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The addition of soy milk to pineapple chellies as a complementary alternative to nutritious snacks for children

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ABSTRACT

One of the strategies adopted to introduce fruits to youngsters is achieved by delivering pineapple chellies containing soy milk. This study, therefore, aims to determine the differences in nutrient content, antioxidant activity, physical properties, and organoleptic quality of pineapple chellies with the addition of suitable soy milk as a complementary alternative to children's nutritious snacks. Based on the weights and considerations, P_3 was selected as the best formulation, in terms of the nutrient content and contribution level of the chellies with adequate snack standards.

1. Introduction

School-age children between 7 - 12 years commonly experience rapid growth and development. (Nuryanto et al., 2014). The 2018 Basic Health Research showed the behavior of the population aged ≥5 years with less fruit consumption rate at 95.5% (Ministry of Health Republic of Indonesia, 2018). This infrequent fruit intake possibly increases the risk of experiencing nutritional deficiencies, in terms of vitamins, minerals and fiber as well as disrupts the body's acid-base balance. The street food purchases studied were found to be energy-dense, with high amounts of saturated fat, trans-fat, and sodium, as well as low potassium content, all of which could had a negative effect on health over time (Sousa et al., 2022).

Acceptable children snack is expected to contain 20% of the daily energy adequacy rate with a ratio of 10–20% carbohydrates, 2–4% protein, and 4–6% fat or at least 300 kcal of energy, 5 g of protein, 8.3 g of fat and 45 g of carbohydrate for 100 g of snacks. There is also the need for micronutrients of approximately 27 mg of vitamin C, 7.2 g of crude fiber, and 330 mg of calcium in 100 g of snacks (National Agency for Drug and Food Control of Indonesia, 2016; Wiraningrum et al., 2015).

Pineapple chellies further serve as a preferred alternative snack in enhancing school children's interest, specifically in fruits. Chellies are semi-solid gel boba with an inherent liquid, which tends to break immediately during consumption, and does not cause a choking effect (Slobodan et al., 2011). However, pineapple chellies appear incapable of fulfilling the minimum nutritional recommendations for an adequate snack. This circumstance necessitates the need to introduce other ingredients, including soy milk (Wiraningrum et al., 2015). Dairy products of nuts are suitable alternatives for school children, due to the affordability, sufficient calcium, and the absence of a fishy smell. Calcium is very critical for the growth of children's bones and teeth (Pravina et al., 2015).

Based on this background, pineapple chellies enriched with soy milk serve as a complementary nutritious snack for children. This inclusion was expected to increase the nutrient content, antioxidant activity, physical properties, and organoleptic quality of pineapple chellies. Therefore, it was necessary to analyze these characteristics of pineapple chellies with added soy milk as a complementary alternative to nutritious snacks.

2. Method

This study was categorized under food technology science based on a two-factor completely randomized experimental design. The raw materials consist of honey pineapple and soy milk.

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2.1. Soy milk making

The soy milk was formulated at the Food Laboratory, Department of Nutrition Science, Faculty of Medicine, Diponegoro University. The raw materials for making soy milk were 250 g of soybeans, 1250 ml of water, sugar 0,7%, and NaHCO3 or baking soda 0,5%. Several processes in its production include sorting, soaking, epidermis removal, boiling, grinding, filtration and heating. First, the impurities and damaged seeds were eradicated and the soybeans were then blanched/soaked with 0.5% NaHCO3 or baking soda for 15 min with water at 80 °C (soybean ratio of 3:1). This was followed by draining, washing, and peeling to separate the epidermis. The boiling process lasted for 30 min at 80 °C with water (soybean ratio of 5:1). These samples were then blended with water for 5 min (soybean ratio of 5:1) and the mashed soybeans were filtered with a filter cloth, followed by the addition of 7% sugar. The filtrate was then heated to 80°C and then boiled for 30 min at low heat until cooked. The amount of soy milk obtained in 250 g was 1500 ml. The soy milk that will be tested was made on the same day. Soy milk was stored at 4 °C in a chiller (Usydus et al., 2009; Yuliani, 2017).

