

Physicochemical properties and the texture profile qualities of the combination of honey orange with purple passion fruit jelly candy

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Abstract

Jelly candy is a category of confectionery product usually made from fruit juices or flavored syrups and a gelling agent, which contributes to the chewy texture. This study examined the effect of the ratio of honey orange (*Citrus nobilis*) juice with purple passion fruit (*Passiflora edulis* Sims) juice and different gelatine concentration towards the physicochemical properties of the jelly candy product, such as water activity, total soluble solids, color values, and textural properties of the jelly candy product. The results showed that the ratio of honey orange (HO) juice with purple passion fruit (PPF) juice and gelatin concentration significantly affected ($p < 0.05$) color value of jelly candy. 13% of gelatine concentration gave the highest ($p < 0.05$) chewiness value significantly. The selected formula of HO juice with PPF juice revealed a strong antioxidant activity (92.4589), 1.1055% ash content, 7.66% reducing sugar, and 38.057% total sugar. In conclusion, a combination of HO juice with PPF juice can be expected as food ingredients in a nutritional jelly candy formulation.

1. Introduction

Jelly candy is one of the confectionery products produced by mixing sugar with fruit juices or flavored syrups and a gelling agent such as gelatine, which contributes to the chewy texture with various flavors and shapes. However, the synthetic food coloring used in jelly candy is a major source of food intoxication, which leads to severe health problems (Dey and Nagababu, 2022). Due to this health issue, developing jelly candy with nutritional content and having desirable color and texture properties will be challenging. Therefore, the objective of this study was to develop a healthy jelly candy by examining the effect ratio of HO juice with PPF juice and different gelatin concentrations. Both fruits are the trademark fruits in the Berastagi Area, North Sumatra (Hutabarat *et al*, 2016; Batubara *et al*, 2023). High moisture content in horticultural products causes them to deteriorate faster if they're not stored under certain conditions. Hence, it's necessary to process those fruits into functional products to extend their shelf life.

Gelatine, which is crucial in the production of jelly candy, is a versatile protein derived from collagen found in animal skin and bones. Gelatine is widely used due to its unique properties, such as its ability to form a gel-like substance when mixed with water and cooled. When

heated and dissolved, gelatine transforms into a semi-solid state upon cooling, leading to desirable texture and consistency crucial to the delectable treats. In the world of culinary, gelatine is the key ingredient behind various dishes such as jellied desserts, mousses and gummy candies. Its ability to bind and its gelling properties allow it to create the characteristic chewy yet yielding texture that defines jelly candy (Chandra and Shamasundar, 2015).

2. Materials and methods

2.1 Materials

The fresh honey orange (HO) and purple passion fruit (PPF) were collected from the Berastagi Area, North Sumatra, Indonesia. Other ingredients were sucrose, glucose syrup °Brix 75, and gelatine 200 Bloom.

2.2 Preparation of the juice extraction

Both HO and PPF were washed and then cut in half. For HO, the juice extraction was done using an orange squeezer, while for PPF, the pulp and seeds were collected from the outer skin, and then the pulp from the seeds was blended for a while. The HO juice and PPF juice obtained were then filtered.

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2.3 Jelly candy formulation

HO juice and PPF juice with three different ratios (50:50, 60:40, 70:30) were mixed with sucrose (50%) and glucose syrup (10%) until completely blended. The blend was then heated to 70°C for 5 min. Gelatine at various concentrations (11%, 12%, 13%) was then added, and then heated for another 5 min. The jelly candy liquid was poured into molds, cooled at room temperature, and then stored in the refrigerator for 24 h.

2.4 Experimental design and statistical analysis

The experimental design was a 3 × 3 factorial design with experimental factors using three different ratios of HO juice and PPF juice (50:50, 60:40, 70:30) with three different concentrations of gelatine (11%, 12%, 13%). This research used three replicates, and the data were analyzed with ANOVA followed by the Duncan test using the statistical software SPSS. The results values were reported as the mean value ± SD (standard deviations).

2.4 Chemical and texture profile analysis

Total soluble solid and color values of HO juice and PPF juice were analyzed. The water activity, total soluble solid, color values, and texture properties (gumminess, hardness, chewiness, cohesiveness, adhesiveness, and springiness) of the jelly candy product were analyzed. The best formulation was then tested for the ash content, reducing sugar, total sugar, sucrose content, total plate count, and antioxidant activity.

2.4.1 Water content

Water content testing was carried out based on the AOAC Official Method 934.06.

