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# Development of Whey Beverage by using Jackfruit (*Artocarpus heterophyllus* L.) Pulp

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## ABSTRACT

**Background:** In the present study, whey beverage was prepared by using paneer whey obtained from buffalo milk incorporated with *Barka* (soft flesh) type jackfruit pulp at different levels @ 5, 10, 15 and 20 per cent and sugar were added @ 10 per cent of whey for all treatments.

**Methods:** Jackfruit pulp whey beverage was prepared in dairy processing laboratory under hygienic condition with slight modification in reported methodology.

**Result:** From the results of the present investigation, it may be concluded that jackfruit pulp could be successfully utilized for the preparation of whey beverages. The addition of jackfruit pulp in whey beverage improved the sensory quality and overall acceptability of the finished product. The most acceptable quality was found in whey beverage prepared by incorporated jackfruit pulp @ 15 per cent ($T_3$) scored highest points (8.52) and whey beverage contained total solids, fat, protein, titratable acidity and pH as 16.56, 0.29, 0.60, 0.22 per cent and 5.00, respectively. The overall score for treatment $T_2$ and $T_4$ was almost the same *i.e.,* 7.82 and 7.83, respectively which indicates that the overall acceptability of the beverage at these treatments was equally good. The lowest score was recorded in treatment $T_1$ *i.e.*, whey beverage prepared with 5 per cent jackfruit pulp (7.76). The differences in scores possessed by all the treatments were highly significant.

**Key words:** Consistency, Jackfruit pulp, Protein, Whey beverage.

## INTRODUCTION

Whey is a by-product produce mainly during the manufacturing of chhana, paneer, cheese and also during the separation of curd/coagulated products that result from acid or proteolytic enzyme-mediated coagulation of milk (Darade and Ghodake 2012). During the manufacture of these products, about 10- 20 per cent portion of milk solids are recovered in end product and the remaining 80-90 per cent liquid portion is the whey. whey is recognized as a potential source of nutrients and are exploited for its bioactive ingredients. Because of its high nutritional composition, it is used in several commercial food product applications and is significantly associated with the dairy industry (Almeida *et al.*, 2013). The current world production of whey is estimated at 165 million tonnes. (Anonymous, 2010) in which about 68 per cent. In India, nearly 5 million tonnes of whey are produced of which chhana and paneer whey contribute around 80 per cent of total whey (Gupta, 2008).

Whey is used in the food industry for its high nutritional value, excellent functional properties and for reducing the cost of production of main food products. Whey is used in the preparation of meat and meat products, reduced-fat products, yoghurt, ice cream, cheese, bakery products, confectionery and pastry products, infant formula, whey beverage and for encapsulation of sensitive foods and edible coating of foods. The functional properties of whey proteins, mainly used in the production of food products are solubility, gelling, emulsifying and water binding properties, antioxidant activity, flavour improvement and fat mimetics (Królczyk *et al.,* 2016).

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The conversion of whey into beverages through fermentation or without fermentation is one of the most attractive avenues for the utilization of whey for human consumption. Beverages based on fruit and milk products are currently receiving considerable attention as their market potential is growing. Besides being delicious, these beverages are highly nutritious. In terms of functionality, whey protein enhances the protein content of beverages while improving their quality. Different fruits and vegetables have been tried for fortification of whey beverages like mango, orange, kokum (Karjivkar, 1992) pineapple, lemon and banana (Singh *et al.,* 1994). Whey fortified with fruit pulp/syrup and vegetable juices not only enhances its quality but also attracts the consumer as a variety product (Khodke *et al.*, 2018).

Konkan region of Maharashtra is a humid western coastal track, where Jackfruit (*Artocarpus heterophyllus* L.)

crop is found commonly. It is an ancient fruit that is widely consumed as fresh fruit. The use of Jackfruit bulbs and their parts has also been reported since ancient times for their the rapeutic qualities. The beneficial physiological effects may also have preventive application in a variety of pathologies. The health beneûts of jackfruit has been attributed to its wide range of Physico-chemical applications.

