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## Physico-chemical properties of Paneer whey beverage incorporated with grape juice

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### Abstract

The present study of investigation was carried out during 2025-26 at the Section of Animal Husbandry and Dairy Science, College of Agriculture, Nagpur. The study aimed to develop a palatable and nutritious whey-based beverage by incorporating grape juice at five different levels, viz., 0% (T<sub>1</sub>), 4% (T<sub>2</sub>), 8% (T<sub>3</sub>), 12% (T<sub>4</sub>) and 16% (T<sub>5</sub>) with sugar maintained at 10% in all treatments. The prepared beverages were evaluated for sensory attributes, physicochemical properties and production cost. The findings indicated that increasing the proportion of grape juice resulted in a decrease in fat and ash content, while protein, total solids, acidity and total sugar increased progressively. Among the treatments, T<sub>3</sub> containing 8% grape juice exhibited the highest sensory acceptability, recording an overall acceptability score of 8.43 out of 9, along with a desirable nutritional composition. Depend on the overall sensory performance, nutritional characteristics and economic considerations, the beverage containing 8% grape juice and 10% sugar was identified as the most suitable treatment.

**Keywords:** Paneer whey beverage, Grape juice, Physico-chemical properties, reported that the, in the preparation of Paneer whey beverage

### Introduction

Milk is a highly nutritious food containing proteins, fats, carbohydrates, vitamins and minerals. The dairy industry plays an important role in producing nutritious and value-added products. Paneer whey, a major by-product of paneer production, contains valuable lactose, proteins, minerals and water-soluble vitamins, but is often underutilised and may cause environmental pollution when discarded.

Grape juice is a wealthy source of sugars, vitamins and bioactive compounds such as polyphenols, flavonoids and anthocyanins, which contribute to its nutritional and functional properties. Therefore, incorporation of grape juice into paneer whey can provide an opportunity to develop a nutritious, palatable and value-added beverage while improving the utilization of whey. The present study was undertaken to develop and evaluate a paneer whey beverage using grape juice, with emphasis on sensory acceptability, physicochemical properties and cost of production.

### Material and Methods

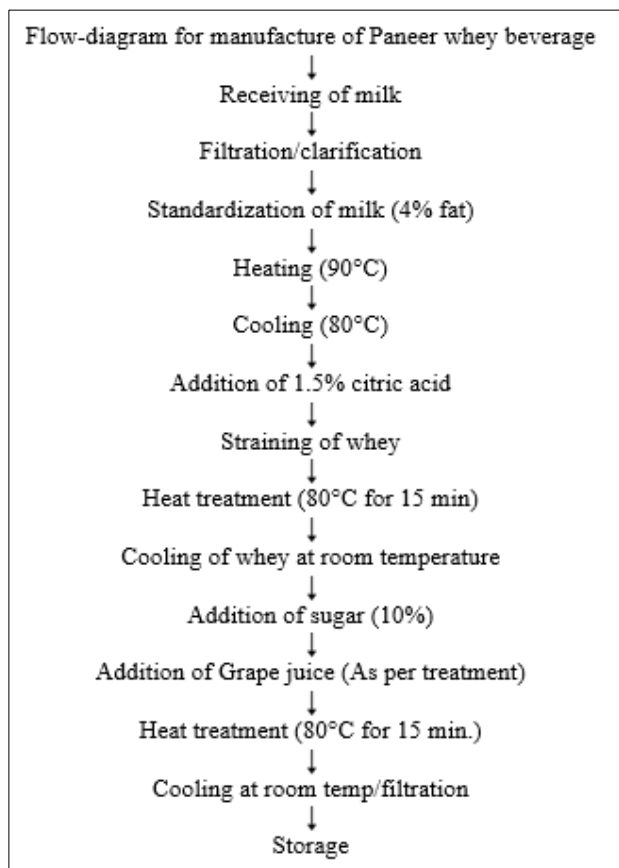
#### Treatment details used for the study

The paneer whey beverage is prepared by formulating different levels of grape juice and whey as control T<sub>1</sub> (100:0)%, T<sub>2</sub> (96:04)%, T<sub>3</sub> (92:08)%, T<sub>4</sub> (88:12)% and T<sub>5</sub> (84:16)% with the addition of 10% sugar in all treatments. The finished product level were finalised by sensory evaluation by using 9 point Hedonic Scale given by (Nelson and Trout) and analysed for physico chemical properties of the product.

