

## Characteristics of Secang Jelly Drink as Functional Drink with the Addition of Red Ginger Extract for Antioxidant Source

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### Article History:

Received : 13 September 2023

Revised : 29 September 2023

Accepted : 22 October 2023

### Keywords:

Antioxidant,  
Functional drink,  
Jelly drink,  
red ginger,  
Secang woods.

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### ABSTRACT

*Secang wood (Caesalpinia sappan L.) and red ginger can be used as alternative functional drinks in form of jelly drinks, due to the antioxidant properties contained in these two ingredients. In this study, we wanted to know the characteristics of secang jelly drinks with addition of red ginger extract at various concentrations. The research was conducted with ginger extract concentrations of 20% (J1), 25% (J2), 30% (J3), 35% (J4), and 40% (J5) executed completely random. The results of the research regarding the characteristics of secang jelly drink with the addition of red ginger extract have significant differences ( $p < 0.05$ ) for viscosity, pH value, antioxidant activity, and sensory as well as hedonic quality. The best treatment is obtained from red ginger extract concentration of 35% with an average viscosity of 986.7 cP, pH of 4.47, antioxidant activity with an IC50 value of 72.97 (strong), sensory score for aroma, texture, and taste is 5, hedonic quality score for aroma, texture, and taste is 4. This treatment also results in average total flavonoid content of 24.29 mg/100 g. No heavy metal contamination was found and total plate number was  $< 10^2$  colonies/mL.*

## 1. INTRODUCTION

In this modern era, more and more people are starting to pay attention to consuming food that not only satisfies the appetite and fills the stomach, but also can achieve a perfect level of health or body fitness (Suter, 2013). For this reason, functional food is needed, namely food that functions to increase the body's immunity, fight the effects of free radicals, maintain body health, and slow or delay aging (Mawardi *et al.*, 2016). Functional food can be processed into various types of food and beverage products, such as jelly drinks, which are potentially preferred by various groups.

According to the Food and Drug Monitoring Agency (BPOM, 2019a), jelly drink is a drink in the form of a semi-liquid (gel) produced by mixing water, hydrocolloids with or without the addition of other food ingredients. Jelly drinks are often consumed to curb hunger and help smooth the consumer's digestive system. Therefore, jelly drinks are suitable to be developed as functional drinks. The texture of jelly drinks is influenced by the presence of hydrocolloids as the main component forming the gel. Apart from texture, jelly drinks must also have color, aroma and taste that can attract consumer interest. Secang wood (*Caesalpinia sappan* L.) extract can be used as raw material for making jelly drinks because of its potential as a functional food and its attractive color.

Secang wood is a type of spice that is quite often found in Indonesia. Secang wood is usually processed into natural dyes, and several types of drinks in Indonesia use secang wood as the main ingredient, such as *pletok* beer, secang tea, and *uwuh* tea (Batubara *et al.*, 2022; Rahmawati, 2011). Until now, it can be said that the processing of secang wood as a drink tends to lack variety. Secang wood has quite a large potential to be used as a functional drink

in the form of jelly drink because secang wood has many health benefits. Secang wood extract is thought to be able to treat diarrhea, syphilis, malaria, tumors and other diseases (Sari & Suhartati, 2016). Secang wood contains active components such as brazilin, which is a flavonoid compound which has antioxidant activity which can ward off the effects of free radicals and plays a role in producing a dark red color in decoction of secang wood (Nirmal *et al.*, 2015). Secang wood extract has an attractive color and good functional value, but secang wood extract has no aroma and the taste is also bland (Adlina, 2019). Sumartini & Suliasih (2021) reported that the taste produced by the secang jelly drink came from the sweetener used, namely sucrose. Research by Pradanasari (2021) showed that adding the concentration of secang wood has no effect on the resulting aroma, namely it has no smell. Therefore, red ginger (*Zingiber officinale* var. *Rubrum*) is the right food ingredient to add to improve this, because red ginger has a spicy taste and a strong characteristic ginger aroma. Ginger is a type of spice plant in Indonesia that has a distinctive aroma and taste. Red ginger extract is very suitable to be added to making jelly drinks because red ginger contains more essential oils than other ginger. Red ginger contains 2.58-3.90% essential oil (Tritanti & Pranita, 2019). Another type of ginger, namely elephant ginger, contains 0.82-1.66% essential oil and emprit ginger 1.50-3.50% (Setianingrum *et al.*, 2019). This is what makes red ginger have a stronger aroma than other types of ginger. On the other hand, red ginger also contains compounds that can produce the distinctive spicy taste of red ginger, namely zingeron, gingerol, shogaol, and oleoresin. However, this compound can also produce a bitter taste if too much is added (Mulia *et al.*, 2019). Based on research by Prakoeswa *et al.* (2020), these compounds also have very strong antioxidant activity.

