



Effect of Different Concentration of Strawberry and Beetroot Juice on Quality and Storage of Strawberry Beetroot Candy

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation entitled "Effect of different concentration of strawberry and beetroot juice on quality and storage of strawberry beetroot candy" was undertaken in the Horticulture Department, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the year 2022. The treatment combinations viz., T₀ Strawberry (80g)+ Water (20ml)+ Geletin

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(20g)+Sugar (80g), T₁Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Geletin (25g)+ Sugar (80g), T₂ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Geletin (30g)+ Sugar (80g), T₃Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g), T₄Strawberry (80g)+ Beetroot (25g)+ Water (10ml)+ Geletin (40g)+ Sugar (80g), T₅Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Pectin (20g)+Sugar (80g), T₆ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Pectin (25g)+Sugar (80g), T₇Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Pectin (30g)+Sugar (80g) and T₈ Strawberry (80g)+ Beetroot (25g)+ Water (10ml)+ Pectin (35g)+Sugar (80g), It was observed that the T₃Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g) gave significantly best result in relation to TSS content of 65.72 °Brix, pH content of 3.29, Acidity (%) content of 0.73, ascorbic acid mg100g content of 14.24 and total sugar (%) content of 17.15. Where as the maximum organoleptic quality viz., colour score of 8.06, taste score of 7.94, flavour score of 8.20, overall acceptability score of 8.07 was found in treatment T₃Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g) of strawberry and beetroot jelly. The cost of production per 1kg candy pouch came out to ` 1219.50 and benefit cost ratio (1:1.56) was found in treatment Strawberry (80g) + Beetroot (25g) + Water (10ml) + Pectin (35g) + Sugar (80g).

Keywords: Jelly candy; strawberry; beetroot; physico-chemical analysis and organoleptic test;

1. INTRODUCTION

Candy is a processed food product that is liked by many people from adults to children. There are two types of candy circulating in the community, namely hard candy and soft candy. The difference between the two types of candy is in the texture. One type of soft candy is jelly candy made from water or fruit juice and gelling materials. Jelly candy has general characteristics that vary from having a chewy texture to a slightly hard texture [1]. Jelly candy recipes are mostly developed by experienced food technologists and chemists. By blending together different ingredients, they can control the various characteristics of jelly candy, such as texture, taste, and appearance. The primary ingredients include water, gelatin, sweeteners, flavors, and colors. The main ingredient responsible for the candy's unique and gummy characteristics is gelatin [2].

Strawberry (*Fragaria ananassa*) is one of the important fruit belonging to family *Rosaceae* and is nutritionally rich source of vitamin C, organic acids, anthocyanin, phosphorus, iron, flavonoids, malic acid and other minerals [3]. The fruit is widely appreciated for its typical aroma, bright red fruit color and juicy texture. Nutritionally, strawberry contains low calorie carbohydrate and a potential source of vitamin C than oranges. The main composition per 100 g of fresh strawberries are 91.75 g water, 7.02 g carbohydrate, 2.3g fiber, 14.0 mg calcium, 166.0 mg potassium and 64.4mg vitamin C with 27 IU of vitamin A [4].

Beetroot (*Beta vulgaris* L.) including tubers, contains substances that are very necessary for health, including iron, vitamin C, potassium, phosphorus, magnesium, folic acid, and fiber. Beet bulbs contain mostly vitamin A and vitamin C, calcium iron, phosphorus, protein, and carbohydrates. Beet tubers are not only used as natural dyes but can also be used as sweeteners [5]. Beets are also high in folate and betacyanin [6]. Besides that, beetroots are rich in nutrients, namely folic acid, potassium, vitamin C, magnesium, iron, copper, and phosphorus [7]. To get a low-calorie jelly candy, it is necessary to avoid the use of sucrose as a sweetener. Types of natural sweeteners or artificial sweeteners that provide health effects are needed in the food processing industry. The types of sweeteners that can be used in the processing of jelly candy are High Fructose Syrup (HFS) and sorbitol [8]. The most commonly used osmotic substances are sugar and honey. The functionality of fruits can be improved by using an osmotic process to enrich them with functional ingredients. Because of the higher osmotic pressure of the infusion medium, dehydration as well as osmotic exchange of dissolved sugars and ingredients takes place, resulting in the infusion of solids into fruit. Partially dehydrated fruits prepared in this way can be added to food products such as desserts, yogurt, ice-cream and baked goods [9].

The addition of pectin into a gelatin-based gummy gel made the gummy jelly less chewy, break easily into small pieces, and more brittle, while the flavor of the gels such as sweet and fruity increased. The addition of fruit purée into

gummy jelly also has been studied. Another researcher also studied the effect of incorporating red pitaya fruit purée into pectin and gelatin based gummy jelly (Hani et al., 2015). The addition of red pitaya fruit puree modifies the texture of the gummy jelly, reducing the hardness and gumminess.

