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RESEARCH ARTICLE

Development of whey-ginger based beverage incorporated with jaggery powder

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Abstract: Development of whey-based ginger beverages incorporated with jaggery powder, ginger and saffron was successfully developed with good sensory attributes. Six different formulations were prepared and among these, the formulation containing 100 ml whey, 2.5 ml ginger extract, 7g jaggery, and four strands of saffron got the highest acceptability score using 9 point headonic scale with respect to color and appearance (8.88± 0.51), flavor (8.53 ± 0.42), consistency (8.59 ± 0.46) and overall (8.83 ± 0.41). The development of the product uses whey, incorporated with the therapeutic and preservative properties of ginger, mineral nutrients of jaggery in the form of jaggery powder and soothing saffron. This study concluded that the developed beverage was shelf stable at refrigerated temperature (8°C) for 6 days without addition of any chemical preservatives. By developing by-product based beverage can helps the dairy industry to use whey and reduce environmental pollution.

Keywords: Preservative-free Total phenolic content, Sensory, composition, Shelf life

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Introduction

Whey is the part of milk that is produced following the coagulation of the milk protein casein with a coagulant. Citric acid, lactic acid, or other pure chemical reagents may be introduced as the coagulating agent, or it may be created by microorganisms that are permitted to grow in milk.

The production of whey worldwide is projected to be 165 million tons, out of which cheese whey accounts for 95%. (Birania et al. 2021). Over 3 million tonnes of whey are produced in India, with over 2 lakh tonnes of essential milk proteins contained in that whey (Kumar et al. 2018). Due to the large levels of organic matter in whey, disposal poses a severe challenge for environmental pollution. The dairy business would greatly benefit from developing any method for its practical application. At this point, it is relatively possible to diversify products using whey as a water infrastructure without significantly changing the current infrastructure. The global market need for beverages is increasing, and India is no exception. Whey drinks are known to be a genuine thirst quencher that is also light, refreshing, healthy, and nourishing (Panghal et al. 2018). Compared to other drinks, whey-based fruit beverages are healthier (Joshi et al. 2020). In the care of prevalent long-term illnesses like HIV, heart disease, and cancer. whey and its biological components have demonstrated their effectiveness. Its high nutritional content makes it suitable for use in drinks for young children, the elderly, and those with diabetes. (Patel, 2015). Many techniques have been developed throughout the years to turn huge amounts of whey into food products.

The addition of Ginger has a wide range of therapeutic actions, including anti-rheumatic, antioxidant, and hypocholesterolemic properties indicating the excellent potential for processing into valuable products (Basiouni et al. 2023). Whey contains a high ratio of lactose to glucose an unpleasant taste, and too much acidity so to give a pleasant flavour to the whey beverage jaggery powder is incorporated also it is used as medicine, blood purifier, and base material for syrups. It is consumed as a source of energy and as a sweetener in practically every segment of society.

One of the most encouraging developments in the utilization of whey is the development of a novel, healthful, enjoyable whey beverage utilizing a proper combination of whey and fruit juice or pulp. The most efficient way to deal with whey disposal issues is to use affordable technologies to divert whey solids into the manufacturing of human meals. An effort has been made to develop a whey-based ginger beverage incorporating jaggery powder.

Materials and Methods

Materials

For the preparation of whey, pasteurized milk with 3% fat and 8% SNF was obtained from the nearby Varanasi dairy. The Surabhi variety of ginger was acquired from Varanasi's local market. The ginger extract was created with slight adjustments, following the described method (Patel et al. 2007). Jaggery powder was used to substitute for sugar and mineral fortification as it is rich in minerals. It was bought from Varanasi's local market. Shahi Kishtwari Saffron was used for the preparation and was procured from the local market. Chemicals were purchased from Merck Specialties Pvt. Ltd. and Hi-media Laboratories Pvt. Ltd. in Mumbai, India (Mumbai, India) and Fisher Scientific (Mumbai, India). Glassware (Make: Borosil, India) was used in the entire study. PET bottles of 150 ml capacity were used to store formulated products.

