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EFFECT OF MALTODEXTRIN CONCENTRATION ON ANTIOXIDANTS ACTIVITY AND STABILITY OF NATURAL COLORING POWDER OF SECANG WOOD (CAESALPINIA SAPPAN L) IN VARIOUS CONDITIONS OF PH AND TEMPERATURE

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ABSTRACT

This research was aimed to determine the effect of different concentrations of maltodextrin on antioxidants and stability of the natural dye powder of sappan wood under various pH and temperature conditions. This study used a completely randomized experimental design with five treatments and three replications. The treatments in this study were: A (addition maltodextrin 5%), B (addition maltodextrin 10%), C (addition maltodextrin 15%), D (addition maltodextrin 20%), and E (addition maltodextrin 25%). Before the drying process, maltodextrin was added to the sappan wood extract that had been created. Yield, color analysis, solubility test, color stability test based on pH and heating temperature fluctuations, water content, and antioxidant activity are among the observations made. The addition of maltodextrin had a substansial impact on yield, and color the addition of maltodextrin had a substantial impact on yield, color analysis, solubility, water content, and antioxidant activity, according to the findings. The best treatment in this study was treatment A (addition maltodextrin 5%) with the characteristics of yield 18.33,%, hue value in color analysis was 39,58%, with yellow red color, solubility 87,33%, water content 6,83, and 17,80 ppm antioxidant activity (strong category), as well as maltodextrin which was stable against various pH and temperature treatments.

Keyword: *sappan wood, maltodextrin, antioxidant activity, color stability*.

INTODUCTION

Color is one of the important factors in the quality of a food product. Manufacturers often add dyestuffs to a food product, so that the food product is more acceptable to consumers. Dyestuffs as additives in food are of two types, namely natural dyestuffs and synthetic dyestuffs (Cahyadi, 2008). To produce food products, it is highly recommended the use natural dyes, because in general it is safer and does not have a bad influence on health (Effendi, 2009).

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The pigment brazilein which is a pigment derived from sapwood (Caesalpinia sappan L.) is very potential to be used as a natural dye. This is because brazilien has an interesting color, namely the red color, which is the result of the oxidation of brazilin compounds (Dapson and Bain, 2015). Brazilin is also easily oxidized when in contact with atmospheric oxygen or other chemical oxidants, thus becoming a brazilien compound with the loss of hydrogen atoms of the carbonyl group (Dapson and Bail, 2015). The specific pigment in secang shows a sharp and bright red color at a neutral pH (Fardhiyanti and Riski, 2015). This compound is an antioxidant compound that has the effect of protecting the body from poisoning due to chemical radicals, and is also suspected to have anti-inflammatory and antibacterial effects.

According to Heyne (1987) in (Wetwitayaklung, et al., 2005) secang wood is a family of Caesalpiniaceace. The availability of secang is also quite abundant in Indonesia. This plant is known in several regions such as West Sumatra, Central Java, Yogyakarta, and North Sulawesi. Secang wood (Caesalpinia sappan L.) including one of the plants that are widely used in traditional medicine (Rina, 2013). The advantages of natural dyestuffs in secang wood are not only because they can be used for a long time, but can also be used as traditional Chinese medicine to activate blood circulation and eliminate stasis (Fu, et al., 2008). Secang is also a plant that is widely used as a traditional medicine that has many healing properties and is often consumed by the public as a health drink (Sugiayanto, et al., 2013). Secang wood can also be a material for the treatment of various diseases such as tuberculosis, diarrhea, dysentery, activating blood flow, and dissolving blood clots (Dalimartha, 2009).

In general, the dyestuffs from secang wood used in food products are only in the form of liquid extracts, such as Puspita (2012) who has conducted research on the manufacture of dodol arrowroot with the addition of secang wood extract. Deli (2018) conducted research on making kolang kaling jam with the addition of secang wood extract. (Rina, et al., 2012) research the addition of secang wood extract as a dye in minced meat, and (Rina, et al., 2017) research on the addition of secang wood extract as a dye in beverage products. Not only in food products, secang extract is also added to non-food products, such as Yuni (2019) who has research on making cosmetics with variations of secang extract.

