

## THE EFFECT OF ADDING TOMATO EXTRACT (*Solanum lycopersicum L.*) to APPLE-BASED SHEET JAM (*Malus sylvestris L.*) AS AN ANTIOXIDANT

Bina Lohita Sari<sup>1\*</sup>, Cantika Zaddana<sup>2</sup>, Riski Agung Saputra<sup>3</sup>

<sup>1,2,3</sup> Pharmacy Study Program, Faculty of Mathematics and Natural Sciences, Universitas Pakuan

e-mail:

<sup>1</sup>[binalohitasari@unpak.ac.id](mailto:binalohitasari@unpak.ac.id)

<sup>2</sup>[cantika.zaddana@unpak.ac.id](mailto:cantika.zaddana@unpak.ac.id)

<sup>3</sup>[riskisaputra12360@gmail.com](mailto:riskisaputra12360@gmail.com)

### ABSTRACT

Sheet jam is the development of jam in the form of compact, plastic and non-sticky sheets. It's especially serving with bread. Apple fruit (*Malus sylvestris* (L). Mill.) and Tomato (*Solanum lycopersicum* L.) with polyphenol and lycopene as active compounds have antioxidant activity and could reduce or eliminate other oxidants and synthetic preservatives. This research aimed to find the best formula of apple puree sheet jam added with differences of tomato extract concentration. There are 4 sheet jam formulas which are F1, F2, F3, and F4 use 100 g of apple puree and add tomato extract of 0 g, 60 g, 75 g, and 90 g respectively. The parameter test used for this research were hedonics test for panelists, water and ash content, pH value, total plate count, mold/yeast test, and antioxidant activity. Formula 4 sheet jam is preferred by panelists then evaluate of proximate (water, ash content), phytochemical tests, pH value, microbiological test (total plate count, mold/yeast), and antioxidant activity determination. Formula 4 is the preferred sheet jam from 30 panelists with pH value of 4.23. The proximate test was related to SNI 3746:2008, positive test for alkaloid, flavonoid, saponin, and tannin. Total plate count of  $7.5 \times 10^2$  colonies/mL, and mold/yeast  $<10^1$  cfu/mL. The antioxidant activity value of Formula 4 sheet jam is 87.14 ppm which is classified as strong. The addition of 90 g of tomato juice on 100 g of apple puree produces sheet jam with strong antioxidant activity.

Keywords: Apple, tomato, sheet jam, antioxidant activity.

---

### Introduction

Sheet jam is a modified version of traditional jam, transformed from a semi-moist consistency into compact and non-sticky pliable sheets. Its convenient form makes it practical for consumption and easy to use as bread filling. The production of sheet jam involves three main ingredients, that are pectin, citric acid, and sugar,

combined in specific proportions to achieve optimal results. The previous research, sheet jam of apple puree and green tea liquid extract with antioxidant activity of 91.75 ppm (Zaddana et al., 2020).

Some fruits, including citrus fruits (such as lime and lemon), grapes, pomegranates, and apples, along with green, yellow, and red vegetables like cabbage, carrots, and tomatoes, are known to contain antioxidant compounds. The consumption of fruits and vegetables, whether raw or processed, as part of a plant-based diet rich in fruits and vegetables, can help reduce the risk of developing chronic diseases in humans (Jideani et al., 2021). Manalagi apple (*Malus sylvestris*), a subtropical plant commonly found in Indonesia, is a fruit that can be used as functional food due to its natural antioxidant content. Tomato (*Solanum lycopersicum*) contains the main compound lycopene, along with polyphenols (flavonoids), carotenoids, ascorbic acid, vitamin A, and vitamin C in considerable amounts (Hadi, 2023). The antioxidant activity of tomato juice is 60.86 ppm, indicating strong antioxidant potential (Castro et al., 2021). The substitution of 15% tomato juice in black soybean yoghurt preparation increased the vitamin C content by 0.00107 IU (Ningrumsari et al., 2024). Fruits are essential for human nutrition and play a key role in preventing chronic diseases such as cardiovascular and cerebrovascular conditions, eye and nerve disorders, stroke, cancer, diabetes, and hypertension (Jideani et al., 2021).

