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Preparation of Jam and Jelly using star fruit and assessment of biochemical and organoleptic properties of these value-added products

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A B S T R A C T

Making of jam and jelly is the common method of preserving fruit, the main factor being high concentration of sugar that helps in preservation. In Bangladesh, the star fruit (*Averrhoa carambola* L.) BARI Kamranga-1 is available from September through October and January through February. To obtain the health benefits (anti-inflammatory, analgesic, hypoglycemic, antimicrobial, hepato-protective and anti-ulcer activity) of star fruit throughout the year, jam and jelly products were developed using star fruit. Five jams and five jellies were prepared as value-added products using different ingredients with different combinations. Biochemical properties, chemical analysis, and organoleptic observations of star fruit jam and star fruit jelly were measured to determine the quality of the products and overall public acceptance. The overall acceptability of Jam 2 was the highest, and in case of jelly , Jelly 4 showed the highest score. Additional study is needed to understand better, how star fruit can be processed because there are so many local sorts and variants of the fruit. This will enable us to decide which kinds are most suitable for developing specific goods with the potential to enhance health.

Keywords: Star fruit, Jam, Jelly, Organo-leptic properties, Biochemical properties

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Introduction

Star fruit (*Averrhoa carambola* L.*)* is a small, bushy, evergreen tree that grows very well under hot, humid, tropical conditions. It is called "Star" because a cross-section cut reveals a star-like shape in the inner portion of the fruit and "Apple" because of its spherical shape like the apple (Darkwa and Nana, 2020). The deep orange to red fruit, with its leaves and tree bark, is said to have curative and nutritive properties, which are extremely beneficial to our well-being (Iddris *et al.*, 2021).

Like any fruit, Star fruit does not last forever; they can be kept under room temperature for two to five days until ripe, one to two weeks once it is ripe in the refrigerator and ten to twelve months in the freezer. According to Joy and Abraham (2013), fruit preservation is the process of treating and handling food to stop or slow down spoilage but allows the fruit to be stored over a longer period. Using fruit to make jam as a preservation method involves boiling, adding sugar and sealing, yet maintaining nutritional value, texture and flavor. According to Pérez-Herrera *et al.* (2020), the earliest fruit preserves were made by mixing the soft, moist part of a fruit that was pounded to a pulp with honey that was dried in the sun, which created a texture more like that of a jellied sweet.

Star fruit contains high pectin, making it suitable for the production of jam. It is rich in vitamins C, A and B complex, minerals such as magnesium, potassium and phosphorus, carotenoids, gallic acid and oxalic acid (Ferrara, 2018). In addition, it has a low caloric value (34 kcal / 100 g), due to its high humidity, which leads to its perishability and can be stored only for a few days (Suhaimi, 2021) at room temperature, because there is rapid dehydration and browning of the pulp (Das *et al.*, 2020). It can also be industrialized in the form of fruit juice, canned, yogurts, dehydrated and dried products (Chakraborty, 2018; Gregório *et al.*, 2020).

Since only few references are available on star fruit jam and jelly, it was decided to determine the compositional changes of star fruit jam and jelly. Therefore, the objectives of the research work were to formulate an acceptable star fruit jam and star fruit jelly in combination with different ingredients with desirable tastes and to assess the nutritional variations of these value-added products.

Materials and Methods

Collection and preparation of experimental materials

The star fruit (BARI Kamranga-1) samples were collected from the local market of Dinajpur. The experiment was conducted in the laboratory of Agricultural Chemistry, Hajee Mohammad Danesh Science and Technology University, from March 2021 to November 2021 to develop value added star fruit products (jam and jelly). The maximum and minimum relative humidity of the room was 84% and 74%, respectively, under the room temperature of 28-32°C.

Ingredients used

Star fruit, sugar, salt, clove, bay leaf, cinnamon and cardamom, were used in the experiment.

Treatments

The ingredients used in jam and jelly formulations are shown in Table 1 and Table 2.