2.4.2 Water activity

The sample was tested using an a_w meter. Samples were taken according to the size of the a_w meter container. The a_w meter was turned on first, then waited until the warm-up process was complete. Then the a_w meter was opened, the sample was taken, and closed. The results shown on the display screen were then recorded.

2.4.3 Total soluble solids

Total soluble solid testing was determined by weighing 2 g of material, and 18 g of distilled water was added (total volume of 20 g). First, the hand-refractometer was standardized using distilled water. Drip the jam solution with a dropping pipette on the prism of the hand-refractometer as many as 2-3 drops, observe the refractive index in a lighted place, and

calculate the scale to °Brix (Sudarmadji *et al.*, 1997). The calculation applies the following formula:

Total soluble solids = number of hand – refractometer × diluent factor

2.4.4 Color values

The analysis was conducted based on the method described by Hutching (1999) using a CR-410 type chromameter. The sample was placed on white paper, then the chromameter was pointed at the sample, and the L^* , a^* , and b^* values were obtained. The " L^* " notation is a notation that reports the color sharpness of the sample and has a scale of 0 (black) to ±100 (white). Increasing L^* values indicate that the sample is getting sharper. The " a^* " notation is a notation that indicates the color of the red-green combination and has a scale of 0 to +100 for red samples ($+a^*$) and -80 to 0 for green samples. The " b^* " notation reports the color of the blue-yellow combination with a scale of 0 to +70 for yellow samples ($+b^*$) while a scale of -80 to 0 for blue samples ($-b^*$). After obtaining the a^* and b^* results, the °Hue is calculated using the formula:

$$^{\circ}\text{Hue} = \tan^{-1} \frac{b}{a}$$

18° - 54° was expressed as the color red (R); 54° - 90° was expressed as yellow-red (YR) color.

90° - 126° was expressed as yellow (Y); 126° - 162° was expressed as yellow-green (YG).

162° - 198° was expressed as green-color (G); 198° - 234° was expressed as blue-green (BG) color.

234° - 270° was expressed as blue-color (B); 270° - 306° was expressed as blue-violet (BP) color.

306° - 342° was expressed as purple color (P); 342° - 18° was expressed as purple-red color (RP).

2.4.5 Texture properties

Texture analysis of jelly candy was conducted using Brookfield Texturometer and Brookfield Engineering Labs Inc's TexturePro CT V1.4 Build 17 software. The settings used were a 10000 kg load cell, double compression, 1 mm/s speed, TA44/100 compression plate probe, 0% deformation. The criteria observed were hardness, adhesiveness, springiness, cohesiveness, gumminess, and chewiness. Samples were analyzed with dimensions of 50 mm in diameter and 20 mm in thickness.

2.4.6 Ash content

Determination of ash content was carried out based on the method described by Sudarmadji *et al.* (1997). Samples were dried until their weight reached a constant

value, and 5 g of sample was placed into a porcelain cup that had previously been measured. The cup was then burned in a furnace at 100°C for 1 h, at 300°C for 2 h, and at 500°C for 2 h. After that, the cup was allowed to stand and taken from the furnace before being placed into a desiccator for a span of 15 min. The ash content of the sample can be calculated using the formula:

$$\text{Ash content (\%)} = \frac{\text{BA (g)}}{\text{BS (g)}} \times 100\%$$

Where BA = ash weight and BS= initial sample weight

2.4.7 Reducing sugar

The reducing sugar was determined by the Somogyi method (Nelson, 1944).

2.4.7.1 Standard curve determination

The standard solution was made by mixing 10 mg of anhydrous glucose with 100 mL of distilled water. The standard glucose solution was then diluted six times, and the obtained glucose solution concentrations were 2, 4, 6, 8, and 10 mg/100 mL. Six clean test tubes were prepared, and 1 mL of the above standard glucose solution was added to each tube. One test tube was filled with distilled water for a blank, then 1 mL of Nelson's reagent was added to each test tube, and all tubes were warmed on a water heater for 20 min. All tubes were removed and left in a goblet containing cold water until the temperature of the tubes reached 25°C. After all the tubes were cold, 1 mL of Arsenomolybdate reagent was added and stirred until dissolved. Absorbance testing was carried out at a wavelength of 540 nm, and then a standard graph was formed.