However, due to their perishable nature, fruits are generally processed into more stable forms such as jams, jellies, juices, pickles, and many other products (Laxmi et al., 2021; Zaddana et al., 2021). The sheet jam made from Manalagi apple juice demonstrates antioxidant activity with an  $IC_{50}$  value of 104.96 ppm, classifying it as having moderate antioxidant activity (Zaddana et al., 2020). The production of sheet jam made from apples and tomato juice is an innovative development of traditional jam. When prepared with the appropriate formula and process, it results in a sheet jam related to physical and chemical quality standards and is acceptable to panelists. In the market we still only know cheese sheet jam, but we haven't found fruit sheet jam yet. Further research is needed to formulate sheet jam containing apples and tomatoes and determine its antioxidant activity.

## **Methodology**

The research was conducted at the Pharmaceutical Laboratory, Faculty of Mathematics and Natural Sciences, Pakuan University, Bogor. The research methods employed were:

### 1. Preparation of Apple Pulp and Tomato Juice

One kilogram each of apple and tomato, thoroughly washed and deseeded, were chopped into small pieces. The apples were mixed with water in a 1:1 ratio and blended to produce apple pulp (Zaddana et al., 2020). Tomato juice was extracted by pressing or crushing the tomatoes using a juicer (Ningrumsari et al., 2024). The yield of both the apple pulp and tomato juice was determined.

### 2. Phytochemical Tests

**Flavonoid:** The samples (apple pulp and tomato juice) were dissolved in 95% ethanol. Magnesium (Mg) or zinc (Zn) powder and a few drops of concentrated HCl were added from the side of the test tube, followed by gentle shaking. The appearance of a red to orange color indicates the presence of flavonoids.

**Alkaloid:** The sample was treated with 2 N HCl and heated over a water bath for a few minutes. After cooling, the mixture was filtered, and Dragendorff's reagent was added to the filtrate. The formation of an orange-brown precipitate confirms a positive result for alkaloids.

**Tanin:** Each sample was treated with a 1% gelatin solution. The formation of a white precipitate indicates the presence of tannins. Additionally, adding 2–3 drops of 1% FeCl<sub>3</sub> solution results in a dark green to ink-blue color, confirming the presence of tannins (Novia et al., 2023).

**Saponin:** The sample was mixed with hot water and 2 N HCl. The formation of stable foam, which remains even after the addition of 2 N HCl, indicates a positive saponin result.

### 3. Formulation of Apple Pulp and Tomato Juice Sheet Jam

The sheet jam was formulated into four different variations: F1, F2, F3, and F4, as presented in Table 1 below.

**Table 1. Formulation of Apple Pulp and Tomato Juice Sheet Jam**

Formula	F1(g)	F2 (g)	F3(g)	F4(g)	Usability
Tomato Juice	-	60	75	90	Antioxidant
Apple Pulp	100	100	100	100	Antioxidant
Sucrose	60	60	60	60	Sweetener
Glycerol	1.5	1.5	1.5	1.5	Humectant
Agar-agar	5	5	5	5	Gelling Agent

Citric Acid	0.2	0.2	0.2	0.2	Preservative
Air	50	50	50	50	Solvent
Total	216.7	276,7	291,7	306,7	

### Sheet Jam Preparation

Agar-agar was dissolved in preheated water at a temperature of approximately 95–100 °C for about 3 minutes. Apple pulp, tomato juice, glycerol, and citric acid were mixed and then added to the agar solution. The mixture was heated at 70 °C for 5 minutes, while sucrose was gradually incorporated with continuous stirring until a homogeneous mixture was obtained. The cooking process continued for 20 minutes. The jam mixture (17 gr each) was poured into molds measuring 8 × 8 × 0.2 cm and evenly spread to form uniform sheets. The sheets were then packaged in polypropylene plastic (Zaddana et al., 2020).