Preparation of Star fruit jam

Ripe star fruit was carefully cleaned with tap water to eliminate any dirt. Afterward, they were sliced diagonally and the seeds and any other undesirable parts were removed. Using a grinder (specifically, a Prestige Super Blender, Model No: MXT-17, manufactured in China), the fruit was blended, followed by straining through a 2 mm mesh sieve. The strained pulp was heated through boiling for approximately 10 minutes to facilitate smooth blending. Following this, the boiled pulp was measured to 500 ml for each sample, and various ingredients listed in Table 1, such as sugar, salt, cardamom, cinnamon, cloves, and bay leaf, were incorporated. All the listed ingredients from Table 1 were added to the pulp simultaneously, and the mixture was boiled once more for around 35 minutes. Continuous stirring was maintained throughout to prevent the jam from burning, and the boiling process was ceased when the mixture noticeably thickened, indicating the formation of jam.

Preparation of Star fruit jelly

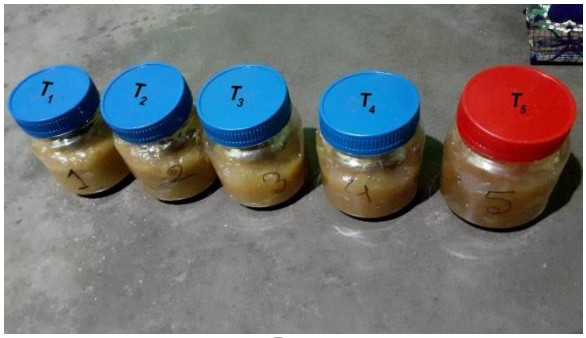
In the experiment, jelly was made using treatments labeled as T1 to T5, where the amounts used were 375 ml, 500 ml, 625 ml, 750 ml, and 875 ml, respectively. Supportive ingredients listed in Table 2 were added accordingly during the preparation process. The heat was reduced to medium, and the mixture was cooked for 15 minutes until the core was no longer visible. A few drops of liquid pectin were added to the mixture immediately after it was taken off the heat to achieve a jelly-like consistency.

Table 1. Preparation of jam with different proportions of star fruit pulp and other ingredients.

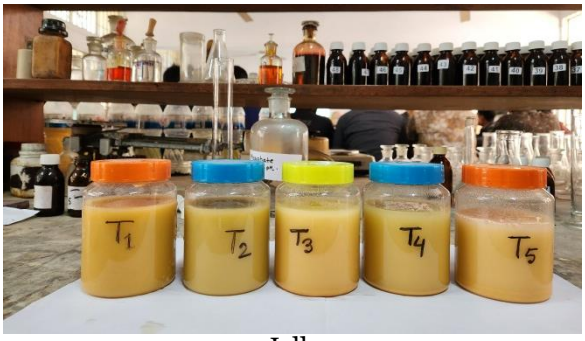
Ingredients	T_1	T_2	T_3	T_4	T_5
Fruit pulp (ml)	500	500	500	500	500
Sugar (g)	150	125	100	75	50
Salt (g)	10	10	10	10	10
Cardamom (g)	2	2	2	2	2
Cinnamon (g)	2	2	2	2	2
Clove (g)	1	1	1	1	1
Bayleaf (g)	1	1	1	1	1

Table 2. Preparation of jelly with different proportions of star fruit pulp and with other ingredients.

Ingredients	T_1	T_2	T_3	T_4	T_5
Fruit pulp (ml)	375	500	625	750	875
Sugar (g)	300	350	400	450	500
Salt (g)	10	10	10	10	10
Cardamom (g)	2	2	2	2	2
Cinnamon (g)	2	2	2	2	2
Clove (g)	1	1	1	1	1
Bayleaf (g)	1	1	1	1	1



Jam



Jelly

Fig. 1. Photographs of jam and jelly preparation using star fruit.

Experimental design and method of analysis

This experiment was laid out in a Completely Randomized Design (CRD) with three replications. All the prepared samples were stored at room temperature (28-32°C).

