J. Agric. Res. Technol., 50 (3) : 305-311 (2025) https://doi.org/10.56228/ JART.2025.50309

Process Optimization For Preparation of Whey Beverage Blended with Dragon Fruit (*Hylocereus* Spp.)

S. A. Patil, D. K. Kamble, U. S. Gaikwad, A. T. Lokhande and A. M. Kadam
Department of Animal Husbandry and Dairy Science, Post Graduate Institute, MPKV, Rahuri, India.
*Corresponding author Email : psnehal8087@gmail.com
(Received : 20.02.2025 Accepted : 10.07.2025)

Abstract

The main objective of this research work was to optimize levels of dragon fruit and sweetner, to study sensory qualities of whey beverage. Initially, experimental trials were conducted to decide the cultivar, form, sweetner and whey. The data generated during the course of this investigation was statistically analyzed using Completely Randomized Design (CRD). On the basis of results of sensory evaluation, the most acceptable three levels of dragon fruit pulp (1, 2 and 3 per cent) and two levels of jaggery (7 and 8 per cent) were selected for experimental trials. It was observed that, all sensory attributes *viz*., flavour, colour and appearance, consistency and overall acceptability of fresh whey beverage under different treatment combinations were significant. The treatment T_3 (8.38) had maximum flavour score and treatment T_0 (7.13) had the lower score. Treatment T_3 (8.33) had maximum colour and appearance score and treatment T_0 (7.21) had lower score. Treatment T_5 (8.34) had maximum consistency score and treatment T_0 (7.18) had lower score and the treatment T_3 (8.30) had maximum overall acceptability score and treatment T_0 (7.18) had lower overall acceptability score, respectively. The average chemical compositions of fresh whey beverage samples prepared under different treatment combinations ranged from 0.30 to 0.58 per cent fat, 0.47 to 3.32 per cent protein, 0.43 to 0.68 per cent ash, 4.23 to 4.42 per cent reducing sugar, 8.07 to 8.28 per cent non reducing sugar, 13.50 to 17.12 per cent total solid, 4.56 to 5.60 pH, 0.68 to 0.79 per cent acidity and vitamin C was upto 2.56, respectively.

Key words : Channa whey, dragon fruit pulp, jaggery and whey beverage.

Whey is the liquid portion of milk that remains after the separation of curd or coagulated products, which results from the acid or proteolytic enzyme-mediated coagulation of milk. It is a major by-product of the milk industry during the production of products like channa, paneer, chakka, casein and cheese.

Whey has long been considered an important food medium. It is a rich source of carbohydrates (4-5 per cent lactose). It also contain minerals (0.60 per cent, including Ca, P, Na, Mg, etc.), and whey proteins such as lactalbumin (22 per cent of whey protein), lactoglobulin (59 per cent of whey protein), and serum albumin (6 per cent of whey protein). Additionally, it contains water-soluble vitamins, including B complex. (Ghosh and Singh, 1997; Parekh, 1997).

Various syrups and soft drinks containing artificial fruit flavours are well-known worldwide, the primary factors driving their popularity are their nutritive and therapeutic values (Boghani *et al*. 2012). This fruit is popular for its nutritional value, as it is a good source of minerals, glucose, fructose, dietary fiber and vitamins. It helps strengthen the immune system and is also used in the treatment of diabetes, heart diseases and in maintaining a healthy body weight. The yield and nutritional value of dragon fruit vary depending on the species, cultivation practices, growing area and harvesting time. Additionally, the peel of the dragon fruit has a high potential for use as a natural dye. (Hossain *et al*. 2021).

Materials and Methods

The investigation was undertaken in laboratory of Animal Husbandry and Dairy

Science, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist-Ahilyanagar (MS), India during the year 2024-2025. All the raw materials dragon fruits, jaggery etc. were collected from the local market of Rahuri.

Preparation of channa whey : Fresh, good-quality milk standardized for 3.5 per cent fat and 8.5 per cent SNF was collected and passed through a clean muslin cloth to remove any visible impurities, ensuring the milk was suitable for further processing. The filtered milk was then heated to a temperature of 90°C for 10 min. After heating, the milk was allowed to cool slightly (typically to around 78-80°C), after which a food-grade coagulant such as citric acid (1-1.5 per cent) solution was added gradually with gentle stirring. This causes the milk proteins (mainly casein) to coagulate, forming curds. Once coagulation is complete, the mixture was allowed to stand undisturbed for about 15 minutes to facilitate separation of curd and whey. The curd was then collected by draining off the liquid portion (channa whey) through a muslin cloth.

