.02) was observed for fresh samples with 6% sugar (C1D1). However, the lowest interaction score (5.24) was noted for C3D5, indicating that prolonged storage negatively impacted flavour.

The data was found to be significant at the 5% level with a Critical Difference (CD) of 0.73 for fruit types (A), 0.96 for juice levels (B), 0.84 for sugar levels (C), and 0.94 for storage periods (D). Additionally, significant interactions were observed for AB (CD = 1.24) and BC (CD = 2.15), highlighting the importance of optimal combinations of these factors to maintain the flavour quality of whey beverages with different fruit juices**.**The results of the current study for flavor were similar to those reported by Prasad *et al.* (2013) [22], who prepared a whey-based mango beverage and observed an average sensory score for flavor ranging from 6.23 to 8.76.

Table 2 Colour and Appearance

The colour of Whey beverage with different fruit juices plays a crucial role in consumer acceptance. It should be visually appealing, uniform, and free from any visible foreign matter. The colour of beverages prepared with Pineapple juice (A1) varies from pale yellow to light golden, where as beverages made with Pomegranate juice (A2) range from pinkish-red to bright red, and those with Sweet Lime juice (A3) display a pale yellowish hue. The effect of various factors on the colour and appearance of the beverage is summarized in Table 2 (A & B), and the statistical analysis is provided in Table 4.1.2 (C). The data reveal the following observation.

Table 2: (A) The effect of Fruit juices (A), Levels of fruit juices (B), Levels of sugar (C) and Storage period (D) on Colour and Appearance of Whey beverage with different fruit juices.

	B1	B2	B3	B4	C1	C2	C3	D1	D2	D3	D4	D5	Mean
A1	6.12	6.37	6.67	6.63	6.40	6.41	6.54	8.06	7.30	6.48	5.58	4.83	6.45
A2	5.65	5.88	6.37	6.16	5.92	6.07	6.05	7.65	6.86	6.01	5.15	4.40	6.01
A3	5.75	5.99	6.33	6.24	6.03	6.03	6.18	7.70	6.91	6.11	5.19	4.48	6.08
B1					5.75	5.81	5.96	7.45	6.68	5.88	4.96	4.23	5.84
B2					5.99	6.08	6.17	7.70	6.93	6.09	5.21	4.47	6.08
B3					6.20	6.47	6.71	8.09	7.30	6.46	5.59	4.86	6.46
B4					6.53	6.30	6.19	7.96	7.19	6.37	5.46	4.73	6.34
C1								7.73	6.96	6.15	5.24	4.51	6.12
C2								7.79	7.01	6.18	5.30	4.56	6.17
C3								7.88	7.11	6.27	5.38	4.65	6.26
Mean	5.84	6.08	6.46	6.34	6.12	6.17	6.26	7.80	7.02	6.20	5.31	4.57	

	A	B	C	D	AB	AC	AD	BC	BD	CD
SE(d)	0.008	0.009	0.008	0.010	0.015	0.013	0.017	0.015	0.020	0.017
SE(M)	0.005	0.006	0.005	0.007	0.011	0.009	0.012	0.011	0.014	0.012
CD at 5%	0.015	0.020	0.017	0.019	0.026	0.030	0.034	0.044	0.030	0.034

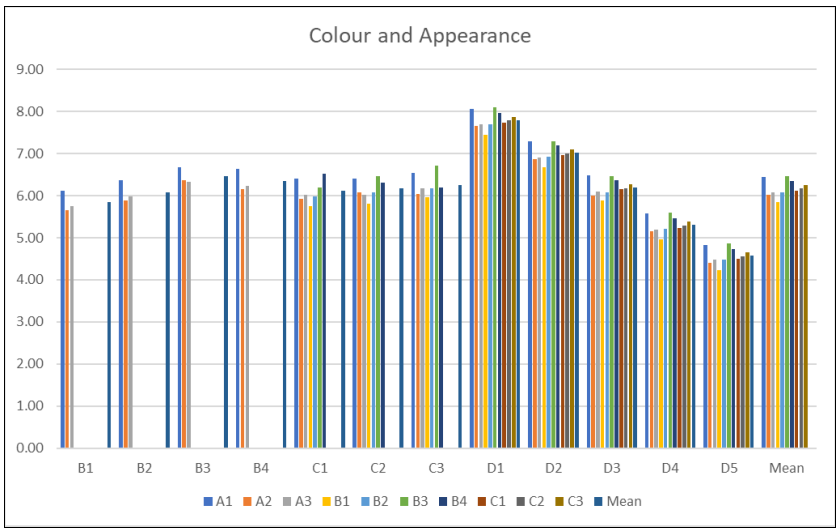


Fig 2: The effect of Fruit juices (A), Levels of fruit juices (B), Levels of sugar (C) and Storage period (D) on Colour and Appearance of Whey beverage with different fruit juices