Objective – To evaluate the effect of different concentrations of strawberry and beetroot jelly candy.

2. MATERIALS AND METHOD

The present investigation entitled “Effect of different concentration of strawberry and beetroot juice on quality and storage of strawberry beetroot candy” was laid out in the Post Harvest Laboratory of Horticulture Department, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the year 2022.

The experiment consist of nine treatments. The treatment combinations viz., T₀ Strawberry (80g)+ Water (20ml)+ Geletin (20g)+ Sugar (80g), T₁ Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Geletin (25g)+ Sugar (80g), T₂ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Geletin (30g)+ Sugar (80g), T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g), T₄ Strawberry (80g)+ Beetroot (25g)+ Water (10ml)+ Geletin (40g)+ Sugar (80g), T₅ Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Pectin (20g)+ Sugar (80g), T₆ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Pectin (25g)+ Sugar (80g), T₇ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Pectin (30g)+ Sugar (80g) and T₈ Strawberry (80g)+ Beetroot (25g)+ Water (10ml)+ Pectin (35g)+ Sugar (80g), It was observed that the T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g) gave significantly best result in relation to TSS content of 65.72 °Brix, pH content of 3.29, Acidity (%) content of 0.73, ascorbic acid mg/100g content of 14.24 and total sugar (%) content of 17.15. Where as the maximum organoleptic quality viz., colour score of 8.06, taste score of 7.94, flavour score of 8.20, overall acceptability score of 8.07 was found in treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g) of strawberry and beetroot jelly. The cost of production per 1kg candy pouch came out to ` 1219.50 and benefit cost ratio (1:1.56) was found in treatment Strawberry (80g) + Beetroot (25g) + Water (10ml) + Pectin (35g) + Sugar (80g). Fruits of

fresh but raw strawberry were procured from the local market Prayagraj. It was ensured that the collected ripe strawberry were fresh, undamaged and hygienic for our use. Fruits of fresh but raw beetroot were procured from the local market Prayagraj. It was ensured that the collected beetroot were fresh, undamaged and hygienic for our use. Strawberry and beetroot were taken to Post Harvest Laboratory of Horticulture Department, SHUATS, Prayagraj for further processing. Ripe and clean beetroot were selected for the study. The defective and injured fruits were sorted out and healthy ones were retained for pulp extraction. Fresh raw beetroot were cleaned and washed thoroughly with clean running water to remove dirt or other foreign material. The standardized method was then used for preparation of pulp for further studies. The raw beetroot were peeled and converted into pulp using mixer grinder. The pulp was divided into two lots. One lot conditions for further use.

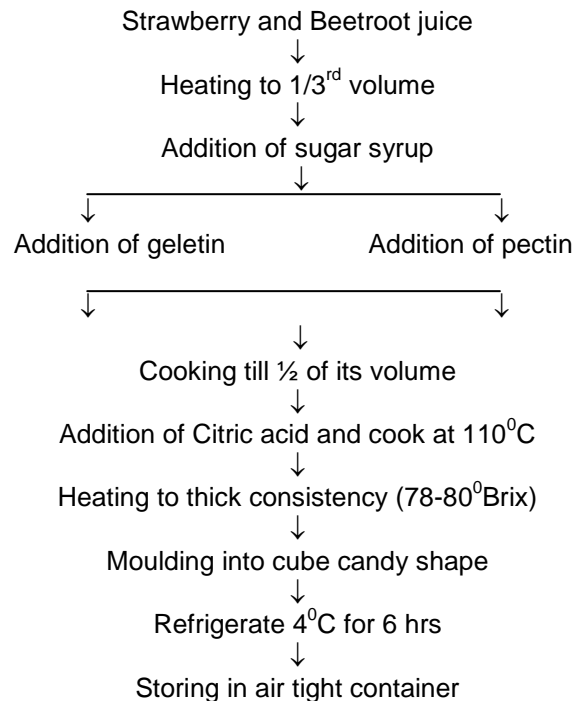


Chart 1. Flow chart for preparation of strawberry and beetroot jelly candy

3. RESULT AND DISCUSSION

The results obtained are presented under the following headings after 30 days storage observations. In the Table 1 the result show:

The highest TSS content of 65.72 °Brix was recorded in treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+

Sugar (80g). A further review of table also revealed that treatment T₆ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Pectin (25g)+Sugar (80g), T₅ Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Pectin (20g)+ Sugar (80g) and T₁ Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Geletin (25g)+ Sugar (80g) as found to be statistically at par to treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g). Whereas, as the lowest TSS content of 63.07°Brix was recorded in treatment T₀ Strawberry (80g)+ Water (20ml)+ Geletin (20g)+Sugar (80g). This explained that high sugar concentration in jelly candy makes a colligative effect and gelatin water absorbance capacity [10]. The total sugar was decreased in fruit jelly candies comparing to control candy, because of using a large amount of sugar in the processing of control candy than fruit jelly candy to reach acceptable taste and a prorate TSS.