Preparation of whey beverage : Initially fresh selected type of whey was collected and filtered through muslin cloth to remove any residual curd particles, ensuring a clear base liquid for the beverage formulation. Then added the selected form of dragon fruit i.e., pulp and selected sweetner in it.

The mixture was stirred thoroughly to ensure uniform blending of all ingredients. The formulated whey beverage was then heated to a temperature of 85°C for 5 min. to ensure microbial reduction and ingredient solubilization. After heating, the mixture was allowed to cool naturally to room temperature. The cooled beverage was filled into pre-sterilized glass or food-grade plastic bottles (HDPE) under hygienic conditions, leaving appropriate headspace to allow for thermal expansion during pasteurization. The filled and sealed bottles undergo in-bottle pasteurization by heating at 63°C for 30 minutes. This mild heat treatment enhances the microbial safety of the final product without significantly affecting its nutritional or sensory qualities. After pasteurization, the bottles are cooled gradually to room temperature to prevent thermal shock and condensation inside the packaging. The pasteurized whey beverage was then stored under refrigeration at 5 ± 1°C to maintain its quality, shelf life, and safety for consumption.

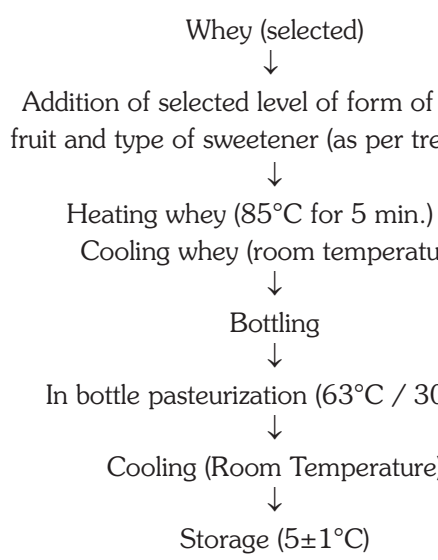

Fig. 1. Flow diagram for preparation of whey beverage

Result and Discussion

Sensory quality of freshly prepared dragon fruit whey beverage samples is depicted in Table 1.

Flavour : The mean flavour score of whey beverage for treatments T_0, T_1, T_2, T_3, T_4, T_5, and T_6, were 7.13, 7.52, 7.65, 8.22, 8.13, 8.04 and 7.92, respectively. The flavour score was significantly ($P<0.05$) affected by both the ingredients. Treatment T_1 and T_3 were at par

Table 1.

Treatments	Mean (score)			
	Flavour	Colour and appearance	Consistency	Overall acceptability
T_0	7.13^f	7.21^e	7.18^e	7.18^e
T_1	8.35^a	8.29^b	8.20^c	8.28^a
T_2	7.65^e	7.53^f	7.72^d	7.54^d
T_3	8.38^a	8.33^a	8.24^b	8.30^a
T_4	8.13^b	8.02^c	8.26^b	8.09^c
T_5	8.04^c	8.07^c	8.34^a	8.15^b
T_6	7.92^d	7.82^d	8.31^a	8.07^c
SE(m) ±	0.03	0.01	0.01	0.01
CD at 5%	0.09	0.03	0.04	0.05

with each other. The treatment T_3 (2 per cent dragon fruit pulp) was most acceptable. Further, level of 3 per cent of dragon fruit pulp in whey beverage was not as much liked by judges and commented that whey beverage had slightly unpleasant flavour due to increasing pulp level.

It was noticed that score for flavour of dragon fruit whey beverage was superior when 2 per cent of dragon fruit pulp and 7 per cent of jaggery level. The flavour score is more in accordance with Bhavsagar *et al*. (2001) as they reported 7.9 flavour score in preparation of pineapple flavoured beverage from channa whey. Prasad *et al*. (2001) observed the superior flavour of mango whey beverage contained 12 percent sugar and 20 percent mango pulp.