Basically after the extraction process and producing the extract, the natural dye will be more resistant when processed into powder, compared to in the form of a liquid extract, which will be more flexible and practical, because its use will be wider and easier, has a low moisture content, a longer shelf life than in liquid form, is practical in use and does not take up much space in packaging. Research on the manufacture of secang powder has been carried out by (Anna, et al., 2011), with the treatment of variations in the amount of water, and has also been carried out by (Purba, 2003) with motto spray drying.

In the manufacture of a powdered product, a filler is needed in the manufacturing process. One of the fillers commonly used in the manufacture of powders is maltodextrin. The purpose of adding maltodextrin is to replace the flavor component, increase the total amount of solids, increase the volume, speed up the drying process, prevent material damage during heating, and increase the solubility of the powder (Putra, 2013). With the advantages of maltodextrin, it is expected to be able to maintain the important components in the natural dyeing products of secang wood during processing, as well as maintain the stability of brazilein pigment at various levels of pH and differences in heating temperatures. Research on the natural dye of secang wood powder has been carried out (ancient, 2003) by the spray drying method and with various types of filling materials, with the concentration of fillers ranging from 2% to 4%.

In the drying process, materials dried by the spray dyer method are more susceptible to losing active components, while the temperature used is quite high, which is 300-500oC. Meanwhile, using a food dehydrator can produce better products, because it makes the product not excessively physically or chemically damaged.

Based on existing studies, the author is interested in making the same innovation, to get the best product development by increasing the concentration of filler materials in natural dye products of sapwood by using a dryer cabinet dryer to be able to see the influence on antioxidant levels and product stability in various pH conditions and heating temperature conditions.

Based on the description above, the author will conduct research on the manufacture of natural powder of secang wood with the title "Effect of Maltodextrin Concentration on testing the Antioxidant Activity and Stability of Secang Wood Dye Powder In Various Ph And Temperature Conditions".

EXPERIMENTAL SECTION

A. Material

The materials used in this study are secang wood powder from The Sarbini Herbal Shop Yogyakarta, 50% ethanol, maltodextrin, NaOH sea (Sodium Hydroxide) 0.1 N, HCl (Hydrochloric Acid) solution 0.1 N, aquades, DPPH reagent (2,2-Diphenyl-1-Pikrilhydrazyl), silica gel and filter paper.

The instruments that used during the study were sieves, goblet cups, hot plates, food dehydrators, and blenders. While the tools used for analysis are ultrasonic bath (Elma-Elmasonic S 30 H), spectrophotometer (HACH DR 2700), oven (Memmert, WB 10WNB), desiccator, Hunter Lab (Color Flex Ez, CFEZ 0725), aluminum dish, drip pipette, Erlenmeyer, funnel, stopwatch, analytical scales.

B. Method of Research

This research method uses a Complete Randomized Design (RAL) with 5 treatments and 3 tests. The addition of maltodextrin is carried out to the secang wood extract produced before undergoing the drying process. The treatment of maltodextrin concentration consisted of: 5%, 10%, 15%, 20%, and 25%. As follows:

A : addition of maltodextrin 5%

B : addition of maltodextrin 10%

C : addition of maltodextrin 15%

D : addition of maltodextrin 20%

E : addition of maltodextrin 25%

C. Research Implementation

Extraction of Secang Wood(Moditification of Sofyan et al., 2018).

The secang wood extract was made using 50 g of secang wood powder which was put into a 1000 mL cup glass, then extracted at a temperature of 60oC using a 50% ethanol solvent with a ratio of powder to a solvent of 1:6 for 3 hours with a temperature of 60oC, in a dark state (the cup glass was lapped with aluminum foil), then left at room temperature for 30 minutes. After cooling, then filtered using a filter cloth for the first sieve, and using filter paper on the second sieve, then boiling is carried out again until the extract volume is obtained to 1/3 of the initial volume. The extract is stored in a sealed container.