#### 1. Hedonic Test

A sensory evaluation was carried out involving 20 panelists (both male and female) aged 20–22 years. The test assessed the organoleptic characteristics of the apple pulp and tomato juice sheet jam (formulations F1, F2, F3, and F4), focusing on color, taste, aroma, and texture. The assessment was based on preference levels using a 5-point scale: (5) strongly like, (4) like, (3) neutral, (2) slightly dislike, (1) dislike. Data was collected through a questionnaire. The hedonic test data were analyzed using SPSS version 18, employing a Completely Randomized Design (CRD) method, followed by Duncan's multiple range test (Zaddana et al., 2020).

#### 2. Sheet Jam Evaluation

##### a. Water Content Determination

The water content of the apple pulp and tomato juice sheet jam was determined using the gravimetric method. A sample of 2 gr of sheet jam was accurately weighed and then dried at 105 °C for 5 hours. After drying, the sample was placed in a desiccator to cool and subsequently weighed. The drying process continued with intervals of 1 hour until the difference between consecutive weighing did not exceed 0.25% (Ministry of Health, 2017). Calculate the water content of the sample as Formula 1.

Water content =

$$\% \text{Water content} = \frac{(\text{mass of container and wet sample, g}) - (\text{mass of container and oven dry sample, g})}{(\text{mass of container and oven dry sample, g}) - \text{mass of container, g}} \times 100\% \quad ..(1)$$

b. pH Determination

The pH of the sheet jam was measured using a pH meter that had been calibrated at pH 4 and 7 (Ministry of Health, 2020). A 1 gr sample of sheet jam was dissolved in 10 mL of water and stirred until completely dissolved. The pH meter electrode was then immersed in the prepared solution and left undisturbed until a stable reading was obtained.

c. Total Plate Count Test

A 25 g sample of sheet jam was weighed and placed into a bottle containing 225 mL of Buffered Peptone Water (BPW), resulting in a  $10^{-1}$  dilution. Next, 1 mL of the diluted sheet jam was mixed with 9 mL of BPW to achieve a 1:10 dilution ( $10^1$ ), and serial dilutions were prepared up to  $10^4$ . From each dilution ( $10^1$  to  $10^4$ ), 1 mL was pipetted into sterile petri dishes in duplicate. Then, 12–15 mL of molten Plate Count Agar (PCA) at 45 °C was poured into each petri dish. The petri dishes were incubated at 37 °C for 24–48 hours in an inverted position. Colony counts were performed using a colony counter, and the number of colonies was multiplied by the dilution factor (Rahmawati et al., 2022).

d. Yeast and Mold Count Test

One milliliter from each dilution ( $10^{-1}$  to  $10^{-4}$ ) was transferred into sterile petri dishes in duplicate. Inoculation was carried out using Potato Dextrose Agar (PDA) as the culture medium. A blank sample was prepared by pouring 1 mL of Buffered Peptone Water into a sterile petri dish, followed by the addition of PDA. The petri dishes were incubated at room temperature for 5 days. After incubation, colony counts were conducted, and the results were multiplied by the corresponding dilution factor (Rahmawati et al., 2022).

e. Antioxidant Activity Determination

The antioxidant activity of apple pulp and tomato juice was evaluated using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) reagent. A DPPH stock solution was

prepared by dissolving 40 mg of DPPH in 100 mL of methanol. The optimal wavelength was determined within the range of 510–520 nm, while the incubation time was optimized by measuring the absorbance at intervals of 10, 20, 30, 40, 50, and 60 minutes. For the standard curve, 100 ppm vitamin C stock solution was pipetted in volumes of 0.2, 0.4, 0.6, 0.8, and 1 mL into separate 10 mL volumetric flasks to obtain standard concentrations of 2, 4, 6, 8, and 10 ppm, respectively. Subsequently, 1 mL of 1 mM DPPH solution was added to each flask and diluted to volume with methanol. Sample stock solutions were prepared at 1000 ppm. Aliquots of 0.4, 0.6, 0.8, 1, and 1.2 mL were pipetted into 10 mL volumetric flasks to achieve concentrations of 40, 60, 80, 100, and 120 ppm, respectively. Each sample was mixed with 1 mL of 1 mM DPPH solution and then diluted to the mark with methanol p.a. (Baliyan et al., 2022). The percentage inhibition of DPPH was calculated using the formula 2:

$$\% \text{ inhibition} = \frac{A_p - A_s}{A_p} \times 100\% \dots\dots\dots (2)$$