### Chemical analysis of Paneer whey beverage

#### Determination of Fat

The fat was determined by Gerber method as per procedure in SP: 18 (Part XI), 1981.

**Flow-diagram for manufacture of paneer whey beverage****Determination of Protein**

Protein percentage of beverage was determined as per the semi micro Kjeldahl method as recommended in IS:1479 part II (1961).

**Determination of Total solids**

The total solids percentage in paneer whey beverage was determined by using gravimetric method as per the procedure of IS: 1479 (Part II) (1961).

**Determination of Acidity:** The acidity of milk expressed on per cent lactic acid will be determined by method described in IS: 1479 (Part II) 1961.

**Determination of Ash:** Ash content of paneer whey beverage was determined as per the procedure described in IS: 1479 (Part II) 1961.

**Determination of total sugar:** Total sugar content of whey was determined as per Lane-Eynon's method given in IS: SP:18, (Part XI) 1981.

**Cost of Production of paneer whey beverage**

The cost of materials used in preparation of paneer whey beverage during the experimental period was considered for estimating the production cost. Since the beverage was prepared on a laboratory scale, only the expenses incurred on recurring materials and other consumable items were included in the cost estimation.

**Statistical analysis:** The data generated at various stages of the study were statistically analysed using a Completely Randomized Design (CRD), comprising five treatments with four replications.

**Results and discussion**

**Sensory evaluation:** The present study and investigation were analysed for the sensory evaluation focused on flavour, body and texture, colour and appearance, as well as overall acceptability as per the method suggested by Nelson and Trout (1964) <sup>[4]</sup>.

**Table 1:** Sensory score for paneer whey beverage with grape (*Vitis vinifera*) juice (Score out of 9)

| Treatments           | Flavour | Body and texture | Colour and appearance | Overall acceptability |
|----------------------|---------|------------------|-----------------------|-----------------------|
| T <sub>1</sub> (0%)  | 7.81    | 7.78             | 7.90                  | 7.74                  |
| T <sub>2</sub> (4%)  | 8.14    | 8.12             | 8.19                  | 7.95                  |
| T <sub>3</sub> (8%)  | 8.44    | 8.54             | 8.33                  | 8.43                  |
| T <sub>4</sub> (12%) | 7.50    | 7.60             | 7.74                  | 7.54                  |
| T <sub>5</sub> (16%) | 7.36    | 7.40             | 7.50                  | 7.30                  |
| SE(m) ±              | 0.0300  | 0.0227           | 0.0305                | 0.0335                |
| C.D. 5%              | 0.0887  | 0.0820           | 0.0902                | 0.0993                |
| Results              | Sig     | Sig              | Sig                   | Sig                   |

The scores of overall acceptability for T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> were 7.74, 7.95, 8.43, 7.54 and 7.30, respectively. T<sub>3</sub> recorded the highest overall acceptability score of 8.43 out of 9, while T<sub>5</sub> had the lowest score of 7.30. Based on the overall sensory response, T<sub>3</sub> was identified as the most acceptable formulation.

**Chemical composition of paneer whey beverage**

The milk was analyzed for its chemical composition. Cow milk was standardised at 4 per cent fat and analyzed for moisture, fat, protein, total solids, ash, acidity, and total sugar. Paneer whey beverage prepared under different treatments were determined for fat, protein, total solids, ash, acidity and total sugar.