Manufacture of Natural Dye Powder Of Secang Wood (Modification Astuti, 2018)

The entire result of the thick extract of sapwood added maltodextrin according to the treatment, namely 5%,10%,15%,20%, and 25% of the total amount of extract, then dried in a cabinet dryer at a temperature of 60°C for 9 hours. After drying, the formed powder is crushed using a blender and re-mashed with a mortal until smooth, then sifted with a sieve of 60 mesh.

D. ANALYSIS PROCEDURE

Amendment of Secang Wood Pigment Powder (Muchtadi and Sugiyono, 2014)

Amendment is the percentage of the final product with the main raw materials. It can be expressed in decimals or percents. With the following calculations:

$$\text{Rendemen} = \frac{\text{The weight of the final product (g)}}{\text{Initial product weight (g)}} \text{x } 100\%$$

Color Analysis (Hendrawan Modification, 2016)

Color analysis was performed using the Color Meter Hunterlab Color Flex E2, color tests were carried out with the hunter color system L*, a*, b*. The colorimeter is first calibrated with the white color standard contained in the tool. The resulting white degree analysis results are in the form of L*, a*, and b* values. Color degree measurement is used based on white as a standard. The value of L* represents a reflective light that produces white, gray, and black acrimonoius colors. The value of a* represents the chromatic color of the red-green mixture and the value of b* indicates the mixture of chromatic colors of the blue-yellow mixture. The result in the form of numerical data for each variable L*, a*, and b* will appear 3 times followed by the average. The average will be the reference for the formula:

$$°\text{Hue} = \tan^{-1}\left(\frac{b}{a}\right)$$

Solubility of Dye Powder (Fardiaz et al., 1992)

Measurement of solubility (dispersibility) is carried out to measure the degree of solubility of the resulting powder dye. The solubility test procedure is to weigh the dye powder as much as 1 g. Then dissolve in 50 mL aquadmagnetic stirrer at a speed of 900 rpm for 5 minutes. The entire mixture is filtered into filter paper that has previously weighed in weight. The resulting filter is heated in an oven with a temperature of 105 °C for 3 hours.

$$Insoluble\ parts\ = \frac{\mathrm{W2 - W1}}{\mathrm{W2}}\ x\ 100\%$$

% Solubility of powder = 100% - bagian tidak larut

Color Stability Test (Fauziah, 2016)

a. Temperature influence

Bubuk dilarutkan sebanyak 0,5 g dalam 50 mL aquades. Larutan dipanaskan dengan variasi suhu 60°C, 80°C, 100°C, dan 120°C selama 1 jam. Kemudian diukur absorbansinya dengan *scanning* spektrofotometri dilakukan menggunakan spektofotometri UV-Vis pada panjang gelombang 200-800 nm.

b. Effect of pH

3 pieces of solution with a pH concentration of 4.7, and 9 are provided. Furthermore, the powder of 0.5 g is dissolved in 50 mL of aquades. 1 mL of dye solution was taken and then 4 mL of solution was added with each pH concentration, namely: 4.7, and 9. Then the absorbance was measured by scanning spectrophotometry carried out using UV-Vis spectrophotometry at a wavelength of 200-800 nm.

Water content gravimetric method (AOAC, 1995)

Clean empty aluminum cups are dried in a 105°C oven for 30 minutes. Then the saucer is cooled in the desiccator for 15 minutes and weighed (Wo) as much as 2 g of the sample weighed in an aluminum dish of known weight (W1). Drying is carried out in the oven at 105°C for 3 hours. Furthermore, the sample is cooled in a desiccator for 15-30 minutes and weighed until the weight is constant (W2), then calculated using the following formula:

$$KA(\%\ b/b) = \frac{\mathrm{W1 - W2}}{W1 - W0} X\ 100\ \%$$

Antioxidants of ic50 (Rahmawati et al., 2017)

