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DEVELOPMENT OF LOW SUGAR GREEN TEA KIWI JAM FROM GREEN TEA EXTRACT AND KIWI PULP

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ABSTRACT

A diet rich in foods with high levels of antioxidants is associated with longevity, good health and can prevent cancer, cardiovascular and chronic diseases. Both kiwi fruit and green tea are rich in antioxidant such as vitamin C, Catechins, Epicatechin (EC), Epigallocatechin (EGC), Epicatechin gallate (ECG) and Epigallocatechin gallate (EGCG). The objective of the study was to develop a kiwi jam by incorporating different concentration (10%, 12%, 15%) of green tea. Sensory evaluation was done by hedonic rating scale. 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, total omega 6 fatty acid, Vitamin A, Vitamin C content also increased. However carbohydrate content and total sugar content decreased as green tea concentration 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 and antioxidant.

INTRODUCTION

Jam is one of the most popular shelf-stable products made from fruits, both at the household and commercial levels. To manufacture fruit jams, fruits and sugar are combined in similar ratios, and cooked to produce a tasty product of sufficiently high sugar content with satisfactory storage qualities. Nowadays, consumers are increasingly better informed about diet and health, and as a result, desire more foods which offer, in addition to convenience, high quality, safety, optimum nutrient balance, less fat and sugar and fewer calories. At the same time foods must remain tasty and at an economical price.[1]

Higher sugar content of jam increases its calorific value. Since the dietary awareness of consumers is more it has become very important to see for alternative sweeteners with less calorific value. This can be accomplished by partial or full replacement of sucrose with other carbohydrate or non-carbohydrate sweeteners like xylitol, sorbitol, aspartame, acesulfame-K, cyclamate, stevioside, sucralose etc.[2]

People with diabetes frequently consume low-energy products containing high-intensity sweeteners in an attempt to reduce their sugar and/or energy intake. This is because the dietary management of diabetes often includes a reduction in sugar and energy intake, especially for overweight or obese individuals with type 2 diabetes. As a result, it is likely that the consumption of sucralose - sweetened products by this patient population will be both long term and above average.[3]

Green tea is one of the most popular beverages in the world.[4] 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).[5]

Kiwifruit has high levels of vitamin C. The focus of antioxidant research has changed from quantity to bioavailability. The antioxidants in kiwifruit, most notably vitamin C, are among the most readily absorbed by the body. So, move over berries – kiwifruit consumption was shown to increase cells' resistance to oxidative damage and produce a significant increase in blood antioxidant capacity.[6] 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.

MATERIAL AND METHODS

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 then 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%, Sample C. Green tea 15%. Phase II include sensory evaluation of the samples was carried out using 20 panelists from Manav Rachna International University. A nine-point Hedonic scale one (1) and nine (9) representing "extremely dislike" and "extremely like", respectively, was used. The qualities assessed include appearance, texture, colour, taste, aroma, mouth feel and overall acceptability. 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). Vitamin A was determined by spectro photometric. Ascorbic acid was determined by the titration method as reported in AOAC.

The last phase was statistically test was done by using SPSS20 software. The analysis includes mean, standard deviation, ANOVA for comparative results.

RESULTS AND DISCUSSION

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

Parameters	Standard M±SD	T_1(Sample) M±SD	T_2(Sample) M±SD	T_3(Sample) M±SD	f-value	P- value (Anova-Test)
Appearance*	7.1±0.8	7.6±0.8	6.7±1.3	7.0±1.0	3.910	0.011
Texture*	7.1±0.8	7.6±0.7	6.9±1.2	6.6 ±1.1	4.196	0.008
Colour*	7.1±1.1	7.8±0.9	6.7±1.3	6.8± 1.0	5.163	0.002
Taste*	7.1±0.9	7.7±0.7	6.8±1.1	6.0±1.2	10.216	0.000
Aroma*	7.2±0.9	7.2±1.0	6.8±1.1	6.0±1.0	7.353	0.000
Mouthfeel*	7.3± 0.9	7.6± 1.0	6.5 ±1.2	5.9± 1.3	11.730	0.000
Overall acceptability*	7.6± 0.9	7.8± 0.6	6.9± 1.0	6.1 ±1.0	17.063	0.000

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 1 depicts mean acceptability score of attributes between the samples: green tea kiwi jam by hedonic rating score.

In appearance, there was statistically significant difference between the sample as determined by one way ANOVA i.e. ($p<0.005$). Sample T_1 has the highest mean value i.e. $7.6^{\pm}0.8$ whereas sample T_2 has lowest mean value i.e. 6.7 ± 1.3. The result revealed that T_1 was most acceptable regarding appearance as compared to other samples.

Sample T_1 has the highest mean value for texture i.e.7.6 ± 0.7 whereas sample T_3 has lowest mean value i.e. 6.6 ± 1.1. The differences were statistically significant among samples as determined by one way ANOVA i.e. ($p<0.005$). The result stated that T_1 was most acceptable regarding texture as compared to other samples.