The lowest pH of 3.29 was recorded in treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g). A further review of table also revealed that treatment T₂ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Geletin (30g)+ Sugar (80g) and T₅ Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Pectin (20g)+Sugar (80g) as found to be statistically at par to treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g). Whereas, as the highest pH of 4.29 was recorded in treatment T₀ Strawberry (80g)+ Water (20ml)+ Geletin (20g)+Sugar (80g). These phenomena may be related to the higher acidity value of pineapple than papaya. Moreover, Ali et al. [11] represented that the jelly candies enriched with strawberry and red beetroot fibers had lower pH values than the control sample, which could be due to the citric acid present in fruits. In this respect, Mutlu et al. [10] reported that the hot mixing technique at 115°C improved the titrable acidity and reduced the pH value of the honey jelly candies. Modifications of acidity and pH in honey jelly candies may be related to sugar acids induced by hexose oxidation at high temperatures, as it is reported that sugars turn to low acids in weakly acidic media at high temperatures.

The lowest acidity (%) of 0.73 was recorded in treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g). A further review of table also revealed that treatment T₁ Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Geletin (25g)+ Sugar (80g), T₄

Strawberry (80g)+ Beetroot (25g)+ Water (10ml)+ Geletin (40g)+ Sugar (80g), T₅ Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Pectin (20g)+Sugar (80g) and T₆ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Pectin (25g)+Sugar (80g) as found to be statistically at par to treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g). Whereas, as the highest pH of 0.98 was recorded in treatment T₀ Strawberry (80g)+ Water (20ml)+ Geletin (20g)+Sugar (80g). In this respect, Mutlu et al. [10] reported that the hot mixing technique at 115°C improved the titrable acidity and reduced the pH value of the honey jelly candies. Modifications of acidity and pH in honey jelly candies may be related to sugar acids induced by hexose oxidation at high temperatures, as it is reported that sugars turn to low acids in weakly acidic media at high temperatures.

The highest ascorbic acid mg100g of 14.24 was recorded in treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g). A further review of table also revealed that treatment T₂ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Geletin (30g)+ Sugar (80g) as found to be statistically at par to treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g). Whereas, as the lowest ascorbic acid mg100g of 13.08 was recorded in treatment T₀ Strawberry (80g)+ Water (20ml)+ Geletin (20g)+Sugar (80g). Meanwhile, there is no growth in any other samples that may be due to the jelly candy's content of phenolic compound and ascorbic acid, which showed a good effect as antimicrobial. Also, jelly candies have a high sugar content that reduces microbial growth by limiting water available for the growth of microorganisms [12]. This study showed that strawberry or red beetroot jelly candies were safe for human consumption.

The highest total sugar (%) of 17.15 was recorded in treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g). A further review of table also revealed that treatment T₄ Strawberry (80g)+ Beetroot (25g)+ Water (10ml)+ Geletin (40g)+ Sugar (80g) and T₅ Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Pectin (20g)+ Sugar (80g) as found to be statistically at par to treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g). Whereas, as the lowest total sugar (%) of 14.15 was recorded in treatment T₀ Strawberry (80g)+ Water (20ml)+ Geletin (20g)+Sugar (80g).

Table 1. Effect of different concentration of strawberry and beetroot juice on quality and storage of strawberry beetroot candy