The stock solution is made by weighing a sample of 1 g and then sufficient in volume up to 10 mL. Furthermore, dilution is carried out again by making 5 series of solution concentrations (100 mg / L, 150 mg / L, 200 mg / L, and 250 mg / L)

For the determination of antioxidant activity, each concentration is picketed as much as 1 mL of sample solution with a micropipette and put into a test tube, then add 4 mL of DPPH 50 μM solution. The mixture is homogenized and left for 30 minutes in a dark place, absorption is measured with a UV - Vis spectrophotometer at a wavelength of 517 nm.

The antioxidant activity of the sample is determined by the magnitude of the resistance to the absorption of DPPH radicals through the calculation of the percentage (%) inhibition of DPPH absorption using the formula (Molyneux, 2004):

$$\%\ \mathrm{Inhibisi} = \frac{\mathrm{(Absorban\ blanko - Absorban\ sampel}}{\mathrm{Absorban\ Blanko}}$$

RESULT AND DISCUSSION

Amendments

The amendment in question is a comparison between the weight of the extraction results that have been made into a powder to the weight of the raw materials used for the extraction process. Amendment analysis is an important component to carry out because it will be used to determine the efficiency and effectiveness of a process. The higher the resulting yield value, the more efficient the process used (Hasrini et al, 2017). Brazilin and brazilein are included in flavonoid compounds, where flavonoids in plant tissues can be extracted using water, methanol, and ethanol (Suradikusumah, 1989). The extraction of brazilein from secang wood is usually done using a methanol solvent, but due to the consideration of methanol toxicity, the use of ethanol is the best choice to obtain high yields. Based on the results of the fingerprint analysis of the moisture content at the level of 5%, it is known that the difference in maltodextrin concentration has a significant effect on the amendment of the natural dye powder of secang wood. The average amendment of the secang wood dye powder with the addition of maltodextrin can be seen in table 1 as follows.

Table 1. Average amendment of secang wood dye powder with the addition of maltodextrin

Treatment	Amendments	
A (addition of maltodextri 5%)	17,04 ± 0,43	a
B (addition of maltodextri 10%)	17, 61 ± 0,33	ab
C (addition of maltodextri 15%)	18,00 ± 0,72	bc
D (addition of maltodextri 20%)	18,67 ± 0,08	c
E (addition of maltodextrin 25%)	18,77 ± 0,12	c
KK=2,29 %		

From Table 1 it can be seen that the yield of natural dye powder of sapwood ranges from 17.04% - 18.77%. The lowest yield was obtained at treatment A (addition of maltodextrin 5%) with a value of 17.04%. While the highest yield was obtained in the E treatment (addition of maltodextrin 25%) with a value of 18.77%.

Based on Table 1, shows that the higher the addition of maltodextrin concentrations, the more the yield of the resulting product increases. This is in accordance with research conducted by (Yuliawaty et al., 2015) which states that the effect of maltodextrin concentration on the yield value has a tendency to increase the indicated increase from the increase in the total yield produced. This is in accordance with research conducted by (Yuliawaty et al., 2015) which states that the effect of maltodextrin concentration on the yield value has a tendency to increase the indicated increase from the increase in the total yield produced. This is the same as the research conducted by (Raharjo, 2016) on the effect of the addition of maltodextrin on the characterization of secang wood instant powder drinks, where the resulting yield increases as the concentration of maltodextrin is used increases. The more maltodextrin is added, the higher the yield of the product produced, it is because maltodextrin itself can increase the time of a product produced. This is in accordance with (Nugroho et al., 2006) who emphasize that one of the functions of the use of maltodextrin in certain products is as a filler that can increase the yield of the final product produced.

Color Analysis

Color analysis of natural dye powders of wood was measured using Hunter Lab Colour Flex EZ based on parameters L, a*, and b*. The notation L* indicates the brightness where 0 (black) and 100 (white), the notation a* indicates the chromatic values of red (positive) and green (negative), and the notation b* indicates the chromatic values of yellow (positive) and blue (negative). Then calculated the value of °Hue to find out the value of the overall color.