Methods

Preparation of Whey Ginger Beverage

The whey ginger beverage was made with slight adjustments using the method outlined (Patel et al. 2007). Different six formulations (T_1, T_2, T_3, T_4, T_5 and T_6) were prepared (Table 1) using whey as base, ginger and jaggery as a taste enhancer and saffron for aroma and color. 100 mL of whey and four strands of saffron were used in all formulations with varying amounts of ginger and jaggery powder. The beverage formulation was packed in 150 mL sterilized pet bottles (High-Pressure steam sterilizer (Autoclave), SX-500, TOMY) and was sealed with the help of a capping machine (Versa Max Spindle Capper Machine). For further analysis, the formulations were stored in the refrigerator.

Physio-chemical and Sensory Analysis

The proximate composition of the ginger beverage made from whey was examined, and using the Kjeldahl method, the protein content was evaluated (AOAC, 2000), and the fat content was analyzed through the Gerber method, utilizing a butyrometer. The titratable acidity (expressed as % lactic acid), ash, and moisture content were measured according to AOAC (1995) procedures. The total solid was calculated as the method recommended by Ranganna (1986). Taking into consideration the dilution factor in the formula, the total phenolic content was determined in milligrams of Gallic acid equivalent (GAE) per milliliter of extract (Stankovic, 2011). An evaluation panel, partially trained, utilized a 9-point hedonic scale, and the samples were appropriately labeled.Based on colour and appearance, flavour, taste, and general acceptability, judges were to evaluate the treatments and assign scores correspondingly.

Statistical Analysis

To ascertain the significant difference between combinations, data collected during the study were appropriately analyzed using Analysis of Variance (ANOVA). The t-test was also applied to determine the acceptance of the product with control.

Result and Discussion

Physico-chemical Analysis

The different physico-chemical properties of whey ginger beverages are presented in Table 2. The average fat percentage of the test sample conditions ranged from 0.49 % (T_1) to 0.67 % (T_6) and increased considerably ($P<0.05$). Hande and Chavan (2019) regardless of the pulp of the kiwi fruit incorporation in the *chhana* whey beverage samples, it was found that all combinations of experimental treatments had a substantial impact on fat content. Tidake et al. (2024) reported that *paneer* whey beverage blended with bottle gourd had a 0.51% fat content. Kumar and Peter, (2015) developed an aonla beverage with a whey base and reported a fat content ranging from 0.05 to 0.07 % and Sharma et al. (2020a) produced fruit drinks with a whey base, chhana, and stated that the fat level ranged from 0.02 to 0.96%.

Table 1: Formulation combinations

Formulations	Whey (mL)	Ginger extract (mL)	Jaggery (g)	Saffron (no. of strands)
T_1	100	0.5	3	4
T_2	100	1.0	4	4
T_3	100	1.5	5	4
T_4	100	2.0	6	4
T_5	100	2.5	7	4
T_6	100	3.0	8	4

Protein content mean values ranged from 0.69 (T_1) to 0.79 (T_2) for (T_6). In the T_6, the highest value for protein content was 0.79. T_6 was the only treatment sample that differed significantly from the others. It could be due to ginger extract's protein content. Similarly, Hande (2016) studied the impact of experimental procedures on the amount of protein in chhana whey beverages ranging from 0.71 (T_1) to 0.89 (T_3). It could be a result of the pulp's increased protein content.

Lactose content in the various testing samples ranged from 4.62 (T_1) to 4.91 (T_6) considerable lactose content ($P<0.05$). The treatment T_6 has the highest lactose content of 4.90. Similarly, it was found that whether the kiwi fruit pulp was added to the *chhana* whey beverage, the lactose concentration was considerably impacted by all combinations of the experimental treatments (Hande, 2016).

The sugar amounts in the test samples went from 13.91% (T1) to 15.18% (T_6) was significant ($P<0.05$) and among all treatment T_6 was the most effective. Hande (2016) added different amounts of kiwi pulp affected the total sugar content in the *chhana* whey beverage. Zaman et al. (2023) observed that the development and storage stability of whey sugarcane based functional beverage had a total sugar level of 19.50% were considerably impacted by all the combinations of experimental treatments.

The mean total solids percentage ranged between 16.38 and 16.76 % were significant ($P<0.05$). It's because the ginger powder contains solids. Similarly, Hande (2016) studied the amount of kiwi fruit pulp utilized in the product, the average total solids content in the various testing samples ranged from 20.24- 24.28% (Mohamed et al. 2014) studied the functional whey beverage based on papaya in terms of its physical, chemical, and microbiological properties, and found that its total solids (TS) content was 18%.