Jackfruit containsa good amount of vitamin A, vitamin C, thiamine, riboûavin, calcium, potassium, iron, sodium, zinc and niacin among many other nutrients. Jackfruit has a low caloric *i.e.* 94 Kcal/100g (Mukprasirt and Sajjaanantakul, 2004). Jackfruit is a rich source of potassium with 303 mg found in 100 g. Studies show that food rich in potassium helps to lower blood pressure. Another benefit of eating jackfruit is that it is a good source of vitamin C. The human body does not make vitamin C, so one must eat food that contains vitamin C to reap its health benefits. Vitamin C is an antioxidant that protects the body against free radicals, strengthens the immune system and keeps our gums healthy (Umesh *et al.*, 2010).

The ripe jackfruit pulp has high nutritive value as well as a peculiar taste.So far jackfruit pulp has been successfully utilized for the value addition of milk products like basundi, flavoured milk and milk pudding.Thus, considering the nutritive value and peculiar flavour of jackfruit, the present study was carried out entitled “Preparation of whey beverage by incorporation of jackfruit (*Artocarpus heterophyllus* L.) pulp”.

## MATERIALS AND METHODS

The fresh buffalo milk was collected from the Instructional Dairy Farm of College of Agriculture, Dapoli. Under hygienic conditions, whey was collected during the preparation of paneer in the dairy processing laboratory. Other ingredients like sugar and *barka* jackfruit pulp were purchased from the local market at Dapoli, Maharashtra.

### Methodology

Jackfruit pulp whey beverage was prepared as per the method given by Chavan *et al*. (2015) for mango whey bevereage with slight modification as below:

Paneer whey
↓
Heating (72±2°C/5 minutes)
↓
Cooling (25-30°C)
↓
Filtration (through 4-fold muslin cloth)
↓
Addition of Sugar (10%)
↓
Mixing (Jackfruit pulp) as per the treatments
↓
Filtration
↓
Bottling and crown corking
↓
Cooling and storage (8-10°C)

### Chemical analysis

The ingredient *viz*., paneer whey, Jackfruit pulp and Jackfruit pulp whey beverage were analyzed. The total solids content was determined by the gravimetric method as per IS: 1479 (Part II). The fat content of whey jackfruit whey beverage was determined by using the standard Gerber method as described in IS: 1224 (Part I). The protein content was determined by estimating the per cent nitrogen by the Micro Kjeldahl method as recommended in IS:1479 (Part II). The acidity of milk expressed as per cent lactic acid was determined by the method described in IS:1479 (Part II). The pH was determined by using pH meter CAT No. CL-54. To minimize experimental error, at a time five samples were analyzed from every treatment during each replication.

### Sensory evaluation

The product was served to a panel of 8 to 10 semi trained judges for organoleptic evaluation. They were provided with nine points hedonic scorecard for evaluation as per IS:6273 (Part II) 1971. The whey beverage was evaluated by the judges for sensory attributes *viz.,* colour and appearance, flavour, consistency and overall acceptability.

### Economics of finish product

The production cost of whey beverage under different treatments was worked out by using prevailing market rates of ingredients only.

### Statistical analysis

The data were tabulated and analyzed in randomized block design using six replication (Snedecor and Cochran 1994).

## RESULTS AND DISCUSSION

### Chemical analysis of panner whey and jackfruit pulp

For the preparation of good quality whey beverage, the chemical quality of panner whey and jackfruit pulp were assessed and presented in Table 1.