Colour and appearance : The scores of the dragon fruit based whey beverage in terms of colour and appearances for treatment T0, T_1, T_2, T_3, T_4, T_5, and T_6 were 7.21, 7.65, 7.53, 8.21, 8.02, 8.07 and 7.82, respectively. The colour and appearance of dragon fruit whey beverage samples prepared using different levels of dragon fruit pulp significantly ($P<0.05$) affected due to addition of dragon fruit pulp in channa whey. Treatment T_4 and T_5 were at par with each other. The score of the treatment T_3 was recorded significantly ($P<0.05$) highest among all treatments. The effect of levels of dragon fruit pulp and jaggery on colour quality of whey beverage was noticed as colour changes from faint pink to slightly dark pinkish tinge. It was seen that with addition of dragon fruit pulp and jaggery the colour of whey beverage increased in pinkish tinge.

Similar trend was noticed by Susanti *et al*. (2022) for Yogurt Ice Cream Fortified with Red Dragon Fruit Puree and Sulistyowati *et al*. (2023) for salad dressing soft candy made from dairy goat milk and dragon fruit and as they reported that score for colour and appearance increased with increasing dragon fruit level in ice cream and candy, respectively.

Consistency : The scores of the dragon fruit based whey beverage in terms of consistency for treatment T0, T_1, T_2, T_3, T_4, T_5, and T_6 were 7.18, 8.20, 7.72, 8.24, 8.26, 8.34 and 8.31, respectively. The effect of levels of dragon fruit pulp and jaggery on consistency of whey beverage found to be significant ($P<0.05$). The highest score for consistency was recorded for treatment T_6 (8.43) and the lowest score was recorded for treatment without addition of dragon fruit pulp i.e., T_0 (7.18). It means that consistency increased with increased in the levels of dragon fruit pulp and jaggery. The treatments T_5 and T_6 as like treatment T_3 and T4 were at par with each other.

It was also observed that consistency improved with addition of dragon fruit pulp and jaggery in the whey beverage. Similar findings was reported by Babar *et al*. (2008) for whey prepared by using pomogrante juice and Dhadge (2022) for Whey Beverage prepared with banana extract.

Overall Acceptability : The scores of the

dragon fruit based whey beverage in terms of overall acceptibility for treatment T0, T_1, T_2, T_3, T_4, T_5, and T_6 were 7.18, 8.28, 7.54, 8.30, 8.09, 8.15 and 8.07, respectively. The maximum score obtained for formulation containing of 2 per cent of dragon fruit pulp and 7 per cent jaggery level and minimum score obtained for control sample without addition of dragon fruit pulp. Treatment T_3 found to be significantly ($P<0.05$) superior treatment over all other treatments in terms of better flavour, colour and proper consistency. From the data it is clear that all the levels of dragon fruit were accepted. The treatments T_1 and T_3 were at par with each other.

Babar *et al*. (2008) recorded the similar trend for pomegranate juice added Channa Whey Beverage. Also Bhavsagar *et al*. (2001),

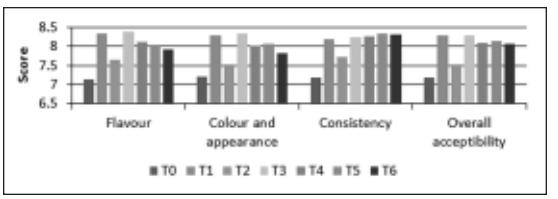

Fig. 2. Sensory score of fresh whey beverage samples

Susanti *et al*. (2022) observed that sensory scores for overall acceptability in whey beverage increased up to some extent and then it gradually decreased.

Chemical composition of fresh whey beverage samples : The freshly prepared whey beverage samples were chemically analysed for fat, protein, ash, reducing sugar, non reducing sugar, total solids, pH, acidity and vitamin C value. The values of chemical constituents are presented in Table 2.

Fat : The average fat content in dragon fruit based whey beverage were 0.30, 0.58, 0.57, 0.56, 0.54, 0.53 and 0.51per cent for treatment T0, T_1, T_2, T_3, T_4, T_5, and T_6, respectively. The fat content in whey beverage significantly ($P<0.05$) differed by addition of dragon fruit pulp and jaggery at different level. The treatments T_1, T_2 and T_4, T_5 were at par. These observations clearly indicates that, as the level of dragon frit pulp and jaggery increased the fat content in final product was decreased

These findings are in accordance with Mundhpane (2016) for watermelon whey beverage reported mean fat percentage were 0.51,0.49, 0.48, 0.47, 0.46 and 0.49, 0.47, 0.45, 0.43, 0.42 for treatments T_1, T_2, T_3, T_4 and T_5, respectively.