**Table 2:** For Physico-Chemical evaluation of Paneer whey beverage

| Treatments           | Fat    | Protein | Total Solids | Ash    | Acidity | Total sugar |
|----------------------|--------|---------|--------------|--------|---------|-------------|
| T <sub>1</sub> (0%)  | 0.47   | 0.38    | 6.66         | 0.57   | 0.18    | 14.35       |
| T <sub>2</sub> (4%)  | 0.46   | 0.39    | 7.07         | 0.56   | 0.20    | 14.77       |
| T <sub>3</sub> (8%)  | 0.45   | 0.40    | 7.47         | 0.55   | 0.22    | 15.19       |
| T <sub>4</sub> (12%) | 0.44   | 0.41    | 7.88         | 0.54   | 0.24    | 15.60       |
| T <sub>5</sub> (16%) | 0.43   | 0.42    | 8.29         | 0.53   | 0.26    | 16.02       |
| SE(m) ±              | 0.0054 | 0.0065  | 0.0150       | 0.0065 | 0.0091  | 0.0154      |
| C.D. 5%              | 0.0160 | 0.0191  | 0.0446       | 0.0191 | 0.0270  | 0.0456      |
| Results              | Sig    | Sig     | Sig          | Sig    | Sig     | Sig         |

### Fat content

The average fat content of the beverage was significantly affected by the addition of grape juice. The fat content of beverages prepared with paneer whey and grape juice in the proportions of 100:0 (T<sub>1</sub>), 96:4 (T<sub>2</sub>), 92:8 (T<sub>3</sub>), 88:12 (T<sub>4</sub>) and 84:16 (T<sub>5</sub>) was 0.47, 0.46, 0.45, 0.44 and 0.43 per cent, respectively. The highest fat content (0.47%) was recorded in T<sub>1</sub>, where no grape juice was added, whereas the lowest fat content (0.43%) was observed in T<sub>5</sub> containing 16 per cent grape juice. The results indicated that the fat content of the beverage decreased gradually with an increase in the proportion of grape juice. This reduction might be attributed to the comparatively lower fat content of grape juice than paneer whey, resulting in a dilution effect as the proportion of grape juice increased.

The findings of the present investigation were comparable with Tidake *et al.*, (2023) [3] reported that the fat content of the control and whey beverages containing bottle gourd extract was 0.51, 0.48, 0.46 and 0.44 per cent, respectively. A significant decreasing trend in fat content was observed with increasing incorporation of bottle gourd extract. This decrease was attributed to the comparatively lower fat content of bottle gourd extract (0.40%) than paneer whey.

### Protein content

The average protein content of the beverage was significantly influenced by the addition of grape juice. The protein content of the beverages prepared under T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> treatments was 0.38, 0.39, 0.40, 0.41 and 0.42 per cent, respectively. The highest protein content was recorded in T<sub>5</sub> (0.42%) containing 16 per cent grape juice, whereas the lowest was observed in T<sub>1</sub> (0.38%) without grape juice. From the present investigation, it was observed that the protein content of the beverage increased gradually with an increase in the level of grape juice.

The findings of the present investigation were comparable with Tidake *et al.*, (2023) [3] stated that the protein content of whey beverages containing bottle gourd extract increased progressively from 0.42 per cent in the control (T<sub>1</sub>) to 0.45, 0.47 and 0.49 per cent in T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>, respectively. The control treatment recorded the lowest protein content (0.42%), while T<sub>4</sub> exhibited the highest value (0.49%). The authors observed that the increase in protein content was associated with the increasing proportion of bottle gourd extract in the beverage.

**Total Solids content:** The incorporation of grape juice in the preparation of paneer whey beverage influenced the total solids content. The average total solids content of beverages prepared with paneer whey to grape juice proportions of 100:0 (T<sub>1</sub>), 96:4 (T<sub>2</sub>), 92:8 (T<sub>3</sub>), 88:12 (T<sub>4</sub>) and 84:16 (T<sub>5</sub>) was 6.66, 7.07, 7.47, 7.88 and 8.29 per cent respectively. The highest total solids content was recorded in T<sub>5</sub> (8.29%), while the lowest was observed in T<sub>1</sub> (6.66%). It was evident that the total solids content increased progressively with an increase in the level of grape juice in the beverage.