The potential that exists in secang wood and red ginger is one of the strong reasons for developing these two materials as basic ingredients for making jelly drinks which are expected to become alternative functional drinks. Secang jelly drink with the addition of red ginger extract is a product that has never been researched before. Therefore, this research aims to obtain the right proportion of ingredients to be used as a jelly drink formula that can be accepted by the public or consumers. This research was also carried out to test the antioxidant content of secang jelly drink with the addition of red ginger extract.

## 2. MATERIAL AND METHODS

### 2.1. Research Location and Time

The research was carried out from December 2022 to August 2023. Making secang jelly drink and organoleptic tests consisting of hedonic and hedonic quality tests were carried out at the Food Processing Laboratory, Sahid University, Jakarta. Physical and chemical quality testing consisting of viscosity, syneresis, pH and antioxidant activity was carried out at the Chemistry Laboratory, Sahid University. Meanwhile, microbiological testing, namely the total plate number, was carried out at the Microbiology Laboratory, Sahid University. The testing for total flavonoid levels was carried out at the Vicma Laboratory in Bogor, as well as testing for heavy metal contamination was carried out at the TUV Nord Laboratory, Cikarang.

### 2.2. Materials and Tools

The ingredients that will be processed to make the jelly drink consist of shaved secang wood and red ginger which comes from the Toko Rempah Homecalist; sucrose or granulated sugar with the Superindo 365 trademark; kappa carrageenan and citric acid from Toko Deli Sentosa Prima, and mineral water with a pH of 7.24 (trademark Aqua). The analytical materials consist of ethanol, methanol (pa), acetic acid, quercetin, distilled water, I<sub>2</sub> 0.01 N, DPPH powder, H<sub>2</sub>O<sub>2</sub> pa 30%, quercetin, AlCl<sub>3</sub>, KMnO<sub>4</sub> 0.01 N, HNO<sub>3</sub> pa 65%, KH<sub>2</sub>PO<sub>4</sub>, HClO<sub>4</sub> pa 70 %, PCA media, and PDA media. Then, a digital balance, boiling pot, container, knife, cutting board, gas stove, thermometer, spoon, filter cloth, bottle, label paper and plastic cup are some of the equipment needed to make secang jelly drink. Meanwhile, for test analysis, the tools used are a Brookfield viscometer (LVDVE model with a speed range of 0.3-100 rpm), a refrigerator, a UV-Vis spectrophotometer (CECIL CE 1021 series 1000 with a wavelength of 200-1100nm), a hand refractometer (Manual Atago MASTER-M, °Brix scale with measuring range 0.0%-33.0%), pH meter (Jenway 3510), Surface Area Analyzer (SAA), beaker, analytical balance, measuring pipette (size 5 and 10 mL), measuring cup, flask measuring (volume 100 and 250 mL), Petri dishes, test tubes, micropipette tips, incubator (Bio WTC binder), and autoclave (Hirayama with model HL-36AE).

## 2.3. Research Methods

This research is an experimental type of research and a single factor Completely Randomized Design (CRD) with 5 treatment levels of red ginger extract concentration and 3 repetitions. Then, a further test was carried out using the Duncan Multiple Range Test (DMRT) method if the ANOVA test results were significantly different. The research results are then discussed and conclusions are drawn.

### 2.3.1. Research Implementation

The initial stage of this research is the process of making secang jelly drink with the addition of red ginger extract. The formulation was then subjected to physical, chemical and organoleptic analysis. Then the best treatment is selected based on the best antioxidant and organoleptic activity and supporting tests are carried out.