Moisture, ash content and lipid content were determined by dry oven, muffle furnace and soxlate methods, respectively (AOAC, 2000). Vitamin C content was determined according to the 2, 6-dichlorophenol indophenol visual titration method (AOAC, 2000). Total sugar, reducing sugar and non-reducing sugar content were determined by fehling's method (AOAC, 2000). Ca^{2+} and Mg^{2+} were analyzed by complexometric titration whereas K^{+} and Na^{+} were estimated by flame emission spectrophotometer. Sulphur and phosphorus were estimated by UV-visible spectrophotometer (APHA, 2005).

Sensory evaluations

The sensory characteristics of the enhanced products were assessed for qualities like color, flavor, taste, texture, and overall appeal by a group of 20 evaluators. These participants were chosen from the staff, students, and faculty members of the Department of Agricultural Chemistry at Hajee Mohammad Danesh Science and Technology University, Dinajpur. The participants were instructed to assess the provided samples using a 9-point hedonic scale, where ratings ranged from 9 for "Like extremely" to 1 for "Dislike extremely".

Statistical analysis

The collected data on various parameters were statistically analyzed using MSTAT statistical software. The mean value for all the treatments was calculated and the analysis of variance was accomplished by F variance test. The significance of the difference between pair of means was tested by Duncan's Multiple Range Test (DMRT) test at 1% probability (Gomez and Aguilera, 2004).

Results and Discussion

Biochemical constituents of star fruit jam

Moisture content

In terms of moisture content, the samples of star fruit jam varied significantly from one another. Table 3 shows that Jam 1 contained the highest amount of moisture (37.36%), whereas Jam 5 contained the lowest amount (33.74%). It is predicted that the heating process used to make jam and the addition of sugar caused moisture to evaporate. Food's moisture content is typically utilized as a shelf-life indicator (Fellows *et al.*, 2000). Low moisture content suggests that the jams have a long shelf life; high moisture shows that the samples are more susceptible to microbial invasion, mainly fungi and mould, which can cause deterioration than the other samples (Ihekoronye and Ngoddy, 2005).

Ash content

Ash content did not differ significantly from one sample to the next. Statistics show that the ash content in all the jams is the similar. However, Jam 1 had the greatest ash content (0.015%), whereas Jam 4 and Jam 5 had the lowest (0.012%) (Table 3). According to Haque *et al.* (2009) ash concentrations in fresh fruits ranged from 0.053% to 0.902%, but in this study we determined the ash content from fruit jam that can cause the variations of the result.

Lipid content

Jam 1 had the greatest lipid content (0.127%) and Jams 3 and Jam 5 had the lowest. The study demonstrated that there was little fat in the jam and all of the jam samples performed statistically similarly. A small quantity of fat is good for human health, especially for people participating in weight-control programs.

Fiber content

According to Haque *et al.* (2009) the fiber content of various fruits varied between 0.008% and 1.27%. Jam 1 had the highest fiber content (2.64%), while Jam 5 had the lowest value (2.11%).

Vitamin C

Vitamin C content varied significantly in the prepared jams. Jam 1 had the highest value (11.74 mg/100g) for vitamin C content, while Jam 4 had the lowest value (9.73 mg/100g) which was statistically similar to Jam 2. According to Panchal *et al.* (2018) the vitamin-C content of dragon fruit jelly made from dragon fruit juice was quite low. It might be because of prolonged high-temperature heating destroyed the majority of the vitamin C present in the pulp.

Protein content

The jam samples' protein contents did not differ significantly from one another. Jam 1 had the highest protein content value (1.56%), while Jam 5 had the lowest. According to the nutritional labeling, fruits, sugar, pectin, and citric acid are the most often used ingredients in jam. Because none of these ingredients is a good source of protein, the jam has a low protein level.

Reducing, non-reducing and total sugar content

The samples from Jam 2 and Jam 1 had the highest concentration of reducing sugars, and the remainder had the lowest concentration of this substance. It lies between 68.29% and 70.71%. *Nur* mixed jam had the highest concentration of reducing sugar (60.30%), whereas Agrokomerc pineapple jam had the lowest concentration (28.00%) (Lokonuzzaman, 2015). In this study star fruit jam contains a high amount of reducing sugar, which may help in lowering the risk of developing overweight, obesity and diabetes. It also has a significant effect on lowering dental caries.