2.2. Chellies making

The chellies were produced at the Food Laboratory, Department of Nutrition Science, Faculty of Medicine, Diponegoro University. First, a 2% solution of sodium alginate was formulated with 1 L of water. This liquid served as a medium for the formation of chellies spherification. Sodium alginate is a polymer generated from algae or brown seaweed that develops in cold environments. Sodium alginate is used as a thickener, stabilizer, gelling agent, and emulsifier in the food business (Szekalska et al., 2016). The honey pineapples were washed and sliced before being mashed (mixed) with soy milk and 2% calcium lactate. Spherification (formation of chellies balls) occurred in the sodium alginate solution by dripping the juice mixture, followed by rinsing with water (Sen, 2017). Chellies had a diameter ranging from 8 to 9 mm. Each chellies weighs approximately 5 g. Chellies were only made when an analysis was to be carried out. Chellies were kept in plastic cup containers with plastic cup lids in the freezer at −19°C, labeled according to the treatment groups.

2.3. Proximate analysis test

The protein content was determined using the Kjeldahl method (AOAC, 2005). The fat content was determined using the Soxhlet method (AOAC, 2005). The water content was determined by gravimetric method. The ash content was determined using the dry ashing method (AOAC, 2005). The carbohydrate content was analyzed by difference, where its composition was calculated by subtracting 100% of the nutrient content from the water, ash, protein, and fat components (Apriani et al., 2011). This research was conducted with 4 treatments and 3 replications to obtain 12 experimental units for water content, ash content, protein, fat and carbohydrates.

2.4. Antioxidant activity test

The antioxidant activity test for chellies was using the DPPH method (Sami and Rahimah, 2016). Sample of 0.01 g was added with 10 ml of methanol, and then vortexed until homogeneous state. 1000 ppm of the sample solution was pipetted up to 400 μL (80 ppm), 500 μL (100 ppm), 600 μL (120 ppm), 700 μL (140 ppm), and 800 μL (160 ppm), respectively. Absolute methanol of 5 ml was also added and vortexed until a homogeneous state. Approximately, 1 ml of DPPH solution was then introduced and vortexed until homogeneous before cooling for 30 min. The resulting samples were subsequently measured spectrophotometrically with a wavelength of 517 nm using a UV–Vis spectrophotometer.

2.5. Vitamin C test

The vitamin C test was performed in duplicate using the iodimetry method (Sulaeman et al., 1993). First, about 200–300 g of the sample was weighed and blended until smooth. 25 g of the sample solution was introduced to 75 ml of distilled water and agitated vigorously, before being centrifuged or filtered. The filtrate was subsequently placed in a 100 ml volumetric flask where distilled water was added to a volume limit of 100 ml. This was followed by measuring 25 ml of the filtrate from the previous stage with the addition of 75 ml of distilled water and 25 ml of $H_2SO_4$2N solution before titrating with 0.1000 N standard solution of iodine, using starch solution as an indicator. Equivalence value: each mL of 0.1000 N iodine solution is equivalent to 8.8 mg of vitamin C.

2.6. Crude fiber test

Analysis of crude fiber content according to Sudarmadji (Sudarmadji et al., 1997). First, the sample was crushed and weighed up to 2 g, followed by the fat extraction process, using the Soxhlet method. The resulting portion was then transferred to a 600 ml Erlenmeyer before the addition of 0.5 g of ignited asbestos and three drops of anti-foam agent. About 200 ml of hot 1.25% H_2SO_4 was also introduced and covered with reverse cooling before boiling for 30 min with occasional shaked and then filtered.

Subsequently, the Erlenmeyer residue was washed with boiling water until no acidity was observed after testing with litmus paper. This sample was then transferred quantitatively from the filter paper back into the Erlenmeyer using a spatula. The side was washed again with 200 ml of boiling 1.25% NaOH solution until all the residue was obtained. Furthermore, the content was simmered on reverse cooling for 30 min and stirred occasionally. This was followed by additional filtering using a filter paper with a known weight or a gooch crucible ignited while washing with 10% K_2SO_4 solution. The resulting sample was again rinsed with boiling water and about 15 ml of 95% alcohol. Meanwhile, the filter paper or crucible with its contents were oven-dried at 110°C to constant weight for 1–2 h and cooled in a desiccator before weighing. It was also important to reduce the weight of asbestos during usage.