Protein : The average protein content in

Table 2. Chemical composition of fresh whey beverage samples

Treatments combination	Fat (%)	Protein (%)	Ash (%)	Reducing sugar (%)	Non reducing sugar (%)	Total solid (%)	pH	Acidity (%)	Vitamin C (mg/ 100gm)
T_0	0.30^e	0.47^f	0.43^f	4.23g	8.07^f	13.50g	5.60g	0.68g	NDg
T_1	0.58^a	3.32^a	0.60^e	4.25^f	8.09^e	16.84^f	5.54^f	0.71^f	1.42^f
T_2	0.57^a	3.30^b	0.61^d	4.28^e	8.10^e	16.86^e	5.41^e	0.73^e	1.58^e
T_3	0.56^b	3.29^b	0.64^c	4.31^d	8.13^d	16.93^d	5.28^d	0.74^d	2.02^d
T_4	0.54^c	3.27^c	0.65^b	4.34^c	8.19^c	16.99^c	5.13^c	0.75^d	2.13^c
T_5	0.53^c	3.25^d	0.66^b	4.37^b	8.23^b	17.04^b	4.86^b	0.77^c	2.43^b
T_6	0.51^d	3.23^e	0.68^a	4.42^a	8.28^a	17.12^a	4.56^a	0.79^b	2.56^a
S.Em.±	0.006	0.005	0.006	0.006	0.004	0.005	0.007	0.005	0.03
CD at 5%	0.019	0.017	0.019	0.018	0.015	0.018	0.023	0.016	0.09

dragon fruit based whey beverage were 0.47, 3.32, 3.30, 3.29, 3.27, 3.25 and 3.23 per cent for treatment T0, T_1, T_2, T_3, T_4, T_5, and T_6, respectively. The protein content in whey beverage significantly (P<0.05) differed by addition of dragon fruit pulp and jaggery at different level. Though variation in the protein content was in narrow range but the effect of dragon fruit pulp and jaggery was significant. The treatments T_2 and T_3 were at par. It was noticed that as the levels of dragon fruit pulp and jaggery the protein content goes on decreasing.

The findings are in collaboration with Bhavsagar *et al*. (2010) who reported that the addition of pineapple pulp had significantly affected the protein content of whey beverage. Khote (2021) have reported decreasing the value of protein from 3.50 to 3.05 in lassi blended with dragon fruit.

Ash : The average ash content in dragon fruit based whey beverage were 0.43, 0.60, 0.61, 0.64, 0.65, 0.66 and 0.68 per cent for treatment T0, T_1, T_2, T_3, T_4, T_5, and T_6, respectively. The values recorded were found to be increasing order from the treatment T0 to T_6. All the treatments showed significant difference for ash content in dragon fruit whey beverage. The treatments T_4 and T_5 were at par with each other. The addition of dragon fruit pulp could significantly affect ash content of dragon fruit whey beverage.

Andharepatil (2020) reported the mean average values for ash percentage of dragon fruit shrikhand were 1.90, 1.70, 1.40 and 1.35 for the treatments T_1, T_2, T_3 and T_4. These findings are in accordance with Kamble (2022) for Beetroot added whey beverage.

Reducing sugar : Reducing sugar content in dragon fruit whey beverage under treatments T0, T_1, T_2, T_3, T_4, T_5, and T_6 were varied with significant values 4.23, 4.25, 4.28, 4.31, 4.34, 4.37 and 4.42 per cent, respectively. The content of reducing sugar in the sample of dragon fruit whey beverage prepared under various treatment differed significant (P<0.05) due to various level of dragon fruit pulp. Maximum reducing sugar content in T_6 (4.42%) while treatment T_0 had contains lowest reducing sugar of (4.23%).

The values of reducing sugar were resembles with Gagrani *et al*. (1987) reported 4.20% reducing sugar in whey beverage with orange, pineapple, guava and mango fruits. Similar trend reported by Bothe (2013) in whey based mango herbal and Bhosale (2024) also found same trend dragon fruit yoghurt.