2.4.7.2 Determination of reducing sugar in samples

An aliquot (1 mL) of the sample was pipetted into a 100 mL volumetric flask and then diluted to the mark. An aliquot (1 mL) of the sample was pipetted into a test tube, and 1 mL of Nelson's reagent was added and then continued in the same manner as the preparation of the standard curve above. Reduced sugar content was measured based on the standard curve of glucose solution. The calculation of reducing sugar is as follows:

$$\text{Reducing sugar content} = \frac{\text{reducing sugar (mg)}}{\text{sample (mg)}} \times \text{Diluent Factor} \times 100\%$$

2.4.8 Total sugar

The total sugar was determined by the Somogyi method (Nelson, 1944).

2.4.8.1 Standard curve determination

A standard glucose solution was prepared by

dissolving 10 mg of anhydrous glucose in 100 mL of distilled water. The standard glucose solution was diluted six times to produce glucose solutions with concentrations of 2, 4, 6, 8, and 10 mg/100 mL. Six clean test tubes were prepared, each tube was pipetted with 1 mL of standard glucose solution, while one tube included 1 mL of distilled water for the blank. After that, 1 mL of Nelson's reagent was pipetted into each test tube, and then each tube was placed in a water bath for 20 min. After heating, all tubes were removed and allowed to stand in cold water in a glass cup until the temperature of the tube became 25°C. Next, 1 mL of Arsenomolybdate reagent was pipetted into each tube and homogenized until all CuO pulp was completely dissolved. After that, 7 mL of distilled water was pipetted and stirred well. Absorbance measurements were taken at a wavelength of 540 nm, then a standard graph was formed.

2.8.8.2 Determination of total sugar

A total of 25 mL of filtrate was taken and pipetted into an Erlenmeyer, then pipetted 15 mL of distilled water and 5 mL of 30% HCl were pipetted. The solution was heated in a water heater at 70°C for 10 min and then allowed to cool quickly to a temperature of 20°C. The solution was neutralized with 40% NaOH and then diluted in a 100 mL flask, and then continued as in the preparation of the standard curve above. Calculation of total sugar is done with the following formula:

$$\text{Total sugar} = \frac{\text{sugar weight (mg)} \times \text{diluent factor}}{\text{sample weight (mg)}} \times 0.95 \times 100\%$$

2.4.9 Sucrose content

Sucrose content in jelly candy was determined by calculating total sugar and total reducing sugar using the Somogyi method (Nelson, 1944). This determination was based on the assumption that non-reducing sugars in a material are all or mostly sucrose. The determination of sucrose content was calculated using the following formula:

$$\text{Sucrose} = (\text{Total sugar} - \text{total reducing sugar}) \times 0.95$$

2.4.10 Total plate count

The PCA solution was prepared using 22.5 g PCA/L of distilled water and heated to boiling. A 1 mL sample was taken using a micro pipette and placed into a test tube containing 9 mL of 0.9% NaCl. One mL from the last test tube dilution was then spread evenly on the PCA agar medium that had been provided on a Petri dish. Samples were incubated for 48 h at 37°C in inverted conditions (Mailoa et al., 2017). Then counted how many colonies were with the following formula:

$$\text{Total Plate Count} = \text{total counted colonies} \times \frac{1}{\text{diluent factor}}$$

2.4.11 Antioxidant activity with 1,1-Diphenyl-2-Picrylhydrazyl

2.4.11.1 Determination of 1,1-Diphenyl-2-Picrylhydrazyl maximum wavelength

Approximately 2 mL of DPPH solution with a concentration of 40 ppm was placed into a cuvette. The absorbance of the solution was measured in the wavelength range of 400-800 nm with a UV-Vis Spectrophotometer, until the maximum wavelength of DPPH was obtained.

2.4.11.2 Measurement of absorbance of blank solution

Two mL of DPPH solution with a concentration of 40 ppm was placed into a test tube, added with 2 mL of methanol, stirred well, and allowed to stand in the dark for 30 min. After that, the blank absorbance measurement was carried out at the maximum wavelength of DPPH that had been previously identified.

2.4.11.3 Absorbance measurement of jelly candy

The stock solution of jelly candy was diluted to obtain three concentrations of solution (100, 200, and 300 ppm). To determine the absorbance, 2 mL of the sample solution was placed into a test tube. Next, 2 mL of 40 ppm DPPH solution was pipetted into each test tube. The mixture was stirred until homogeneous and allowed to stand for 30 min in an unlit room, after which the absorbance was measured with a UV-Vis Spectrophotometer at the maximum wavelength that had been identified.