#### a) Preparation of Secang Wood Extract (Pradanasari, 2021)

Secang wood extract was made with a secang wood to water ratio of 1:100 (w/v). The shaved secang wood was weighed and washed until clean. Then, put it into a pan filled with water. The boiling process was carried out for  $\pm 5$  min at a temperature of 70-80 °C. Then, filtration was carried out with a filter cloth to obtain secang wood extract.

#### b) Preparation of Red Ginger Extract (Mayani *et al.*, 2014)

Red ginger extract was made in a red ginger to water ratio of 1:10 (w/v). Red ginger rhizomes were sorted and washed until clean. Next, the red ginger rhizome was crushed and then weighed and placed in a pan filled with water. Then boil for  $\pm 5$  min at a temperature of 80-90 °C. Next, filter it using a filter cloth to get the extract.

#### c) Preparation of Secang Jelly Drink

The secang jelly drink formula consisted of five levels of red ginger extract concentration treatments, namely 20% (J1), 25% (J2), 30% (J3), 35% (J4), and 40% (J5). Secang wood extract and red ginger extract were put into the pot according to each treatment. Then, put into the mixture crystal sugar with a concentration of 14%, 0.05% citric acid (to adjust the pH), and 0.35% carrageenan (w/v of the total mixture of secang wood extract and red ginger extract). Next, it was heated for 5 min at a temperature of 70-80 °C, while stirring. Next, let the jelly drink for a while until the temperature of 25-30 °C. The jelly drink was filled in a cup of 100 mL and then cooled in the refrigerator.

#### d) Chemical and Physical Tests

The pH value was measured according BSN (2004). The electrode of a pH meter was rinsed using distilled water and then dried using a tissue paper. The pH was measured by dipping the electrode into 20 mL of sample jelly drink.

The Antioxidant activity was measured following Marxen *et al.* (2007). A 100 mL of sample stock solution was prepared by dissolving 10 mg of extract in 100 mL of methanol. Then the sample was diluted using methanol solvent by making concentrations of 100, 120, 140, 160, 180 and 200 ppm. Dissolve 5 mg of DPPH powder in 100 mL of methanol to make a DPPH stock solution. Then a control solution was prepared containing 2 mL of PA methanol and 1 mL of 50 ppm DPPH solution for comparison. For test samples, prepare 2 mL of sample solution and 2 mL of DPPH solution each. Then incubation was carried out for 30 min. The absorbance of the samples was measured using a spectrophotometer with a wavelength of 550 nm. All data obtained is then calculated using the linear regression formula to obtain the IC50 value. If the IC50 value is less than 50, it is classified as a very strong antioxidant, classified as strong if the value is (50-100), moderate (100-150), and weak (151-200).

Viscosity of the jelly drink was analyzed according to AOAC (2007). The viscosity value is determined by reading the scale on the viscometer. Results can be read after a full rotation of one minute. The results read are adjusted to the spindle used at a speed of 60 rpm. The viscosity value is expressed in centipoise units (cP). The jelly drink samples measured were in the temperature range of 10-15°C.

Syneresis was also analyzed according to AOAC (2007). Syneresis was observed by storing secang jelly drink at refrigerator temperature (10 °C) for 3 days of observation (days 1, 2, and 3). The level of syneresis is calculated by measuring the weight of the jelly after storage, namely after the water that comes out of the jelly is separated, then

comparing it with the initial weight of the jelly. The gel syneresis was calculated as the following:

$$\text{Gel syneresis} = \frac{K-J}{K} \times 100\% \quad (1)$$

where  $K$  is the mass of initial jelly drink before storage (g), and  $J$  is the mass of jelly drink after storage (g).

Total flavonoid levels was measured following [Ipandi \*et al.\* \(2016\)](#). Total flavonoid levels were measured using the colorimetric method ( $\text{AlCl}_3$ ) using a UV-Vis spectrophotometer at a wavelength  $\lambda$  of 410 nm and the quercetin equivalent ( $EQ$ ) was expressed as the total flavonoids.

Heavy metal contamination was analyzed according to [BSN \(2020\)](#). The direct method was used for sample preparation, namely weighing 10 g of the sample and placing it in a 100 mL beaker. Next, the sample was heated until the  $\text{CO}_2$  gas or alcohol in the drink evaporates completely. Then, the sample was put into a 100 mL volumetric flask and diluted with distilled water until it reached the mark line. The sample solution was then measured for heavy metal contamination (Hg, As, Cd, Pb, and Sn) with a Surface Area Analyzer (SAA) model NOVA-1000.

