

Development of Antioxidant Rich, Low Sugar Jam From Green Tea Extract and Kiwi Pulp

Research Article

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Abstract

There is a considerable demand for fresh fruits as well as their products. Since many types of fruit are seasonal and their shelf life is limited, they must be processed to keep the quality. The fruits contain good amount of antioxidants and flavonoids which plays a very important role in preventing oxidative stress. The antioxidants in kiwifruit, most notably vitamin C, are among the most readily absorbed by the body. Similarly, green tea is also an antioxidant rich (flavonoid) which is Catechins, Epicatechin (EC), epigallocatechin (EGC), Epicatechin gallate (ECG) and epigallocatechin gallate (EGCG). Therefore it is recommended by nutritionists for consumption as it can prevent cancer, cardiovascular and other chronic diseases. The objective of the study was to develop a Green tea kiwi jam, by developing a standardized kiwi jam and incorporating different concentration (10%, 12%, and 15%) of green tea. The sugar of kiwi jam was replaced by sucralose. Sensory evaluation was done by composite scoring. Then the product was further analyzed for proximate analysis and antioxidant content of jam. The data revealed that as the green tea concentration increased the potassium, vitamin A, vitamin C content was also increased that means higher the concentration of green tea incorporated in jam had high antioxidant content. However there was decrease in the carbohydrate content and total sugar content as the concentration of green tea increased. The study concluded that low sugar green tea kiwi jam with 10% concentration of green tea is highly acceptable and could be recommended for the obese, overweight person, and diabetic person.

Keywords: Green tea; kiwi pulp; Flavonoids; Sucralose

Introduction

There is a considerable demand for fresh fruits as well as their products. Since many types of fruit are seasonal and their shelf life is limited, they must be processed to keep the quality [1]. Processing may include preservation by several methods, such as the addition of sugar to make a jam, fermentation, and drying. Jam processing is a fruit preservation method [2]. It is usually produced as a result of cooking fruits with sugar and other additions such as pectin and citric acid [3]. Good jam has a soft even consistency without distinct pieces of fruit, a bright colour, good flavour and a semi-jelled texture that is easy to spread but has no free liquid [4].

Sucralose is a sweetener that, although artificial, has excellent sensory profile and shares a considerable part of the worldwide commerce for high intensity sweeteners. Sucralose is a powerful and high quality sweetener stable at a wide range of pH. It is non-

caloric and is obtained from the chlorination of sucrose resulting in a stable product with excellent physical and chemical characteristics that allows its application in various foods and beverages [5].

Kiwifruit are attributed to a high content of specific minerals, vitamins and phytonutrients like carotenoids and essential fatty acid. The antioxidants in kiwifruit, most notably vitamin C, are among the most readily absorbed by the body [6].

Green tea is one of the most popular beverages in the world [7]. The major polyphenol of green tea are flavonoids. The four major flavonoids in green tea are the Catechins, Epicatechin (EC), epigallocatechin (EGC), Epicatechin gallate (ECG) and epigallocatechin gallate (EGCG) [8].

Therefore, the present study was done to develop the antioxidant rich and low sugar jam which will be beneficial in various medical

conditions such as diabetes, obesity, cardiovascular disease, cancers etc.

Methodology

The study was done under four phases. Phase I was product development. The green tea kiwi jam was prepared by standardized recipe by using kiwi pulp, pectin, citric acid, 10% of green tea. After the standardized of green tea kiwi jam, the sugar was replaced by sucralose. The three variation of green tea in low sugar jam were made, Sample A. Green tea 10%, Sample B. Green tea 12%, and Sample C. Green tea 15%. Phase II include sensory evaluation of the samples was done by composite score rating scale, carried out using 25 panelists from Manav Rachna International University. Composite score card has been prepared which include the factor like appearance, texture, color, taste, aroma, mouth feel and overall acceptability etc. Jams were evaluated by a 25 trained panelist for assessing the palatability and acceptability of jam. Phase III includes proximal analysis and antioxidant analysis of the product. The proximal analysis was done for moisture, ash, and crude fiber contents were determined by the AOAC (2000). The total carbohydrate was determined by difference: Carbohydrate = 100 - (% moisture + % protein + % fat + % ash + % crude fiber). Potassium was determined using the standard method of (AOAC, 2010), Ascorbic acid was determined by the titration method as reported in AOAC. Vitamin A was determined by spectrophotometric. Ascorbic acid was determined by the titration method as reported in AOAC.

The last phase was statistically test was done by using SPSS 20 Version software. The analysis includes mean, standard deviation, ANOVA for comparative results.

Results and Discussion

Table 1 depicts mean acceptability score of attributes between the samples: green tea kiwi jam by composite scoring.