2.7. Calcium test

The calcium test was implemented at the Chemistry Laboratory, Semarang University, where the material was first destroyed by dry ashing. Subsequently, 20–100 ml of the dry ash solution was pipetted and placed in a 250 ml beaker before adding 25–50 ml of distilled water. About 10 ml of saturated ammonium oxalate solution and 2 drops of the metal red indicator were also introduced. The solution was prepared slightly alkaline by adding dilute ammonia and slightly acidic with minimal drops of acetic acid until a pink coloration was observed (pH 5.0). The sample was then heated two boiling and cooled for a minimum of 4 h at room temperature, before filtering with Whatman filter paper no. 42 and rinsed with hot distilled water until the filtrate was free of oxalate. The filtrate from the last filter should be Cl-free by testing with AgNO3 if HCl was used in preparing the ash solution. Furthermore, the end of the filter paper was perforated with a glass rod, and the filtrate was rinsed before being transferred to the beaker containing calcium with hot dilute H2SO4. The filtrate was then rinsed with hot water at 70–80°C before titrating with 0.01 N KMnO4 until the first persistent pink solution was obtained. The filter paper was added next, and the titration was repeated until the second persistent pink hue was achieved (Sumantri, 2010).

2.8. Color test

The color test on chellies was conducted in 3 repetitions at the Diponegoro University Integrated Laboratory, using a digital colorimeter (CS-10 Colorimeter). First, the samples were placed into the line of the paper box before pressing the IChat program, video, and video preview. The cursor was then directed to the four sides of the video preview, while the analysis results were shown on the display unit.

Also, the measurement produced L, a, and b values. The brightness parameter is represented by the L* notation, which has a value range of 0–100 (black-white). The notation a* denotes a red-green mixed chromatic color (a+ = 0–100 for red, a- = 0-(-80) for green), while the outcome for blue-yellow mixture was indicated by the notation b* value (b+ = 0–70 for yellow, b- = 0-(-70) for blue) (Taufik et al., 2020).

2.9. Hardness and elasticity test

The hardness and elasticity tests were both performed with the Brookfield CT3 texture analyzer at the Diponegoro University Integrated Laboratory (Kusnadi et al., 2012). The needle (probe) was installed and positioned until it was close to the sample. This type consists of a cylindrical probe with a diameter of 1 cm and speed of 1.0 mm/s, while the trigger was set in a 3-mile formation. The sample was placed on the sample testing then the probe moved downwards which was driven by a load cell to press the sample and then returned to the top. Subsequently, the value of the analysis results was shown on the display unit. TPA curves were analyzed for both the hardness and elasticity tests. The hardness value refers to the amount of compressive force in suppressing the solid products as indicated by the absolute (+) peak, which was the maximum force with units of gram force (gf) while the elasticity value was measured in millimeters (mm). Furthermore, the test was performed with 3 repetitions.

2.10. Chellies acceptance rate analysis

The organoleptic quality test involved asking 40 untrained panelists. The samples to be tested were chellies with various treatments P0 (100%), P1 (75%:25%), P2 (50%:50%), P3 (25%:75%) chellies that had been applied as a topping on the snack, namely yogurt (Original Cimory Yogurt). The addition of yogurt was used to see if adding chellies to a food or beverage affected its acceptance. 1 tablespoon (5 g) of yogurt was used as a topping for chellies. Panelists were asked to assess how much they liked the color, taste, and aroma of Chellies products. The evaluation of the hedonic test was categorized into ascale of 1–4 (1 = very dislike, 2 = dislike, 3 = like, 4 = very like) (Mareta, 2019).