Non reducing sugar : Average mean value of non reducing sugar content of whey beverage was ranged from 8.07 to 8.28 per cent. Significantly (P<0.05) highest non reducing sugar content was noticed in sample containing 3 and 8 per cent dragon fruit pulp and jaggery i.e., T_6 (8.28 per cent). The lowest non reducing sugar content was noticed in control sample i.e., T0 (8.07 per cent). The treatments T_1 and T_2 were at par with each other. It indicated that non reducing sugar content in whey beverage increased with the addition of dragon fruit pulp.

The present findings are contradictory with Hande (2016) have reported in channa whey beverage with kiwi fruit pulp and Khote (2021) have reported in dragon fruit lassi.

Total solid : The average total solids content was 13.50, 16.84, 16.86, 16.93, 16.99, 17.04 and 17.12 per cent for treatment T0, T_1, T_2, T_3, T_4, T_5, and T_6, respectively. The total solid content differed significantly (P<0.05) due to level dragon fruit pulp and jaggery. Treatment T_6 was superior over all the other treatments.

Sameem *et al*. (2018) who reported the

highest mean value for total solids percentage in dragon fruit Shrikhand (57.33) was obtained from the treatment T_3 (control) followed by T_2 (56.02 %), T1 (54.75 %). The T_0 obtained the minimum score (53.48 %).

pH : The average pH content in dragon fruit based whey beverage were 5.60, 5.54, 5.41, 5.28, 5.13, 4.86 and 4.56 per cent for treatment T0, T_1, T_2, T_3, T_4, T_5, and T_6, respectively. The pH content in whey beverage significantly ($P<0.05$) differed by addition of dragon fruit pulp and jaggery at different level. These observations clearly indicates that, as the level of dragon frit pulp and jaggery decreases the pH content in final product was decreased.

These findings are in accordance with Kamble (2022) for Beetroot added whey beverage. Similar trend reported by Bhosale (2024) in dragon fruit yoghurt.

Acidity : The average acidity content of whey beverage of T0, T_1, T_2, T_3, T_4, T_5, and T_6 treatments were 0.68, 0.71, 0.73, 0.74, 0.75, 0.77 and 0.79 per cent, respectively. Significantly ($P<0.05$)) highest acidity content was recorded in whey beverage T_6 (0.79 per cent) prepared with 3 per cent of dragon fruit pulp and 8 per cent jaggery level and lowest acidity content was noticed in whey beverage T_0 (0.68 per cent) prepared without addition of dragon fruit pulp. The treatments T_3 and T_4 were at par with each other. It indicated that acidity content in whey beverage increased with the increased dragon fruit level.

Similar increasing trend for acidity was noticed by Lashkare (2019) in sugarcane juice blended paneer whey, Andharepatil (2020) in dragon fruit shrikhand and Dhadge (2022) for banana whey beverage.

Vitamin C : The average vitamin C content of whey beverage of T0, T_1, T_2, T_3, T_4, T_5, and T_6 treatments were 1.42, 1.58, 2.02, 2.13, 2.43 and 2.56 mg 100^{-1} gm, respectively. The vitamin C content in control sample of whey beverage is not detected while in whey beverage samples the vitamin C content increased as dragon fruit pulp level increased from treatment T_1 to T_6.

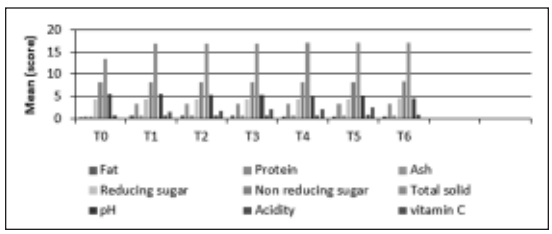

Fig. 3. Chemical composition of fresh whey beverage samples

These finding are similar with Susanti (2022) in yogurt Ice Cream Fortified with Red Dragon Fruit Puree, while similar trend reported by Madavi (2025) in jamun juice whey beverage.

Conclusion

Among the treatment combinations of level of dragon fruit pulp and jaggery the whey beverage containing 2 per cent of dragon fruit pulp and 7 per cent of jaggery was sensorily superior. The sensory superior whey beverage had chemical composition 0.56, 3.29, 0.65, 4.31, 8.13, 16.95, 5.28, 0.74 and 2.02 per cent fat, protein, ash, reducing sugar, non reducing sugar, total solid, pH, acidity and vitamin C (mg 100^{-1} g) respectively.

References

Andharepatil, P. S. 2020. Preparation of shrikhand blended with dragon fruit [*Hylocereus undatus*] pulp (Doctoral dissertation, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani).