In appearance, there was statistically significant difference between the sample as determined by one way ANOVA i.e. ($p < 0.05$).

Sample T_1 has the highest mean value i.e. 17.4 ± 1.3 whereas standard sample has lowest mean value i.e. 14.3 ± 1.7 . The result revealed that T_1 was most acceptable regarding appearance as compared to other samples.

Sample T_1 had the highest mean value for texture i.e. 7.6 ± 1.1 whereas standard sample has lowest mean value i.e. 7.1 ± 0.8 . But differences were not statistically significant among samples ($p = 0.193$). The result revealed that T_1 was most acceptable regarding appearance as compared to other samples.

Regarding colour the highest mean value was of T_1 (8.3 ± 1.0) & lowest for sample T_2 (7.0 ± 1.5). However the differences are statistically significant ($p < 0.05$) which means T_1 was most acceptable regarding colour as compared to other products.

For taste, Sample T_1 had the highest mean value i.e. 16.5 ± 3.6 whereas sample T_3 has lowest mean value i.e. 13.6 ± 4.0 and the differences were statistically significant among groups ($p < 0.05$). The results revealed that T_1 was most acceptable regarding taste as compared to other samples.

In aroma, there was statistically significant difference between the sample as determined by one way ANOVA ($p < 0.05$). Sample T_1 has the highest mean value i.e. 7.9 ± 1.2 whereas sample T_3 has lowest mean value i.e. 7.0 ± 1.4 which means that T_1 was most acceptable regarding aroma as compared to other products.

Sample T_1 had the highest mean value for mouth feel i.e. 8.4 ± 1.0 whereas sample T_3 has lowest mean value i.e. 6.8 ± 1.7 . The differences were statistically significant among samples ($p < 0.05$). The result determined that T_1 was most acceptable regarding mouth feel as compared to other samples.

The overall acceptability was highest for sample T_1 with the mean value i.e. 17.7 ± 2.3 , however it was lowest for sample T_3 with the mean value 14.3 ± 4.0 and the difference were statistically significant ($p < 0.05$). The results depicts the sample T_1 (low sugar jam 10% GT)

Table 1: Mean acceptability score of attributes between the samples: green tea kiwi jam by composite scoring.

Parameters	Standard M $\pm$ SD	T_1 (Sample) M SD	T_2 (Sample) M $\pm$ SD	T_3 (Sample) M $\pm$ SD	P Value (ANOVA-TEST)
Appearance*	14.3 ± 1.7	17.4 ± 1.3	15.6 ± 2.2	15.3 ± 2.7	0.000
Texture	7.1 ± 0.8	7.6 ± 1.1	7.1 ± 1.1	7.1 ± 1.0	0.193
Colour*	7.1 ± 1.1	8.3 ± 1.0	7.0 ± 1.5	7.3 ± 1.2	0.001
Taste*	14.2 ± 1.8	16.5 ± 3.6	14.7 ± 3.6	13.6 ± 4.0	0.020
Aroma*	7.2 ± 0.9	7.9 ± 1.2	7.2 ± 1.3	7.0 ± 1.4	0.056
Mouthfeel*	7.3 ± 0.9	8.4 ± 1.0	7.3 ± 1.4	6.8 ± 1.7	0.000
Overall Acceptability*	15.3 ± 1.8	17.7 ± 2.3	15.3 ± 3.6	14.3 ± 4.0	0.002

Standard sample: (Sugar jam 10% Green Tea)

Sample T_1 : (Low Sugar Jam 10% Green Tea)

Sample T_2 : (Low Sugar Jam 12% Green Tea)

Sample T_3 : (Low Sugar Jam 15% Green Tea)

*Significant at $p < 0.05$

Table 2: Mean score of proximate analysis between the samples.

Nutrients	Standard M $\pm$ SD	T ₁ (Sample) M $\pm$ SD	T ₂ (Sample) M $\pm$ SD	T ₃ (Sample) M $\pm$ SD	P _{Value} (ANOVA-TEST)
Carbohydrate (gm)*	24.2 $\pm$ 0.2	23.2 $\pm$ 0.4	22.8 $\pm$ 0.21	21.8 $\pm$ 0.1	0.000
Moisture (%)	9.3 $\pm$ 0.02	9.0 $\pm$ 0.23	8.7 $\pm$ 0.1	8.5 $\pm$ 0.3	0.231
Ash (%)	1.8 $\pm$ 0.01	1.4 $\pm$ 0.02	1.4 $\pm$ 0.32	1.4 $\pm$ 0.04	0.094
Fiber (gm)	6.3 $\pm$ 0.02	5.8 $\pm$ 0.1	6.1 $\pm$ 0.11	6.4 $\pm$ 0.05	0.065
Potassium (mg)*	175 $\pm$ 0.10	175 $\pm$ 1.0	180 $\pm$ 0.02	185 $\pm$ 1.2	0.000
Total sugar content (gm)*	12.5 $\pm$ 0.03	10.6 $\pm$ 0.2	10 $\pm$ 0.07	9.7 $\pm$ 0.1	0.000

Standard sample: (Sugar jam 10% Green Tea)

Sample T₁: (Low Sugar Jam 10% Green Tea)

Sample T₂: (Low Sugar Jam 12% Green Tea)

Sample T₃: (Low Sugar Jam 15% Green Tea)

*Significant at p<0.05

Table 3: Mean score of antioxidant content between the samples.

