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## Studies on utilization of passion fruit pulp and passion fruit peel in fruit yogurt

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### Abstract

The consumption of fermented dairy products is increasing in recent years, mainly due to its excellent nutritional value and they are considered source of proteins, carbohydrates, fats and minerals which are fundamental for the body development. Further, to increase Yogurt consumption, anti-bacterial Passion fruit pulp and fibre rich Passion Fruit peel can be added to improve their nutritional, therapeutic and functional properties. In this direction, this research study had been attempted to develop anti-bacterial Fruit Yogurt rich in fibres with the addition of Passion fruit pulp will help in enhancing the nutra-ceutical value and health benefits. Trails were conducted to adjust the most acceptable levels of Passion Fruit pulp (12%,13% and 14%) and Passion fruit Powder (3%, 2% and 1%) on the basis of and Physico-chemical, micro-nutrient and sensory analysis of product. Statistical analysis showed that yogurt with 13% of passion fruit pulp and 2% passion fruit peel was more acceptable than others comparing all quality characteristics. The results revealed that addition of passion fruit pulp and peel at different ratio tends to increase the fibre content and vitamin C. The overall acceptability were observed at 13% level of passion fruit pulp and 2% level of passion fruit peel.

**Keywords:** nutritional, therapeutic, fortified, passion fruit pulp, passion fruit peel, fibre

### Introduction

Dairy products like Cheese, Acidophilus milk, Butter, Dahi, Buttermilk, Yoghurt and Kefir etc play a great role in human life. They are imbued with a host of health -promoting and therapeutic properties and are useful in osteoporosis prevention, lactose intolerance, nutrient synthesis and bioavailability etc. The beneficial effects ascribed to probiotic strains or fermented foods arise not only from bacteria themselves but also from the metabolites produced during fermentation Verma *et al.*, 2012) [26]. Milk products prepared by lactic acid fermentation (e.g. yoghurt) or a combination of this and yeast fermentation (e.g. Kefir) are called fermented or cultured milks. Fermented milk is the collective name for products such as Curd, yoghurt, kefir, cultured buttermilk, filmjöl (Scandinavian sour milk), cultured cream and koumiss (a product based on mare's milk). The generic name of fermented milk is derived from the fact that the milk for the product is inoculated with a starter culture which converts part of the lactose to lactic acid IHEMEJE A (2015) [16, 18].

Mckinley (2005) defined, "Fruit Yoghurt is one of the most popular fermented milk products worldwide and has gained widespread consumer acceptance as a healthy food. It provides an array of nutrients in significant amounts, in relation to its energy and fat content, making it a nutrient-dense food. In particular, it can provide the body with significant amounts of calcium in a bioavailable form. Furthermore, it has many health benefits beyond the basic nutrition it provides, such as improved lactose tolerance, a possible role in body weight and fat loss, and a variety of health attributes associated with probiotic bacteria"

Passion fruit (*Passiflora edulis*) is an attractive, nutritious fruit crop highly appreciated for fresh consumption and industrial purposes because of its diverse uses for juice, jelly and ice cream products. Inside, the fruit is more or less filled with an aromatic mass of double-walled, membranous sacs containing orange colour pulpy juice and as many as 250 small, hard, dark brown to black pitted seeds. A ripe fruit is refreshing, delicate flavour with pleasing aroma and high nutritive value B. Y. Deng (2013) [7]. In India, it is found to be grown wild in many parts of Western Ghat such as Nilgiris, Kodaikanal, Shevroys, Coorg and Malabar and North Eastern States like Manipur, Nagaland and Mizoram. Currently, more than 110 phytochemical constituents have been found and identified from the different plant parts of *P. edulis* in which flavonoids and triterpenoids held the biggest share.

Various extracts, fruit juice and isolated compounds showed a wide range of health effects and biological activities such as antioxidant, anti-hypertensive, anti-tumor, antidiabetic, hypolipidemic activities, and so forth. Daily consumption of passion fruit at common doses is non-toxic and safe. *P. edulis* has great potential development and the vast future application for this economically important crop worldwide, and it is in great demand as a fresh product or a formula for food, health care products or medicines Morton JF. Banana (1987) [27]. Fruit and yogurt have been identified individually as indicators of healthy dietary patterns. Fruits are relatively low in energy density and are an excellent source of antioxidants and prebiotic fibers and polyphenols, which can promote digestive health. The local Passion fruit pulp is mainly related to the volatile compound ethyl hexanoate, methyl hexanoate and D-limonene therefore making the product more acceptable for consumption due to its pungent, strong aroma. Yogurt, on the other hand, is a nutrient-dense food that is a good source of dairy protein, calcium, magnesium, vitamin B-12, conjugated linoleic acid, and other key fatty acids. In fact, the dairy industry and researchers are presently looking for products with lower fat content, with little or no sugar, and enriched with fiber. Therefore, the aim of the study was to provide an alternative to the stirred yoghurt with the enrichment of passion fruit pulp and skin powder. To find the sensory characteristics and to estimate the cost of using Passion Fruit Pulp and its Peel in fruit yoghurt.