#### g) Total Plate Number ([ISO, 2013](#))

The analysis was started by sterilizing Petri dishes. As much as 1 mL of the sample was pipetted into a Petri dish and 9 mL of distilled water was added to a dilution of  $10^{-1}$ . The same procedure was repeated to have dilution of  $10^{-2}$ . Using sterile pipette, 1 mL of sample from dilution  $10^{-1}$  and dilution  $10^{-2}$  was taken and put in different sterile Petri dishes. Pour 15-20 mL of PCA agar media into a Petri dish when the temperature is  $\pm 44-47^\circ\text{C}$  and homogenize. Then, wait until it solidifies and incubate with the cup was inverted upside down. Incubation was carried out in an incubator at temperature of  $30^\circ\text{C}$  for 72 h. The growth of the colonies on each plate was recorded.

#### e) Organoleptic Test

Organoleptic tests was carried out according to ([BSN, 2006](#)) including hedonic tests and hedonic quality. The hedonic test aims to see the panelists' preference or level of liking for a jelly drink. On the other hand, hedonic quality is carried out to see the panelists' assessment objectively regarding the parameters of a product. The parameters tested are color, aroma, taste and texture (mouthfeel). The scale used for hedonic testing and hedonic quality consists of a score of 1-6 with a description as presented in Table 1.

Table 1. Description for hedonic test and hedonic quality scale

Scale	Hedonic Test	Hedonic Quality			
		Color	Ginger Aroma	Ginger Taste	Texture
1	Dislike very much	Very pale yellow	Very weak	Very weak	Very difficult to be chewed
2	Dislike	Pale yellow	Weak	Weak	Difficult to be chewed
3	Dislike slightly	Yellow	Slightly weak	Slightly weak	Slightly difficult to be chewed
4	Like slightly	Slightly brownish yellow	Slightly strong	Slightly strong	Slightly easily destroyed
5	Like	Brownish yellow	Strong	Strong	Easily destroyed
6	Like very much	Very brownish yellow	Very strong	Very strong	Very easily destroyed

## 3. RESULTS AND DISCUSSION

### 3.1. Chemical Quality

The chemical properties of secang jelly drink with the addition of red ginger extract includes the pH value and  $\text{IC}_{50}$  value to determine antioxidant activity. The results of the chemical quality analysis can be seen in Table 2. It shows that the pH of secang jelly drink tends to increase as the concentration of red ginger extract increases. Based on the results of the ANOVA test, the addition of red ginger extract with various concentrations showed a significant effect ( $\alpha = 0.05$ ) on the pH of jelly drink. The pH value continues to increase as the concentration of red ginger extract increases. Jelly drinks have a pH below 4.6 because they use acid in the manufacturing process. Meanwhile, red Table 2. Average pH and  $\text{IC}_{50}$  values of secang jelly drink with the addition of red ginger extract ginger extract using the size reduction method by crushing has a pH of 6.87 ([Mayani \*et al.\*, 2014](#)). This is what causes the pH of secang jelly drink to continue to increase as the concentration of red ginger extract increases, because red ginger extract has a higher pH.

Concentration of Red Ginger Extract	pH	IC <sub>50</sub> Value
J1 (20%)	3,96±0,0 <sup>a</sup>	91,23±0,2 <sup>a</sup>
J2 (25%)	4,07±0,1 <sup>b</sup>	89,30±0,6 <sup>b</sup>
J3 (30%)	4,21±0,1 <sup>c</sup>	74,86±0,5 <sup>c</sup>
J4 (35%)	4,47±0,0 <sup>d</sup>	72,97±1,0 <sup>d</sup>
J5 (40%)	4,57±0,0 <sup>e</sup>	63,91±1,0 <sup>e</sup>

Note: numbers with different letter notations show significant differences at the 5% level according to the DMRT test

One of the quality requirements for jelly drinks is based on SNI 8897:2020 (BSN, 2020) concerning jelly drinks, where jelly drinks must have a pH of no more than 4.6. Therefore, our jelly drink produced from all treatments are in accordance with SNI requirements.