2.4.11.4 Data analysis

The antioxidant activity of the samples was measured by determining the extent to which the samples inhibited the absorption of DPPH radicals, and the results were expressed in percentage (%) inhibition of DPPH absorption using the formula:

$$\% \text{ inhibition} = \frac{(\text{absorbance of blank solution} - \text{absorbance sample})}{\text{absorbance of blank solution}} \times 100\%$$

Where absorbance of blank = Absorption of 40 ppm DPPH radical at maximum wavelength (516 nm) and absorbance of sample = Absorption of sample in 40 ppm DPPH radical at maximum wavelength (516 nm)

In evaluating the free radical scavenging activity, calculations were performed using IC (Inhibitory Concentration) values. IC reflects the concentration of the test compound required to inhibit free radicals by 50%. The calculation of IC for each sample concentration was done using the linear regression equation $Y = ax + b$, where the sample concentration

(ppm) is the abscissa x (abscissa), and the % inhibition value is the abscissa y (ordinate). The value of IC was calculated by the formula:

$$IC_{50} = \frac{50 - b}{a}$$

Where a = intercept (line intersection at abscissa y) and b = slope.

3. Results and discussion

3.1 Water activity

The results showed that the effect of the interaction between the ratio of HO juice and PPF juice and gelatine concentration on water activity and total soluble solids was shown in Table 1. Water activity determines the portion of the total humidity of a material which is free and usually subject to the growth of microorganisms and to different chemical reactions which might affect the stability of the product. Food with water activity above 0.95 can supply ample moisture for bacteria and molds to thrive and proliferate, potentially leading to spoilage (Utomo *et al.*, 2014). Different ratio of HO juice and PPF juice gives no significant difference. However, different gelatine concentration gives significant differences except for the sample with a 60:40 ratio of HO juice and PPF juice. Sample P7 with the ratio 70:30 of HO juice and PPF juice and 11% gelatine showed the highest water activity value of 0.9033 ± 0.01 and was significantly different from all samples except sample P1. In contrast, the ratio of 50:50 of HO juice and PPF juice and 13% gelatine had the least water activity and thus was the most likely to last. This result was in accordance with the function of gelatine, as a water binder, which was due to the OH group in gelatine, which has a hydrophilic property. When gelatine is heated to a temperature of 70°C , it will dissolve through the breakdown of molecular aggregates and the water that was previously free becomes trapped so that the solution becomes bound. When the concentration of the

Table 1. Water activity and total soluble solid of jelly candy.

Sample	a_w	Total soluble solids ($^{\circ}\text{Brix}$)
P1	0.89 ± 0.006^{ab}	47.69 ± 0.219^{ef}
P2	0.88 ± 0.006^c	52.36 ± 0.420^d
P3	0.86 ± 0.006^d	68.50 ± 0.613^a
P4	0.89 ± 0.000^b	45.48 ± 1.728^{fg}
P5	0.88 ± 0.006^{bc}	49.69 ± 4.249^{de}
P6	0.87 ± 0.006^{cd}	64.88 ± 1.036^b
P7	0.90 ± 0.010^a	44.37 ± 0.411^g
P8	0.89 ± 0.010^b	48.39 ± 0.396^{ef}
P9	0.87 ± 0.006^{cd}	61.16 ± 0.437^c

Values are presented as mean $\pm$ SD. Values with different superscripts in the same column are statistically significantly different ($p \leq 0.05$).

added gelatine was increased, more water was bound in the material, causing the availability of free water in the material to lessen so that the water activity would decrease (Ratih *et al.*, 2019).

3.2 Total soluble solids

Total dissolved solids showed the content of materials dissolved in a solution. Based on Table 1, different ratio of HO juice and PPF juice gives no significant difference. However higher total soluble solids obtained were higher in jelly candy with a 50:50 ratio of HO juice and PPF juice compared to jelly candy with 60:40 and 70:30 ratios of HO juice and PPF juice. Purple passion fruit juice, with its elevated total soluble solids, which was 16.25 ± 0.2 compared to the total soluble solids of HO juice with the value of 12.52 ± 0.2 (Table 2), leads to a higher overall concentration in jelly candy when it contains a greater percentage of PPF juice. Meanwhile, different gelatine concentration gives significant difference ($p < 0.05$). In this study, sample P3, made up of a 50:50 ratio of HO juice and PPF juice and 13% gelatine concentration, had the highest total soluble solids with the value of 68.5 ± 0.61 and was significantly different from other samples. In contrary, the ratio of 70:30 of HO juice and PPF juice and 11% gelatine concentration had the lowest total soluble solids. Gelatine, as a hydrocolloid, is a remarkable substance renowned for its ability to bind soluble particles while simultaneously engaging free water molecules. This unique property enables gelatine to transform liquid solutions into cohesive, semi-solid structures by trapping and immobilizing the dispersed particles within its matrix. As it gels, gelatine captures and encapsulates both the soluble components and the surrounding water,

thereby enhancing the concentration of total soluble solids within the structure (Lubis *et al.*, 2020).