2.11. Best formulation analysis

The best formulation was selected using a weighting technique on the test results for macronutrient content and antioxidant activity of the chellies. Initial weighting was performed based on the aspect of the chellies' contribution to the snack standard, while the value specified for 25% for each treatment was in accordance with the parameter analyzed. Furthermore, each formula was measured according to the test, and the highest value was specified as the maximum score.

2.12. Data analysis

The data analysis process was conducted using the statistics Software program and its normality was tested with Saphiro-Wilk because the number of samples occurred below 50. The protein content, crude fiber, physical properties of hardness, elasticity, and an acceptance rate of the pineapple chellies were also examined using Kruskal Wallis followed by the Mann Whitney test. Meanwhile, the water content, ash, fat, carbohydrate, vitamin C, calcium, antioxidant activity, IC50 value, and the color properties of the pineapple Chellies were evaluated using ANOVA (Analysis of Variance), followed by the Bonferroni post hoc test the occurrence of a variation. The results showed that the effect of the independent variable on the dependent variable was considered significant with the p-value ≤ 0.05.

3. Result and discussion

3.1. The nutrient content of pineapple chellies containing soy milk

The protein, fat, water content, ash content and carbohydrate content of chellies ranged from 0.49 to 4.80%; 0.19–1.03%; 5.63–6.07%; 0.16–0.27; 87.28–93.50% (Table 1) showed the results of the proximate analysis of Chellies. The rise in the chellies' protein content with an increase in the soy milk content was influenced by the composition of soy milk. Soybeans contained complete essential amino acids which help to maintain the balance of the body's metabolism. Processed soybeans also contained easier digestible proteins (Santosa and Suliana, 2009).

The rise in the chellies' fat content with an increase in the soy milk content was influenced by the composition of soy milk. This was attributed to the higher fat content, compared to pineapple. Honey pineapple contains 0.12 g/100 g of fat, while soy milk contains 2.03 g/100 g. According to a previous study, the total fat content of a food sample depends on the fat content of the food ingredients as well as other ingredients added to the food (Setiyono, 2008). Honey pineapple was composed of 86% water and this water content decreases after processing into chellies. Furthermore, the use of sodium alginate and calcium lactate in the production of pineapple chellies also influences the water content. According to previous studies, sodium alginate had an excellent water-absorbing ability, while calcium lactate resulted in lower water content and was significantly different in Sukade products (Ratnasari et al., 2012; Wardani et al., 2009).

The ash content of the chellies increased with the addition of soy milk because soy milk had a higher ash content (0.53%), compared to honey pineapple (0.22%). In addition, the carbohydrate content of chellies in all treatment groups reduced with an increase in the content of soy milk because the addition of soy milk tends to increase the water content of the chellies, consequently, decreased the carbohydrate content of the remaining mass.

According to the ALG (Nutrition Label Reference), the crude fiber content of processed food is 6 g (National Agency for Drug and Food Control of Indonesia, 2016). Therefore, processed food containing at least 3.6 g/100 g are believed to be a source of crude fiber, while those greater than 7.2 g/100 g are assumed to be rich in fiber. The crude fiber content of the chellies increased with an increase in the soy milk content because soy milk contains a polysaccharide group consisting of arabinogalactan and water-insoluble cellulose materials (Nilasari et al., 2017).

The highest vitamin C content of 6.63 mg/100 g was recorded for treatment P0. Based on the ALG regulations (Nutrition Label Reference),

Table 1
The results of the proximate analysis of chellies.

