Effect Of Sucrose Concentration on Antioxidant Activity and Vitamin C in Red Guava Juice

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ABSTRACT
The potential of guava in Gorontalo Regency is quite abundant to be used as raw material for functional drinks with high nutritional content. The nutritional content of red guava is mostly vitamin C found in the skin and soft outer flesh, and the vitamin C content of guava also reaches its peak before cooking while the edible part is 82%. Therefore, one of the efforts to utilize red guava fruit is to make fruit juice drinks that can be consumed by all levels of society. This research was conducted to determine the effect of sucrose concentration on antioxidant activity and vitamin C in red guava juice. This research uses completely randomized (CRD) with three treatments and three replications. The treatment used was P1 = 50 g of granulated sugar, P2 = 100 g of granulated sugar, P3 = 150 g of granulated sugar. While the parameters used are analysis of vitamin C, antioxidant activity, and organoleptic tests including color, aroma, taste and texture. The results showed that there was a significant effect between sugar concentration on antioxidant activity with the highest value P1 namely 44.97%, as well as organoleptic tests for aroma, taste and texture with the highest values sequentially P1 4.08 (like), P3 4.08 (like), and P1 4.12 (likes). However, it did not have a significant effect on the content of vitamin C and the taste assessment of red guava juice.

Keywords : fruit juice, red guava, vitamin c, antioxidants

INTRODUCTION

Guava fruit (*Psidium guajava* L.) is a tropical plant originating from Brazil and Central America and then spreading to Thailand and other Asian countries such as Indonesia. Until now, guava has been widely cultivated in Java. Guava is also known as Guava Klutuk, Guava Siki or Guava Batu (Mahendra et al., 2017).

Gorontalo Regency is one of the districts which is famous for its high fruit production. In 2016 guava production was 508 trees per bunch and production was 321 (quintals)(Central Bureau of Statistics, 2016). Guava has green fruit with white or red flesh and tastes sweet and sour. Guava fruit is known to contain high levels of vitamin C and Apart from being a good source of vitamin C, guava is also high in fiber, which is related to the fruit's natural antioxidants (Jiménez et al., 2001; Prisca Priscilla, 2012).

The nutritional content of red guava in 100 grams contains 51 kcal of energy, 11.88 g of carbohydrates, 0.82 g of protein, 0.6 g of fat, and 183.5 mg of vitamin C, and the edible part is 82%. Most of the vitamin C is concentrated in the skin and outer flesh which is soft and thick, and the vitamin C content of guava also reaches its peak before ripening (Ramayulis, 2013)

In addition, guava contains phytochemicals such as polyphenols, essential oils which can give a distinctive aroma to guava (eugenol), saponins combined with oleanolat, quercetin flavonoids, lycopene, tannins, ursolic acid, psidolic acid, kratogolic acid and oleanolat. tamarind and oleic acid, guava verin (Ramayulis, 2013). Antioxidants can prevent or delay the emergence of free radicals due to the oxidation process.
Antioxidants can prevent damage to cells in the body in the form of cell destruction that occurs in the respiratory system, such as inhaling cigarette smoke, cars, pollution and sun exposure which cause cancer. Cancer is caused by several reasons mentioned above. But the most important thing is to pay attention to the right lifestyle. Chemical substances and some drugs found in the community also play a role. to reduce the occurrence of cancer, it is necessary to consume antioxidants derived from vitamins A, C and E. These antioxidants are found in fruits and vegetables (Kiay et al., 2019)
Children ages 13 to 20 need 80 to 100 mg of vitamin C and adults 70 to 75 mg. The weight of 1 red guava fruit, which is 275 g/fruit, can meet the daily requirement of vitamin C for 3 adults or 2 children aged 13-20 years. This high vitamin C content is useful as an antioxidant that can increase endurance, accelerate wound healing and participate in the formation of intracellular collagen in the body. Collagen is a protein compound that is abundant in cartilage, deep skin, bone, dentine and vascular endothelium. Vitamin C plays a role in the synthesis of the neuroepinephrine neurotransmitter which is important for the brain to synthesize carnitine which functions to transport fat to mitochondria to be converted into energy (Ramayulis, 2013)(Kumari et al., 2013) (Rishika, Dev and Sharma, 2012)
Based on this background, guava fruit can be used as a food supplement. Now there are other foods made from red guava fruit in Indonesia in the form of juice, jelly and instant powder. One of the dietary supplements currently consumed by many people is red guava juice supplement. Based on these problems, a study was conducted on the effect of sucrose concentration on antioxidant and vitamin C activity of red guava fruit juice as a functional drink that contains high antioxidants.