There was no discernible difference in the non-reducing sugar amount among the jam samples. However, Jam 2 (17.68%) had the highest non-reducing sugar level, whereas Jam 5 (15.82%) had the lowest. It can be stated that in all the samples non-reducing sugar is almost the same. Non-reducing sugar in plants acts as protectant against various abiotic stresses, including heat, drought, high salinity, and UV rays. As the amount of non-reducing sugar is in a good proportion in these jams, these could be the source of antibiotic.

The jam samples varied significantly in total sugar content. The highest value for the total sugar content was found in Jam 3 (88.61%), which was statistically comparable to Jam 2 (88.38%), while the lowest value was found in Jam 4 (84.61%), which was comparable to Jam 1. Research on the grape, apricot, strawberry and blueberry jam had a total sugar content lies between 52.43 g/100 g to 54.78 g/100 g (Naeem *et al.*, 2017) lower than those reported in this study. The variation may be caused by different varieties of fruits used for the jams.

Table 3. Biochemical constituents of star fruit jam.

Sample	Moisture (%)	Ash (%)	Lipid (%)	Fiber (%)	Vit-C (mg/100g)	Protein (%)	Reducing sugar (%)	Total sugar (%)	Non-reducing sugar (%)
Jam 1	37.36 a	0.015a	0.127 a	2.640 a	11.74 a	1.56 a	69.53 ab	85.49c	15.96 a
Jam 2	35.70 b	0.013a	0.097a	2.150c	9.79 bc	1.54 a	70.71 a	88.38a	17.68 a
Jam 3	35.08bc	0.012a	0.090a	2.197 b	10.05 b	1.56 a	69.43 b	88.61a	15.82 a
Jam 4	34.67 c	0.012a	0.100a	2.140bc	9.73 c	1.55 a	68.95 b	84.61c	16.33 a
Jam 5	33.74 d	0.012a	0.090a	2.110 c	10.05 b	1.54 a	68.29 b	86.40bc	15.82 a
LSD	0.668	0.057	0.057	0.057	0.287	0.057	1.210	2.049	2.242
CV (%)	1.04	1.91	10.58	1.43	1.54	1.86	0.96	1.30	7.55

Mineral constituents of star fruit jam

Calcium

Among the prepared jams, Jam 1 has the highest calcium content (74.65 mg/100g). Jam 5 had the least calcium content of all the jams (Table 4). By employing several fruit jams in his research, Adetoro *et al.* (2022) demonstrated that the calcium concentration was highest in Date Soybean Apple Jam (0.94 mg/kg) and lowest in sucrose Soybeans Monkey Kola Jam (0.57 mg/kg). Therefore, it can be a good source of Ca because the amount in star fruit jam is much higher than the afore-mentioned jams.

Magnesium

The Jam 1 has the greatest magnesium content (22.63 mg/100g), which is statistically different from other jams. Jam 5 recorded the least (17.19 mg/100g), which is comparable to Jam 4 (17.21 mg/100g). In a study on banana fruit jam, Awolu *et al.* (2018) discovered that the magnesium level ranged from 0.50 to 0.80 mg/100g, which is much lower than star fruit. According to Hernandez *et al.* (2016) the Mg concentration in BAU kul Jam ranged from 11 to 16 mg/100 g and was low than this study.

Sulphur

Based on sulphur content, Jam 1 had the highest concentration (19.73 mg/100 g), while Jam 4 had the lowest level of sulphur (18.22 mg/100 g). Mumtaz *et al.* (2019) found sulphur content of selected jams varied from 1.25 ± 1.00 mg per 100g.

Potassium

Jams 2 produced the most potassium (201.2 mg/100g), which was statistically distinct. The lowest figure, however, was obtained in Jam 1 and Jam 5 (139.7 and 148.5 mg/100g, respectively). According to Jahan *et al.* (2011), monkey jack jam contains the most potassium (785 mg/100 g).

Sodium

The highest sodium concentration was found in Jam 1 (52.19 mg/100g), which is statistically comparable to all jam samples except Jam 5 (49.08 mg/100g). Jahan *et al.* (2011) discovered that star fruit has the highest sodium level (66 mg/100g).