3.3 Color analysis

The color values of jelly candy with different ratio of HO juice and PPF juice and different gelatine concentrations are presented in Table 3. The L^* value specifies the brightness, the a^* value specifies the color between red and green, the b^* value specifies the color between yellow and blue, and the $^{\circ}\text{Hue}$ value specifies the position color in the color wheel, representing the pure spectrum color and is measured in degrees ranging from 0° to 360° .

Both the ratio of HO juice and PPF juice and gelatine concentration significantly affected ($p < 0.05$) L^* , a^* and b^* values of jelly candy. As the percentage of HO juice and gelatine concentration increases, the value of L^* and b^* also increases, except a value. a^* value of jelly candy decreased as the percentage of HO juice and gelatine concentration increased from 3.17 ± 0.09 to -2.92 ± 0.04 (an indicator of the tendency towards greenness). The data reveals that the sample with a ratio 50:50 and 60:40 of HO juice and PPF juice possessed the same colour, which was yellow red meanwhile the sample with a ratio 70:30 of HO juice and PPF juice possessed the colour of yellow. The result obtained was in line with research by Handayani *et al.* (2021), which showed that the higher the concentration of gelatine used, the lower the L^* value of the jelly candy, hence the colour of the jelly candy becomes darker. This dark colour may come from the Maillard reaction, which occurs due to the amino acids in gelatine reacting with reducing sugars and producing melanoidin compounds,

Table 2. Total soluble solids and color values (L^* , a^* , b^* and $^{\circ}\text{Hue}$) of HO juice to PPF juice.

Material	Total soluble solids ($^{\circ}\text{Brix}$)	Color values			
		L^*	a^*	b^*	$^{\circ}\text{Hue}$
HO juice	12.51916 ± 0.2	44.49 ± 1.1	0.78 ± 0.07	21.92 ± 1.7	87.94 ± 0.3
PPF juice	16.25342 ± 0.2	33.49 ± 0.5	6.77 ± 0.4	9.82 ± 0.15	55.41 ± 1.9

Values are presented as mean $\pm$ SD.

Table 3. The color values (L^* , a^* , b^* and $^{\circ}\text{Hue}$) of jelly candy.

Sample	L^*	a^*	b^*	$^{\circ}\text{Hue}$
P1	37.89 ± 0.39^g	2.85 ± 0.02^b	6.38 ± 0.12^g	65.88 ± 0.48^i
P2	35.26 ± 0.08^h	3.17 ± 0.09^a	8.62 ± 0.30^f	69.80 ± 0.95^h
P3	31.64 ± 0.22^i	2.96 ± 0.09^b	11.43 ± 0.47^c	75.44 ± 0.77^g
P4	51.71 ± 0.03^d	2.88 ± 0.07^b	16.31 ± 1.46^d	79.92 ± 0.92^f
P5	46.66 ± 0.65^e	1.48 ± 0.12^c	18.73 ± 0.17^c	85.48 ± 0.38^e
P6	41.45 ± 0.48^f	0.15 ± 0.02^d	21.39 ± 0.23^a	89.60 ± 0.07^d
P7	72.39 ± 0.30^a	-2.14 ± 0.11^e	22.35 ± 0.62^a	95.36 ± 0.15^c
P8	65.38 ± 0.66^b	-2.34 ± 0.10^f	19.83 ± 0.12^b	96.74 ± 0.32^b
P9	62.97 ± 0.65^c	-2.92 ± 0.04^g	18.86 ± 0.17^{bc}	98.81 ± 0.17^a

Values are presented as mean $\pm$ SD. Values with different superscripts in the same column are statistically significantly different ($p \leq 0.05$).

which are brown in colour hence darkening the color of jelly candy (Handayani *et al.*, 2021). Higher L^* value obtained from a higher percentage of honey orange juice is also caused by the higher value of L^* in honey orange juice, which is 44.49 ± 1.23 while the value of L^* in purple passion fruit juice is 33.49 ± 0.68 . The lower a^* value resulted from jelly candy with a higher percentage of HO juice, which was caused by the low value of a^* of HO juice, which was 0.78 ± 0.09 . The b^* value was higher in jelly candy with a higher percentage of HO juice and gelatine concentration. This result was in line with research by Timisela *et al.* (2023), which showed that the higher the concentration of gelatine used, the higher the b^* value. Honey orange juice has the b^* value of 21.92 ± 1.82 which also contributed to the higher b^* value of jelly candy with a higher percentage of HO juice.