Table 2 shows that the IC<sub>50</sub> value of secang jelly drink tends to be lower as the concentration of red ginger extract increases. Based on the results of the ANOVA test that was carried out, the addition of red ginger extract with various concentrations showed a significant difference ( $\alpha=0.05$ ) in the IC<sub>50</sub> value of secang jelly drink. The IC<sub>50</sub> value gets lower as the concentration of red ginger extract increases. According to Setyawati et al (2019), antioxidant activity is stronger if the resulting IC<sub>50</sub> value is lower. Vice versa, the greater the IC<sub>50</sub> value means the weaker the antioxidant activity. So it can be said that, the greater the concentration of red ginger extract, the stronger the antioxidant activity. The antioxidant activity becomes stronger with addition, in line with research by Munadi (2020), where red ginger extract has an IC<sub>50</sub> value of 10.35 µg/mL or is classified as very strong antioxidant activity. Therefore, the more concentration of red ginger extract added, the stronger the antioxidant activity of secang jelly drink. A compound that has an IC<sub>50</sub> value of less than 50 is classified as a very strong antioxidant, classified as strong if the value is (50-100), medium (100-150), and weak (151-200). The results of the tests that have been carried out show that all treatments produce relatively strong antioxidant activity values. The calculation results show that the 40% concentration has higher antioxidant activity than other treatments.

The antioxidant activity value was measured by determining the IC<sub>50</sub> value using a linear regression formula using the line equation  $y = ax + b$ . The calculation is carried out by entering the  $y$  value ( $y = 50$ ), and the  $x$  value is obtained as the IC<sub>50</sub> value. Table 3 provides the results of linear regression calculations from secang jelly drink with the addition of 35% red ginger extract (treatment J4).

Table 3. Calculation of IC<sub>50</sub> values for Treatment J4 using the linear regression formula

y	a	b	$y = ax + b$	IC <sub>50</sub>
50	8.2179	14.733	4.291	73.0750
50	8.3611	14.019	4.303	73.9494
50	8.0684	15.507	4.275	71.8854
Average IC <sub>50</sub> value of treatment J4				72.97±1.0 <sup>d</sup>

### 3.2. Physical Quality

The physical properties of secang jelly drink with the addition of red ginger extract include viscosity and syneresis. The results of the physical quality analysis can be seen in Table 4. Viscosity was tested using a Brookfield Viscometer using a 63 spindle and a speed of 60 rpm. Table 4 shows that the viscosity of secang jelly drink tends to increase as the concentration of red ginger extract increases. The addition of red ginger extract with various concentrations provides a significant difference ( $\alpha = 0.05$ ) in the viscosity of secang jelly drink when seen from the results of the ANOVA test that has been carried out. Concentrations of 30%, 35%, and 40% have the highest viscosity values compared to other treatments. In food, viscosity is the level of thickness of a food product. Concentration, temperature, dissolved molecular weight, and pressure are several elements that can influence the viscosity of a product. The concentration of the solution is directly proportional to the viscosity of the product, which means that the greater the concentration of a solution, the higher the viscosity value, and vice versa (Lumbantoruan & Yulianti, 2016). The concentration of ginger used in making red ginger extract is using a ratio of ginger and water of 1:10. The addition of red ginger extract further increases the concentration of the solution which also causes the increase in viscosity value.



Table 4. Average values of viscosity and syneresis of secang jelly drink with the addition of red ginger extract

Concentration of Red Ginger Extract	Viscosity (cP)	Syneresis (%)
J1 (20%)	517.3±14.2 <sup>a</sup>	1.39±0.40 <sup>a</sup>
J2 (25%)	860.7±37.2 <sup>b</sup>	1.26±0.35 <sup>a</sup>
J3 (30%)	949.3±29.7 <sup>bc</sup>	1.16±0.40 <sup>a</sup>
J4 (35%)	986.7±66.5 <sup>c</sup>	0.95±0.27 <sup>a</sup>
J5 (40%)	1055.3±48.8 <sup>c</sup>	0.76±0.26 <sup>a</sup>

Note: numbers with different letter notations show significant differences at the 5% level according to the DMRT test

In addition, the viscosity value can be related to the pH value. According to [Pumpente \*et al.\* \(2019\)](#), this is because hydrogen ions ( $H^+$ ) play an important role in assisting the hydrolysis process in the glycosidic bonds of the carrageenan molecule, so that the viscosity of the solution containing carrageenan will increase as the pH value increases. On the other hand, the increase in pH value is due to the pH of red ginger extract being higher than the pH of secang wood extract, so the pH of secang jelly drink will increase as the concentration of red ginger used increases.