The titratable acidity ranged from 0.20% LA (T1) to 0.23 % LA (T6) was significant ($P<0.05$). The titratable acidity level in the different samples might be related to the acidity concentration of the ginger extract. The results showed that as the amount of ginger extract added to the samples increased, the acidity content of the whey ginger beverage samples increased correspondingly. Hande (2016) studied the impact on titratable acidity of adding different amounts of kiwi fruit pulp, which ranged from 0.49% LA (T_1) to 0.66% LA (T_3). (Chaudhary et al. 2019) reported The titratable acidity in various treatments ranged from 0.59% to 0.62% lactic acid while making flavored pineapple beverages from chhana whey. Sharma et al. (2020b) developed a low calorie apple whey beverage ready-to-drink (RTS) beverage using whey, featuring acidity level 0.03%.

Whey ginger beverages have mean pH values ranging from 5.11 to 5.19. The pH pattern in the various whey ginger beverage samples was similar (Chaudhary et al. 2019), who reported the pineapple-flavored *chhana* whey beverages had pH values ranging from 3.91 to 3.89 (Mohamed et al. 2014). It was observed that the fresh, functional papaya whey beverages had a pH range of 4.90 to 5.30.

The total phenolic content of the beverage was 14.21 ± 0.265 mg of gallic acid equivalent/100mL of extract, found using the standard curve. Solanki et al. (2023) also used 2.0 ginger juice for the development of herbal kulfi and found 56.96 mg GAE/100g of total phenolic content. The results indicate the presence of more amounts of total phenols because studies found that phenolic compounds in legumes may form conjugates with fatty acids, proteins or sugars; while cooking, these compounds get dissociated, resulting in increased total phenolic content (Oyeyinka et al. 2021).

Sensory evaluation

Each of the six formulations was sensory scored using a 9-point hedonic scale (Table 1.) and the best was decided. T_5 formulated using 100 mL whey, 2.5 mL ginger extract, 7g jaggery and four strands of saffron got the highest acceptability concerning colour and appearance (8.88 ± 0.51), flavour (8.53 ± 0.42), consistency (8.59 ± 0.46) and overall acceptability of (8.83 ± 0.41) given in Table 3. There were noticeable variations in the color and appearance of the whey beverage($P< 0.05$) due to adding varying amounts of jaggery powder and ginger extract. When the amounts of jaggery powder and ginger extract were varied, it was noticed that the whey beverage's colour and appearance changed. T5 offers the most vibrant color and appearance. The color of the

Table 2: Physico-chemical properties of whey ginger beverage (n=3)

Formulations	Fat (%)	Protein (%)	Lactose (%)	Total Sugar (%)	Total Solid	Titratable acidity	pH
T1	0.49	0.69	4.62	13.91	16.38	0.50	5.18
T2	0.53	0.71	4.81	14.39	16.45	0.50	5.16
T3	0.56	0.73	4.61	15.12	16.54	0.51	5.17
T4	0.62	0.74	4.65	15.14	16.67	0.52	5.19
T5	0.65	0.77	4.60	15.17	16.72	0.53	5.14
T6	0.67	0.79	4.91	15.18	16.76	0.53	5.11
SE(m)	0.015	0.004	0.052	0.850	0.889	0.05	0.06
CD	0.022	0.018	0.021	0.045	0.068	0.02	0.02

Fig. 1 Sensory Evaluation of whey-based ginger (n=7)