Phosphorus

The Jam 1 has the highest phosphorus content (38.60 mg/100g), which is statistically comparable to all other jam samples except Jam 5. On the other hand, Jam 5 contained the lowest amount of phosphorus (36.60 mg/100g).

Table 4. Mineral constituents of star fruit jam.

Sample	Ca (mg/100g)	Mg (mg/100g)	K (mg/100g)	Na (mg/100g)	S (mg/100g)	P (mg/100g)
Jam 1	74.65 a	22.63 a	139.7 d	52.19 a	19.73 a	38.60 a
Jam 2	60.73 b	18.41 b	201.2 a	52.04 a	18.97 ab	37.89 a
Jam 3	60.93 b	18.47 b	184.8 b	50.71 ab	18.26 b	38.38 a
Jam 4	59.75 bc	17.21 c	160.2 c	50.28 ab	18.22 b	37.80 a
Jam 5	58.74 c	17.19 c	148.5 d	49.08 b	19.01 ab	36.60 b
LSD	1.390	1.119	11.170	2.056	1.255	0.992
CV (%)	1.21	3.27	3.68	2.22	3.66	1.44

Biochemical constituents of star fruit Jelly

Fiber content

The statistics revealed that there is no appreciable difference among the jelly samples (Table 5). However, Jelly 4 had the highest fiber content (0.08%), statistically inferior to other jelly samples, while Jelly 5 had the lowest value (0.06%). The fiber in star fruit binds to and removes cancer-causing substances from the colon, protecting the mucous membrane of the colon.

Ash content

Ash content did not differ significantly from one sample to the next. However, Jelly 3 had the greatest ash concentration (0.009%) and Jelly 2 had the lowest. Ash content of fresh fruits ranged from 0.053% to 0.902%, according to Haque *et al.* (2009).

Lipid content

With reference to lipid content, there was no discernible variation. Statistics show that the lipid content in all the jellies is identical. However, Jelly 3 and Jelly 4 had the highest lipid content (0.083%), whereas Jelly 1 and Jelly 2 had the lowest.

Moisture content

The Jelly 4 sample had the highest moisture content of star fruit (25.86%), whereas the other samples were statistically similar. It is usual for there to be a difference in moisture between processed and raw star fruit due to the heating procedure and sugar addition used to make jelly, which evaporated moisture.

Vitamin C

The Jelly samples had different amounts of vitamin C. The highest vitamin C level was found in Jelly 3 (16.65 mg/100 g), which is statistically similar to Jelly 2, and the lowest level was found in Jelly 4, which is comparable to all other samples. In a study for making candy jelly star fruit and papaya with a proportion of 50%:50%, with a content of 35.10 mg of vitamin C and fiber 0.95% (Hariadi, 2020). In this study, the vitamin C value is low because of the compositional differences in the jelly mixture.

Protein content

Significant differences in protein content were observed among the jelly samples. Jelly 4 had the greatest protein content value (0.610%), which is statistically comparable to Jelly 5, while Jelly 2 and Jelly 3 had the lowest value (0.47%).

Reducing, non-reducing and total sugar content

All of the jelly samples performed statistically differently. Jelly 5 had the highest reducing sugar level (82.82%) which was statistically comparable to Jelly 4. In comparison, Jelly 1 had the lowest reducing sugar content (79.07%) that was comparable to all other samples.

The highest non-reducing sugar concentration was found in Jelly 2 and Jelly 3 (4.54%), while the lowest was found in Jelly 1. Non-reducing sugar inverts to reducing sugar due to the presence of acid in products, which results in a decrease in non-reducing sugar.

The overall sugar level of the jelly samples did not differ considerably from one another. The total sugar content values for Jelly 4 and Jelly 5 were the highest (86.37% and 86.36%, respectively), and the remaining samples were the lowest. The gradual inversion of non-reducing sugars (Jain *et al.*, 2011) and the conversion of polysaccharides into simple sugars (Sogi and Singh, 2001) in jelly are two possible explanations for the rise in total sugar concentration during preservation.

Table 5. Biochemical constituents of star fruit jelly.