The result values of panner whey are in close agreement with values reported by Singh *et al.* (1994) and De (2011). The jackfruit pulps composition were quite similar to the values reported by Bhore *et al.* (1980) mentioned the moisture, carbohydrates, fat, protein, fibre, ash and total solids as 79.00, 16.25, 0.20, 1.95, 1.20, 0.90 and 21.00 per cent, respectively of local type jackfruit., Similar results were

**Table 1:** Chemical analysis of paneer whey and jackfruit pulp (per cent).

| Constituents | Paneer whey (%) | Jackfruit pulp (%) |
|---|---|---|
| Total solids | 6.40 | 23.69 |
| Fat | 0.32 | 0.22 |
| Protein | 0.42 | 1.75 |
| Acidity | 0.21 | 0.25 |
| pH | 5.12 | - |
| Ash | - | 0.93 |

*Mean of six replications.

reported by Antarkar (1991), Shiputkar (1999), Rahman *et al.* (2001).

**Chemical analysis of Jackfruit pulp whey beverage**

The chemical analysis of whey beverage prepared by using different levels of jackfruit pulp was analyzed *viz.*, total solids, fat, protein, titratable acidity and pH. The values of analyzed data are presented in Table 2.

**Total solid**

The average total solid content recorded @ 5, 10, 15 and 20 per cent of jackfruit pulp whey beverage was 15.46, 16.26, 16.90 and 17.64 per cent, respectively. It was observed that treatment differences are significant @ 5 per cent level of significance. Total solid content was increased with the ascendent level of jackfruit pulp and it may be due to the high total solid content of jackfruit pulp. The adequate amount of total solid content in jackfruit pulp is reported in Table 1 (23.69 per cent) as compared to the total solids content of whey (6.40 per cent). The presented value of total solids content in experimental whey beverage are more or less similar to values reported by Karjivkar (1992), Singh *et al.* (1994), Girisha (2011). Yadav *et al.* (2016) observed that the total solids content in soy-based beverages ranged between 16.2±1.43 to 23.8±1.54 per cent.

**Fat**

The data about the fat content of whey beverages influenced by the addition of jackfruit pulp at different levels were found to be significant. The fat content was significantly decreased with the increase in the level of jackfruit pulp.The average fat percent of whey beverage @ 5, 10, 15 and 20 per cent level of jackfruit pulp was 0.31, 0.30, 0.30 and 0.28 per cent, respectively.This decrease in fat content of whey beverage may be attributed to the fact that the fat content of jackfruit pulp is less (0.22 per cent) as compared to whey (0.32 per cent).The average fat content of whey beverages was 0.29 per cent which is a quite similar to values reported by Karjivkar (1992) and Singh *et al.* (1994) stated that the fat content at different fruit beverages *viz.*, mango, pineapple, lemon and banana varied from 0.32 to 0.38 per cent.

**Protein**

The average protein content of whey beverage @ 5, 10, 15 and 20 per cent level of jackfruit pulp was 0.47, 0.58, 0.65 and 0.73 per cent, respectively. The protein content of the prepared whey beverage was observed highly significant due to the addition of different levels of jackfruit pulp. The values were revealed that the increase in the level of jackfruit pulp increases the protein content and it may occur due to the jackfruit pulp was added over and above the weight of whey added in per cent basis also increase in protein content may be attributed to the fact that protein content of jackfruit pulp is higher (1.75 per cent) as compared to the protein content of whey (0.42 per cent). These findings are quite comparable with the values reported by Karjivkar (1992), Singh *et al.* (1994), Khamrui and Rajorhia (1998). Chavan *et al*. (2015) reported 0.75 per cent protein content in whey-based mango beverages.

**Table 2:** Chemical analysis of Jackfruit pulp whey beverage.

| Treatments | Total solids | Fat | Protein | Acidity | pH |
|---|---|---|---|---|---|
| $T_1$ | 15.46 | 0.31 | 0.47 | 0.21 | 5.18 |
| $T_2$ | 16.26 | 0.30 | 0.58 | 0.22 | 5.05 |
| $T_3$ | 16.90 | 0.30 | 0.65 | 0.22 | 4.91 |
| $T_4$ | 17.64 | 0.28 | 0.73 | 0.23 | 4.87 |
| SE | 0.0532 | 0.00045 | 0.0122 | 0.0021 | 0.0321 |
| CD | 0.1605 | 0.0138 | 0.0368 | 0.0065 | 0.0968 |

Mean score of six replications *Significant at 5% level of significance.

