

## Development of Hydrolyzed Carbonated Whey Beverage with Pomegranate Peel Extract and Guava Leaves Extract

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**ABSTRACT:** Present study was aimed to develop a carbonated whey beverage for effective utilization of paneer whey. Lack of efficient utilization of whey makes it as an environmental burden. For the study, whey was obtained from the manufacture of paneer. Lactose in whey was hydrolyzed by Lactase ( $\beta$  – galactosidase) enzyme at a pH of 6.6. Lactose hydrolyzed whey beverage was prepared by mixing sugar (10%), pomegranate peel extract (1, 2, 3 and 4%) and guava leaves extract (1, 2, 3 and 4%) to the hydrolyzed whey. Carbonation was carried out by the injection of CO<sub>2</sub>. Optimizing the levels of incorporation of pomegranate peel extract and guava leaves extract in carbonated hydrolyzed whey beverage was based on sensory analysis. The hydrolyzed whey beverage with 3% Pomegranate peel extract and 3% Guava leaves extract was more acceptable among all other samples. The physico-chemical analysis such as pH, Acidity (% lactic acid) and Total soluble solids (°Brix) in the optimized beverage was analyzed and it was found to be 6.54, 0.18 and 18.45 respectively. From the current findings, it is observed that pomegranate peel extract and guava leaves extract can be successfully incorporated into hydrolyzed whey beverage and the developed product is highly acceptable compared with control. This study can be considered as a method for the efficient utilization of the by-products.

**Keywords:** Pomegranate peel extract, Guava leaves extract, Hydrolyzed whey, Carbonation, whey beverage.

### INTRODUCTION

“Beverages” can be considered as a potential source of water which starts consuming from newborn as breast milk to the whole life in some other forms. There is an expected compounded annual growth at the rate of 2.53% in the global beverage market from US\$1,561.084 billion in 2019 to US\$1,859.278 billion by 2026 (Global Beverage Market, 2022). In consumption of Beverages, other than its thirst-quenching ability it is important in its “food value” also.

Whey in general is the drain leftover after the cheese or casein are manufactured from the milk. Normally, 100L of milk can yield 87L of whey as byproduct. Whey contains a nutritional component with biological value, such as  $\alpha$ -Lactalbumin,  $\beta$ -Lacto globulin and lactoferrin that helps to reduce health risks (Smithers *et al.*, 1996). Production of whey-based beverages might be a better method for improving the healthiness quotient of beverages, since the acid whey is rich in valuable proteins having high nutritional values like the casein macropeptide, that will shield against the

bacteria and viruses and can stimulate the human immune system (Rizzolo *et al.*, 2017).

Hydrolysis of lactose content either by fermentation or controlled enzymatic hydrolysis have been claimed to have beneficial effect like greater digestibility (Clemente, 2000; Frokjaer, 1994). Lactose when hydrolyzed can improve its desirability by the improved flavor enrichment, better osmotic pressure, easily digestible, quickly soluble, more sweetness and good fermentability (Coton, 1980; Arndt and Wehling 1989).

Carbonated beverages are more accepted currently, particularly by the younger adults and a diverse range of soft drinks are available in the market as well. Sugar-sweetened carbonated beverages increase sugar intake and now accounts for a substantial portion of the total calorie consumption of younger adults (El-Hazmi *et al.*, 2002).

Pomegranate (*Punica granatum* L.) peel is considered as an agro waste in juice industries are the potential source of several bioactive components like phenolic acid and flavonoids. Pomegranate peel have

antibacterial, anti-inflammatory and anti-cancerous properties (Gullon *et al.*, 2020).

Guava (*Psidium guajava* L) is a common tropical fruit known as “super food” because of the presence of bioactive components and nutrients in it. Guava leaves are a potential source of several bioactive components like phenolic compounds, flavonoids, glutamic acid etc. which makes the guava leaves a rich source of antioxidants. Guava leaf extract contains many bioactive components such as polyphenolic compounds, rosmarinic, gallic and caffeic acids, carvacrol, eugenol and catechin (Jang *et al.*, 2014; Ademiluyi *et al.*, 2016). Carbonated hydrolysed whey beverages are one of the new trend in research area and there are very negligible studies related to this topic, hence this study was anticipated to develop a nutrient rich carbonated hydrolysed whey beverage with utilization of pomegranate peel and guava leaves extract, which is more acceptable for lactose intolerance people.

## MATERIAL AND METHODS

### A. Materials

Whey (paneer whey) was obtained from Incubation centre of College of Food and Dairy Technology, Chennai, Tamil Nadu. The  $\beta$ -galactosidase (Maxilact® L 5000 Lactase) enzyme was purchased from DSM Food specialties, Denmark. Good grade sugar was purchased from local market-Redhills, Chennai. Pomegranate peel was obtained from local market-Redhills Chennai. Fresh Guava leaves were collected from guava trees of CFDT college compound, Alamathi.