METHOD

The process of making red guava juice

Fresh red guava fruit was weighed at 250 g for each treatment. Washing the Red Guava is done first with running water. Peeling the guava to remove the skin from the guava flesh after that is done by cutting it into small pieces. Remove the guava seeds from the guava flesh and then crush them using a blender by adding 750 ml of (boiled) water for each treatment. After that, the first filter is carried out using a filter cloth that has been sterilized and then take the juice. Then the fruit juice is pasteurized at 65-80^{o}C for 15 minutes. During the pasteurization process added sugar in each treatment, namely 50 g, 100 g and 150 g. Then filtered again to obtain clean fruit juice. Then it is packaged and labeled.

Research design

The research design used in this study was a completely randomized design (CRD) with three treatments and three replications. If the results of the analysis are significantly different or very significantly different, then proceed with the BNT follow-up test. The treatment used in this study was P1=50 g of granulated sugar, P2=100 g of granulated sugar, P3=150 g of granulated sugar,

Organoleptic Test

Organoleptic assessment was carried out using the hedonic scale assessment, namely in the form of the level of preference for color, aroma, and texture, with 25 panelists, the hedonic scale used was 1 =Dislike, 2 =Somewhat dislike, 3 = Rather Like, 4 = Like , 5= Really Like.

Vitamin C Analysis

Pipette 2 ml of the sample solution and then put it into an Erlenmeyer after which 5 ml of metaphosphoric-acetic acid is added. Titrate using 2.6 dichlorophenol indophenol solution until a steady pink color is formed as the end point of the titration. Planko is determined. Vitamin C levels are calculated by the formula:

$$\text{Vitamin C } (= \frac{mg}{g}) = \frac{(Vt - Vb)x \text{ equality x VI}}{Vp \text{ x Bs}} \quad (1)$$

Information:
Vt : Titration volume (ml)
Vb : Blank Volume (ml)
V1 : Measured flask volume (ml)
Vp : Pipetting Volume (ml)
Bs : Sample Weight (g)

Determination of Antioxidant Activity with the Ferric Reducing Antioxidant Power (FRAP) method

Determination of total antioxidants in red guava juice is determined according to(Halvorsen et al., 2002). 0.1 ml of red guava juice solution added with FRAP reagent (2.5 ml of acetate buffer; 2.5 ml of 2,4,6-trippyridyl-s-triazine (TPTZ) solution) and 2.5 ml of FeCL3.6H2O solution 3 ml in a test tube. The absorbance of the solution was read with a spectrophotometer at a wavelength of 596 nm. The total antioxidant content can be expressed as the equivalent of vitamin C mg/kg fruit juice. A calibration curve was prepared in the same way using vitamin C as a standard.

RESULTS AND DISCUSSION

Determination of Antioxidant Activity with the Ferric Reducing Antioxidant Power (FRAP) method

Antioxidants are compounds that protect cells from free radicals which can cause cell damage. A free radical is an atom that has lost an electron pair so it will interfere with healthy cells. Antioxidants play a role in completing the lack of electrons possessed by free radicals, as well as limiting the formation of a chain response from the production of free radicals. Based on the results of research on the antioxidant activity of red guava juice, it can be seen in the diagram below.