**Acidity**

The variation in titratable acidity due to jackfruit pulp was statistically significant. The increase in the acidity may be due to the acidic nature of jackfruit pulp (0.25 per cent) as compared to the acidity of whey (0.21 per cent). The obtained result values are quite similar to the findings reported by Singh *et al.*(1994) recorded the titratable acidity of beverages ranged from 0.337 to 0.341 per cent and Sirohi (2002) documented the titratable acidity of beverage ranged between 0.20 to 0.22 per cent.

**pH**

The data documented in Table 2 show that the addition of jackfruit pulp @ 5, 10, 15 and 20 per cent of whey beverage was found pH 5.18, 5.05, 4.91and 4.87, respectively. It was observed that the pH of whey beverage is decreased with an increase in the level of jackfruit pulp. It was statistically found significant. The finding of pH is well comparable with the pH values of different whey beverages reported by Karjivkar (1992) prepared beverages from shrikhand whey fortified with kokum, mango and orange fruit juices and noted that the pH of beverages ranged from 3.98 to 4.35. Yadav *et al.* (2016) studied on development and storage of whey-based banana herbal beverage and observed that the pH of whey beverage was 5.51. Girisha (2011) also recorded similar findings.

**Sensory evaluation Jackfruit pulp whey beverage**

**Colour and appearance**

The colour and appearance are most important and it is the first impression towards the product for acceptance by the consumers. The score values obtained revealed that the whey beverage prepared by using 15 per cent jackfruit pulp was found superior amongst all the treatments in colour and appearance which recorded the maximum score (8.44), followed by whey beverage with 20 per cent jackfruit pulp (score = 7.73) represented in Fig 1. The lowest score was obtained by the product with 5 per cent jackfruit pulp. It was observed that the whey beverage with 15 per cent jackfruit pulp showed slight yellowish jackfruit colour with a clear and clean appearance which was liked very much by the

judges.The variation in score may be due to the intensity of colour observed that light dull yellow to dark yellowish @5 and 20 per cent level of jackfruit pulp which may not be liked by the Judges.

**Flavour**

The values presented in Fig 1 was shown that the highest score was recorded in whey beverage with 15 per cent jackfruit pulp (8.56) amongst all the treatments, the lowest score was found in whey beverage with 5 per cent jackfruit pulp (7.74).The flavour score was observed quite similar in whey beverages with 15 and 20 per cent jackfruit pulp. The reasons for the low score may be due to the deep aromaof pulp found at a higher level whereas mild dull flavour found inthe lower level which was not liked by judges.The differences in scores obtained by all the treatments were found to be significant.

**Consistency**

Consistency is an important parameter in evaluating fluid products including whey beverages.Thevalues presented in Fig 1observed that the consistency of whey beverage @ 5, 10, 15 and 20 per cent level of jackfruit pulp was 7. 72, 7.83, 8.39 and 7.84, respectively. The addition of jackfruit pulp had found a significant effect on the consistency of whey beverage. The highest scorewas found in the 15 per cent level of jackfruit pulp (8.39) indicating that the whey beverage at 15 per cent jackfruit pulp was the best quality product with the desired consistency. The whey beverage with 5 per cent jackfruit pulp was recorded a lower score due to comparatively thin consistency (7.72). All treatments are statistically significant at a 5 per cent level of significance.

**Overall acceptability**

Overall acceptability is the indicative parameter of the sensory quality of products in totality. The overall acceptability of whey beverage prepared by using 15 per cent jackfruit pulp scored the highest points (8.52). The overall score of whey beverage with jackfruit pulp10 and 20 per cent was observed a quite similar score 7.82 and 7.83, respectively which indicates that overall acceptability of the beverage at these treatments was equally good. The lowest score was found in whey beverage prepared with 5 per cent jackfruit pulp (7.76). The differences in scores possessed by all the treatments were highly significant. Based on the results, we can affirmatively state that amongst the different levels of jackfruit pulp, $T_3$ treatment(15% jackfruit pulp) was found to be most acceptable by the judges *i.e.*, good quality whey beverage was obtained with the addition of 15 per cent jackfruit pulp.

