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Original Research

Formulation and Antioxidant Activity of Combination Jam Red Dragon Fruit *(Hylocereus polyrhizus)* and Green Tea Extract *(Camellia sinensis)*

Formulasi dan Aktivitas Antioksidan Sediaan Selai Kombinasi Buah Naga Merah (Hylocereus polyrhizus) dan Sari Teh Hijau (Camellia sinensis)

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Abstract: *Red dragon fruit and green tea are plants that can be made as food products that contain catechins needed as antioxidants. This study aims to determine the formula of jam that the panelists like and determine the content of flavonoids and antioxidant activity in jam products. The method of determining flavonoid content was carried out using the aluminum chloride (AlCl3) calorimetry method and antioxidant activity can be measured using the DPPH (1,1- diphenyl-2-picrylhydrazyl) free radical deterrent method by spectrophotometry Uv-Vis. This study used 4 jam formulas which were distinguished from the concentration of green tea extract namely formula 1 (0), formula II (5%), formula III (10%), and formula IV (15%). The parameters measured in this study were panelist like, flavonoid levels, and antioxidant activity. The results of the analysis show that formula 3 is the most preferred formula for panelists based on the average value of the hedonic test. Flavonoid levels of formula 3 jam were 0.0274% and had antioxidant activity with IC50 of 108.5335.*

Keywords: Dragon Fruit, Green Tea, Jam, Antioxidant

1. INTRODUCTION

Red dragon fruit has bioactive substances in the form of betalains as antioxidants and dietary fiber in the form of pectin. According to Pratama's research (2017) IC50 in red dragon fruit was obtained at 128.37 ppm. One of the uses of red dragon fruit is by processing it into fruit jam. Red dragon fruit has a nitrogenous pigment so it can be used applicatively because of its use as an attractive food coloring (9).

Green tea contains bioactive compounds called polyphenolic compounds. In general, polyphenols in plants consists of flavonoids and phenolic acids. Flavonoids are the largest group of polyphenols which are very effective as antioxidants (3). According to research by Kusmiyati M *et al*., (2015) the total phenol content of green tea is 334.68 mg/g sample. The total flavonoid content of green tea was 334.68 mg/g sample, the total flavonoid content of green tea was 0.34 mg quercetin/g sample, and the IC50 value was 21.44 ppm.

Preparations that can be made from a mixture of red dragon fruit and green tea include jam. Jam products are popular with the public, which are usually spread on bread or as

ingredients for making cakes (Untari, 2008). The processing of red dragon fruit processed products is still very limited in the market, therefore diversification of the types of processed products is carried out, such as making red dragon fruit jam, to create new products of good quality, and to extend shelf life. Abriantoro's research (2013) made jam from red dragon fruit using a ratio of fruit flesh and sugar of 100:50. The ingredients added are dyes, flavors, pectin, and acids to complement the deficiencies of the fruit (2). The addition of CMC to the manufacture of jam aims to thicken and form a suspension so that it can be applied as a thickener and enhance the taste of spreadable jam preparations because it can bind water and inhibit syneresis (5). The addition of acid in jam making must also be considered because the addition of excess acid will cause the pH to be low, resulting in synersis, namely the release of water from the gel. If the pH is too high it will cause the gel to break (6).

Based on the description that has been described, jam combination of red dragon fruit and green tea aims to increase its antioxidant activity. In addition, the anthocyanin pigment content of red dragon fruit is used as a coloring agent in making jam and can attract panelists' preferences.

2. METHODS

This research was carried out for 3 months from February to April 2019 which took place at the Pharmacy Laboratory of the Faculty of Mathematics and Natural Sciences, Pakuan University, Bogor.

Tool and Materials

The tools used are digital scales, large pot, stainless steel knife, cutting board, spoon, blender (Philips), frying pan, basin, spatula, clean cloth, strainer/sifter, glass jam jar and lid (container), gas stove, aluminum foil, spoon, spatula, oven, filter paper, evaporator cup, spatula, drip plate, filter paper, bath cloth, water bath, UV-VIS spectrophotometer, thermometer and other glassware for analysis.

The materials used are red dragon fruit, green tea leaves, citric acid, Carboxy methyl cellulose (CMC), PDAM water for washing raw materials, and sucrose (granulated sugar), 96% ethanol, 1%, Hydrochloride (HCl) 2N, HCl concentrated, Bouchardat reagent, Mayer's reagent, Dragendorf's reagent, Mg powder, quercetin standard solution, Aluminum chloride (AlCl3), 1 M sodium acetate, DPPH.

Making Red Dragon Fruit Pulp

Red dragon fruit is split into 2, separated between the skin and the flesh, placed in a container. Dragon fruit flesh is cut into cubes and then blended (without adding water) at speed no. 1 for 2 minutes and speed no. 2 for 2 minutes, namely until a smooth fruit is formed as a raw material for jam.