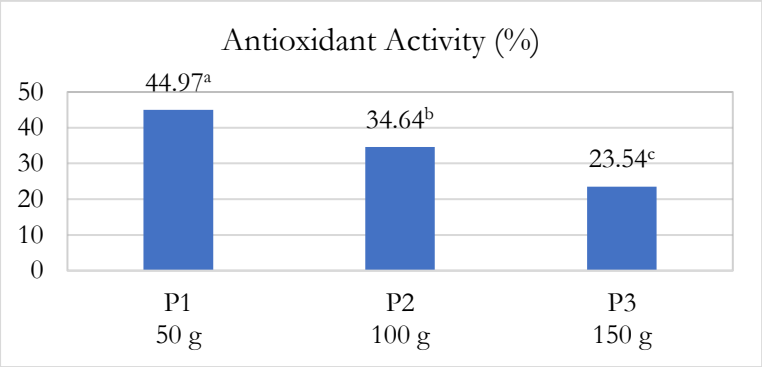

Figure 1. Bar chart of antioxidant activity of red guava juice

Based on the diagram in Figure 1, it can be seen that the average antioxidant activity produced ranges from 23.54 % to 44.97%. In treatment P1 (50 g sugar) with an average of 44.97%, in treatment P2 (100 g sugar) with an average of 34.64%, and in treatment P3 (150 g of sugar) with an average of 23.54%. The highest antioxidant activity in red guava juice was in treatment P1 (50 g sugar) with an average of 44.97% and the lowest was in treatment P3 (150 g sugar) with an average of 23.54%.

This means that the higher the sugar content in the red guava juice, the lower the antioxidant activity in the red guava juice. This decrease can be caused by the provision

of increased concentration (sugar) which causes degradation of sugar in acidic conditions which can simultaneously reduce the antioxidant content during the heating process of red guava juice. The decrease in anthocyanin occurs due to the process of degradation of sugar into furfural and 5-hydroxymethyl-furfural which is formed especially in acidic conditions and sugar is heated simultaneously which will react with anthocyanins to form brown fruit juice.(Rahmasari & Susanto, 2014).
In addition, the results of this study are in line with previous studies which showed that the higher the concentration of added sugar, the lower the antioxidant activity contained in Buni fruit juice. This is due to the damage to anthocyanins and vitamin C which increases in line with the addition of sugar in Buni fruit juice during the heating process(Octaviani & Rahayuni, 2014).
The results of the analysis of variance showed that the concentration of granulated sugar had a very significant effect on antioxidant activity. The results of this study were also supported by Duncan's further test, which showed that each treatment had a different notation for each treatment. The difference can be caused by the concentration of sugar added to the different red guava juice. This is consistent with the statement from the results of previous studies that the difference in the value of antioxidant activity in each treatment is affected by the amount of sugar concentration in the different treatments.(Muflihunna et al., 2014).
Vitamin C Analysis
Vitamin C is a compound in the form of white crystals and dissolves easily in water. In a dry state, vitamin C is quite stable but is easily damaged when it dissolves in water due to contact with air (oxidation), especially when exposed to heat. Based on the research results, the average vitamin C in red guava juice can be seen in the following diagram.