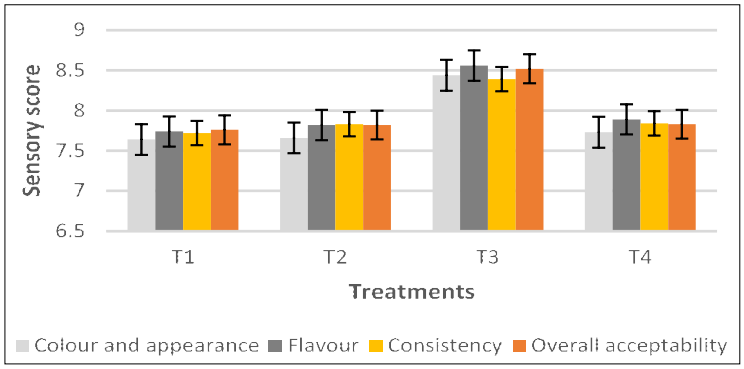


**Fig 1:** Sensory score of Jackfruit pulp whey beverage.

**Table 3:** Cost of production (`) of whey beverage blended with jackfruit pulp (Based on cost of ingredients only).

| Ingredients | Rate (`) | Treatments | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $T_1$ | | $T_2$ | | $T_3$ | | $T_4$ | |
| | | Qty (g) | Cost (`) | Qty (g) | Cost (`) | Qty (g) | Cost (`) | Qty (g) | Cost (`) |
| Paneer whey (By-product) | 0 | 500 | 0 | 500 | 0 | 500 | 0 | 500 | 0 |
| Sugar (`/kg) | 40/- | 50 | 2.0 | 50 | 2.0 | 50 | 2.0 | 50 | 2.0 |
| Jackfruit pulp (`/kg) | 190/- | 25 | 4.75 | 50 | 9.50 | 75 | 14.25 | 100 | 19.00 |
| Total quantity (g) and cost of whey beverage (`) | - | 556 | 6.75 | 580 | 11.50 | 604 | 16.25 | 626 | 21.00 |
| Per cent recovery | - | 96.69 | - | 96.66 | - | 96.64 | - | 96.30 | - |
| Total cost of whey beverage (`/100 g) | - | - | 1.21 | - | 1.98 | - | 2.69 | - | 3.35 |
| Total cost of whey beverage (`/1000 g) | - | - | 12.10 | - | 19.80 | - | 26.90 | - | 33.50 |

Note: As a whey, a by-product of paneer industry, is not commercially used, its cost treated as Nil (` 0).

### Cost of production

One of the main objectives of the present study was to find out the effect of the addition of jackfruit pulp on the production cost of whey beverages. While calculating the production cost of whey beverage, the cost of ingredients only was considered. Expenditure is given in Table 3. From this table, it can be said that the cost of whey beverage prepared by using different levels of jackfruit pulp was different from treatment to treatment.

The highest cost ( 33.20/Lit.) was recorded in the case of whey beverage prepared with 20 per cent jackfruit pulp ($T_4$) while the lowest cost (`12.10/Lit.) was recorded in the case of whey beverage with 5 per cent jackfruit pulp ($T_1$). It was observed that the cost of whey beverage increased with the increase in the level of jackfruit pulp. The production cost of the most acceptable level ($T_3$) was 26.90 per Lit.

## CONCLUSION

From the results of the present investigation, it may be concluded that jackfruit pulp could be successfully utilized for the manufacturing of whey beverages. The most acceptable quality whey beverage can be prepared by using 15 per cent jackfruit pulp. Such replacement did not affect appreciably the composition of whey beverage. Jackfruit had a positive effect on sensory attributes of whey beverage on its acceptability and consumption. Besides peculiar flavour, it also adds nutritional importance to the product.

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**Conflict of interest:** None.

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