Description:

$A_p$  = Comparative absorbance (blank)

$A_s$  = Absorbance sampel

## RESULT AND DISCUSSION

The apples and tomatoes used in this study were identified at the National Research and Innovation Agency (BRIN) Cibinong. The identified plant species were Manalagi apple (*Malus sylvestris* (L.) Mill) from the Rosaceae family, and tomato (*Solanum lycopersicum*) belonging to the Solanaceae family.

### 1. Apple Pulp and Tomato Juice Production Results

A total of 800 g of tomato juice and 830 g of apple pulp were obtained from 1 kg of each fruit. The tomato juice appeared red with a slightly sweet and mildly bitter taste, typical of tomatoes. The Manalagi apple pulp had a brownish color, a sweet flavor, and a distinctive apple aroma. The yield of tomato juice was 80%, while the yield of apple pulp was 83%.

### 2. Phytochemical Test Results

The apple pulp and tomato juice tested positive for the presence of flavonoidalkaloids, tannins, and saponins, as shown in Table 2.

**Table 2. Phytochemical Test Results**

No	Identification	Phytochemical Result	Test Result Apel Pulp	Test Result Tomato Juice
1	Flavonoids			
	-Mg powder	Red/Orange	+	+
	-Zn powder	Red/Orange	+	+
2	Alkaloids			
	-Dragendorff	Brownish-Orange Percipitate	+	+
3	Tannin			
	-Larutan gelatin 1%	White precipitate	+	+
	-FeCl <sub>3</sub>	Blue-Green to Black	+	+
4	Saponin	Foam Formation HCl 2N unchanged	+	+

The flavonoids, alkaloids, and saponins present in tomato extract function as antioxidants, enhancing the activity of glutathione (GSH) in the body (Junnaeni et al., 2019). Tannins found in tomato seeds also demonstrate antioxidant properties. As a widely occurring plant compound, tannins are not only present in the seeds but are also found in the fruit of tomatoes (Jideani et al., 2021; Kumar et al., 2021).

#### 1. Sheet Jam Formulation from Apple Pulp and Tomato Juice Results

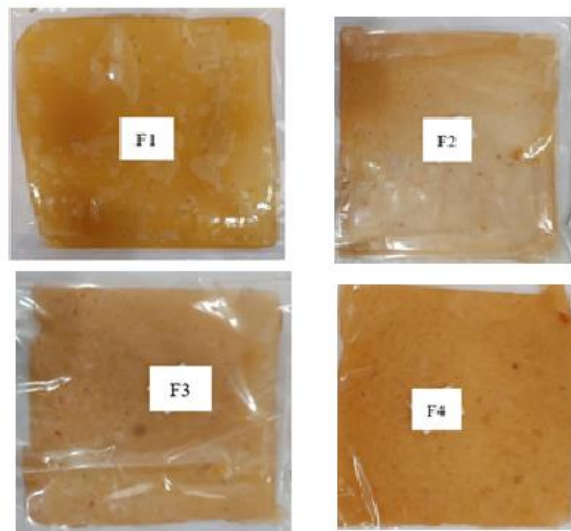
Formulas 1, 2, 3, and 4 produced sheet jams with a characteristic aroma and a chewy texture. The color and taste profiles of these formulations are presented in Table 3. The texture of the sheet jam obtained in this study is consistent with previous research on sheet jams made from kolang-kaling (*Arenga pinnata*) pulp, super red dragon fruit juice, and agar, all of which demonstrated a chewy, elastic consistency. Sheet jam represents a modified version of spreadable jam, distinguished by its solid yet pliable consistency, neither too soft nor excessively firm. The resulting texture is compact, non-sticky, and easy to spread on bread. This product is packaged in plastic, as demonstrated in the packaging design (Natan et al., 2019).