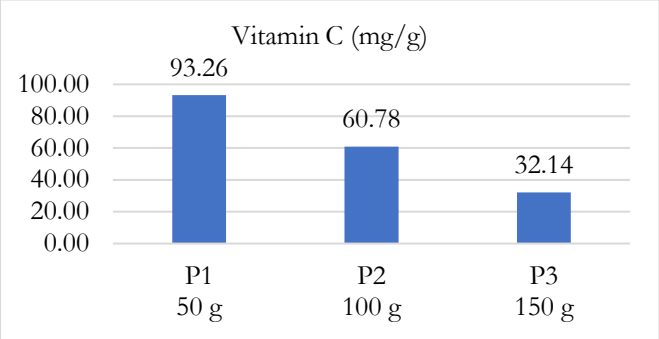

Figure 2. Bar chart of vitamin C red guava juice
Based on the results of the research in Figure 2, the levels of vitamin C in the red guava juice produced ranged from 32.14 mg/g to 93.26 mg/g. In treatment P1 (50 g sugar) with a yield of 93.26 mg/g, P2 (100 g sugar) with a yield of 60.78 mg/g, and P3 (150 g sugar) with a yield of 32.14 mg/g. It can be seen that the highest vitamin C was in treatment P1 (50 g sugar) with a yield of 93.26 mg/g and the lowest was in treatment P3 (150 g sugar) with a yield of 32.14 mg/g.
Vitamin C in each treatment showed a difference, because the addition of sugar concentration was also different in each treatment. The higher the concentration of sugar, the lower the level of vitamin C. This could be caused by the heat applied during the processing. Where, the higher the concentration of sugar used will lead to a longer processing or heating process.
The content of vitamin C will decrease along with the duration of heating given during the processing (Atviolani, 2016). In addition, the reduced Vitamin C in red guava juice was caused by the sample having contact with outside air and the effect of heating. Vitamin C is a very sensitive and easily damaged vitamin, several factors that cause

damage to vitamin C are temperature, salt and sugar concentrations, pH, oxygen, light, metal catalysts, water content (Nikkhah et al., 2007). Oxidation will be inhibited if vitamin C is left in an acidic state or at low temperatures. The results of this study are not much different from the production of Buni fruit juice which undergoes a heating process at 75^{o}C which can reduce the levels of vitamin C in the fruit juice (Octaviani & Rahayuni, 2014).

Based on the results of the analysis of variance, it showed that the concentration of sugar did not significantly affect vitamin C, so further tests were not carried out. The low content of vitamin C in red guava juice could be due to the concentration of added sugar, which affects the heating time given during processing. The heating process that is too long can cause a decrease in the vitamin C content of the red guava juice produced.

Organoleptic Test

Color

Determination of the quality of food ingredients in general is highly dependent on factors one of which is color. From the results of the study, the average preference of panelists for the color of red guava juice can be seen in the following diagram:

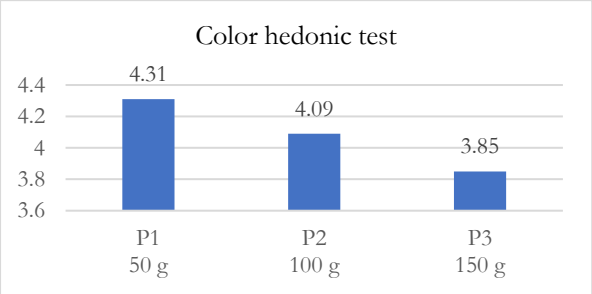

Figure 3. Organoleptic test bar diagram for the color of red guava juice

Based on the results of the research in Figure 3, it can be seen that the panelist's assessment of the color of the red guava juice produced ranged from 3.85 to 4.31. According to the results of the panelist's assessment, the color was stated in treatment P1 (50 g sugar) with a score of 4.31 (rather liked it), treatment P2 (100 g sugar) with a score of 4.09 (liked), treatment P3 (150 g sugar) with a score of 3 .85 (likes). So it can be seen that the highest panelist rating was in treatment P1 (50 g of sugar) with a score of 4.31. The high level of preference of panelists for the color of red guava juice at P1 (50 g) could be caused by the color of red guava juice which is red guava (ripe) in general.

Granulated sugar gives a brownish color because granulated sugar has properties that can cause browning reactions, namely caramelization and millard (Fitri et al., 2017). During the heating process there is degradation of sugar without amino acids which is indicated by a change in color due to the caramelization reaction which causes a non-enzymatic browning reaction, this is related to the fruits after cooking will change color (Desrosier, 1988).

The results of the analysis of variance showed that the average organoleptic test for red guava juice color in each treatment with sugar concentrations showed no significant effect on the color of the red guava juice produced.