## Materials and Methods

### Raw Materials

Full cream milk was collected from the "Student Dairy Plant, SHUATS, Prayagraj, Uttar Pradesh". Sugar was collected from local market of Prayagraj, Uttar Pradesh. Starter Culture

was purchased from Nurturing By Cultures Ltd. Passion fruit was purchased from Meg industry (Meghalaya).

### Procedure for Preparation of passion fruit pulp and passion fruit peel

Fresh ripe fruits (passion fruit) was gently wash under tap water, cut with the help of a knife, and scooping of the pulp was done with a spoon and then was subjected to pulp extraction. The pulp was added with 50% of sugar and was heated at 85 °C for 20 mins and cooled to 5 °C. The prepared fruit homogenates were filled into jars and pasteurized at 95 °C for 15 min as shown in fig 1 Passion fruit peels were dehydrated in an Hot air oven at 60 °C for 24 h (until reaching constant weight). After that, they was ground in a knife mill, and the flour obtained was passed through a 35-mesh sieve (Abronzinox, 0.425 mm) to obtain a uniform material. The flour was packed in polyethylene bags, and frozen (-18 °C) for up to 30 days as shown in fig 1

### Production of yoghurt

Milk was Standardized (milk fat 3%, SNF8.5%) will be adjusted to 12% with addition of SMP (skim milk powder). The mix was heated to 60 °C and homogenized at 2000-2500psi. The mixture was pasteurized at 90 °C for 30 min. and then rapidly cooled to 45 °C. Starter culture of yoghurt (*Streptococcus thermophiles*) was added in ratio 1% to the milk and completely mixed, then incubated at 40 °C for 4 hours at pH 4.7, the curd will be stirred to break and the passion fruit pulp and skin powder will be added to the yoghurt at ratio 0%, 15% (12:3), 15%(13:2), 15%(14:1) for T0, T1, T2, T3 respectively. The final product was mixed then packed in plastic cups and stored at 4 °C as shown in fig 2.