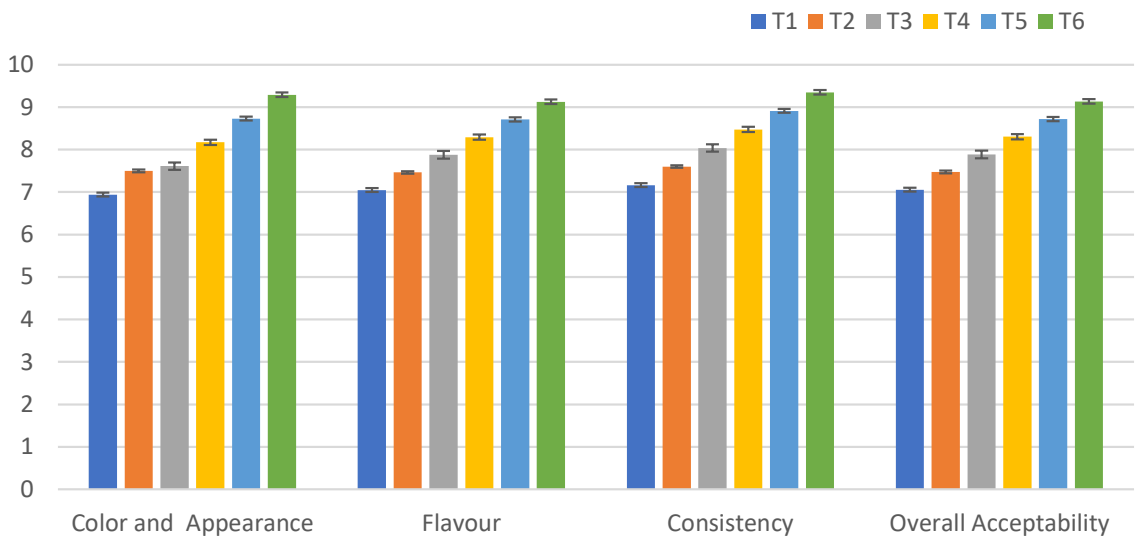


Table 3: Sensory evaluation of various combinations of whey ginger based beverage

Formulations	Color and Appearance	Flavour	Consistency	Overall Acceptability
T_1	7.51±0.56	7.46±0.43	7.60±0.44	7.47±0.42
T_2	7.62±0.45	7.53±0.62	7.73±0.42	7.65±0.46
T_3	7.91±0.62	7.71±0.56	7.85±0.62	7.83±0.62
T_4	8.63±0.56	8.33±0.51	8.66±0.41	8.33±0.62
T_5	8.88±0.51	8.53±0.42	8.59±0.46	8.83±0.41
T_6	8.52±0.42	8.21±0.51	7.96±0.51	8.36±0.42

N=7, Values are presented in Mean±SD

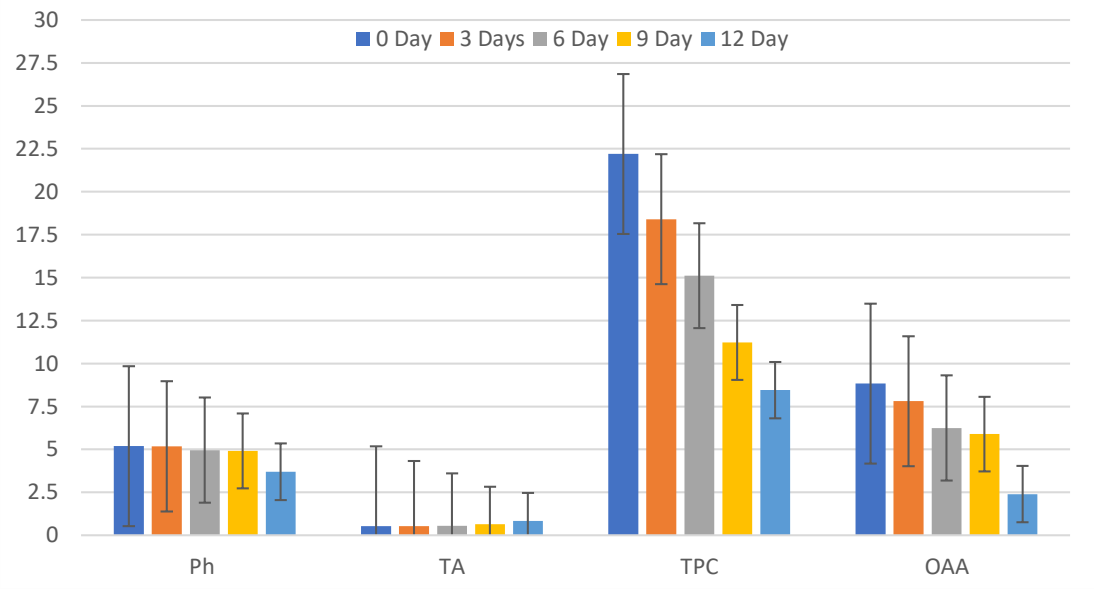
Table 4: Storage stability of the optimized whey ginger based beverage