Sample	Moisture (%)	Ash (%)	Lipid (%)	Fiber (%)	Vit-C (mg/100g)	Protein (%)	Reducing sugar (%)	Total sugar (%)	Non-reducing sugar (%)
Jelly 1	24.09 b	0.008a	0.076a	0.066a	15.28 b	0.497 b	79.07 b	83.90 b	3.47 a
Jelly 2	23.96 b	0.006a	0.076a	0.073a	15.98 ab	0.477 b	79.43 b	85.31ab	4.54 a
Jelly 3	23.71 b	0.009a	0.083a	0.070a	16.65 a	0.477 b	79.99 b	84.53 b	4.54 a
Jelly 4	25.86 a	0.007a	0.083a	0.080a	15.11 b	0.610 a	82.64 a	86.37 a	3.73 a
Jelly 5	24.79 b	0.007a	0.083a	0.063a	15.20 b	0.580 a	82.82 a	86.36 a	3.58 a
LSD	1.037	0.057	0.057	0.057	0.857	0.057	1.861	1.631	2.118
CV (%)	2.33	4.95	7.16	6.33	3.01	2.93	1.27	1.05	29.30

Mineral constituents of star fruit Jelly

Calcium

The calcium content of the Jelly 4 and Jelly 5 is statistically significantly higher (59.54 and 58.57 mg/100g, respectively) than others (Table 6). Jelly 1 and Jelly 3 had the least calcium amount (45.65 mg/100). According to Hernández *et al.* (2016), Spanish and Chinese jujube jelly had calcium concentrations of 45.6-118 mg/100 g and 23-72 mg/100 g, respectively. Developed squash from star fruit contained 19.17±0.21 mg calcium per 100 g (Anamika and Sashi, 2018), which is lower than the jelly we prepared.

Magnesium

Jelly 3 had the highest magnesium content (17.30 mg/100g) (Table 6). However, Jelly 5 had the lowest magnesium concentration (14.28 mg/100g), statistically equivalent to other jellies. In another study star fruit squash had 1.27±0.04 mg magnesium per 100 g (Anamika and Sashi, 2018).

Potassium

Potassium content of all of the jelly samples produced statistically identical findings. Though Jelly 2 and Jelly 3 are statistically similar, Jelly 3 had the highest potassium level (178.00 mg/100g), while Jelly 4 had the lowest (167.3 mg/100g). Anamika and Sashi (2018) reported that star fruit squash contained 0.05±0.01 mg potassium per 100 g, much lower than our star fruit jelly.

Sodium

The most sodium is included in Jelly 1 (53.18 mg/100g), which is statistically comparable to Jelly 2. Jelly 5 and Jelly 3 had the least sodium per 100 grams (49.18 and 49.77 mg, respectively). According to Mohammad *et al.* (2015), star fruit jelly contains 0.05 mg /g of sodium.

Sulphur

The Jelly 1 is statistically different from the other sweets because it has the highest sulphur content (19.99 mg/100g). On the other hand, Jelly 4 had the least sulphur (18.46 mg/100g).

Phosphorus

Regarding phosphorus concentration, all of the jelly samples were statistically different. Jelly 3 and Jelly 5 were statistically similar. Jelly 4 had the highest concentration of phosphorus (41.16 mg/100g), and the Jelly 2 had the lowest (38.65 mg/100g).

Table 6. Mineral constituents of star fruit jelly.

Sample	Ca (mg/100g)	Mg (mg/100g)	K (mg/100g)	Na (mg/100g)	S (mg/100g)	P (mg/100g)
Jelly 1	45.65 c	14.61 b	172.7 b	53.18 a	19.99 a	39.12 b
Jelly 2	54.87 b	14.51 b	176.9 a	51.94 ab	18.73 bc	38.65 b
Jelly 3	45.65 c	17.30 a	178.0 a	49.77 c	18.85 bc	40.32 ab
Jelly 4	59.54 a	14.39 b	167.3 d	50.54 bc	18.46 c	41.16 a
Jelly 5	58.57 a	14.28 b	169.9 c	49.18 c	19.67 ab	39.64 ab
LSD	3.40	1.48	2.17	1.45	0.95	1.62
CV (%)	3.54	5.40	0.69	1.57	2.74	2.24