Flavor

The aroma of food so much determines the delicacy of the food. Therefore, aroma is one of the factors for determining quality. The average of the panelists' research results on the aroma hedonic test is shown in the following diagram

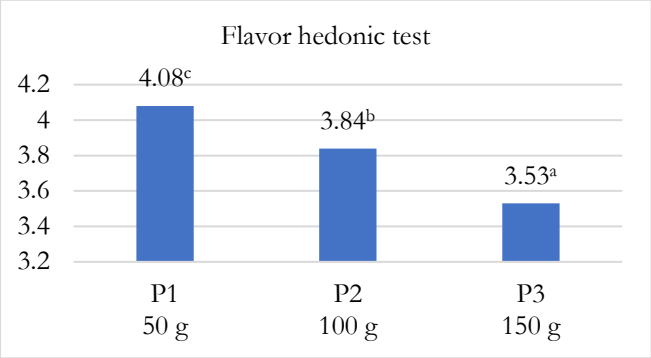

Figure 4. Bar diagram of the organoleptic test for the aroma of red guava juice

Based on the research results contained in Figure 4, the panelists' assessment of the aroma of red guava juice produced ranged from 3.53 to 4.08. From the diagram above it can be seen that the panelists stated the aroma in treatment P1 (50 g sugar) with a score of 4.08 (liked it), P2 (100 g sugar) with a score of 3.84 (rather like it), P3 (150 g sugar) with a score of 3 .53 (rather like). This shows that each panelist likes red guava juice with the addition of 50 g of sugar (P1).

This treatment had a higher concentration of red guava juice so that the aroma that was smelled was the fresh aroma of red guava juice which the panelists liked. The sugar content contained in red guava juice does not have a significant effect on the aroma because sugar has a neutral aroma. This is in accordance with previous studies which stated that basically sugar does not have much effect on syrup because sugar does not have a prominent and strong aroma(Asrawaty et al., 2017). Previous studies have also shown that the more star fruit juice used in making syrup, the sharper the fruit aroma will be (Fitri et al., 2017).

In addition, the process of decreasing the preference of panelists as the sugar concentration increased was also caused by volatile compounds in the fruit that evaporated due to the heating process, giving each treatment a different smelling aroma. The cooking process uses heating in the manufacture of Pamelo Orange marmalade, causing the volatile aroma of oranges to evaporate so that the distinctive aroma of oranges in the marmalade is reduced and does not smell. It plays an important role in forming the aroma and flavor.(Ismail et al., 2018).

Based on the results of the analysis of variance, the treatment with the addition of different sugar concentrations had a very significant effect. This is because each red guava juice produced by each treatment smells of a different aroma of red guava juice. The results of this study were also supported by Duncan's further test which showed that each treatment had a different notation. Treatment using different concentrations of sugar produces a different aroma. With the different aroma of red guava juice in each treatment, it will affect the panelist's preference value for the aroma produced.

Taste

Taste is part of an important indicator of testing a sample to determine public acceptance of the product produced. From the results of the study, the average panelist assessment of the hedonic taste test can be seen in the following diagram:

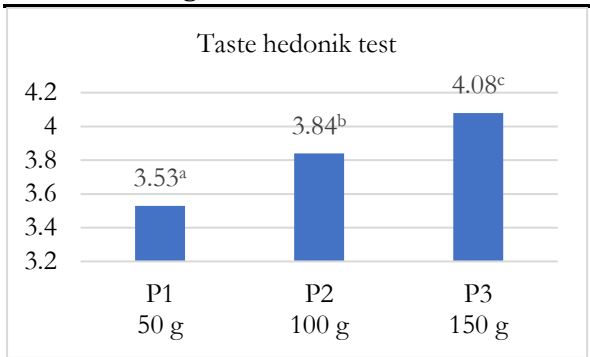

Figure 5. Bar diagram of the organoleptic test for the taste of red guava juice

Based on the research results contained in Figure 5, the panelists' assessment of the taste of red guava juice produced ranged from 3.53 to 4.08. The diagram above shows that the panelists liked the P3 treatment (150 g of sugar) with a score of 4.08 (liked). Changes in the level of preference of panelists for the taste of red guava juice can be seen in Figure 5. Respondents preferred the distinctive taste of sugar in red guava juice treatment P3 (150 g of sugar) because the taste of sugar was more dominant. This is in accordance with the statement of previous research that giving too much sugar substitution can make the distinctive taste of sugar more dominant and the distinctive taste of the main ingredient components become more disguised (Ismail et al., 2018). The resulting interaction of flavors also comes from the components of guava juice and the right sugar, resulting in a more balanced taste that the panelists like. The flavor component is also caused by the heating process which causes the sour taste of the fruit to evaporate. The high temperature used will accelerate the rate of respiration and trigger evaporation so that the acid content decreases(Susanto et al., 2013). Food ingredients generally contain 2-4 kinds of flavors, if a flavor component has a higher concentration than other components, then the taste of that component will be dominant (Kartika et al., 1988)