Nutrient content (%)	P0	P1	P2	P3
Protein[1]	0.49 ± 000[a]	1.37 ± 0.02[b]	3.02 ± 0.02[c]	4.80 ± 0.04[d]
Fat[2]	0.19 ± 0.00[a]	0.63 ± 0.00[b]	0.73 ± 0.00[c]	1.03 ± 0.03[d]
Water content[2]	5.63 ± 0.03[a]	5.77 ± 0.03[b]	5.92 ± 0.03[c]	6.07 ± 0.04[d]
Ash content[2]	0.16 ± 0.00[a]	0.19 ± 0.01[b]	0.21 ± 0.00[c]	0.27 ± 0.02[d]
Carbohydrate[2]	93.50 ± 0.0[a]	92.02 ± 0.06[b]	90.09 ± 0.06[c]	87.82 ± 0.11[d]
Crude Fiber[1]	2.09 ± 0.01[a]	3.75 ± 0.22[b]	4.13 ± 0.38[c]	4.24 ± 0.39[d]
Vitamin C[2]	6.63 ± 0.40[a]	5.46 ± 0.50[b]	4.36 ± 0.32[c]	3.43 ± 0.32[d]
Calcium[2]	4.02 ± 0.50[a]	4.38 ± 0.39[a]	4.84 ± 0.32[a]	4.91 ± 0.43[a]

Description: Numbers followed by different superscript letters (a, b, c, d) indicate significant differences,[1]Kruskal-Wallis test; [2]One Way Anova test. n = 12 (4 experiments × 3 replications) for proximate analysis.

processed food is believed to be a source of vitamin C, particularly in cases where the material is characterized by at least 15% of solid form or 7.5% in the liquid state. The ALG stipulated vitamin C content of processed food is 90 mg (National Agency for Drug and Food Control of Indonesia, 2016), thus, processed food containing at least 13.5 mg/100 g is believed to be a source of vitamin C, while those with 27 mg/100 g or more were assumed to be enriched.

In this study, the reduction in the vitamin C content occurred due to the vitamin's labile nature. Vitamin C was easily damaged by exposure to light, high temperatures, the presence of oxygen, and processing (Putri and Setiawati, 2015; Razak et al., 2012). The peeling of pineapples caused the meeting of polyphenol oxidase (PPO) with phenolic components to experience enzymatic browning, producing a brown color. This process had the capacity to a reduction of up to 41.8% in vitamin C content (Putri and Setiawati, 2015). Recent research showed that several thermolabile antioxidants, like vitamins, could be degraded during culinary processes (Huarte et al., 2021).

The highest calcium content of 491 mg/100 g was recorded for treatment P3 (25% honey pineapple and 75% soy milk), which was classified as high-calcium food. These processed food were said to be a good source, particularly in cases where the sample contained at least 15% of the ALG requirement in solid form or 7.5% in liquid state. According to the ALG regulations, the calcium content of processed food is 1100 mg (Sami and Rahimah, 2016). Hence, samples with at least 165 mg/100 g were classified as a good source, while those greater than 330 mg/100 g were considered to be enriched. The process of dropped gel chellies in a bath containing sodium alginate creates bond interactions between alginate and calcium where cross-links occured to formed chelate bonds (Sa et al., 2019; Tsai et al., 2017). Alginate which was soluble in water formed a gel in an acidic solution due to the presence of calcium, therefore, the addition of calcium lactate as a coagulant was bound to increase the calcium content.

3.2. Antioxidant activity

The antioxidant activity of the chellies increased with an increase in the soy milk content, with the highest and least values being 34.99% and 17.28%, respectively (Table 2) showed the results of Antioxidant Activity. The IC50 values of chellies in all treatment groups were classified as very weak antioxidants because the sample tested was in the form of crude extract, which was assumed to contain other compounds, for instance, salt, minerals, and other nutrients with the ability to inhibit the antioxidant activity (Wikanta et al., 2005).

Another factor responsible for the chellies' weak antioxidant activities was that the flavonoids in soy milk might still be glycosides, which were known to reduced antioxidant activity (Zaheer and Akhtar, 2017). Unfermented processed soybeans, including soy milk, had a 99% composition of isoflavones in the form of glycosides were conjugated by binding to one sugar molecule. Furthermore, pineapple had an IC50 value of 1549.88 ppm which was classified as a very weak antioxidant.

Table 2
The antioxidant activity of pineapple chellies containing soy milk.