The values of °Hue are grouped based on the following (Mclellan, Lind, and Kime, 1995 cit Sumelda, 2018 cit Ardi, 2019).

^{0}Hue 18 – 54	: red
^{0}Hue 54 – 90	: yellow red
^{0}Hue 90 – 126	: yellow
^{0}Hue 126-162	: yellow green
^{0}Hue 162 – 198	: green
^{0}Hue198–23	:blue green
^{0}Hue 234 – 270	: blue
^{0}Hue 270 – 306	: blue purple
^{0}Hue 306 – 342	: purple
^{0}Hue 342 – 18	: red purple

Table 2. Average value Hue powder dye wood secang with the addition of maltodextrin

Treatment	**L***	**a***	**b***	**°Hue**	**Warna**
A (addition of maltodextrin 5%)	29,83	22,04	13,33	39,58	Red
B (addition of maltodextrin 10%)	36,82	22,27	17,83	59,06	Yellow red
C (addition of maltodextrin 15%)	38,04	21,27	18,38	67,13	Yellow red
D (addition of maltodextrin 20%)	43,22	23,58	22,52	81,06	Yellow red
E (addition of maltodextrin 25%)	47,50	22,52	24,65	111,62	Yellow
KK =7,00%					

°Hue is a quantity that shows the color position of an object in the Lab color diagram. The Hue value is obtained by calculating the tangent inverse of the ratio of b and a, so that it can be obtained from the color diagram. Based on the Hue value data in table 5, it can be seen that °Hue the resulting secang wood natural dye powder ranges from 39.58-111.62. The lowest °Hue was obtained at treatment A (5% addition of maltodextrin) with a value of 39.58. Meanwhile, the highest °Hue was obtained in the E treatment (25% maltodextrin addition) with a value of 111.62. This suggests that the higher the concentration of maltodextrin added, the higher the °Hue and L* produced.

The higher the L* value indicates the brighter the color of a product, meaning that the powder dye from the resulting sapwood extract tends to have a less red color. This is thought to be because the extraction method uses a 50% ethanol solvent, where brazilein extract in 50% ethanol has a reddish-yellow color because it is acidic with a pH of about 5.5 (Kristie, 2008). This is supported by the addition of maltodextrin, where maltodextrin can increase the number of solids, where the solids do not contain color, thereby reducing the proportion of red color contained in the dye powder from the sapwood extract, it is shown from the resulting color, which starts from red to yellow. The higher the concentration of maltodextrin, the degree of white tends to increase, it is influenced by the nature of maltodextrin which has a bright color. The results of the study are in accordance with those reported by Yuliawati et al (2015) that the more additional concentrations of maltodextrin, the higher the degree of whiteness. Maltodextrin has a color that tends to be white so when mixed with secang wood extract which is red in color, it will give a brighter color.

Solubility of Dye Powder

Based on the results of fingerprint analysis of moisture content at the level of 5%, it is known that the difference in maltodextrin concentration has a significant effect on the solubility of natural dye powder. The average solubility of the secang wood dye powder with the addition of maltodextrin can be seen in table 3 as follows.

Table 3. The average solubility of the secang wood dye powder with the addition of maltodextrin

Treatment	**Solubility ± SD**	
A (addition of maltodextrin 5%)	87,33 ± 0,57	a
B (addition of maltodextrin 10%)	88,33 ± 0,57	a
C (addition of maltodextrin 15%)	91,33 ± 0,57	b
D (addition of maltodextrin 20%)	93,00 ± 1,00	c
E (addition of maltodextrin 25%))	94,00 ± 0,0	c
KK = 0,75 %		