### B. Methods

**Preparation of pomegranate peel and guava leaves extract.** Pomegranate peel and Guava leaves were washed cleaned and thoroughly with water. Then the Peels and leaves were cutted in to small pieces of about 0.5 cm<sup>2</sup> and dried at 40°C for 12 hours in the solar dryer. The dried peels and leaves were cooled to 37°C and powdered 5 g pomegranate peel powder was added to 300 ml of boiling water and kept for 5 minutes. Then the mixture is cooled to 37°C and left in dark at room temperature for 1 hour. Then the extract is filtered through whatman No.1 filter paper, resulting extract is centrifuged at 3500 rpm for 10 minutes. 20 grams of guava leaves powder was added to 500 ml of boiling water and kept for 5 minutes. Then the extract is filtered through whatman No. 2 filter paper (Chen and Yen 2007; Jalal *et al.*, 2018).

**Preparation of Carbonated whey beverage.** Fresh whey obtained from channa or paneer making was filtered with muslin cloth and cream separated using cream separator. Then it was pasteurized at 80°C for 10

minutes and cooled to 37°C. The pH of whey was adjusted to 6.6 using 1N KOH for the lactose hydrolysis. Lactase enzyme (Maxilact® L 5000 Lactase enzyme) was added at 0.3ml/litre. Then the whey was incubated at 40°C for 3 hours in the incubator (Mabrouk and Gemiel 2020). After incubation the enzyme was inactivated by heating at 80°C for 5 minutes. The hydrolyzed whey was cooled to 37 °C and added the other ingredients like Sugar, Pomegranate peel extract and Guava leaves extract. Then again, the whey was pasteurized at 80°C for 10 minutes and immediately cooled to 5°C. The resulting beverage was carbonated at 15 psi pressure, filled in glass bottle, crown corking and kept for storage at refrigerated temperature (4°C).

**Sensory analysis.** The whey beverage samples with different levels of extracts were subjected to sensory analysis for their color, flavor, taste, mouth feel and overall acceptability using 9 Point hedonic scale (Pandey *et al.*, 2019).

**Chemical Analysis.** The pH and Titrable acidity were estimated by the procedure given in FSSAI (2016). TSS (°Brix) content was determined by using the Digital Refractometer (Niveadhitha *et al.*, 2018).

**Statistical analysis.** Statistical analysis was performed using one way analysis of variance (ANOVA). Statistical analysis was conducted with IBM SPSS® 20.0 for Windows® software software program.

## RESULTS AND DISCUSSION

**Sensory analysis of developed carbonated whey beverage.** A preliminary trial was carried out to optimize the whey beverage with different concentration of pomegranate peel extract (1, 2, 3 and 4%) on the basis of sensory analysis by 9-point hedonic scale.

Based on preliminary trials, 3% pomegranate peel extract was optimized. Four different levels of guava leaves extract *i.e.* 1.0% (T<sub>1</sub>), 2.0% (T<sub>2</sub>), 3.0% (T<sub>3</sub>) and 4.0% (T<sub>4</sub>) and 10% sugar was added in to hydrolyzed whey with 3% pomegranate peel extract. There was a highly significant difference (P<0.01) on sensory attributes observed between the developed carbonated whey beverages. The whey beverage with 3% pomegranate peel extract and 3% guava leaves extract (T<sub>3</sub>) scored highest for color and appearance (8.63/9.0), flavor (8.62/9.0), taste (8.58/9.0), mouthfeel (8.51/9.0) and overall acceptability (8.62/9). The Sensory score of carbonated whey beverage effected by different concentrations of pomegranate peel extract is given in Table 1. Sensory score of carbonated whey beverage affected by different concentrations of guava leaves extract is given in Table 2.

**Table 1: Sensory score (Mean±SE) <sup>@</sup> of carbonated whey beverage effected by different concentrations of pomegranate peel extract.**

Particulars	Control	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	F value
Color and Appearance	7.32±0.10 <sup>a</sup>	7.75±0.11 <sup>a</sup>	8.21±0.09 <sup>a</sup>	8.41±0.10 <sup>a</sup>	8.48±0.10 <sup>a</sup>	20.206**
Flavor	7.52±0.10 <sup>a</sup>	7.68±0.10 <sup>a</sup>	8.28±0.09 <sup>b</sup>	8.30±0.10 <sup>a</sup>	7.54±0.10 <sup>a</sup>	14.994**
Taste	7.53±0.10 <sup>a</sup>	7.81±0.10 <sup>a</sup>	8.10±0.09 <sup>a</sup>	8.42±0.10 <sup>a</sup>	7.42±0.10 <sup>a</sup>	17.274**
Mouthfeel	7.28±0.10 <sup>a</sup>	7.73±0.10 <sup>a</sup>	7.94±0.10 <sup>a</sup>	8.40±0.10 <sup>a</sup>	7.31±0.10 <sup>a</sup>	19.509**
Overall acceptability	7.32±0.10 <sup>a</sup>	7.72±0.11 <sup>a</sup>	7.95±0.10 <sup>a</sup>	8.52±0.10 <sup>a</sup>	7.58±0.10 <sup>a</sup>	15.786**