Treatment	Antioxidant Activity (%)	IC50 (ppm)
P_0 (Control)	17.28 ± 0.93*	16915.83 ± 58.97
P_1 (75% honey pineapple and 25% soy milk)	20.05 ± 0.56*	14203.84 ± 4176.10
P_2 (50% honey pineapple and 50% soy milk)	27.83 ± 0.51*	12617.25 ± 180.51
P_3 (25% honey pineapple and 75% soy milk)	34.99 ± 0.73*	10106.54 ± 2800.81
	$p < 0.001^a$	$p = 0.056^a$

Description: the sign (*) indicated a significant difference in the mean values. [a] = One Way Anova Test.

3.3. Hardness, elasticity and color of pineapple chellies containing soy milk

The differences in the hardness of each treatment were influenced by the thickness of the gel layer composed the chellies (Bubin et al., 2019). Table 3 showed the results physical properties of pineapple chellies containing soy milk. In this study, pineapples were produced through reverse spherification, a technique where pineapple juice, honey, and soy milk were mixed with calcium lactate and then were dripped into a bath filled with sodium alginate liquid. However, this technique was limited because the main ingredients (honey pineapple liquid and soy milk) must had high density with the consistency of heavy cream to penetrate the sodium alginate solution which also had a high density, and obtained a good chellies shape (Sen, 2017).

An increase in the content of soy milk was bound to reduce to lighten the consistency of chellies, thereby reduced the hardness of the chellies membrane layer. Similarly, the elasticity was affected by the thickness of the gel layer that formed the chellies, which was influenced by the consistency of the main ingredients. The L* value obtained in this study indicates that the pineapple chellies generally had a fairly bright color. However, an increase in the soy milk content tends to reduce this brightness, causing the chellies to become pale yellow. These results were in line with a previous study on the production of yogurt with soy milk, where the color brightness decreased with the addition of soy milk (Kazemi et al., 2013).

3.4. Organoleptic quality test of pineapple chellies containing soy milk

The addition of soy milk resulted in pale-colored chellies, which the panelists did not like. Table 4 showed the results organoleptic quality of pineapple chellies containing soy milk. This was in line with a previous study on ice cream production where the addition of soy milk resulted in a darkened and pale color (Kusumastuti and Adriani, 2017). The presence of riboflavin in soybeans was responsible for the yellowish color of soy milk (Handayani and Wulandari, 2016).

Furthermore, the preferred taste of chellies was the typical sweet, slightly sour, and fresh taste of pineapple (Kumar et al., 2016). The distinctive and fresh pineapple aroma was preferred by the panelists who disclosed that the addition of soy milk resulted in an unpleasant soy aroma (Endrasari and Nugraheni, 2012). This aroma was caused by the presence of volatile carbonyl groups such as n-hexanal, which resulted from the oxidation of unsaturated fatty acids in soybean seeds due to the lipoxygenase enzyme's activity (Nizori et al., 2008).

The texture of the chellies was influenced by the production technique used and the thickness of the main ingredients (Sen, 2017). Certain panelists disliked the texture of P3 chellies because the chellies were too light because of the thin gel layer, resulting in a poor breaking sensation. This result was not in line with the theory previously described in the analysis of hardness and elasticity, where a good breaking sensation (breaks easily) due to a thin gel layer, was most

Table 3
The Physical Properties of Pineapple Chellies containing Soy Milk.

Physical Properties		P0	P1	P2	P3
Hardness[1]		40.17 ± 3.04[a]	36.92 ± 5.49[a]	34.83 ± 12.56[a,c]	29.92 ± 1.86[b,c]
Elasticity [1]		2.10 ± 0.10[a]	2.13 ± 0.21[a]	2.23 ± 0.06[a]	2.33 ± 0.06[a]
Color	**(L*)**[2]	60.43 ± 6.68[a]	64.66 ± 5.71[a]	61.98 ± 2.75[a]	52.80 ± 0.9 [a]
	(a*)[1]	−5.71 ± 1.37[a]	−6.27 ± 1.19[a]	−7.16 ± 0.56[a]	−5.70 ± 0.52[a]
	(b*)[2]	43.84 ± 7.49[a]	43.62 ± 5.62[a]	33.65 ± 0.96[a]	17.44 ± 0.77[b]

Description: Numbers followed by different superscript letters (a, b, c) indicated significant differences, [1]Kruskal-Wallis test; [2]One Way Anova test.