3.4 Texture profile analysis

Texture analysis plays a pivotal role in the food industry, influencing consumer preferences and overall product quality. Understanding and optimizing texture is crucial as it directly impacts sensory experiences, influencing how food feels, breaks, and interacts in the mouth. This analysis allows manufacturers to fine-tune their products to meet specific textural expectations. Hardness or firmness, which represents the force needed to reach a given deformation (Yusof *et al.*, 2019), is one of the most important textural properties in product jelly candy, which will also affect chewiness as it's the first characteristic of texture perceived by consumers. The hardness properties showed that the sample P9, with a ratio of 70:30 of HO juice and PPF juice and 13% of gelatine possessed significantly the highest ($p < 0.05$) value significantly compared to the other samples. Similar results were obtained for gumminess and chewiness properties, with the highest values obtained from sample P9 (Table 4). For the results of cohesiveness, the highest value was obtained from P3 with a ratio of 50:50 of HO juice and PPF juice and 13%

of gelatine, with no significant differences among the other samples with the same concentration of gelatine. Cohesiveness refers to the degree to which its internal particles or components stick together; the higher the cohesiveness value, will give the difficulty in breaking down the internal bonds of jelly candy (Radocaj *et al.*, 2011). Gumminess and chewiness increase along with hardness, due to the use of gelatine. Gelatine may form a new-packed three-dimensional grid structure between its molecules, hence resulting in a hard texture of jelly candy (Peng and Regenstein, 2007). Jelly candy with a hard texture will need more energy to be disintegrated, hence the increase in values of gumminess and chewiness. The result of springiness shows that gelatine concentration gives a significant effect ($p < 0.05$), but the ratio of fruit juice gives no significant effect ($p > 0.05$). The highest value of springiness was obtained from sample P1 with a ratio 50:50 of HO juice and PPF juice and 11% of gelatine concentration. Springiness, also known as elasticity, refers to the ability of an object to rebound to its original shape after deformation (Chandra and Shamasundar, 2015).

On the other hand, for adhesiveness, samples P3, P6 and P9 with the same concentration of gelatine, which was 13%, showed the same value of adhesiveness, which was 0.000 ± 0.00 . The highest value of adhesiveness was obtained from sample P7 with a ratio 70:30 of HO juice and PPF juice and 11% of gelatine concentration. The ratio of HO juice and PPF juice shows no significant effect ($p > 0.05$) on the adhesiveness of jelly candy. Adhesiveness, also known as stickiness, refers to the tendency of an object to stick to surfaces such as teeth, plate or fingers due to its gel-like consistency, creating a sticky sensation during consumption. Hence, jelly candy with low adhesiveness is preferred by consumers (Osorio *et al.*, 2007).

Ratio 60:40 of HO juice and PPF juice with 13% gelatine and ratio 70:30 of HO juice and PPF juice with 11% gelatine resulted in not significantly different in the

Table 4. Texture profile analysis of jelly candy.

Sample	Gumminess (g)	Hardness (g)	Chewiness (mj)	Cohesiveness	Adhesiveness (mJ)	Springiness (mm)
P1	127.00 ± 4.00^f	124.00 ± 5.57^g	6.30 ± 0.20^c	0.76 ± 0.05^c	0.27 ± 0.06^a	4.30 ± 0.07^a
P2	387.00 ± 7.00^c	150.00 ± 3.00^e	14.47 ± 0.25^d	0.94 ± 0.05^b	0.17 ± 0.06^b	3.12 ± 0.06^b
P3	495.67 ± 6.11^b	231.66 ± 4.73^c	19.70 ± 0.46^b	1.17 ± 0.04^a	0.00 ± 0.00^c	2.54 ± 0.06^d
P4	124.33 ± 6.51^f	118.33 ± 2.08^g	6.37 ± 0.15^c	0.84 ± 0.03^{cd}	0.27 ± 0.06^a	4.25 ± 0.03^a
P5	372.00 ± 11.53^d	178.66 ± 7.37^d	14.47 ± 0.45^d	0.92 ± 0.06^{bc}	0.13 ± 0.06^b	3.12 ± 0.03^b
P6	507.67 ± 4.16^b	255.33 ± 4.04^b	20.73 ± 0.35^a	1.12 ± 0.09^a	0.00 ± 0.00^c	2.64 ± 0.04^c
P7	116.00 ± 11.14^f	132.67 ± 3.51^f	6.63 ± 0.15^c	0.85 ± 0.05^{cd}	0.33 ± 0.06^a	4.32 ± 0.04^a
P8	357.67 ± 4.04^c	176.00 ± 4.58^d	16.50 ± 0.62^c	0.94 ± 0.03^b	0.13 ± 0.06^b	3.15 ± 0.04^b
P9	526.00 ± 7.94^a	278.33 ± 3.05^a	21.33 ± 0.45^a	1.16 ± 0.06^a	0.00 ± 0.00^c	2.68 ± 0.03^c