Parameters	0 Day	3 Day	6 Day	9 Day	12 Day
pH	5.19±0.06	5.18±0.31	4.96±0.15	4.91±0.01	3.70±0.35
TA	0.54±0.00	0.54±0.00	0.55±0.01	0.65±0.01	0.83±0.36
TPC	22.21±0.23	18.4±0.33	15.12±0.33	11.23±0.36	8.45±0.48
OAA	8.83±0.42	7.81±0.48	6.25±0.31	5.89±0.43	2.40±0.63

N=3 , Values are presented in Mean±SD. TPC = Total Phenolic Content in % (mg of gallic acid equivalent / 100 mL of Sample), TA= Titratable Acidity %, OAA=Overall acceptability,

whey beverage gradually becomes darker as the level increases. For colour, whey guava beverages have sensory scores ranging from 6.02 to 7.82 across the various combinations studied by (Singh et al. 2014). Fermented milk drink was given an average colour and appearance score of 6.00 to 7.93 after adding pseudo-cereal i.e. *Amarnath* (Shinde et al. 2025). The flavor was considerably altered ($P<0.05$). T5 received the highest flavor rating of all the treatments. The variations in mean consistency scores between treatments were significant ($P<0.05$). T5 exhibited a higher level of consistency. The addition of jaggery powder to whey beverage samples considerably changed the consistency of the samples. The consistency score declined as the amount of jaggery powder added increased. It can be the result of the product containing more jaggery powder. As the amount of jaggery powder in the mixture grew, the consistency thickened (Gaikwadet al. 2022). Sabri and Khalil (2023)mentioned that The two most common sweeteners that are added to food and beverages to improve consistency and palatability are sugar and jaggery. Taste, consistency, colour, and appearance are examples of sensory aspects that influence consumer approval of a product T5 has the highest overall acceptance (8.83), whereas T_1 has the lowest (7.47). Kaur et al. (2018) reported the different blends of pineapple-flavored *chhana* whey beverages received an overall acceptance score ranging from 7.7 to 7.9.

Fig. 2 Storage Stability of optimized whey ginger beverage (n=7)



TA- Titrable acidity, TPC- total phenolic content, OAA- overall acceptability

Storage stability

Total phenolic content, pH, % titratable acidity and overall product acceptability were studied at 8°C to observe the effect of storage. A decreasing trend and an increasing trend were obtained for pH and titratable acidity over nine days. This was due to a slight increase in acidity of the product, which made the product's pH show a slight increase. A gradual decrease in the beverage's total phenolic content was estimated, mainly due to the loss of phenols in storage. This study was in acceptability for 0, 3, 6, 9, and 12 days. The acceptability in terms overall had decreased from 8.83±0.516 to 5.89 ± 0.342 (Table 4 and figure 2). The freshly prepared beverage was liked very much, and a fall in acceptance was there with a slight liking of the beverage persisted till six days of storage. The study indicates that the beverage when kept at 8°C without the use of preservatives, has a shelf life of six days.

Conclusion

A whey based beverage prepared by incorporating ginger extract, jaggery powder and saffron does not include any chemical preservatives and can be refrigerated for up to six days and acceptable by consumers. The product to be a nutritionally enriched with total phenolic contents , low in fat (below 1.0%), possess pleasant flavour and colour, several vital minerals presents in whey and boosting energy.

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Conflict of interest

There is no conflict of interest among authors

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References

AOAC (1995) Official methods of analysis, 16th edn. Association of official analytical chemists. Washington, D.C.

AOAC (2000) Official methods of analysis, 17th edn. Association of official analytical chemists. Washington, D.C.

Basiouni S, Tellez-Isaias G, Latorre JD, Graham BD, Petrone-Garcia VM, El-Seedi HR,Shehata AA (2023) Anti-inflammatory and antioxidative phytogenic substances against secret killers in poultry: Current status and Prospects. Veterinary Sci 10(1): 55

Birania S, Rohilla P, Kumar R, Saini P. (2021) Whey and its valorization using Biorefinary: a review. J Pharmacogn Phytochem 10(1S): 542-548

Chaudhary V, Kumar V, Singh K, Kumar R, Kumar V (2019) Pineapple (Ananas cosmosus) product processing: A review. J Pharmacogn Phytochem 8(3): 4642-4652

Gaikwad SS, Ghatge PU, Anerao KK, Gadhe KS (2022) Biochemical characterization, organoleptic evaluation and functional properties of health beverage mix. J Pharm Innov 11(11):164-168