Table 4
The organoleptic quality of pineapple chellies containing soy milk.

Treatment	Acceptance (Mean ± SD)			
	Color	Aroma	Taste	Texture
P0	3.15 ± 0.53[a] (Like)	3.30 ± 0.56[a] (Like)	3.10 ± 0.78[a] (Like)	2.88 ± 0.72 (Like)
P1	3.25 ± 0.49[a,c] (Like)	3.05 ± 0.64[a,c,d] (Like)	3.05 ± 0.75[a] (Like)	3.08 ± 0.73 (Like)
P2	3.03 ± 0.48[a,d] (Like)	2.93 ± 0.62[b,c] (Like)	2.65 ± 0.74[b] (Like)	3.00 ± 0.78 (Like)
P3	2.58 ± 0.71[b] (Like)	2.85 ± 0.80[b,d] (Like)	2.58 ± 0.81[b] (Like)	2.65 ± 0.80 (Like)
P	0.000*	0.02*	0.002*	0.052*

Description: Numbers followed by different superscript letters (a, b, c, d) indicated a significant difference, *Kruskal Wallis Test. The evaluation of the hedonic test was categorized into a scale of 1–4 (1 = very dislike, 2 = dislike, 3 = like, 4 = very like).

preferred. However, P3 was chosen as the best formulation based on the weighted scores and factors in Table 6 because its nutrient content and degree of contribution met the parameters for a high-quality snack.

3.5. Organoleptic quality test of pineapple chellies with the addition of soy milk applied to yogurt

The results showed the addition of soy milk had a significant effect on the color, aroma, taste, and texture parameters of chellies applied to yogurt. Table 5 showed the results organoleptic quality of pineapple chellies with the addition of soy milk applied to yogurt. The bright yellow color of P0 chellies was quite a contrast to the white color of yogurt, therefore, this treatment was considered more attractive by the panelists, compared to the colors of other treatments which became paler with an increase in the soy milk content (Handayani and Wulandari, 2016).

The unpleasant aroma of soy milk caused by the action of the lipoxygenase enzyme in soybeans also influenced the aroma of the chellies (Endrasari and Nugraheni, 2012; Nizori et al., 2008). However, some panelists considered the aroma of yogurt more dominant than the aroma of the chellies.

Several panelists also considered the taste of yogurt more dominant, compared to the chellies. However, the results showed most panelists preferred chellies with little or no soy milk because the distinctive unpleasant taste of soy milk combined with the sour taste of yogurt was disliked by the panelists (Pramono et al., 2011). The panelists' preference for the chellies' texture also decreased with an increase in the soy milk content, because an increase in the soy milk content reduced the thickness of the chellies' membrane layer, making it easier to break when consumed (Sen, 2017). According to the panelists, chellies that

Table 5
The organoleptic quality of pineapple chillies containing soy milk in yogurt application.

Treatment	Acceptance (Mean ± SD)			
	Color	Aroma	Taste	Texture
P0	3.18 ± 0.64[a] (Like)	3.28 ± 0.60[a] (Like)	3.33 ± 0.66[a] (Like)	3.31 ± 0.56[a] (Like)
P1	3.15 ± 0.53[a] (Like)	3.20 ± 0.52[a,c] (Like)	3.28 ± 0.75[a,c] (Like)	3.15 ± 0.58[a] (Like)
P2	2.88 ± 0.61[b] (Like)	2.98 ± 0.53[b,c] (Like)	3.03 ± 0.62[b,c] (Like)	3.03 ± 0.70[a] (Like)
P3	2.55 ± 0.60[c] (Like)	2.98 ± 0.58[b,c] (Like)	2.75 ± 0.74[b] (Like)	2.70 ± 0.69[b] (Like)
P	0.000*	0.03*	0.001*	0.007*

Description: Numbers followed by different superscript letters (a, b, c) indicated a significant difference, *Kruskal Wallis Test. The evaluation of the hedonic test was categorized into a scale of 1–4 (1 = very dislike, 2 = dislike, 3 = like, 4 = very like).