The syneresis test was carried out by storing secang jelly drink at a refrigerator temperature (10 °C) for 3 days. The water that comes out during storage is separated from the jelly and then the weight of the jelly is weighed. Syneresis in jelly drinks can occur because water is not tightly bound or aggregation occurs between polymer chains of carrageenan molecules continuously through hydrogen bonds ([Vania \*et al.\*, 2019](#)). Table 4 shows that the syneresis value of secang jelly drink tends to be lower as the concentration of red ginger extract increases. This means that the greater the concentration of red ginger extract added, the less syneresis will be. Syneresis is related to the amount of water that comes out of the gel. If more water comes out of the gel, it causes the level of syneresis to become greater ([Febriyanti & Yuniarta, 2015](#)). The stronger the gel produced, the smaller the level of syneresis. Apart from viscosity, the gel-forming potential of carrageenan will also increase with increasing pH due to the role of hydrogen ions ( $H^+$ ) ([Pumpente \*et al.\*, 2019](#)). The stronger the gel forming potential can cause the syneresis level to be lower because less water will be released from the gel. However, even though the level of syneresis seems to tend to increase, the addition of red ginger extract shows a difference but is not significant ( $\alpha = 0.05$ ) to the syneresis of secang jelly drink when seen from the results of the ANOVA test that has been carried out.

### 3.3. Organoleptic Test

The organoleptic test of a secang jelly drink with the addition of red ginger extract includes hedonic tests and hedonic quality with color, aroma, taste, and texture (mouthfeel) parameters. The results of the hedonic test for secang jelly drink can be seen in Table 5. The appearance of a food product is one of the attributes that contributes to consumers' judgments when they buy or consume a product ([Meilgaard \*et al.\*, 2016](#)). The appearance of a beverage product is influenced by various things, one of which is color ([Rifkowsaty, 2016](#)). The average color hedonic score is in the range of 4.80-4.84 (like). Based on the results of the ANOVA test, the addition of red ginger extract did not show any significant difference ( $\alpha = 0.05$ ) on the hedonic score of the color of the secang jelly drink.

Apart from appearance, taste, aroma and texture are also the main indicators of the panelists' assessment of a food product. The addition of red ginger extract showed a significant difference ( $\alpha=0.05$ ) on the hedonic score of aroma, taste and texture of secang jelly drink. The average value of the aroma hedonic score is in the range of 4.49 to 5.22 (like). Then, the average value of the texture hedonic score is in the range of 4.59 to 5.13 (like). The panelists' liking for the texture of the secang jelly drink increased from a concentration of 20% to a concentration of 25% and

Table 5. Average hedonic score of secang jelly drink with the addition of red ginger extract

Concentration of Red Ginger Extract	Color	Aroma	Texture	Taste
J1 (20%)	4.80±0.1 <sup>a</sup>	4.49±0.2 <sup>a</sup>	4.59±0.3 <sup>a</sup>	4.62±0.2 <sup>a</sup>
J2 (25%)	4.82±0.1 <sup>a</sup>	4.52±0.1 <sup>a</sup>	4.79±0.1 <sup>ab</sup>	4.87±0.1 <sup>ab</sup>
J3 (30%)	4.82±0.1 <sup>a</sup>	4.84±0.1 <sup>b</sup>	5.10±0.1 <sup>bc</sup>	5.27±0.1 <sup>d</sup>
J4 (35%)	4.84±0.1 <sup>a</sup>	5.11±0.1 <sup>c</sup>	5.11±0.1 <sup>bc</sup>	5.15±0.1 <sup>cd</sup>
J5 (40%)	4.84±0.1 <sup>a</sup>	5.22±0.2 <sup>c</sup>	5.13±0.1 <sup>c</sup>	4.91±0.1 <sup>bc</sup>

Note: numbers with different letter notations show significant differences at the 5% level according to the DMRT test

stabilized at red ginger extract concentrations of 30%, 35% and 40% or treatments J3, J4 and J5. The panelists' level of preference or preference for the aroma and texture of secang jelly drink seemed to increase along with the increasing concentration of red ginger extract. In addition, the average value of the taste hedonic score is in the range of 4.62 to 5.27 (like). Red ginger extract concentrations of 30% and 35% had the highest level of panelist preference among the other concentrations.