The findings of the present investigation were comparable with Bhalekar *et al.*, (2022) [1] also reported an increasing in total solids content, which increased from 15.46 to 17.64 per cent with an increase in jackfruit pulp from 5 to 20 per cent.

**Ash content:** The average ash content of the paneer whey beverage was significantly influenced by the incorporation of grape juice. The ash content of beverages prepared with

paneer whey to grape juice proportions of 100:0 (T<sub>1</sub>), 96:4 (T<sub>2</sub>), 92:8 (T<sub>3</sub>), 88:12 (T<sub>4</sub>) and 84:16 (T<sub>5</sub>) was 0.57, 0.56, 0.55, 0.54 and 0.53 per cent, respectively. The plain beverage without grape juice (T<sub>1</sub>) recorded the highest ash content (0.57%), whereas the lowest ash content (0.53%) was observed in T<sub>5</sub>, containing 16 per cent grape juice. The gradual decrease in ash content may be attributed to the replacement and dilution of the mineral-rich paneer whey with grape juice, which contributed comparatively less total mineral matter to the beverage.

The findings of the present investigation were comparable with Tidake *et al.*, (2023) [3] reported a significant decrease in the ash content of paneer whey beverage with increasing levels of bottle gourd extract. The ash content decreased from 0.53 per cent in the control treatment to 0.43, 0.37 and 0.32 per cent in T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>, respectively.

### Acidity content

The acidity content of the paneer whey beverage prepared with paneer whey to grape juice in T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> treatments was 0.18, 0.20, 0.22, 0.24 and 0.26 per cent, respectively. Significantly lowest acidity content was noticed in T<sub>1</sub> (0.18%), prepared without addition of grape juice, whereas the highest acidity content was observed in T<sub>5</sub> (0.26%), prepared with 16 per cent grape juice. It indicated that the acidity content of the beverage increased progressively with an increase in the level of grape juice.

The findings of the present investigation were comparable with Tidake *et al.*, (2023) [3] observed rise in acidity may be due to the relatively higher acidity of jackfruit pulp (0.25%) compared with whey (0.21%). Thus, the progressive incorporation of jackfruit pulp into the whey beverage led to a gradual increase in its overall acidity.

### Total sugar content

The average total sugar content of the paneer whey beverage was significantly influenced by the incorporation of grape juice. The total sugar content of beverages prepared with paneer whey to grape juice proportions of 100:0 (T<sub>1</sub>), 96:4 (T<sub>2</sub>), 92:8 (T<sub>3</sub>), 88:12 (T<sub>4</sub>) and 84:16 (T<sub>5</sub>) was 14.35, 14.77, 15.19, 15.60 and 16.02 per cent, respectively. The control beverage without grape juice (T<sub>1</sub>) recorded the lowest total sugar content (14.35%), whereas the highest value (16.02%) was observed in T<sub>5</sub>, containing 16 per cent grape juice. The progressive increase in total sugar content may be attributed to the natural sugars contributed by grape juice, resulting in a concentration-dependent increase in the total sugar content of the beverage.

The findings of the present investigation were comparable with Khodake *et al.*, (2017) reported a progressive increase in the total sugar content of paneer whey beverage with the addition of custard apple pulp. The total sugar content increased from 13.55 per cent in T<sub>1</sub> to 13.93, 14.36, 14.74 and 15.20 per cent in T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub>, respectively.

### Conclusion

Paneer whey beverage can be effectively utilized for the preparation of a value-added beverage by incorporating grape juice at different levels of 0, 4, 8, 12 and 16 per cent, with 10 per cent sugar maintained in all formulations. Protein (%), total solid (%), acidity (%) and total sugar (%) of paneer whey beverage have increased with increase in the per cent of grape juice. Fat (%) and ash (%) of paneer whey

beverage have decrease with increase in the per cent of grape juice.

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