Based on the results of the analysis of variance in the appendix, it was shown that the addition of sugar had a very significant effect on the taste of the red guava juice produced. Giving different sugar concentrations will affect the taste produced by red guava juice, which will affect the level of panelist acceptance. The results of this study were also supported by Duncan's further test which showed that each treatment had a different notation. Treatment using different concentrations of sugar produces a different taste of red guava juice. The different flavors of each treatment will affect the panelists' preference for the taste of red guava juice.

Texture

Texture is an observation made with the mouth (when bitten, chewed, swallowed) or through touching using fingers to describe the product produced. From the results of the study, the average panelist assessment of the texture of red guava juice can be seen in the following diagram

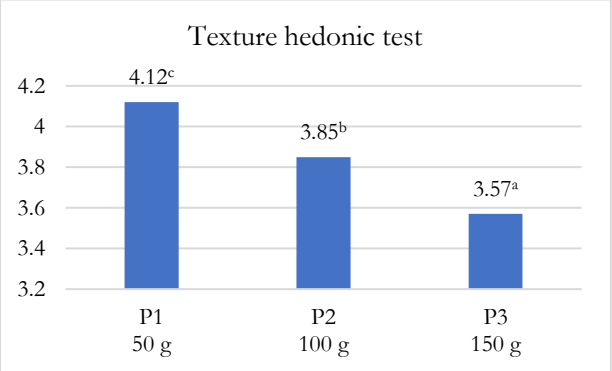

Figure 6. Bar diagram of organoleptic test texture of red guava juice

Based on the results of the research in Figure 6, the panelists' assessment of the texture of red guava juice was at P1 (50 g sugar) with a score of 4.12 (liked), P2 (100 g sugar) with a score of 3.85 (rather liked) , P3 (150 g sugar) with a score of 3.57 (rather like). The panelist's assessment of the texture of red guava juice was highest in treatment P1 (50 g of sugar) with a score of 4.12, the high level of preference of panelists for the texture of red guava juice in treatment P1 was caused by the texture of red guava juice which was not so thick . Giving a sugar concentration of 150 g in treatment P1 affected the texture of the red guava juice produced.

The higher the sugar content in the red guava juice, the thicker the red guava juice produced, this can affect the level of preference of the panelists for the texture of the red guava juice, it decreases. This is in accordance with the opinion of previous studies that the more concentration of sugar used, the thicker the texture of the fruit juice will be(Dari & Junita, 2021).

In addition, sugar also has hydrophilic properties because it has hydroxyl groups that can bind with water through hydrogen bonds which results in reduced water components in the material so that the texture of the red guava juice drink becomes thicker. Not different from previous research from the results of the analysis of variance, the average texture analysis test results on red guava juice in several treatments had a significant effect at the 5% level on the red guava juice produced. This can be caused by the increasing amount of sugar added during processing, so that the red guava juice produced is thicker.

The results of this study are supported by Duncan's further test which shows that each treatment has a different notation. Treatment using different sugar concentrations resulted in a different texture of red guava juice. The different textures of each treatment will affect the panelist's preference value for the texture of the red guava juice produced.

CONCLUSION

Based on the results of the study, it can be concluded that there is a significant effect between the concentration of sugar in red guava juice on antioxidant activity with the highest value P1, namely 44.97% and the organoleptic test for aroma, taste and texture, with the highest value sequentially, namely P1, namely 4.08 (likes), P3 is 4.08 (likes) and P1 is 4.12 (likes). However, it did not have a significant effect on the content of vitamin C and the taste assessment of red guava juice. Giving sugar can increase the panelist's preference for the product produced.

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