### 3.4. Hedonic Quality Test

The hedonic quality test was carried out to see the panelists' assessment objectively regarding secang jelly drink with the addition of red ginger extract at various concentrations. The test parameters assessed include color, aroma, taste and texture (mouthfeel). The results of the hedonic test for secang jelly drink can be seen in Table 6. Based on the results of the ANOVA test, the addition of red ginger extract showed a significant difference ( $\alpha = 0.05$ ) in the hedonic quality scores of color, aroma, texture and taste of secang jelly drink. The hedonic color quality score tends to decrease as the concentration of red ginger extract increases, which means the brownish yellow color decreases. In secang wood, there is a compound called brazilin which produces a dark red color when secang wood is boiled in water. The red color fades to brown when the decoction of secang wood is filtered and added with granulated sugar. The addition of red ginger extract causes the brownish color to become brighter. This happens because of the oleoresin compound contained in red ginger extract. This compound produces a bright yellow color (Ibrahim *et al.*, 2015). Therefore, as the concentration of red ginger extract increases, the brownish yellow color produced decreases and becomes brighter.

Table 6. Average hedonic quality score of secang jelly drink with the addition of red ginger extract

Concentration of Red Ginger Extract	Color	Aroma	Texture	Taste
J1 (20%)	4.91±0.2 <sup>a</sup>	2.82±0.1 <sup>a</sup>	5.24±0.1 <sup>a</sup>	2.87±0.2 <sup>a</sup>
J2 (25%)	4.63±0.2 <sup>a</sup>	3.28±0.4 <sup>b</sup>	4.88±0.1 <sup>a</sup>	3.44±0.2 <sup>b</sup>
J3 (30%)	4.39±0.2 <sup>a</sup>	3.78±0.2 <sup>c</sup>	4.35±0.2 <sup>b</sup>	3.92±0.1 <sup>c</sup>
J4 (35%)	4.31±0.3 <sup>ab</sup>	4.34±0.1 <sup>d</sup>	3.84±0.2 <sup>c</sup>	4.47±0.1 <sup>d</sup>
J5 (40%)	4.23±0.2 <sup>b</sup>	4.62±0.1 <sup>d</sup>	3.72±0.5 <sup>c</sup>	5.06±0.2 <sup>e</sup>

Note: numbers with different letter notations show significant differences at the 5% level according to the DMRT test

The average hedonic quality score for the aroma of secang jelly drink with the addition of red ginger extract is in the range of 2.82 (rather weak ginger aroma) to 4.62 (strong ginger aroma). The aroma hedonic quality score of secang jelly drink tends to increase as the concentration of red ginger extract increases. This happens because red ginger contains 2.58-3.90% essential oil which plays a role in producing aroma (Setianingrum *et al.*, 2019). The main components of ginger essential oil which give rise to the distinctive aroma of ginger are zingeberen and zingeberol (Safitri *et al.*, 2019). Based on the results of statistical tests that have been carried out, the best aroma based on the hedonic score of secang jelly drink is a concentration of 35% and 40%. Based on the panelists' assessment, this treatment has a slightly strong to strong ginger aroma.

The average hedonic quality score for the texture of secang jelly drink with the addition of red ginger extract ranged from 3.72 (somewhat easy to crumble) to 5.24 (easy to crumble). The hedonic quality score for the texture of secang jelly drink tends to decrease as the concentration of red ginger extract increases. According to Pumpente *et al.* (2019), in the process of making jelly drinks there is carrageenan which plays a role in gel formation. It has been explained previously that the gel-forming potential of carrageenan will increase as the pH also increases, which means the texture will become denser because the gel strength increases. This proves that the panelists can feel the difference in the texture of the jelly which becomes denser or more difficult to disintegrate in the mouth as the concentration of red ginger extract increases. The results of statistical tests that have been carried out show the hedonic score for the best texture of secang jelly drink with the addition of red ginger extract in concentrations of 30%, 35% and 40%. Based on the panelists' assessment, this treatment has a hedonic quality, a slightly crumbly texture.