@ Average 6 trials, \*\* Highly significant (P≤0.01), Means bearing various superscripts in the same row differs highly significantly  
PE - Pomegranate peel extract

Control-whey beverage without carbonation and PE; T<sub>1</sub> – Carbonated Whey beverage with 1% PE; T<sub>2</sub> – Carbonated Whey beverage with 2% PE; T<sub>3</sub> – Carbonated Whey beverage with 3% PE; T<sub>4</sub> – Carbonated Whey beverage with 4% PE

**Table 2: Sensory score (Mean±SE) <sup>@</sup> of carbonated whey beverages affected by different concentrations of guava leaves extract.**

Particulars	Color and Appearance	Flavor	Taste	Mouthfeel	Overall acceptability
Control	7.31±0.10 <sup>a</sup>	7.42±0.10 <sup>a</sup>	7.54±0.10 <sup>a</sup>	7.38±0.10 <sup>a</sup>	7.31±0.10 <sup>a</sup>
T <sub>1</sub>	7.45±0.05 <sup>a</sup>	8.00±0.08 <sup>b</sup>	7.92±0.05 <sup>b</sup>	7.34±0.03 <sup>a</sup>	7.48±0.06 <sup>a</sup>
T <sub>2</sub>	7.76±0.06 <sup>b</sup>	7.53±0.04 <sup>a</sup>	7.89±0.05 <sup>b</sup>	7.64±0.04 <sup>b</sup>	8.00±0.08 <sup>b</sup>
T <sub>3</sub>	8.63±0.09 <sup>c</sup>	8.62±0.10 <sup>c</sup>	8.58±0.12 <sup>c</sup>	8.51±0.12 <sup>c</sup>	8.62±0.12 <sup>c</sup>
T <sub>4</sub>	8.76±0.06 <sup>b</sup>	7.54±0.10 <sup>a</sup>	7.56±0.10 <sup>a</sup>	7.82±0.07 <sup>b</sup>	7.79±0.07 <sup>b</sup>
F value	58.075**	35.958**	24.519**	46.975**	32.216**

@ Average 6 trials, \*\* Highly significant (P≤0.01); Means bearing various superscripts in the same column differs highly significantly  
PE-Pomegranate peel extract, GE-Guava leaves extract; Control-whey beverage without carbonation, PE and GE; T<sub>1</sub> – Carbonated Whey beverage with 3% PE and 1% GE; T<sub>2</sub> – Carbonated Whey beverage with 3% PE and 2% GE; T<sub>3</sub> – Carbonated Whey beverage with 3% PE and 3% GE; T<sub>4</sub> – Carbonated Whey beverage with 3% PE and 4% GE

**Physico-chemical properties of developed Carbonated whey beverage.** The physico-chemical characteristics of control and carbonated whey beverage were given in Table 3. There was a significant difference in pH were found between the control and carbonated whey beverage. Control is having higher pH (6.73) than product (6.54). The titratable acidity (% lactic acid) of control (0.14) and product (0.18) shows a

highly significant (P≤0.01) difference. The results are similar with Mabrouk and Gemiel (2020). The higher acidity in product is due to the acidic nature of pomegranate peel (Saleh *et al.*, 2021). Developed Carbonated beverage was having higher TSS content (18.45°Brix) compared to control (12.1°Brix). The results of TSS content are comparable to Mabrouk and Gemiel (2020) in their carbonated whey beverage.

**Table 3: Physico-chemical characteristics of control and developed carbonated whey beverage.**

Parameter	Control	Carbonated whey beverage	t-value
pH	6.73±0.03 <sup>b</sup>	6.54±0.04 <sup>a</sup>	3.420*
Acidity (% lactic acid)	0.141±0.005 <sup>b</sup>	0.180±0.007 <sup>a</sup>	4.167**
Total soluble solids (° Brix)	5.91±0.005 <sup>b</sup>	11.12±0.013 <sup>a</sup>	355.540**

## CONCLUSIONS

Effective utilization of whey is possible by converting whey in to beverages. It was concluded that hydrolyzed whey can be successfully incorporated with pomegranate peel extract and guava leaves extract with carbonation without altering any physico-chemical and sensory properties. Carbonated whey beverage proves to be an alternative to soft drinks. Hydrolyzed whey beverage is easily acceptable by lactose hydrolyzed people.

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**Conflict of Interest.** None.

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