Values are presented as mean $\pm$ SD. Values with different superscripts in the same column are statistically significantly different ($p \leq 0.05$).

highest value of b^* ($p < 0.05$) compared to the other ratios, as PPF juice. The gelatine concentration of 13% produced jelly candy with the lowest water activity and adhesiveness, which are the best in this study and resulted in the highest value of total soluble solid, b^* , °Hue, gumminess, hardness, chewiness and cohesiveness. Meanwhile, gelatine concentration of 11% produced jelly candy with a higher value of L^* and springiness. Based on the results of the study, the best formulation was obtained from a ratio of 60:40 of HO juice and PPF juice with 13% gelatine. The analyses that had been carried out on the best formulation are presented in Table 5.

Table 5. The analysis results in the best formulation of jelly candy.

Parameter	Results
Ash content (%)	1.1055
Reducing sugar (%)	7.6666
Total sugar (%)	38.0573
Sucrose content (%)	28.8673
Total Plate count (CFU/mL)	0.8667×10^2
Antioxidant activity (ppm)	92.4589

Based on SNI 3547.2.2008 for soft candy, the ash content was a maximum of 3%, reducing sugar was a maximum of 25%, sucrose content was a minimum of 27%, total plate count was a maximum of 1×10^2 CFU/ml, so that the jelly candy of ratio 60:40 of HO juice and PPF juice with 13% gelatine fulfilled the national standard of jelly candy. Meanwhile, the antioxidant activity of jelly candy is strong. IC_{50} value of 51-100 ppm was categorized as strong antioxidant activity (Syafriada et al., 2018).

4. Conclusion

The best formulation for jelly candy using a ratio of 60:40 of HO juice and PPF juice with 13% gelatine in the higher value of b^* . The resulting b^* value was 22.35. The gelatine concentration of 13% produced jelly candy with the lowest water activity, the highest value of gumminess, hardness, chewiness and cohesiveness. Although the ratio of HO juice with PPF juice and gelatin concentration might have altered the chemical composition, it was revealed that these ingredients gave a desirable level of jelly candy. The selected formula fulfills the Indonesian National Standard (SNI) of jelly candy and has strong antioxidant activity (92.4589) and can be expected as a sustainable food ingredient in jelly candy formulation.

Conflict of interest

The authors declare that there is no conflict of

interest regarding the publication of this paper.

References

- AOAC INTERNATIONAL. (2012). Moisture in Dried Fruit. (AOAC Official Method 934.06). Official Methods of the Analysis of AOAC INTERNATIONAL. 19th ed. Rockville, USA: AOAC INTERNATIONAL.
- Batubara, W.R.P, Susilawati, T.N. and Indarto, D. (2023). The potency of Berastagi sweet orange (*Citrus sinensis*) peel extract for obesity treatment: an experimental study in male rats. *Nusantara Bioscience*, 15(2), 251-257. <https://doi.org/10.13057/nusbiosci/n150212>.
- Chandra, M.V. and Shamasundar, B.A. (2015). Texture profile analysis and functional properties of gelatine from the skin of three species of fresh water fish. *International Journal of Food Properties*, 18(3), 572-584. <https://doi.org/10.1080/10942912.2013.845787>.
- Dey, S. and Nagababu, B.H. (2022). Applications of food color and bio-preservatives in the food and its effect on the human health. *Food Chemistry Advances*, 1, 100019. <https://doi.org/10.1016/j.focha.2022.100019>.
- Handayani, S., Lindrianti, T., Kurniawati, F. and Sari, P. (2021). Aplikasi variasi sukrosa dan perbandingan gelatine-karagenan pada permen jeli kopi robusta (*Coffea canephora* P.). *Jurnal Agroteknologi*, 15(1), 67-78. <https://doi.org/10.19184/j-agt.v15i01.24023>. [In Bahasa Indonesia]
- Hutabarat, R.C., Tarigan, R., Barus, S. and Nasution, F. (2016). Karakterisasi morfologi dan anatomi markisa F1 di kebun percobaan berastagi. *Jurnal Hortikultura*, 26(2), 189-196. <https://doi.org/10.21082/jhort.v26n2.2016.p189-196> [In Bahasa Indonesia]
- Hutchings, J.B. (1999). Food colour and appearance. Dordrecht, Netherlands: Springer Science Business Media. <https://doi.org/10.1007/978-1-4615-2123-5>.
- Lubis, R.H., Ginting, S. and Yusraini, E. (2020). Effect of gelatine addition and storage time on the quality of semur seasoning pasta. *IOP Conference Series: Earth Environmental Science*, 782, 032084. <https://doi.org/10.1088/1755-1315/782/3/032084>.
- Mailoa, M.N., Tapotubun, A.M. and Matratty, T.E.A.A. (2017) Analysis total plate count (TPC) on fresh steak tuna applications edible coating *Caulerpa* sp. during stored at chilling temperature. *IOP Conference Series: Earth and Environmental Science*, 89, 012014. <https://doi.org/10.1088/1755-1315/89/1/012014>