Making Green Tea Extract

Extraction of green tea is carried out by the infundation method, namely by extraction using a water solvent, at a temperature of 96-98ºC for 15-20 minutes (7). Green tea essence is made with a concentration of 5%, 10%, 15%. The step is taking 5 grams, 10 grams, 15 grams of green tea powder added to 100 ml of water then do the infundation process.

Jam Formulation

Jam was made into 4 formulas to determine the antioxidant activity of jam with concentrations of red dragon fruit and green tea. The jam formula was prepared by modifying the Abriantoro formula (2013) by modifying the concentration of dragon fruit pulp, adding green tea extract, and other additives. Formula concentrations can be seen in Table 1.

Table 1. Jam Formulation

Formula	F1 (g)	F2 (g)	F3 (g)	F4 (g)
Red dragon fruit pulp	70	70	70	70
Green tea extract	-	50,12*	50,34**	50,40***
Sukrosa	85	85	85	85
CMC	1	1	1	1
Citric acid	0,2	0,2	0,2	0,2
Weight total	156,2	206,32	206,54	206,60

Source: Abriantoro Modification (2013).

Information:

* Green tea extract with 5% concentration

** Green tea extract with 10% concentration

*** Green tea extract with 15% concentration

Jam Making

Materials are prepared according to their respective formulations. Red dragon fruit pulp and green tea extract are put into a pan, sucrose, citric acid, and CMC are added. Due to the presence of CMC additives, CMC was developed first with hot mortar and with hot water. Stirring is done continuously until it becomes homogeneous and thickens.

Mixing should not be too fast because it can cause bubbles which can damage the final texture and appearance. The jam is removed and cooled until the jam is completely cold, which takes about 3-15 minutes. Cooling was carried out by allowing it to stand at room temperature, after which the final weight of the jam preparation was weighed in each formula and put into a container. The jam preparations are soaked in water so that cooling can run quickly. Jam will look great with a hardened texture. Jam put in a sterilized container.

Jam Quality Test

Organoleptic Test

This test includes an assessment of the characteristics of the jam, including: color, aroma, taste, texture, and spread ability of red dragon fruit jam and green tea.

Hedonic Test

Sensory quality testing is carried out using an organoleptic test based on a hedonic scale (taste of preference level). The number of panelists was 20 people with the criteria of men and women aged over 20 years. The age range of the panelists ranges from 21-23 years. Prior to implementation, the panelists were given an explanation regarding the instructions that had been written on the score sheet. The parameters tested for taste, aroma, color, texture and spreadability of the jam were presented to the panelists as samples or one by one and then asked to rate the samples based on their level of preference. Assessment was carried out using five numerical scales, namely (1) really like (2) like (3) neutral (4) don't like and (5) don't like. The results of

the hedonic test were analyzed using SPSS 18 with the RAL method with Duncan's advanced test.

Determination of Water Content of Jam Preparations

The procedure for determining the water content of red dragon fruit jam with green tea extract was carried out using the gravimetric method. Weigh carefully 2 grams of the jam preparation, then dry it at 105°C for 5 hours and put it in a desiccator and then weigh it. Continue drying and weighing at 1-hour intervals until the difference between 3 consecutive weighing is not more than 0.25%.

pH test

Measurement of the pH value aims to determine the pH value of red dragon fruit jam and green tea. Measurements using a pH meter that has been calibrated using a pH 4 buffer and a pH 7 buffer.

Determination of Flavonoid Levels (Chang, et al. 2002)

Determination of flavonoid levels was carried out in dragon fruit pulp, green tea extract, a mixture of dragon fruit pulp and green tea extract, and jam preparations. The test was carried out by: Weighing 2 g of sample into a 10 mL volumetric flask, then adding methanol to the mark then sonicating for 10 minutes and filtering. Then pipette 0.5 mL into a vial, add 1.5 methanol, 0.1 mL of 10% aluminum chloride, 0.1 mL of 1 M Na acetate and 2.8 mL of distilled water, shaken homogeneously and incubated at room temperature for 30 minutes ago the absorption was measured at maximum wavelength at 430 nm. The resulting absorbance was entered into the regression equation of the quercetin standard curve, then the levels of flavonoids were calculated.

Antioxidant Activity Test

Preparation of Positive Control (Vitamin C) Standard Solution Series

The vitamin C series solution was prepared in several concentrations, namely 2; 4; 6; 8 and 10 ppm in a 10 ml volumetric flask, pipetted with 100 ppm vitamin C solution as much as 0.2; 0.4; 0.6; 0.8; and 1 ml into a volumetric flask 10 ml. 1 ml of 1 mM DPPH solution was added to each volumetric flask, then diluted with methanol, then homogenized and allowed to stand for the optimum time in the room and the absorption was measured at the maximum wavelength using a UV-VIS spectrophotometer.