The unique apple and tomato aromas observed in Formulas 1 and 4 are crucial to the overall sensory experience of the product, significantly influencing

flavor perception. In the food industry, aroma testing is vital as it directly affects consumer acceptance and preference (Castro et al., 2021). The sheet jam, made from apple pulp and tomato juice, was packaged in polypropylene plastic, as shown in Figure 1.

**Table 3. Sensory Attributes of Sheet Jam Formulas 1, 2, 3, and 4**

Parameter	Formula			
	F1	F2	F3	F4
Taste	Apple Sweet	Sweet slightly sour	Sweet and sour	Sour slightly sweet
Color	Brownish	Brownish	Brownish	Brownish slightly reddish



**Figure 1. Sheet Jam Formulation from Apple Pulp and Tomato Juice Result**

Note: F1, F2, F3, F4 represent Formulas 1, 2, 3, and 4

## 2. Hedonic Test Results

The results of the hedonic test for the sheet jam made from apple pulp and tomato juice show that F4 was the most preferred by the panelists, with a flavor profile of mildly sweet and slightly sour tomato. Aroma and taste evaluations are essential in the food industry, as they play a significant role in shaping consumer preferences (Natan et al., 2019). Table 3 shows the hedonic test results, with the

following scoring system: (5) strongly like, (4) like, (3) neutral, (2) slightly dislike, (1) dislike.

**Tabel 4. Hedonic Test Result**

Formula	Parameter				Average
	Taste	Flavor	Color	Texture	
F1	3.23 <sup>a</sup>	3.26 <sup>a</sup>	3.50 <sup>a</sup>	3.23 <sup>a</sup>	3.30
F2	3.83 <sup>b</sup>	3.56 <sup>a</sup>	3.93 <sup>a</sup>	3.76 <sup>b</sup>	3.77
F3	3.93 <sup>b</sup>	3.60 <sup>a</sup>	4.10 <sup>a</sup>	3.80 <sup>b</sup>	3.85
F4	4.03 <sup>b</sup>	3.76 <sup>a</sup>	4.13 <sup>b</sup>	3.93 <sup>b</sup>	3.96

Note: Numbers followed by the same superscript letter within the same column indicate no significant difference.

The aroma, color, and texture most preferred by the panelists were observed in Formula 4, with hedonic scores ranging from 3.76 to 4.13. In contrast, Formula 1, which did not contain tomato juice, received the lowest scores, ranging from 3.23 to 3.50. Color is one of the key parameters in determining product quality and consumer preference. The red color of tomato juice acts as a natural colorant, deemed safe and free from adverse health effects. Unlike synthetic dyes, which are produced through chemical extraction, the trans-cis isomer of lycopene, formed via oxidation, produces a pigment naturally found in plants or animals. Lycopene in tomato juice exhibits antioxidant properties and can reduce the presence of synthetic oxidizers or preservatives (Castro et al., 2021).

### 3. Sheet Jam Evaluation Results

#### a. Water Content

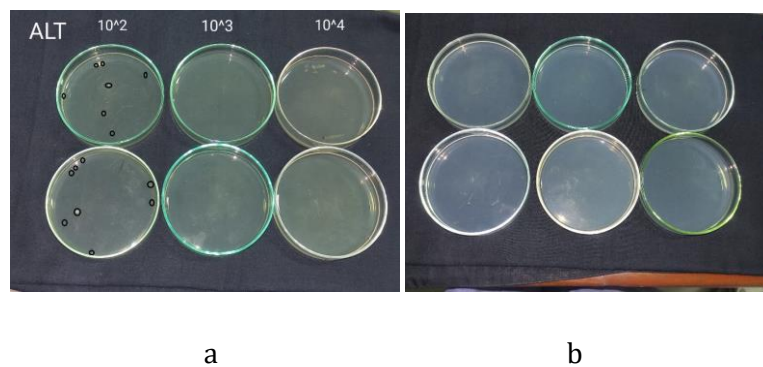
The water content of the sheet jam made from apple pulp and tomato juice was  $21.62 \pm 0.88\%$ . The addition of sugar not only serves as a sweetener but also acts as a moisture-absorbing agent, thereby reducing the water content of the jam. The gel-like or semi-solid consistency of the sheet jam results from the interaction between added pectin, sucrose, and citric acid. This interaction occurs at high temperatures and remains stable after cooling (Arsyad, 2018). The water content obtained in this study was lower compared to previous research on apple and green tea sheet jam, which reported a water content ranging from 38.08% to 44.38% (Zaddana et al., 2020).