Babar, R. B., Salunkhe, D. D., Chavan, K. D. and Thakare, V.M. 2008. Utilization of pomegranate juice for the preparation of chakka whey beverage. Journal of Dairying, Foods and Home Sciences, 27(2): 87-93.

Bhavsagar, M. S., Awaz, H. B. and Patange, U. L. 2010. Manufacture of pineapple flavoured beverage from

chhana whey. Journal of Dairying, Foods and Home Sciences, 29(2):110-113.

Bhosale, R. P. 2024. Process standardization for preparation of yoghurt using dragon fruit (*Hylocerus polyrizus*) pulp. MSc. (Agri.) thesis submitted to M. P. K.V., Rahuri.

Boghani, A. H., Raheem, A. and Hashmi S. I. 2012. Development and storage studies of blended papaya-aloe vera ready-to-serve beverage. Food Processing Technology, Vol. 3:43-47.

Borkar, M. A. 2020. Preparation of chakka whey beverage blended with watermelon (*citrullus lanatus*) juice M. Sc. (Agri.) Thesis submitted Dr. PDKV, Akola (M.S.).

Bothe, G. K. 2013. Development of whey based mango herbal beverage. International Journal of Horticultural Science and Technology,Vol. 8, No. 3, pp. 259-269.

Bothe, G. K. 2013. Development of whey based mango herbal beverage. International Journal of Horticultural Science and Technology,Vol. 8, No. 3, pp. 259-269.

Dhadge, S. P., Kumar, P., Verma, Khandare, K. M., Kumar, V., Solanki, D., Kmar, N., Singh, B. and Kumar, S. 2022. Sensory evaluation of whey based banana beverage. International Journal of Advanced Biochemistry Research 5(4): 1563-1489.

Gagrani, R. L., Rathi, S. D. and Ingale, V. M. 1987. Preparation of fruit flavoured beverage from whey. J. Food Sci. Technol. 24(2) : 93-94.

Ghosh, S. and Singh, S. 1997. Effect of mushroom levels in the quality of mushroom whey soup powder. Indian J. Dairy Sci. 50(2) : 50-52.

Hande, A. M. 2016. Studies on chhana whey beverage prepared by using kiwi (*actinidia deliciosa*) fruit pulp. MSc. (Agri.) thesis submitted to M. P. K.V., Rahuri.

Hossain, M. D., Sharker, M. D., Akhtar N. S. 2021. International Journal of Horticultural Science and Technology,Vol. 8, No. 3, pp. 259-269.

Kamble, S. Y. 2022. Preparation of chakka whey beverage fortified with beetroot (*beta vulgaris*) juice. M.Sc. (Agri.) thesis, submitted to M.P.K.V., Rahuri, (M.S.), India.

Khote, A.T. 2021. Preparation of lassi bleneded with dragon fruit (*Hylocereus undatus*) pulp. M.Sc. (Agri.) Thesis submitted to VNMKV, Parbhani.

Lashkare, S. V. 2019. Preparation of paneer whey beverage blended with sugarcane (*Saccharum officinarum*) juice. M. Sc. (Agri.) Thesis (unpub.) Dr. PDKV, Akola. (MS).

Madavi, V. S., Patil, B. D., Kudale, S. M., Jodave, R. R., Narale, S. B. and Kamble, D. K. 2025. Process standardization for preparation of whey beverage added with jamun (*syzygium cumini*) juice. Plant Archives, 25(1), pp. 3234-3240.

Mundphane, S. T. 2016. Studies on preparation of channa whey beverage blended with watermelon juice. M. Sc. (Agri.) Thesis (unpub.) Dr. PDKV, Akola. (MS).

Parekh, J. V. 1997. Whats new in whey products. Dairy India. 5th Edn. pp.397.

Prasad, K., Sharma, H. K., Mahajan, D. and Jaya, 2001. Utilization of whey based Mango beverage. Beverage and Food World, 28(11): 31-32.

Sameem, M., Singh, A. and Hossain, S. A. 2018. Studies on preparation of Shrikhand by using dragon fruit pulp. The Pharma Innovation Journal, 7(8), 455-458.

Sulistyowati, E., Ningsih, R. P. A., Trinata, Y. P., Suharyanto, S. and Soetrisno, E. 2023. Salad dressing soft candy made of dairy goat milk with the addition of