The average hedonic quality score for the taste of secang jelly drink with the addition of red ginger extract ranged from 2.87 (slightly weak ginger spicy taste) to 5.06 (strong ginger spicy taste). The hedonic quality score of the spicy

taste of the secang jelly drink continues to increase along with increasing red ginger extract concentration. This happens because red ginger contains a compound called gingerol which can produce a distinctive spicy ginger taste (Safitri *et al.*, 2019). On the other hand, red ginger also contains high levels of zingerone, shogaol and oleoresin which give red ginger a strong spicy taste and bitter taste (Tritanti & Pranita, 2019). Based on statistical tests that have been carried out, the hedonic scores for the best taste of a jelly drink with the addition of red ginger extract are found to be concentrations of 30% and 35%. Based on the panelists' assessment, this treatment had a rather strong hedonic quality score for the spicy taste of ginger.

### 3.4. Determining the Best Treatment

The best treatment is selected based on the best organoleptic quality and antioxidant activity. The best organoleptic quality parameters for color, aroma, taste and texture are treatment J4, J3, J5, J2 and J1 respectively. Meanwhile, the best antioxidant activity was treatments J5, J4, J3, J2, and J1, respectively. Based on the results of organoleptic tests and antioxidant activity, J4 treatment was selected as the best treatment.

### 3.5. Supporting Quality

The best treatment is then carried out with supporting tests which include tests for total flavonoid levels, heavy metal contamination and microbial contamination (total plate number). The test results can be seen in Table 7. Flavonoids are a phenolic compound that has antioxidant activity to capture free radicals. Secang wood contains brazilin which is a group of flavonoids, specifically homoisoflavonoid constituents (Nirmal *et al.*, 2015). Secang wood extract has a total flavonoid content of around 0.0667 mg/g (Neswati & Ismanto, 2018). Apart from that, red ginger also contains gingerol and shogaol which are also flavonoids (Verenzia *et al.*, 2022). Red ginger extract has a total flavonoid content of around 46.56 g/g (Pratoko *et al.*, 2018). The results of testing total flavonoid levels using the spectrophotometric method show average levels. contained in secang jelly drink with the addition of red ginger extract with a concentration of 35% is  $24.29 \pm 0.1$  mg/100g.

Table 7. Supporting Quality Test Results

Quality Parameter	Unit	Requirement	Test result
Total flavonoid content	mg/100g	-	24.29±0.1
Heavy metal contamination			
1. Lead (Pb)	mg/kg	max. 0.05	Not found
2. Cadmium (Cd)	mg/kg	max. 0.01	Not found
3. Tin (Sn)	mg/kg	max. 40.0	Not found
	mg/kg	max. 100.0	
4. Mercury (Hg)	mg/kg	max. 0.01	Not found
Arsen (As) contamination		max. 0.05	Not found
Microbe contamination			
1. Total plate number	colony/mL	max. $10^2$	$< 10^2$

Source: BSN (2020)

The results of testing for heavy metal contamination showed that not a single heavy metal was detected in secang jelly drink with the addition of red ginger extract. For microbial contamination (total plate number) the results were  $<10^2$  colonies/mL. Based on the test results obtained, it can be said that this drink complies with the quality standards for heavy metal contamination and microbial contamination stated in SNI 8897:2020 concerning jelly drinks.

## 4. CONCLUSIONS

Based on research regarding the quality characteristics of secang jelly drink with the addition of red ginger extract with various concentrations (20% to 40%) which has been carried out, it is concluded that the best treatment is secang jelly drink with the addition of 35% red ginger extract. This treatment has relatively strong antioxidant activity with an average IC<sub>50</sub> value of  $72.97 \pm 1.0$  ppm. Based on SNI 8897:2020 concerning jelly drinks, it can be concluded that secang jelly drink with the addition of red ginger extract is in accordance with quality standards for condition



parameters (color, taste and aroma), pH value, heavy metal contamination and microbial contamination (plate number total). Based on research regarding the characteristics of secang jelly drink with the addition of red ginger extract that has been carried out, the author suggests researching the estimation of shelf life and good packaging so that it can be commercialized.

## ACKNOWLEDGMENTS

The authors would like to express their gratitude to PT Indofood Sukses Makmur Tbk for financial support through the Indofood Riset Nugraha (IRN) program.

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