#### b. pH Result

The pH value of food products is often associated with both organoleptic and microbiological quality. In jam production, pH not only influences the taste but also affects the product's shelf stability. The pH value of the sheet jam made from apple pulp and tomato juice (Formula 4) was recorded at  $4.23 \pm 0.05$ . This value complies with the recommended range of 3.5 - 4.5, as outlined by the FDA (2007). Previous studies have shown that the pH of apple juice with the addition of 16, 18, and 20 g of sugar ranged between 4.60 and 4.86 (Naben and Pani, 2023). Additionally, tomato paste was reported to have a pH between 3.4 and 4.4 (Sjarif and Rosmaeni, 2020).

### c. Total Plate Count Test

The total plate count (TPC) test is used as an indicator of product sanitation, environmental microbial analysis, and as a basis for determining the acceptance of a product based on its microbiological content. In this study, the TPC test was performed on the sheet jam Formula 4 with three serial dilutions.



**Figure 2. Total Plate Count (a) and Yeast/Mold Count (b)**

The Total Plate Count (TPC) result for Formula 4, as shown in Figure 2a, was  $7,5 \times 10^2$ , which complies with the Indonesian National Standard (SNI) of 2008 that stipulates a maximum TPC of  $1 \times 10^3$  for jam. Therefore, the sheet jam produced from Formula 4 is deemed safe for consumption. The low microbial count observed in the formulation is attributed to minimal contamination during the production process and the application of heat during preparation, which significantly affects the microbiological quality or TPC (Sadiyah and Puji, 2020). Furthermore, the addition of sugar in the formulation acts as a preservative, inhibiting microbial growth. Previous research demonstrated that sugar significantly enhances the preservation of tomato paste, with TPC levels remaining at approximately  $1,82 \times 10^2$  on day 32. In contrast, tomato paste without added sugar exhibited a significantly

higher TPC of  $3,77 \times 10^7$  by day 8 (Sjarif and Rosmaeni, 2019).

#### d. Yeast and Mold Testing Results

After a storage period of 5 days, no visible yeast or mold growth was observed ( $1 \times 10^1$  koloni/g), as presented in Figure 2b. According to the Indonesian National Standard (SNI) 2008, the acceptable limit for yeast and mold in jam is  $5 \times 10^1$  koloni/g. This indicates that the formulated fruit-based sheet jam is microbiologically safe for consumption. The absence of yeast and mold proliferation suggests that no oxidation occurred in the carotenoid components within the sheet jam containing tomato juice. This finding aligns with previous research stating that the addition of tomato juice can prevent oxidation processes in carotenoids, thus maintaining the stability and safety of the final product (Sjarif and Rosmaeni, 2019).

#### e. Antioxidant Activity Test Results

The maximum wavelength of DPPH was obtained at 515 nm, with an absorbance value of 0.8700. The optimal incubation time was determined to be 40 minutes, as it showed the most stable absorbance. These results are consistent with the findings reported by Zaddana (2020), who identified a maximum wavelength of 516 nm and an optimal incubation time of 30 minutes. The antioxidant activity of the sample is evidenced by the color change of the DPPH-methanol solution from purple to yellow. This color transition indicates the reduction of the DPPH radical, reflecting the presence of antioxidant compounds within the sample.