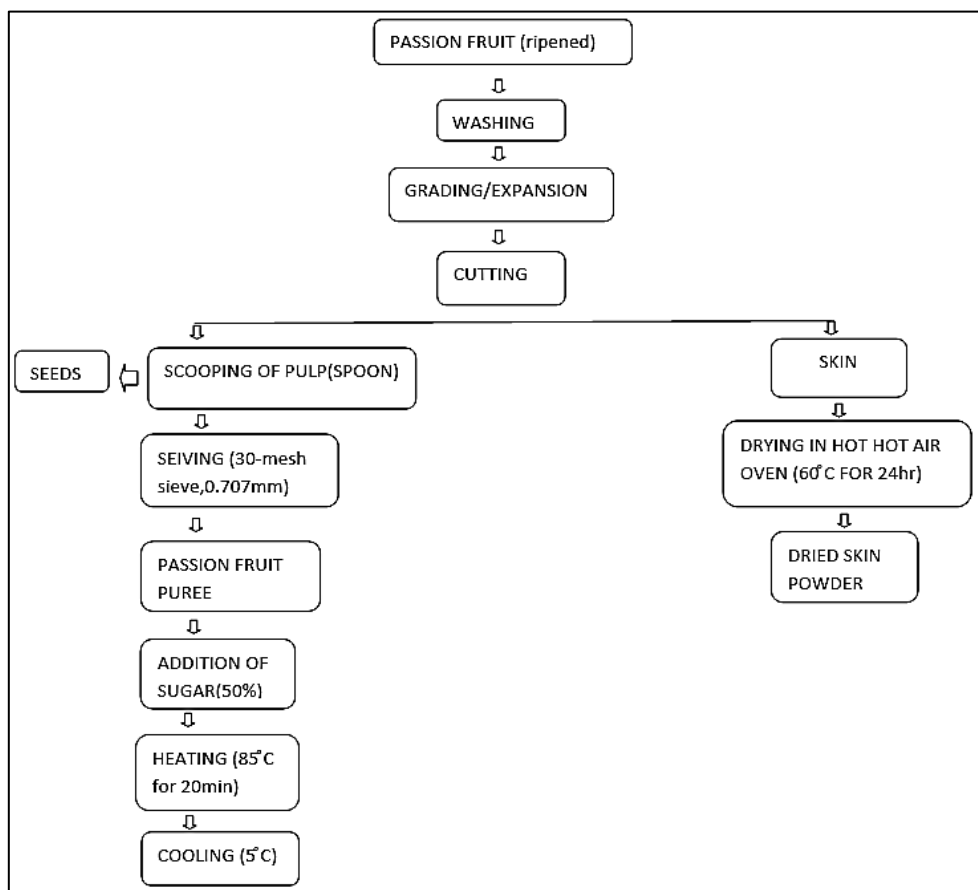
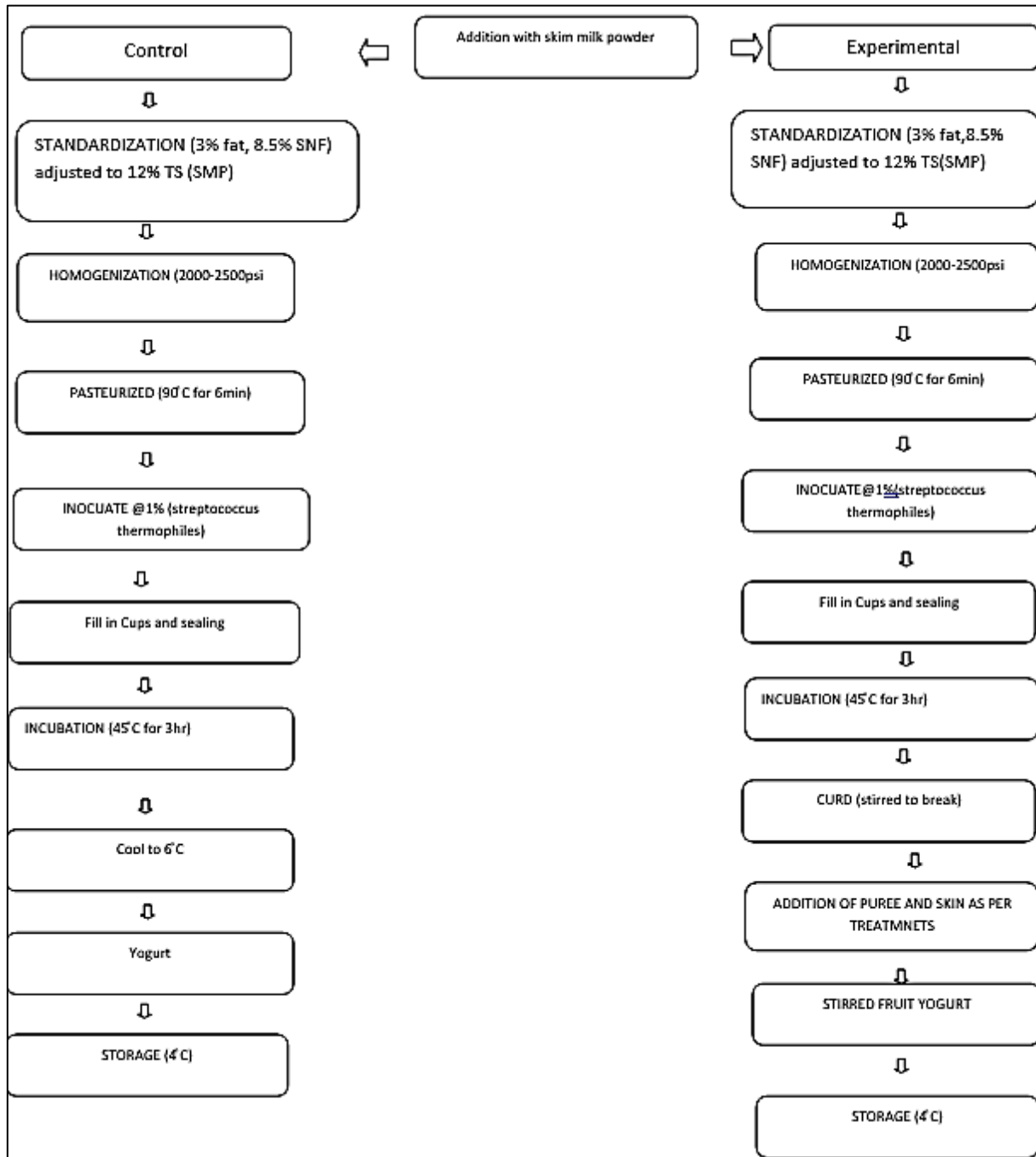