From Table 2 (A), the mean colour and appearance score for Pineapple juice (A1) was the highest at 6.45, followed by Sweet Lime juice (A3) at 6.08, while Pomegranate juice (A2) had the lowest score of 6.01. This indicates that beverages prepared with Pineapple juice are visually more appealing than the other two. Among the different juice levels, 25% juice (B3) recorded the highest score (6.46), while 15% juice (B1) had the lowest (5.84), suggesting that higher juice levels improve the appearance.

The sugar content also influenced the appearance, with 10% sugar (C3) achieving the highest score (6.26), followed by 8% sugar (C2) with 6.17. The lowest score (6.12) was observed with 6% sugar (C1). This shows that moderate sugar levels enhance the beverage's appearance. Storage periods significantly affected the colour and appearance, with fresh samples (D1) achieving the highest score (7.80). However, as the storage period increased, the score declined to 4.57 on the 28th day (D5), indicating visual deterioration over time (Chatterjee *et al.* 2021) [11].

Sweetness

The sweetness of Whey beverage with different fruit juices plays a significant role in it's sensory appeal. The sweetness score, as influenced by various factors such as fruit types, fruit juice levels, sugar levels, and storage duration, is presented in Table 3 (A & B), with the variance analysis shown in Table 3 (C).

Table 3: (A) The effect of Fruit juices (A), Levels of fruit juices (B), Levels of sugar (C) and Storage period (D) on Sweetness score of Whey beverage with different fruit juices.

	B1	B2	B3	B4	C1	C2	C3	D1	D2	D3	D4	D5	Mean
A1	6.01	6.26	6.56	6.52	6.29	6.29	6.43	7.93	7.16	6.35	5.44	4.81	6.34
A2	5.53	5.76	6.25	6.03	5.80	5.95	5.93	7.51	6.71	5.87	5.00	4.37	5.89
A3	5.62	5.86	6.20	6.11	5.89	5.89	6.05	7.55	6.75	5.96	5.03	4.44	5.95
B1					5.63	5.69	5.84	7.31	6.53	5.74	4.81	4.20	5.72
B2					5.87	5.96	6.05	7.56	6.78	5.95	5.06	4.44	5.96
B3					6.08	6.35	6.58	7.95	7.15	6.32	5.44	4.83	6.34
B4					6.41	6.18	6.07	7.82	7.04	6.23	5.31	4.70	6.22
C1								7.59	6.81	6.01	5.09	4.48	6.00
C2								7.65	6.86	6.04	5.15	4.53	6.05
C3								7.74	6.96	6.13	5.23	4.62	6.14
Mean	5.72	5.96	6.34	6.22	6.00	6.05	6.14	7.66	6.87	6.06	5.16	4.54	

	A	B	C	D	AB	AC	AD	BC	BD	CD
SE(d)	0.008	0.009	0.008	0.010	0.015	0.013	0.017	0.015	0.020	0.017
SE(M)	0.005	0.006	0.005	0.007	0.011	0.009	0.012	0.011	0.014	0.012
CD at 5%	0.015	0.020	0.017	0.019	0.026	0.030	0.034	0.044	0.030	0.034

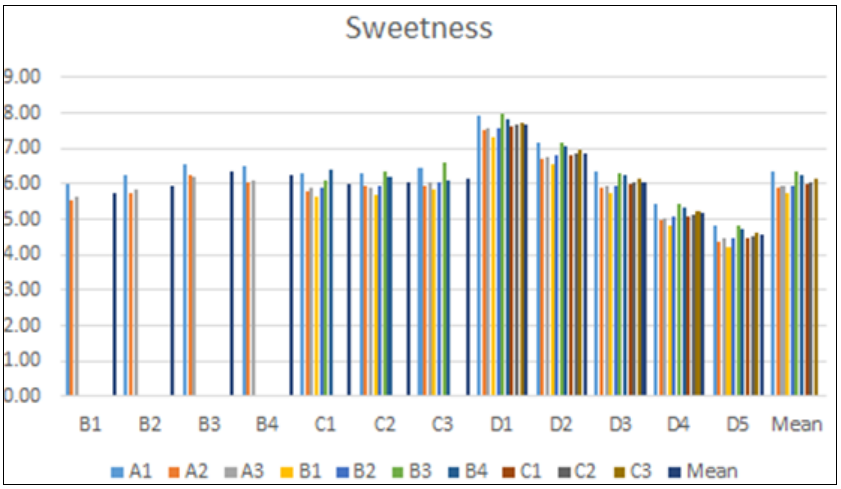


Fig 3: The effect of Fruit juices (A), Levels of fruit juices (B), Levels of sugar (C) and Storage period (D) on Sweetness score of Whey beverage with different fruit juices.