Rating scores of star fruit jam

The Jam 2 has the greatest score in terms of color content (Table 7). The lowest rating (6.50) was achieved by Jam 3, which is statistically comparable to all other samples except Jam 2. This can result from a better component mix that gives the jam's blended consistency a good viscosity. The Jam 2 has the highest score in terms of flavor content. Jam 5, on the other hand, received the lowest rating. The highest ranking (8.00) in terms of texture content is found in Jam 2, which is statistically comparable to Jam 1. Jam 5, on the other hand, received the lowest rating (Table 7). The Jam 2 has the highest rating for taste content. Jam 5, on the other hand, received the lowest rating. A higher grade for the blended jam may have been obtained with the proper pulp ratio to sugar ratio. The Jam 2 has the highest rating for overall appropriateness of content. The lowest ranking (6.00) was achieved by Jam 4, which is statistically equivalent to Jam 3 and Jam 5.

Table 7. Rating score of star fruit jam.

Jam sample	Color	Flavor	Taste	Texture	Overall acceptability
Jam 1	6.95 b	7.70 b	7.35 b	7.80 a	7.05 b
Jam 2	8.30 a	8.45 a	8.20 a	8.00 a	8.40 a
Jam 3	6.50 b	7.80 b	6.85 bc	7.05 b	6.40 c
Jam 4	6.55 b	7.20 b	6.45 cd	6.90 b	6.00 c
Jam 5	6.95 b	6.55 c	6.15 d	6.10 c	6.30 c
LSD	0.55	0.61	0.53	0.58	0.48
CV (%)	12.36	12.88	12.02	12.84	11.22

Rating scores of star fruit Jelly

The most highly rated jelly for color content is Jelly 4. Jelly 1, however, received the lowest grade. The star fruit jelly may have a good viscosity as a result of a better component combination. The Jelly 4 scored highest for flavor content (Table 8). Jelly 1 however, received the lowest grade. This can be due to higher pulp levels, which offered enhanced flavor and fragrance. Jelly 4 has the highest texture content rating (7.10), while Jelly 2 has the lowest texture content rating (4.50). Jelly

4 has the highest taste content rating (7.2). Jelly 2, on the other hand, obtained the lowest rating. Regarding the overall acceptability of the content, Jelly 4 has the highest rankings. Jelly 2, on the other hand, obtained the lowest rating. This could be attributed to the level's enhanced consistency, tolerable color, flavor, and sugar-acid ratio.

Table 8. Rating score of star fruit jellies.

Jellies sample	Color	Flavor	Taste	Texture	Overall acceptability
Jelly 1	5.15 d	4.35 c	5.70 b	5.55 b	5.10 d
Jelly 2	5.45 cd	5.95 b	4.65 c	4.50 c	5.80 c
Jelly 3	5.90 c	5.80 b	5.95 b	5.95 b	6.20 bc
Jelly 4	7.90 a	7.65 a	7.20 a	7.10 a	8.25 a
Jelly 5	6.85 b	6.20 b	5.40 bc	5.10 bc	6.60 b
LSD	0.57	0.63	0.79	0.81	0.56
CV (%)	14.51	16.64	14.72	15.78	13.83

Conclusion

The star fruit jam and jelly have different moisture, pH, acidity, total sugar, fiber, ash, protein, fat, vitamin C content, Ca, Mg, P and K. For rating score of star fruit jelly, Jelly 4 has received the highest rating. However, Jelly 1 obtained the lower grade considering the color content. The jam with the highest taste content rating is Jam 2. However, small food producers have the opportunity and potential to process star fruit, creating jobs and bringing in money for the community. Rural areas of countries that produce star fruit can be the major job hubs for the food processing industry. Jam 2 and Jelly 4 had received the most support overall in this study for producing star fruit jam and star fruit jelly. This will enable us to get high profit using this minor fruit in the production of Jam and Jelly. Star fruit can allow for the addition of novel products to the food processing industry while also increasing the farm incomes of rural populations.

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