Antioxidant Content	Standard M $\pm$ SD	T ₁ (Sample) M $\pm$ SD	T ₂ (Sample) M $\pm$ SD	T ₃ (Sample) M $\pm$ SD	P _{Value} (ANOVA-TEST)
Vitamin A (mg)	25 $\pm$ 1.0	25 $\pm$ 1.3	26 $\pm$.02	27 $\pm$.40	0.619
Vitamin C (mg)	6.0 $\pm$ 1.0	6.0 $\pm$ 0.23	6.4 $\pm$ 0.4	6.8 $\pm$ 0.01	0.069

Standard sample: (Sugar jam 10% Green Tea)

Sample T₁: (Low Sugar Jam 10% Green Tea)

Sample T₂: (Low Sugar Jam 12% Green Tea)

Sample T₃: (Low Sugar Jam 15% Green Tea)

*Significant at p<0.05

was more acceptable regarding all the attributes as well as had the highest overall acceptability as compared to other products.

Table 2 depicts mean score of proximate analysis between the samples. Regarding Carbohydrate, there was statistically significant difference between the sample as determined by one way ANOVA (P<0.05). Standard Sample had the highest mean value i.e. 24.2 $\pm$ 0.2 whereas sample T₃ had lowest mean value i.e. 21.8 $\pm$ 0.1. The result revealed Carbohydrate is decreasing as the concentration of green tea is increasing.

Standard Sample had the highest mean value for the presence moisture in the product i.e. 9.3 $\pm$ 0.02 whereas sample T₃ has lowest mean value i.e. 8.5 $\pm$ 0.3 but the differences were not statistically significant among samples (P=0.231).

Regarding ash, the highest mean value was of standard sample (1.8 $\pm$ 0.01) & lowest for sample T₁ (1.4 $\pm$ 0.02). However the differences were not statistically significant (P=0.094).

For fiber, standard sample had the highest mean value i.e. 6.4 $\pm$ 0.05 whereas sample T₁ had lowest mean value i.e. 5.8 $\pm$ 0.1 but the differences were not statistically significant among groups (P=0.065).

Sample T₃ had the highest mean value for potassium i.e. 185 $\pm$ 1.2 whereas standard sample and sample T₁ had lowest mean value i.e. 175 $\pm$ 0.10. The differences were statistically significant among samples (P<0.05). As the green tea concentration increase the potassium content is also increase.

The results indicated that total sugar content of jam showed a marked decrease in its content in all the variation. In standard sample, total sugar content was 12.5 $\pm$ 0.03 which reduced to 9.7 $\pm$ 0.1 in sample

T₃. There was statistically significant difference between the Samples as determined by one way ANOVA (P<0.05).

Table 3 depicts the mean score of antioxidant content between the samples.

The results indicated that Vitamin A content of jam showed a marked increase in its content in all the variation. In standard sample, Vitamin A content was 25 $\pm$ 1.0 which increase to 27 $\pm$ 0.40 in sample T₃ but there no statistically significant difference between the Samples (P=0.619).

The results indicated that Vitamin C content of jam showed a marked increase in its content in all the variation. In standard sample, Vitamin C content was 6.0 $\pm$ 1.0 which increase to 6.8 $\pm$ 0.01 in sample T₃. There was no statistically significant difference between the Samples (P=0.069). As the green tea concentration increased the vitamin c content was also increased that means higher concentration of green tea incorporated jam had high antioxidant content.

Conclusion

Low sugar green tea kiwi jam (15% green tea) proved to be a high antioxidant rich product but the acceptability of the product contains 10% of green tea was more as compared to 15%. Even the low sugar green tea kiwi jam with 10% also have good potassium, vitamin A & vitamin C which full fill the ½ RDA of antioxidant content of the adult by just consuming 4 spoons per day. Moreover, they could be recommended for caloric reduced diets for obese and over-weight persons. Likewise, the rather relative low carbohydrate content and total sugar content in the green tea kiwi jam with 10% green tea could be recommended for the diet regimen of diabetic persons.

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