Hande AM Chavan KD (2019) Sensory quality of whey based kiwi (Actinidia deliciosa) fruit beverage. Int J Chem Stud 7(4): 2076-2080

Joshi J, Gururani P, Vishnoi S, Srivastava A (2020) Whey based beverages: A review. Octa J Biosci 8:30-37

Kaur S, Bhise SR, Kaur A, Minhas KS (2018) Development of naturally carbonated paneer whey fermented beverage blended with pineapple and strawberry juice. Nutrition Food Sci 49(4): 528-547

Kumar R, Chauhan SK, Shinde G, Subramanian V, Nadanasabapathi S (2018) Whey Proteins: A potential ingredient for food industry-A review. Asian J Dairy Food Res 37(4): 283-290

Kumar A, Peter S (2015) Preparation of whey based Indian Goose berry (*Aonla*) Beverage. Int J Multidisciplinary Res Dev *2*(8): 341–343

Mohamed AG, Hayam MA, Abeer FZ (2014) Physicochemical and microbiological properties of papaya functional beverages based of sweet cheese whey. Life Science J 11(3):257-259

Oyeyinka SA, Abdulsalam AO, , Ahmed El-Imam AM, Oyeyinka AT, Olagunju OF, Adedeji EO, Njobeh PB (2021) Total phenolic content, antioxidant, anti-inflammatory and anti-microbial potentials of Bambara groundnut (*Vigna subterranean* L.) seed extract. Br Food J https://doi.org/10.1108/BFJ-07-2020-0637

Panghal A, Patidar R, Jaglan S, Chhikara N, Khatkar SK, Gat Y, Sindhu N (2018) Whey valorization: current options and future scenario–a critical review. Nutrition and Food Sci 48(3):520-535

Patel S, Prasanth PL, Chaudhari PL, Sahu C (2007) TechnoEconomic feasibility of whey based Mango-Herbal (ginger) beverage. Indian J Dairy Sci 60: 149-155

Patel S (2015) Emerging trends in nutraceutical applications of whey protein and its derivatives. J Food Science Technol 52: 6847-6858

Ranganna S (1986) Handbook of analysis and quality control for fruit and vegetable products. Tata Mc Graw Hill Publication, New Delhi

Sabri D, Khalil S (2023) Evaluation Granola Bars Quality Fortified with Sweet Sorghum Jaggery. Food TechnolRes J 2(1): 27-40

Sharma N, Chavan KD, Jaybhay VB (2020a) Development of ginger (Zingiber officinalis L.) Flavoured Chhana whey beverage. J Pharm Innov SP-9(9): 36-41

Sharma R, Choudhary R, Thakur NS, Bishist R, Thakur A (2020b) Optimization of Fructooligosaccharide fortified low calorie apple-whey based RTS beverage and its quality evaluation during storage. Curr J appl 39 (10): 17-28

Singh D, Singh R and Bhatt F (2014) Development, Quality Evaluation and Shelf Life Studies of Whey Guava Beverage, Int J Current Engineering Technol 4(3): 2171-2175

Shinde NW, Kartikeyan S, Narnaware GN, Adil S (2025) Optimization of Formulation for Development of Amaranth Incorporated Composite Fermented Milk Drink using Response Surface Methodology. Asian J Dairy Food Res 44(4): 548-553. doi: 10.18805/ajdfr.DR-2125

Solanki K, Rani R, Gaur GK (2023) Development and characterization of herbal Kulfi (Ice Cream) using Tulsi, Ginger,and Clove. Indian J Dairy Sci 76 (5): 448-457

Stankoviæ MS (2011) Total phenolic content, flavonoid concentration and antioxidant activity of marrubium peregrinum L. extracts. Kragujevac J Sci 33: 63-72. UDC 581.19:582.929.4:577.164.3

Tidake HR, Shinde AT, Thombre BM (2024) Chemical composition of Paneer whey beverage blended with bottle gourd (Lagenaria siceraria) extract. International Journal of Veterinary Sciences and Animal Husbandry SP-9(1): 534-539

Zaman QU ,Sahar A, Sameen A, Ahmad MH, Muhammad N, Huma N, Afzal FM, Al-Farga, A (2023) Development and storage stability of Whey sugarcane based functional beverage. Int J Food Prop 26(1): 752-763