From Table 3 (A), it was observed that the sweetness score varied across the levels. The highest sweetness score was recorded in sample C3 (7.74) at 12% sugar level, followed by C2 (7.65) at 10% sugar level, while the lowest sweetness score was noted in C1 (6.00). The difference between these samples was statistically significant at 5% (CD=0.017).

In terms of fruit juice levels, B3 (30% juice) achieved the highest score of 6.34, with B2 (25%) at 5.96. The lowest score of 5.72 was observed at 20% (B1). The statistical analysis confirmed these differences were significant (CD=0.020). Regarding fruit type, pineapple juice (A1) exhibited the highest average sweetness (6.34), followed by sweet lime juice (A3) with 5.95, while A2 scored 5.89. The results indicated significant variation between the fruit types at 5% (CD=0.015). Storage periods showed a significant decline in sweetness over time. Fresh samples (D1) scored the highest (7.66), with scores progressively decreasing to 4.54 after 20 days (D5). This trend of reduced sweetness

with storage was statistically significant (CD=0.019) (Naik & Desai, 2017) [20].

Overall-acceptability

The overall-acceptability of Whey beverage with different fruit juices as affected by different factors has been presented in Table 4. (A&B) and its analysis of variance in Table 4. (C). The data presented by figure no. 4, which revealed the following facts.

Table 4: (A) The effect of Fruit juices (A), Levels of fruit juices (B), Levels of sugar (C) and Storage period (D) on Overall-acceptability score of Whey beverage with different fruit juices.

	B1	B2	B3	B4	C1	C2	C3	D1	D2	D3	D4	D5	Mean
A1	6.20	6.45	6.75	6.71	6.48	6.49	6.62	8.09	7.34	6.53	5.70	4.99	6.53
A2	5.71	5.93	6.43	6.22	5.98	6.13	6.10	7.66	6.88	6.04	5.25	4.54	6.07
A3	5.71	5.95	6.29	6.20	5.99	5.99	6.14	7.61	6.83	6.04	5.19	4.52	6.04
B1					5.78	5.84	5.99	7.43	6.67	5.88	5.04	4.34	5.87
B2					6.02	6.11	6.20	7.68	6.92	6.09	5.28	4.58	6.11
B3					6.24	6.51	6.74	8.07	7.29	6.46	5.67	4.97	6.49
B4					6.56	6.34	6.23	7.95	7.18	6.37	5.53	4.85	6.38
C1								7.72	6.95	6.15	5.31	4.62	6.15
C2								7.78	7.00	6.18	5.37	4.68	6.20
C3								7.86	7.10	6.27	5.45	4.76	6.29
Mean	5.87	6.11	6.49	6.38	6.15	6.20	6.29	7.78	7.02	6.20	5.38	4.69	

	A	B	C	D	AB	AC	AD	BC	BD	CD
SE(d)	0.008	0.009	0.008	0.010	0.015	0.013	0.017	0.015	0.020	0.017
SE(M)	0.005	0.006	0.005	0.007	0.011	0.009	0.012	0.011	0.014	0.012
CD at 5%	0.015	0.020	0.017	0.019	0.026	0.030	0.034	0.044	0.030	0.034