Fig 1: Flow chart for the extraction of passion fruit pulp and skin



**Fig 2:** Flowchart preparation of stirred yoghurt with passion fruit pulp and it’s skin powder (control and experimental)

**Sensory evaluation of the Fruit Yogurt fortified with Passion fruit pulp and passion fruit peel.**

Sensory attributes was determined by 9-point hedonic (Amerine *et al.* 1965) by panel of 5 judges selected from the faculty of Warner College of Dairy Technology for various sensory attributes (colour, taste, flavour, and overall acceptability). The extent of differences between the yoghurt samples for each sensory quality was measured on a nine-point Hedonic scale, (where “9” represents extremely like and “1” represents extremely dislike

**Cost Analysis**

**Statistical analysis**

Data will be analyzed using Analysis of Variance (ANOVA)

and Critical Difference (CD) in WASP Software and excel software. The values obtained will be analyzed statistically as per standard procedure.

The data will be analyzed statically by analysis of variance at 5% level of significance.

**Results and Discussion**

**Sensory Characteristics**

Table 1 shows the mean sensory scores of the flavoured yoghurt and the controls for colour, body & texture ,colour and appearance and overall acceptability. The samples containing 13% Passion fruit pulp and 2% passion fruit peel had more acceptable flavor, colour and overall acceptability and there was a decrease in the level of body and texture.

**Table 1:** Sensory properties of Control yogurt and Fruit Yogurt fortified with Passion fruit pulp and Passion fruit peel

Parameters	Treatments			
	T0	T1	T2	T3
Flavour	7 <sup>a</sup> ±0.06	7 <sup>a</sup> ±0.06	7.5±0.06	7.2 <sup>a</sup> ±0.06
Body and texture	7 <sup>a</sup> ±0.06	7 <sup>a</sup> ±0.06	7 <sup>a</sup> ±0.06	6.9 <sup>a</sup> ±0.06
Colour and appearance	6.9 <sup>a</sup> ±0.06	7.3 <sup>a</sup> ±0.06	7.4 <sup>b</sup> ±0.06	7.2 <sup>ab</sup> ±0.06
Overall acceptability	7 <sup>a</sup> ±0.07	7.1 <sup>a</sup> ±0.07	7.2 <sup>ab</sup> ±0.07	7.1 <sup>ab</sup> ±0.07

Data represent mean values for each sample  $\pm$  standard deviation. Means with different superscripts in the same row differ significantly by the Tukey test at 5% probability ( $p < 0.05$ ). T0=Control Yogurt; T1=14% passion fruit pulp & 1% passion fruit peel; T2=13% passion fruit pulp & 2% passion fruit peel; T3= 12% passion fruit pulp & 3% passion fruit peel

### Flavour

The average Percentage for Flavor of Control and Fruit Yogurt fortified with Passion Fruit Pulp and Passion fruit Peel samples was recorded at 7,7,7.5 and 7.2 in T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub>, respectively. There were significant difference ( $P < 0.05$ ) observed between Treatments and Control. T<sub>2</sub> was recorded as the highest and therefore it can be observed that Passion fruit pulp is maintained at 14% and passion fruit peel increase from 2-3%. The values recorded for flavour of Yogurt in this study was found similar with the findings by Agarwal and Prasad (2013) is comparable with our study in case of low fat frozen yoghurt prepared by incorporating carrot pulp i.e. 6.32 to 7.09. But Prakash (2016) [23] observed that the maximum flavor score was recorded in treatment T<sub>0</sub> control followed by T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>. Between isabgol used treatments higher score was observed by treatment T<sub>1</sub> i.e. 7.38 lower than control. All isabgol used treatments were significantly differing from control Yogurt All treatments were acceptable for flavor parameter scored rate more the an 6 point on 9 point Hedonic scale. As the isabgol husk was increased the slightly acidic flavour was observed in treatment T<sub>3</sub> due to which it secured lower score.