Regarding colour, the highest mean value was of sample T_1 (7.8 ± 0.9) & lowest for sample T_3 ($6.8\pm$ 1.0). However the differences are statistically significant as determined by one way ANOVA i.e. ($p<0.005$) which means that sample T_1 was most acceptable regarding colour as compared to other products.

For taste, Sample T_1 has the highest mean value i.e. 7.7 ± 0.7 whereas sample T3 has lowest mean value i.e. 6.0 ± 1.2 and the difference were statistically significant among groups as determined by one way ANOVA i.e. ($p<0.005$). The result revealed that T_1 was most acceptable regarding taste as compared to other samples.

In aroma, there was statistically significant difference between the samples as determined by one way ANOVA i.e. ($p<0.005$). Sample T_1 had the highest mean value i.e. 7.2 ± 1.0 whereas sample T_3 has lowest mean value i.e. 6.0 ± 1.0 which means that T_1 was most acceptable regarding aroma as compared to other products.

Sample T_1 has the highest mean value for mouth feel i.e. 7.6 ± 1.0 whereas sample T_3 has lowest mean value i.e. 5.9 ± 1.3. The differences were statistically significant among samples as determined by one way ANOVA i.e. ($p<0.005$). 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. 7.8 ± 0.6, however it was lowest for sample T_3 with the mean value 6.1 ± 1.0 and the difference were

statistically significant as determined by one way ANOVA i.e. ($p<0.005$). The results depicts the Sample T_1 (Low sugar jam 10% GT) was more acceptable regarding all the attributes as well as had the highest overall acceptability as compared to other products.

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

Nutrients	Standard M±SD	T_1(Sample) M±SD	T_2(Sample) M±SD	T_3(Sample) M±SD	P_{Value} (ANOVA-TEST)
Carbohydrate (gm)*	24.2±0.2	23.2±0.2	22.8±0.1	21.8±0.1	0.000
Moisture (%)	9.3±0.02	9.0±0.01	8.7±0.1	8.5±0.1	0.231
Ash (%)	1.8±0.01	1.4±0.02	1.4±0.02	1.4±0.02	0.094
Fiber (gm)	6.3±0.1	5.8±0.1	6.1±0.1	6.4±0.05	0.065
Potassium (mg)*	175±1.0	175±1.0	180±1.0	185±1.0	0.000
Total sugar content (gm)*	12.5±0.02	10.6±0.2	10±0.07	9.7±0.1	0.000
Total Omega 3 fatty acid*	4.8±0.1	5.8±0.1	4.6±1.0	5.5±0.1	.007
Total Omega 6 fatty acid*	3.8±0.1	4.0±0.1	4.2±0.1	4.6±.1	0.000

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 $p<0.05$.

The above 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±0.2 whereas sample T_3 had lowest mean value i.e. 21.8±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±0.02 whereas sample T_3 has lowest mean value i.e. 8.5±0.1 but the differences were not statistically significant among samples (P=0.231).

Regarding ash, the highest mean value was of standard sample (1.8±0.01) & lowest for sample T_2 ($7.0^{\pm}1.5$). However the differences were not statistically significant (P=0.094).

For fiber, standard sample had the highest mean value i.e. 6.4±0.05 whereas sample T_1 had lowest mean value i.e. 5.8±0.1 but the differences were not statistically significant among groups (P=0.065).

Sample T_3 had the highest mean value for potassium i.e. 185±1.0 whereas standard sample and sample T_1 had lowest mean value i.e. 175±1.0. 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±0.02 which reduced to 9.7±0.1 in sample T_3. There was statistically significant difference between the Samples as determined by one way ANOVA (P<0.05).

For total omega 3 fatty acid, sample T_1 had the highest mean value i.e. 5.8±0.1 whereas sample T_2 had lowest mean value i.e. 4.6±1.0 and the differences were statistically significant among groups (P<0.05). This means the Omega 3 fatty acid was more present in T_1 sample.
Sample T_3 has the highest mean value for Omega 6 fatty acid i.e. 4.6±.1 whereas Standard sample had lowest mean value i.e. 3.8±0.1. The differences were statistically significant among samples (P<0.05). As the green tea concentration increased the Omega 6 fatty acid content was also increased

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

Antioxidant Content	Standard M±SD	T_1(Sample) M±SD	T_2(Sample) M±SD	T_3(Sample) M±SD	P Value (ANOVA-TEST)
Vitamin A (mg)	25±1.0	25±1.0	26±1.0	27±1.0	0.619
Vitamin C (mg)	6.0±0.1	6.0±0.1	6.4±0.4	6.8±1.0	0.069

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 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±1.0 which increase to 27±1.0 in sample T_3 but there no statistically significant difference between the Samples (P=.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±0.1 which increase to 6.8±1.0 in sample T_3. There was no statistically significant difference between the Samples (P=.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, total omega 6 fatty acid, 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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