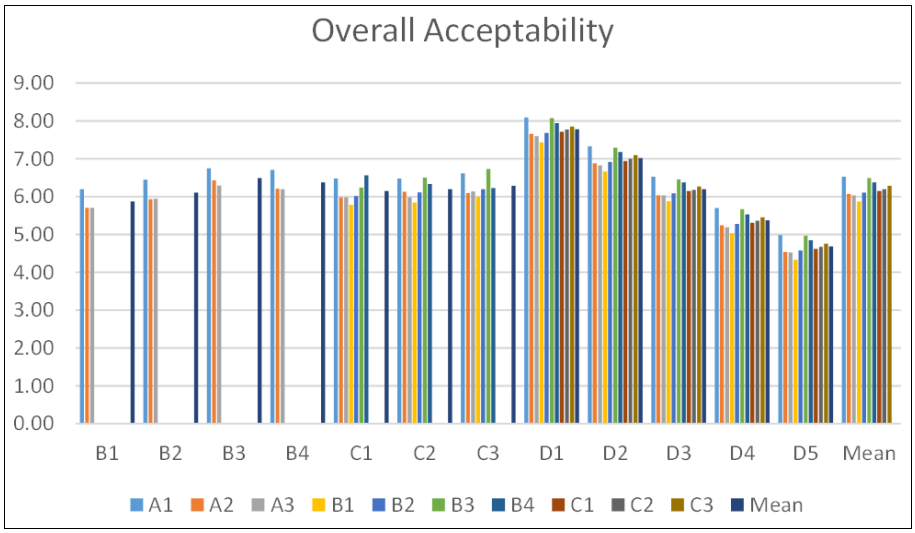


Fig 4: The effect of Fruit juices (A), Levels of fruit juices (B), Levels of sugar (C) and Storage period (D) on Overall-acceptability score of Whey beverage with different fruit juices

From Table 4. (A), the overall-acceptability score of whey beverage with different fruit juices combinations shows significant variations across various treatments. Among different fruit juices (A), the highest mean score (6.53) was observed in A1, indicating better acceptance, while the lowest score (6.04) was found in A3. This suggests that A1 samples were more favorably received. The levels of fruit juices (B) also influenced the overall acceptability. The highest score (6.49) was recorded for B3, while B1 scored the lowest at 5.87. Similarly, the levels of sugar (C) had an impact, with the highest acceptability seen in C3 (6.29) and the lowest in C1 (6.15).

The storage periods (D) had a noticeable effect, where the highest score (7.78) was recorded at the beginning (D1), indicating fresher products are more acceptable. In contrast, the acceptability decreased over time, with the lowest score (4.69) at D5, suggesting a decline in quality with extended storage.

When comparing specific treatment combinations, it was evident that fruit juice type, levels, and sugar interact to impact the acceptability. For instance, C2 samples maintained better scores across different storage periods, while C1 showed a decline in later periods. The results were statistically significant with CD values at a 5% level, indicating the reliability of these findings.

Conclusion

The result obtained from sensory, chemical, microbiological evaluations and cost analysis of whey beverage with different fruit juices prepared with different fruit types, juice levels, sugar levels, and storage periods lead to several important conclusions. Pineapple juice (A1) provided the

best sensory quality, with the highest scores in flavor, color, and overall-acceptability. The optimal sensory combination was found to be 25% juice (B3) with 10% sugar (C3), consumed fresh (D1), as storage negatively impacted sensory attributes, with significant declines observed by the 28th day (D5). The optimal formulation balancing quality and cost was found to be 25% juice with 10% sugar, especially in Pineapple and Pomegranate beverages, consumed within 15 days of refrigerated storage (5°C). While formulations with 30% juice and 10% sugar delivered superior nutritional quality, they also incurred higher production costs. Storage duration emerged as a critical factor, with beverages showing the best quality within 15 days of storage, beyond which sensory quality and microbial safety deteriorated. The use of whey as a cost-effective ingredient ensures sustainable production, providing a nutritious and economical alternative to conventional beverages. The findings demonstrate that whey beverage with different fruit juices offer optimal sensory appeal, chemical stability, and microbiological safety when formulated with balanced juice and sugar levels, consumed fresh, and efficiently priced, making them a commercially viable product.