### Body and Texture

The average Percentage for body and texture of Control and Fruit Yogurt fortified with Passion Fruit Pulp and Passion fruit Peel samples was recorded at 7,7,7 and 6.9 in T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub>, respectively. There were significant difference ( $P < 0.05$ ) observed between Treatments and Control. T<sub>3</sub> was recorded as the lowest and therefore it can be observed that Passion fruit pulp is increased at 12% and passion fruit pulp and 3% peel. Similar reading were reported by Jitender *et al.*, (2016) [20] that the body and texture (consistency) score of the treatment having 7% sugar without pulp (control) scored significantly higher than the all ratios of guava pulp enriched Yogurt higher followed by treatment having 7% sugar with 5% pulp. This shows that increase in pulp decrease the body and texture of the product.

### Color and Texture

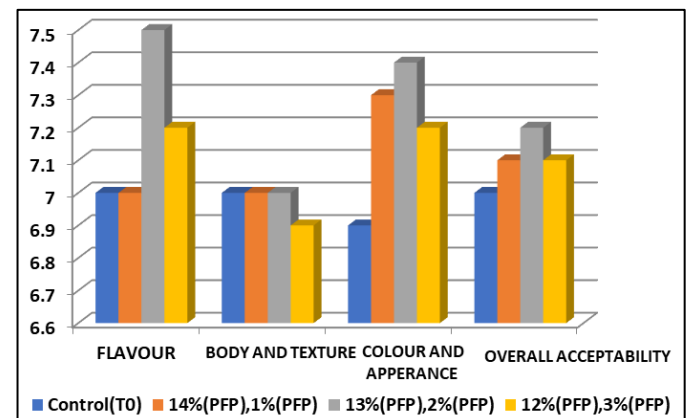
The average Percentage for color and texture of Control and Fruit Yogurt fortified with Passion Fruit Pulp and Passion fruit Peel samples was recorded at 6.9,7.3,7.4 and 7.2 in T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub>, respectively. There were significant difference ( $P < 0.05$ ) observed between Treatments and Control. T<sub>3</sub> was recorded as the highest and therefore it can be observed that Passion fruit pulp is maintained at 13%. In Hossian *et al.*, (2012) study it concluded that the blended food material were

responsible for colour variation in Yogurt e.g. fruit Yogurt prepared from strawberry, orange and grapes showing colour variation. Prakash (2016) [23] study on Effect of Isabgol (*Plantago ovata*) on Quality of Yogurt found that the higher score for colour and appearance was recorded for treatment T<sub>0</sub> followed by T<sub>1</sub>, T<sub>2</sub> and minimum T<sub>3</sub>. This might be due to that as the proportion of isabgol husk increased within the blend the intensity of yellowish brown colour increased in treatment T<sub>3</sub> which reduced its score. The colour of isabgol husk effect on quality of Yogurt was noticeably more yellowish brown as compared to plain buffalo milk Yogurt.

### Overall Acceptability

The average Percentage for Overall Acceptability of Control and Fruit Yogurt fortified with Passion Fruit Pulp and Passion fruit Peel samples was recorded at 7,7.1,7.2 and 7.1 in T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub>, respectively. There were significant difference ( $P < 0.05$ ) observed between Treatments and Control. T<sub>3</sub> was recorded as the highest and therefore it can be observed that Passion fruit pulp is maintained at 13% and passion fruit peel increase at 2%. Similar finding were made by Saker *et al.*, (2016) where the Overall Acceptability score of 0, 5, 10 and 15% levels of Carrot juice Yogurt were 8, 8.3, 8.7, and 9 respectively. The highest total score was recorded in 15% Carrot juice Yogurt and the lowest score were recorded for control. The result of our experiment supports the findings of Desai *et al.*, (2013) [8] who observed the addition of fruit juice improved the Overall Acceptability score of Yogurt

The present study reports that Overall Acceptability Score is the range 7, 7.16, 7.26 and 7.18 Score of different treatments as T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively. But Islam *et al.*, (2015) [19] study observed that the individual and total score of physical parameters of Yogurt were significantly decreased when different levels of soy milk added with buffalo milk. The findings of the experiments agree with Alam (1998) [4] and Reeta (2016) [25] who showed that addition of soy milk decrease individual as well as overall score of reported Yogurt In Prakash (2016) [23] study it shows that the Overall Acceptability Score of Yogurt samples for the treatments T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> were 8.10, 7.49, 7.30 and 6.03 respectively. The lowest overall acceptability score 6.06 was found in treatment T<sub>3</sub> which was due to increased level of isabgol which decreased colour and appearance, body and texture, flavor, and hence its overall acceptability score was less as compared other treatments and statistically differ from other treatments.