**Table 5. Antioxidant Activity Test Results**

Sample	IC <sub>50</sub> (ppm) Value	Activity
Vitamin C	6.46	Very Strong
F1	101.34	Moderate
F4	87.14	Strong
Tomato Juice	39.17	Strong
Apple Pulp	81.78	Strong

The standard series of Vitamin C produced a linear regression equation of  $Y=6.5122x + 7.8993$  with a coefficient of determination  $R^2 = 0.9954$ . The coefficient of determination is used to assess the accuracy and suitability of the linear

regression values relative to the sample data. A coefficient value approaching 1 indicates a high degree of correlation between the concentration and absorbance of the Vitamin C standard. The formulated sheet jam combining apple pulp and tomato juice (Formula 4) exhibited a weaker  $IC_{50}$  value compared to that of pure apple pulp. A slightly alkaline environment in food can enhance antioxidant activity, as the free radical scavenging capacity is mainly derived from the hydroxyl groups present in the food matrix (Çömert et al., 2022). Formula 4 contains a higher concentration of radical scavenging compounds, such as flavonoids, alkaloids, saponins, and tannins, compared to Formula 1. Consequently, the  $IC_{50}$  value of Formula 4 is stronger than that of Formula 1, indicating enhanced antioxidant activity. The development of this research aims to extend the shelf life of apple pulp and tomato jam, as well as for functional food testing.

## **CONCLUSION**

The most preferred sheet jam formula by the panellists is Formula 4, which contains 100 g of apple pulp and 90 g of tomato juice. The sheet jam's form makes it more convenient and practical to use. The slightly acidic nature ( $pH\ 4.23 \pm 0.05$ ) of Formula 4 contributes to the increased presence of hydroxyl groups, thereby enhancing its antioxidant activity. The synergistic effect between apple pulp and tomato juice demonstrates the potential antioxidant interaction within Formula 4 sheet jam, making it suitable for daily consumption with bread as a functional food product. Storage at room temperature for 5 days indicates that the Total Plate Count and Yeast Mold Count meet the required standards. For extended storage, refrigeration is recommended.

The development of processed fruit products is an innovative form of sheet jam, as an alternative to jelly jam and sheet cheese that are currently on the market. Improve the way to practice of fruit sheet jam is diversification of local food product

## **Declaration of Competing Interest**

The authors are grateful to the Research and Community service Institution Universitas Pakuan for the financial support provided through the research grant in 2024.

## REFERENCES

Afam I. O. Jideani, A.I.O., Silungwe, H., Takalani, T., Omolola, A.O., Udeh, H.O., and Anyasi, T.A. 2021. Antioxidant-rich Natural Fruit and Vegetable Products and Human Health. *International Journal of Food Properties* 24 (1): 41–67.

Baliyan, S., Mukherjee, R., Priyadarshini, A., Vibhuti, A., Gupta, A., Pandey, R.P., and Chang, C.M. 2022. Determination of Antioxidants by DPPH Radical Scavenging Activity and Quantitative Phytochemical Analysis of *Ficus religiosa*. *Molecules* 27: 1326.

Castro, T.A., Leite, B.S., Assunção, L.S., de Jesus Freitas, T., Colauto, N.B., Linde, G.A., Otero, D.M., Machado, B.A.S., and Ferreira Ribeiro, C.D. 2021. Red Tomato Products as an Alternative to Reduce Synthetic Dyes in the Food Industry: A Review. *Molecules* 26: 7125.

Cömert, E.E., and Gökmen, V.G. 2022. Effect of Food Combinations and Their Co-digestion on Total Antioxidant Capacity Under Simulated Gastrointestinal Conditions. *Current Research in Food Science* 5: 414–422.

Departemen Kesehatan Republik Indonesia. 2017. *Farmakope Herbal Indonesia Edisi Kedua*. Jakarta: Ditjen POM RI.

Departemen Kesehatan Republik Indonesia. 2020. *Farmakope Indonesia Edisi Enam*. Jakarta: Kementrian Kesehatan RI.

Food and Drug Administration (FDA). 2007. *Approximate pH of Foods and Food Products*.

Jideani, A.I.O., Silungwe, H., Takalani, T., Omolola, A.O., Udeh, H.O., and Anyasi, T.A. 2021. Antioxidant-rich Natural Fruit and Vegetable Products and Human Health. *International Journal of Food Properties* 24(1): 41–67.