Table 6
The weighting score of the chellies' contributions to snack standard.

Treatment	Protein	Score	Fat	Score	Carbohydrate	Score	Antioxidant Activity	Score	Vitamin C	Score	Crude Fiber	Score	Calcium	Score	Organoleptic	Score	Total
P_0 (25%)	1	0.25	1	0.25	4	1	1	0.25	4	1	1	0.25	4	1	4	1	5
P_1 (25%)	2	0.5	2	0.5	3	0.75	2	0.5	3	0.75	3	0.75	1	0.25	3	0.25	4.25
P_2 (25%)	3	0.75	3	0.75	2	0.5	3	0.75	2	0.5	2	0.5	3	0.75	2	0.75	4.75
P_3 (25%)	4	1	4	1	1	0.25	4	1	1	0.25	4	1	2	0.5	1	0.5	55

break easily cause no contrasting texture between chellies and yogurt, and did not produce a good breaking sensation upon consumption.

4. Conclusion

This study's findings showed a significant difference in the mean of macronutrient contents, vitamin C content, crude fiber, antioxidant activity, hardness, and color of pineapple chellies, with the addition of soy milk ($p < 0.05$). The addition of soy milk in the manufacture of pineapple chellies could increase protein, fat, calcium, and antioxidant activity while lowering carbohydrate, vitamin C, and the acceptability of pineapple skin (color, taste, aroma, and texture) when eaten with and without yogurt. Based on the weighting scores and considerations, P3 was selected as the best formulation, because the nutrient content and contribution level of this treatment was of good snack standards.

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Implications for gastronomy

This research relied on human participants. This research started with humans since the ingredients used in this chellies product were safe for human consumption. This study was approved by the ethical clearance with *No.248/VIII/2021/Komisi Bioetik*. Ingredients such as soy milk and pineapple juice were employed as basic ingredients in this chellies product. Furthermore, this study utilized food additives, such as sodium alginate and calcium lactate, as acidity regulators, emulsifiers, thickeners, and stabilizers, all of which were safe and within the suggested usage limits. The combination of sodium alginate and calcium lactate could lead to a spherification process where this process was commonly used in the manufacture of Popping boba/chellies. Chellies were semi-solid gel boba with an inherent liquid, which tends to break immediately during consumption, and did not cause a choking effect. There were no negative side effects because of this research. Based on these, pineapple chellies were enriched with soy milk serve as a complementary nutritious snack for children. This inclusion was expected to increase the nutrient content, antioxidant activity, physical properties, and organoleptic quality of pineapple chellies.

Authors' statement

The Addition of Soy Milk to Pineapple Chellies as A Complementary Alternative to Nutritious Snacks for Children.

We hereby declare that we agree to submit this manuscript to Journal of Gastronomy and Food Science and, if accepted, to transfer the copyright of this article to this bulletin.

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We warrant that there is no conflict of interest with other people or organization that might be construed to influence the results or interpretation of this manuscript.

We confirm that each listed authors has made a substantial contribution to the manuscript and ensure nobody who qualifies for authorship has been excluded. Main Contributor is marked by an asterisk (*)

Diana Nur Afifah: conceptualization, project administration, resources, writing - review and editing, supervision, validation, Amy Febriani Hartono: data curation, writing - original draft, visualization, methodology, Ayu Tri Astuti: visualization, data curation, writing - original draft, methodology, Salmaa Novian Susilo Putri: methodology, writing - original draft, visualization, data curation, Enny Probosari: formal analysis, writing - review and editing, validation, Gemala Anjani: validation, writing - review and editing, formal analysis, Muflihatul Muniroh: formal analysis, validation, writing - review and editing, Nuryanto Nuryanto: writing - review and editing, formal analysis, validation, Aryu Candra: validation, writing - review and editing, formal analysis.

Declaration of competing interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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