**Fig 1:** Effect of different treatments on sensory parameters of Fruit Yogurt fortified with Passion fruit pulp and Passion fruit peel (T<sub>0</sub>=Control, T<sub>1</sub>=14% Passion fruit pulp & 1% Passion fruit peel, T<sub>2</sub>=13% Passion fruit pulp & 2% Passion Fruit peel, T<sub>3</sub>=12% Passion fruit pulp & 3% Passion fruit peel)

## Cost Analysis

### Cost analysis of control & passion fruit pulp with passion fruit peel powder fortified fruit yogurt (per kg)

The data regarding cost (Rs.) of Fruit Yogurt fortified with Passion Fruit Pulp and Passion fruit Peel of products sample of different treatments are presented in table 2 and following observations were made. From the below presented data of cost (Rs) of Fruit Yogurt fortified with Passion Fruit Pulp and

Passion fruit Peel samples of different treatments and control furnished in table and it was noted that highest mean cost (Rs) was recorded in the Fruit Yogurt fortified with Passion Fruit Pulp and Passion fruit Peel sample of T<sub>2</sub> (63.8) followed by T<sub>1</sub> (63.5) and T<sub>0</sub> (56.4). This concludes that with increased in proportion of Passion Fruit Juice and Passion fruit Peel level the cost of production increases.

**Table 2:** Ingredient Cost of Control & Passion Fruit Pulp with Passion Fruit Peel Powder Fortified Fruit Yogurt (Per kg)

ITEMS	Treatment's cost for per kg production of fruit yogurt							
	T0		T1		T2		T3	
	Quantity(g/ml)	Cost(Rs.)	Quantity(g/ml)	Cost(Rs.)	Quantity(g/ml)	Cost(Rs.)	Quantity(g/ml)	Cost(Rs.)
<b>Expenditure (Raw material Cost)</b>								
Milk@46/litre	1000ml	46	1000ml	46	1000ml	46	1000ml	46
Sugar@40/kg	6gm	2.4	6gm	2.4	6gm	2.4	6gm	2.4
SMP@170/kg	12gm	2.04	12gm	2.04	12gm	2.04	12gm	2.04
Passion fruit juice @490/kg	-	-	14ml	6.68	13ml	6.37	12ml	5.88
Passion fruit peel@200/kg	-	-	1gm	0.2	2g	0.4	3g	0.6
<b>Total cost of per kg production for fruit yogurt</b>								
Cost	-	56.44	-	63.5	-	63.8	-	63
<b>Other Analysis</b>								
Product obtained from@Rs/kg	1018ml	50.44	1033ml	57.5	1033ml	57.8	1033ml	57

The average Cost for Control and Fruit Yogurt fortified with Passion Fruit Pulp and Passion fruit Peel samples was recorded Rs. 56.44, Rs 63.5, Rs 63.8 and Rs 63 for T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively

## Conclusion

The result of this study shows that addition of Passion Fruit Pulp and Peel to yoghurt as flavouring agent improved the physicochemical of the Fruit Yogurt. The enriched yoghurt contained higher protein and carbohydrate contents than the unflavoured yoghurt and also improved the colour, flavour, taste, aftertaste, mouthfeel and overall acceptability as seen in the sensory scores obtained with the highest scores being in the flavoured yoghurt that contained 13% juice - 2% passion fruit skin (T<sub>3</sub>). The fat content were lower in enriched yoghurt and higher in unflavoured yoghurt making it an ideal food for obese or weight conscious individuals. The addition of passion fruit skin contributes to the increase in high levels of fiber and minerals when compared to the control. The enriched yoghurt contained higher Potassium, Vitamin C, Calcium and Phosphorous contents than the unflavored yoghurt. The product had more minerals and vitamins than the unflavored yogurt. The high nutrient content of the enriched yoghurt makes it a very nutritious and healthy drink. Yoghurt enriched with 14 – 12% passion fruit pulp conformed to the standard stated in Codex alimentarius for yoghurt, thereby establishing the fact that it is safe and healthy for human consumption. Based on the study, the research on passion fruit flavored yoghurt (especially those flavored with pulp) at commercial level is highly recommended. Passion fruit should be included in the wide range of fruit used to flavor yoghurt as the result obtained in this piece of work had shown it to add to the nutritional content of yoghurt.

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