Treatment Notation	Treatment details	TSS (°Brix)	pH	Acidity (%)	Ascorbic acid mg100g	Total sugar (%)	Colour score	Taste score	Taste score	Flavour score	Overall acceptability
T ₀	Strawberry (80g)+ Water (20ml)+ Geletin (20g)+Sugar (80g)	63.07	4.29	0.98	13.08	14.15	6.05	5.28	5.28	5.89	5.74
T ₁	Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Geletin (25g)+ Sugar (80g)	65.28	3.97	0.87	13.30	17.05	6.26	7.09	7.09	7.06	6.80
T ₂	Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Geletin (30g)+ Sugar (80g)	64.84	3.36	0.78	14.05	17.01	8.11	7.42	7.42	8.01	7.85
T₃	Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g)	65.72	3.29	0.73	14.24	17.15	8.06	7.94	7.94	8.20	8.07
T ₄	Strawberry (80g)+ Beetroot (25g)+ Water (10ml)+ Geletin (40g)+ Sugar (80g)	64.41	3.63	0.86	13.27	16.20	7.06	7.02	7.02	7.10	7.06
T ₅	Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Pectin (20g) Sugar (80g)	65.26	3.55	0.84	13.12	16.24	7.12	7.34	7.34	7.17	7.21
T ₆	Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Pectin (25g)+Sugar (80g)	65.33	3.73	0.87	13.07	15.28	7.15	7.13	7.13	7.76	7.35
T ₇	Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Pectin (30g)+Sugar (80g)	64.64	3.86	0.96	13.60	15.70	6.73	7.55	7.55	7.08	7.12
T ₈	Strawberry (80g)+ Beetroot (25g)+ Water (10ml)+ Pectin (35g)+Sugar (80g)	64.39	4.11	0.89	13.42	15.07	7.08	7.07	7.07	6.73	6.96
	F-Test	S	S	S	S	S	S	S	S	S	S
	S.Ed. (+)	0.186	0.050	0.034	0.066	0.141	0.050	0.078	0.078	0.074	0.029
	C.D. at 0.5	0.393	0.105	0.072	0.140	0.299	0.105	0.234	0.234	0.156	0.062

The highest colour score of 8.06 was recorded in treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Sugar (80g) followed by T₂ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Geletin (30g)+ Sugar (80g), T₅ Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Pectin (20g)+Sugar (80g), T₈ Strawberry (80g)+ Beetroot (25g)+ Water (10ml) +Pectin (35g)+Sugar (80g), T₇ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Pectin (30g)+Sugar (80g) and T₆ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Pectin (25g)+Sugar (80g). Whereas, as the lowest colour score of 6.05 was recorded in treatment T₀ Strawberry (80g)+ Water (20ml)+ Geletin (20g) +Sugar (80g).

The highest taste score of 7.94 was recorded in treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g) followed by T₂ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Geletin (30g)+ Sugar (80g) , T₅ Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Pectin (20g)+Sugar (80g), T₈ Strawberry (80g)+ Beetroot (25g)+ Water (10ml) +Pectin (35g)+Sugar (80g), T₇ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Pectin (30g)+Sugar (80g) and T₆ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Pectin (25g)+Sugar (80g). Whereas, as the lowest taste score of 5.28 was recorded in treatment T₀ Strawberry (80g)+ Water (20ml)+ Geletin (20g)+Sugar (80g).

The highest flavour score of 8.20 was recorded in treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g) followed by T₂ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Geletin (30g)+Sugar (80g) , T₅ Strawberry (80g)+ Beetroot (10g)+ Water (10ml)+ Pectin (20g)+Sugar (80g), T₈ Strawberry (80g)+ Beetroot (25g)+ Water (10ml)+ Pectin (35g)+Sugar (80g), T₇ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ +Pectin (30g)+Sugar (80g) and T₆ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Pectin (25g)+Sugar (80g). Whereas, as the lowest flavour score of 5.89 was recorded in treatment T₀ Strawberry (80g)+ Water (20ml)+ Geletin (20g)+Sugar (80g).

The highest overall acceptability score of 8.07 was recorded in treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g)+ Sugar (80g) followed by T₂ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Geletin (30g)+Sugar (80g), T₅ Strawberry (80g)+

Beetroot (10g)+ Water (10ml)+ Pectin (20g)+Sugar (80g), T₈ Strawberry (80g)+ Beetroot (25g)+ Water (10ml)+ Pectin (35g)+Sugar (80g), T₇ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Pectin (30g)+Sugar (80g) and T₆ Strawberry (80g)+ Beetroot (15g)+ Water (10ml)+ Pectin (25g)+Sugar (80g). Whereas, as the lowest overall acceptability score of 5.74 was recorded in treatment T₀ Strawberry (80g)+ Water (20ml)+ Geletin (20g)+Sugar (80g).

4. CONCLUSION

Based on the above results, it is concluded that strawberry and beet root can be processed into jelly candy with improved nutritional quality. The jelly candy of strawberry and beetroot prepared from treatment T₃ Strawberry (80g)+ Beetroot (20g)+ Water (10ml)+ Geletin (35g) +Sugar (80g) comprised of TSS (65.72 °Brix), pH (3.29), Acidity (%) (0.73), ascorbic acid mg/100g (14.24), total sugar (%) (17.15) and highest scores for colour score (8.06), taste score (7.94), flavour score (8.20), overall acceptability score (8.07) were recorded. The cost of production per 1kg candy pouch came out to ` 1219.50 and benefit cost ratio (1:1.56) was found in treatment Strawberry (80g)+ Beetroot (25g)+ Water (10ml)+ Pectin (35g)+Sugar (80g).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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