References

1. Alim TS, Kumar S, Reddy P. Influence of black mulberry juice on the quality attributes of functional beverages. J Food Sci Technol. 2018;55(4):1324-1332.
2. Alane D, Raut N, Kamble DB, Bhotmange M. Studies on preparation & storage stability of whey-based mango herbal beverage. Int J Chem Stud. 2017;5(3):237-241.
3. Alvarez L, Balkrishnan R. Use of acid whey in chocolate-flavored beverages. J Food Process Preserv. 2013;37(5):697-703.
4. Anonymous. New milk drink Cocktail introduction. Dairy Ind Mag. 2011;32(6):45-47.
5. Anonymous. Suggested requirement of milk & milk products by the Nutrition Advisory Committee. 2023.
6. Babar S, Ramesh S. Utilization of pomegranate juice for the preparation of chakka whey beverage. Int J Dairy Technol. 2013;66(4):245-252.
7. Baccouche A, Ennouri M, Felfoul I, Attia H. A physical stability study of whey-based prickly pear beverages. Food Hydrocoll. 2013;33:234-244.
8. Balasubramanyam N, Reddy V, Ghosh A. Chemical composition of chhana whey. J Food Sci Technol. 2016;53(4):1786-1791.
9. Bhavsagar MS, Hassan B, Patange UL. Manufacturing pineapple-flavored beverage from chhana whey. J Dairying Foods H S. 2010;29(2):110-113.
10. Bhavsagar S, Patel R. Manufacture of pineapple flavored beverage from chhana whey. Int J Dairy Technol. 2015;69(1):104-110.
11. Chatterjee S, Saha A, Das R. Physico-chemical properties of ready-to-drink whey-based orange beverage. J Food Sci Technol. 2021;58(3):1245-1251.
12. Darade R, Kulkarni P, Patil M. Sensory evaluation of fermented products using whey blends with potato. J Dairy Sci Technol. 2023;76(3):211-219.
13. Darade R, Kulkarni S, Jadhav M. Sensory evaluation of pineapple-based chhana whey beverage. J Food Process Preserv. 2019;43(7):e14021.
14. Devi Saradha MS, Banumathi P, Jyothi N. Studies of development and evaluation of whey-based fruit beverages. Bev Food World. 2017;44:39-45.
15. Dhayuthapani R, Ramesh M. Development of enriched whey drink with lemon juice. Indian J Dairy Res. 2016;73(2):125-131.
16. Dubost N, Welch J, Moreau RA. Techniques in whey processing. Int Dairy J. 2003;13(3):567-575.
17. Jadhao A. Cost of production of jamun juice flavored paneer whey beverage. Indian J Dairy Sci. 2022;79(2):88-94.
18. Jadhao A. Utilization of jamun juice in the preparation of paneer whey beverage. Indian J Dairy Sci. 2023;80(2):145-153.
19. Nagadevi, Yamuna Devi Puraikalan. Formulation & quality evaluation of whey-based fruit juice. Int J Sci Res. 2013;4(4):56-61.
20. Naik B, Kumar R, Sharma A. Physico-chemical and sensory characteristics of whey-based watermelon beverage. J Food Sci Technol. 2009;46(4):224-229.
21. Patel R, Sharma S. Blending whey with fruit juices for enhanced health benefits and sensory qualities of functional beverages. Food Sci Nutr. 2023;11(2):407-416.
22. Prasad R, Singh R, Patel S. Sensory & physico-chemical evaluation of whey-based mango beverages. J Food Process Preserv. 2013;37(5):897-905.
23. Ranade S. Preparation & sensory evaluation of chakka whey beverage with pineapple juice. Indian J Dairy Res. 2014;61(4):205-210.
24. Ravikrishna B, Verma R, Patel M. Sensory evaluation of fruit beverages made from chhana whey. Int J Dairy Technol. 2012;67(2):180-186.
25. Reddy V, Kumar R, Sharma A. Flow diagram for whey-based fruit juice beverage. J Food Process Preserv. 1987;25(4):350-360.
26. Reddy V, Patel K, Sharma R. Development of lemon-flavored whey beverage. Indian J Dairy Res. 2011;58(2):127-133.
27. Revathi V, Vinita R. Sensory evaluation of whey-based pineapple beverage. Indian J Dairy Sci. 2019;72(6):347-353.
28. Rupnar K, Deshmukh M, Rane P. Sensory quality of paneer whey beverage with kokum juice. Indian J Dairy Sci. 2021;74(3):213-219.
29. Thamilselvi D, Vijayalakshmi R, Anbu M. Preparation & quality evaluation of lime-based herbal blended RTS beverage. J Food Beverages. 2023;45(2):120-128.
30. Thamilselvi R, Karthikeyan S, Prakash S. Development and storage stability of lime-based RTS beverages with herbal extracts. J Food Sci Technol. 2015;52(9):6152-6159.
31. Yalcin S, Ozdemir N. Utilization of chhana whey for manufacture of soft drinks. J Food Sci. 2012;77(3):189-196.
32. Yin K, Cheng F, Ren H, Huang J, Zhao X, Yuan Z. Insights into the PYR/PYL/RCAR gene family in pomegranates (*Punica granatum* L.): A genome-wide study on identification, evolution, and expression analysis. Horticulturae. 2024;10(5):502.