Preparation of Test Solutions

The test solution in determining antioxidant activity consists of:

1. Dragon fruit pulp 100 mg
2. Extract of green tea 100 mg
3. The mixture of dragon fruit pulp and green tea extract is weighed 70 g / 50 g each, then 100 mg of the mixture is taken
4. Formula 1 is weighted with 100 mg of dragon fruit pulp =
   $\frac{0,1}{70}$ x 156 g = 0,222 g = 222 mg
5. Formula 3 weighed equivalent to 100 mg dragon fruit pulp and green tea extract =
   $\frac{0,1}{120}$ x 206 = 0,171 g = 171 mg

Each sample according to its weight is put into a measuring flask 100 ml and diluted with methanol to the mark (1000 ppm). Each sample was lined up, then added 1 ml of 1 mM DPPH solution and diluted with methanol up to the mark, then shaken and

incubated at room temperature at the optimum time. Absorption is measured at a predetermined maximum wavelength by a UV-VIS spectrophotometer.

Antioxidant Test with DPPH Method

The series of test solutions, the positive control solution series of vitamin C and blanks were measured for their absorbance at the wavelength maximum determined with a spectrophotometer. The percentage value of resistance to DPPH is calculated using the following formula =

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

IC_{50} value (inhibitor concentration) obtained from the cut of the line between 50% inhibition and the concentration axis using the linear equation (y = bx + a), where y = 50 and x denotes IC_{50}

3. RESULTS

4. DISCUSSIONS

1.5 kg of red flesh dragon fruit is prepared, 1.1 kg of pulp is obtained. After calculating, the yield of slurry is 73.33%. Dry green tea is prepared as much as 110 grams, then made into powder to obtain a weight of 100 grams. It is made into an extract for each formula concentrating 5 grams, 10 grams, and 15 grams, then 100 ml of water is added and the infundation process is carried out. Based on the results of the research conducted, it showed that dragon fruit pulp and green tea leaf extract contained flavonoids, tannins, saponins, and alkaloids.

Jam Evaluation Results

Jam Organoleptic Test Results

The organoleptic test results were carried out on 4 jam formulas made with the raw material composition of red dragon fruit puree and green tea extract. The addition of sucrose (sweetener), citric acid, carboxy methyl cellulose (CMC) has the same concentration, it's just that the concentration of green tea extract for each formula is different.

Table 2. Organoleptic Test Results

Formula	Parameter			
	Flavor	**Aroma**	**Color**	**Texture**
F1	Sweet	Typical Fruit	Dark Red	Thick
F2	Sweet	A little	Red	Thick
F3	Sweet (flavored tea)	Distinctive Aroma	Dark Red	Thick
F4	Sweet (the tea tastes bitter)	Distinctive Aroma	Dark Red	Thick

Figure 1. The results of making jam preparation

Formula 1 has an initial total weight amounted to 156.2 g, after it became a jam preparation it became 118 g and a yield percentage of 75.64 was obtained. The initial total weight in formula 2 was 206.32 g, after becoming a jam preparation it was 173 g with a yield of 83.98%, in formula 3 it had an initial total weight of 206.54 g, after it became a jam preparation it was 168 g and the calculation results the yield obtained was 81.5533%, and in formula 4 it had an initial total weight of 206.60 g with a final weight of jam preparation of 162 g and a yield yield of 78.6407%. The decrease in the weight of the jam preparations was caused by the heating process so that it could reduce the weight of the jam preparations.

Hedonic Test Results

The results showed that the taste parameters in formulas 1, 2 and 3 had no significant difference, whereas in formula 4 they were significantly different, this was because the concentration of green tea extract in formula 4 was more concentrated and the taste was quite bitter, causing the panelists' dislike.

The aroma parameters in formulas 1, 2, and 4 have no significant difference, whereas in formula 3 there is a significant difference, the green tea extract concentration of 10% in formula 3 produces the preferred tea aroma by panelists. Likewise, there was no significant difference in the color parameters of formulas 1, 2 and 4, whereas in formula 3 it was significantly different, because formula 3 had a brownish-red color which was quite attractive so that the panelists preferred it. The texture parameters in formulas 1, 2 and 3 did not show a significant difference, while those in formula 4 were significantly different, because the texture of the jam preparations in these formulas was less thick.