- Nelson, N. (1944). A photometric adaptation of the Somogyi method for the determination of glucose. *Journal of Biological Chemistry*, 153(2), 375-380. [https://doi.org/10.1016/S0021-9258\(18\)71980-7](https://doi.org/10.1016/S0021-9258(18)71980-7)
- Osorio, F., Bilbao, E., Bustos, R. and Alvarez, F. (2007). Effects on concentration, bloom degree, and pH on gelatine melting and gelling temperatures using small amplitude oscillatory rheology. *International Journal of Food Properties*, 10(4), 841-851. <https://doi.org/10.1080/10942910601128895>.
- Peng, Z. and Regenstein, J.M. (2007). Comparison of water gel desserts from fish skin and pork gelatines using instrumental measurements. *Journal of Food Science*, 72(4), 196-201. <https://doi.org/10.1111/j.1750-3841.2007.00320.x>.
- Radocaj, O.F., Dimic, E.B. and Vujasinovic, V.B. (2011). Optimization of the texture of fat-based spread containing hull-less pumpkin (*Cucurbita pepo* L.) seed press-cake. *Acta Periodica Technologica*, 42, 131-143. <https://doi.org/10.2298/APT1142131R>
- Ratih, I.A.P.P., Setjiawati, E., Ristiarini, S., Suseno, T.I.P. and Jati, I.R.A. (2019). Pengaruh perbedaan konsentrasi gelatine terhadap sifat fisikokimia dan organoleptik snackbar beras merah dengan perlakuan awal perendaman di larutan CaCl_2 cangkang telur. *Journal of Food Technology and Nutrition*, 18(1), 58-63. <https://doi.org/10.33508/jtpg.v18i1.1988>.
- Sudarmadji, S. Haryono, B. and Suhardi (1997). Prosedur Analisis untuk bahan makanan dan pertanian. Yogyakarta, Indonesia: Liberty Inc. [In Bahasa Indonesia].
- Syafrida, M., Darmanti, S. and Izzati, M. (2018). Effect of Drying Temperature on water Content, Flavonoid Content and Antioxidant Activity of Leaves and Tubers of Teki Grass (*Cyperus rotundus* L.). *Bioma*, 2(1), 44-50. <https://doi.org/10.14710/bioma.20.1.44-50>
- Timisela, N., Breemer, R. and Lawalata, V. (2023). Pengaruh konsentrasi gelatine terhadap karakteristik fisikakimia dan organoleptik permen jelly lemon cina (*Citrus macrocarpa*). *Jurnal Agrosilvopasture-Tech*, 2(1), 69-77. <https://doi.org/10.30598/j.agrosilvopasture-tech.2023.2.1.69>. [In Bahasa Indonesia].
- Utomo, B.S.B., Darmawan, M., Hakim, A.R. and Ardi, D.T. (2014). Physicochemical properties and sensor evaluation of jelly candy from different ratio of k-carrageenan and konjac. *Squalen Bulletin of Marine and Fisheries Postharvest and Biotechnology*, 9(1), 25-34. <https://doi.org/10.15578/squalen.v9i1.93>
- Yusof, N., Irwandi, J., Jamal, P. and Mohammed, S.J. (2019). Texture Profile Analysis (TPA) of the jelly dessert prepared from halal gelatine extracted using High Pressure Processing (HPP). *Malaysian Journal of Fundamental and Applied Sciences*, 15, 604-608. <https://doi.org/10.11113/mjfas.v15n4.1583>.