Junnaeni, Mahati, E., dan Maharani, N. Ekstrak Tomat (*Lycopersicon esculentum* mill.) Menurunkan Kadar Glutathion Darah Tikus Wistar Hiperurisemia. *Jurnal Kedokteran Diponegoro* 8(2): 758-767.

Kumar, M., Tomar, M., Bhuyan, D.J., Punia, S., Grasso, S., Almeida S'a, A.G., Carciofi, B.A.M., Arrutia, F., Changan, S., Radha, Singh, S., Dhumal, S., Senapathy, M., Satankar, V., Anitha, T., Sharma, A., Pandiselvam, R., Amarowicz, R., and Mekhemar, M. 2021. Tomato (*Solanum lycopersicum* L.) seed: A review on Bioactives and Biomedical Activities. *Biomedicine & Pharmacotherapy* 142: 112018.

Laxmi, K.V., Vanajalatha, K., Girwani, A., Sreedhar, M., Aparna, K., and Chary, D.S. Evaluation of Bio active Compounds and Antioxidant Activity of Karonda Jam. *International Journal of Current Microbiology and Applied Sciences* 10(3): 201-221.

Naben, M. N., dan Pani, E. 2023. Pengaruh Berbagai Konsentrasi Gula terhadap Aktivitas Antioksidan pada Sari Buah Apel (*Malus Sylvestris*). *Jurnal Pendidikan Tambusai* 7(3): 20410-20414.

Natan, F., Emmawati, A., dan Marwati. 2019. Pengaruh Formulasi Bubur Kolang-kaling, Sari Buah Naga Super Merah dan Agar-agar Terhadap Sifat Fisiko-kimia dan Sensoris Selai Lembaran. *Journal of Tropical AgriFood* 1(1): 9-18.

Ningrumsari, I., Saputra, A.C., dan Herlinawati, L. 2024. Pengaruh Substitusi Sari Buah Tomat (*Lycopersicum esculentum* Mill) Terhadap Karakteristik Soyghurt Kedelai Hitam (*Glycine soja* L. Merrit). *Composite: Jurnal Ilmu Pertanian* 6 (1): 20-30.

Novia, D., Noviyanty, Y., Putri, T.Y. 2023. Uji Aktivitas Antioksidan Ekstrak Etanol 96% Daun Timba Tasik (*Clerodendrum serratum*) Menggunakan Metode DPPH. *Jurnal Ilmiah Pharmacy* 10(1): 137-143.

Rahmawati, A. N., Saryanti, D., Sari, F. N., dan Turnip, I. Y. 2022. Uji Cemaran Mikroba dan Kapang Khamir Ekstrak Air Daun *Muntingia calabura* L.(Kersen). *Pharmacon: Jurnal Farmasi Indonesia* 19(1): 72-78.

Sadiyah, L., dan Lestari, K. A. P. 2020. Pengaruh Lama Pemanasan Terhadap Nilai ALT Bakteri Teh Kombucha. *Journal Pharmasci* 5(1): 21-24.

Sjarif, S. R., dan Rosmaeni, A. 2020. Pengaruh Penambahan Bahan Pengawet Alami Terhadap Cemaran Mikroba Pada Pasta Tomat. *Jurnal Penelitian Teknologi Industri* 11(2): 71-82.

Zaddana, C., Almasyhuri, A., dan Shalatin, R. A. 2020. Selai Lembaran Kombinasi Apel (*Malus sylvestris* (L.) Mill.) dan Teh Hijau (*Camellia sinensis* L.) Sebagai Pangan Fungsional. *AcTion: Aceh Nutrition Journal* 5(1): 87.

Zaddana, C., Almasyhuri, dan Meida, U. 2021. Formulasi dan Uji Aktivitas Antioksidan Serbuk Minuman Instan Sari Buah Tomat (*Solanum lycopersicum*). *Fitofarmaka: Jurnal Ilmiah Farmasi*, 11 (1), 87-98.