Table 3. Duncan Jam Further Test Analysis Results

Formula	Flavor	Aroma	Color	Texture
1	3.80^{b}	3.40^{a}	3.65^{ab}	3.60^{ab}
2	3.85^{b}	3.20^{a}	3.55^{a}	3.75^{b}
3	4.25^{b}	4.00^{b}	4.00^{b}	4.05^{b}
4	3.05^{a}	3.25^{a}	3.55^{a}	3.25^{a}

Note: Numbers with the same superscript letters in the same column show no significant difference between the formulas based on Duncan's test at the α level of 0.05

Results of Water Content of Jam Preparations

The water content in the red dragon fruit pulp jam sample in Formula 1 (without tea) was obtained at 20.8234%, while the water content in the Formula 3 sample (selected formula) red dragon fruit pulp jam with a combination of green tea extract was obtained at 25.3372%. The results of the water content of Formula 1 are better because there is no addition of green tea extract so it does not affect the water content in the raw material, from Formula 1 and Formula 3 it shows that the results obtained have met the requirements. The maximum water content in jam is 35% because jam is a

semi-wet food, but if it is too runny then the jam that is formed will become unstable (10).

pH Test Results

The pH test is used to determine the pH value contained in the resulting jam preparation product. The results obtained from testing the pH on samples of Formula 1 jam products (without tea) and Formula 3 (selected formula) were respectively 3,1. The results of this test are in accordance with Fachruddin's research (2008) which states that the optimum pH desired in making jam ranges from 3.1 to 3.46.

Flavonoid Test Results

The resulting wavelength is 430 nm with an optimum incubation time of 30 minutes. The relationship between absorbance and concentration gives the line equation y = 0.0081x – 0.0388 and the correlation coefficient R2 = 0.9992. This shows that there is an accurate relationship between concentration and absorbance because the results obtained are close to R2 = 1.

The measurement of flavonoid compounds in red dragon fruit pulp was obtained at 0.0183. The results of this study were very different from the results of research conducted by Kartikasari (2008) which stated that the levels of flavonoids in red dragon fruit juice were obtained at levels of 0.18%. Flavonoid levels are caused by several factors, including different fruit growing places, and the ripening process can also affect it. The results of the flavonoid content in green tea essence were obtained at 0.0490%, not much different from the results of previous studies which obtained green tea flavonoid levels of 0.0555% (Diniatik et al, 2007). The mixture of red dragon fruit pulp and green tea extract yielded a flavonoid content of 0.0387%.

The results of the flavonoid content of the formula 1 jam sample (without tea) averaged 0.0144% and in the formula 3 sample (selected formula) that was 0.0274%. The results of the flavonoid content in the jam formula were smaller because in the preparation process there was a heating process which could affect the decrease in flavonoid levels. The results showed that the value of the levels of flavonoids

The extract of green tea contained in formula 3 is greater than in formula 1 (without tea) because green tea contains relatively high levels of flavonoids compared to red dragon fruit.

Antioxidant Activity Test Results

Based on the test results, the absorption value for the 1,1-diphenyl-2-picrylhydrazyl (DPPH) solution was quite stable at a wavelength of 516 nm for 30 minutes. the antioxidant activity of vitamin C between the concentration and the % inhibition contained in the figure obtained by a linear regression equation y = 7.9935x + 7.4387 in which R2 = 0.9997 obtained IC50 (Inhibition Concentration) of 5.32 ppm has very high potential active as an antioxidant. The antioxidant activity for dragon fruit, green tea, and jam preparations can be seen in the following table.

Table 4. Antioxidant Activity Results

Sample	IC_{50} (ppm)	Antioxidant Activity
Vitamin C	5,32	Very Active
Dragon Fruit Pulp	102.89	Active
Sari Green tea	23,67	Very Active
Mixture Dragon Fruit and Green Tea	65,19	Very Active
Formulas 1	134,42	Active
Formulas 3	108.53	Active

From the results of the tests that have been carried out, formula 1 (without tea) and formula 3 (selected formula) produce moderate antioxidant activity. The results of formula 3 (selected formula) had a better IC50 value of 108.53 ppm, compared to formula 1 (without tea) which had an IC50 value of 134.42 ppm. This is because in formula 3 (selected formula) there is an addition of 10% green tea extract which in Kusmiyati's study (2015) green tea extract has an antioxidant activity of 21.44µg/ml which is classified as strong.

5. CONCLUSIONS

The best jam formula that the panelists liked the most was formula 3 with the addition of 10% green tea extract. The results of testing the levels of flavonoids in formula 3 were 0.0274% and the results of the antioxidant activity of the DPPH method obtained the IC50 value in formula 3 of 108.5335 ppm which is included in moderate antioxidants. It is necessary to carry out a stability test to determine the shelf life of the jam and necessary to carry out a microbial contamination test to determine whether the jam preparation is free of microorganisms or still meets certain time limit requirements.

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