From Table 3 it can be seen that the solubility of the natural dye powder of secang wood ranges from 87.33% - 94.00%. The lowest solubility was obtained at treatment A (5% Addition of Maltodextrin) with a value of 87.33%. While the highest solubility was obtained in the E treatment (25% Maltodextrin Addition) with a value of 94.00%. According to Yuliawaty (2015) if the solubility value obtained is higher, it shows the better the product produced, because the presentation will be easier, this is a very supportive property in the natural dye product and is applicable to use. The solubility of the powder is influenced by several factors, one of which is the rehydration properties of water. Brazilin if oxidized will produce brazilein compounds that are brownish-red in color and can dissolve in water. This is supported by the addition of fillers, namely maltodextrin which has other properties: rapid dispersion, high solubility properties capable of forming a film, low hygroscopic properties, low browning properties, ability to inhibit crystallization, and maltodextrin also has a strong water-binding ability (water holding capacity) (Blancard, 1995) (Moore et al, 2005). Maltodextrin is an oligosaccharide that is very easily soluble in water so that it is able to form an evenly dispersed system (Winarno, 2002). So that the solubility of the natural dye powder product of secang wood has increased, along with the increase in the concentration of maltodextrin.

Color Stabilility Test

a. Color Stability Test based on pH

Spectrophotometric scanning analysis was performed using UV-Vis spectrophotometry at a wavelength of 200-800 nm which obtained the chart trend as shown.

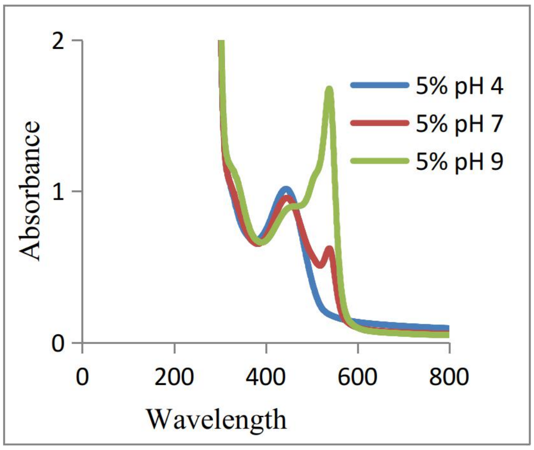

Figure 1. Graph of spectrophotometric scanning results at 5% maltodextrin content against pH difference

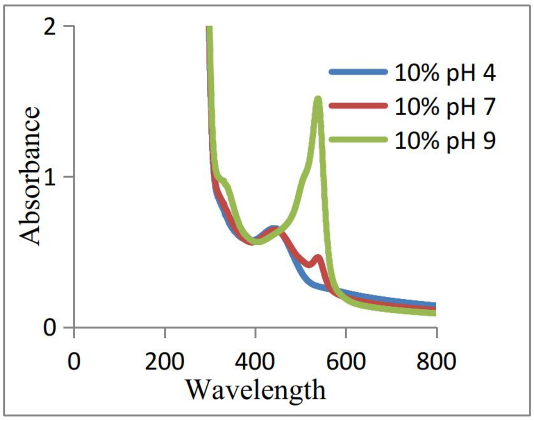

Figure 2. Graph of spectrophotometric scanning results at 10% maltodextrin content against pH difference.

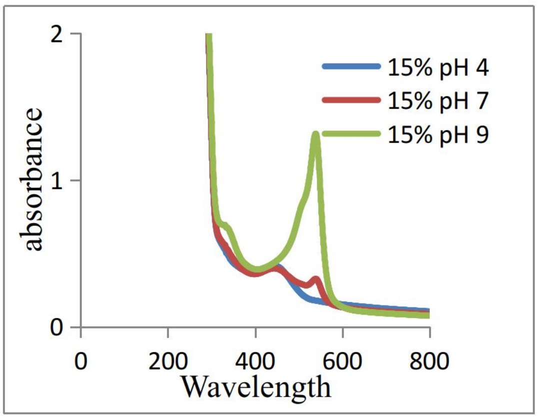

Figure 3. Graph of spectrophotometric scanning results at 15% maltodextrin content against pH difference.

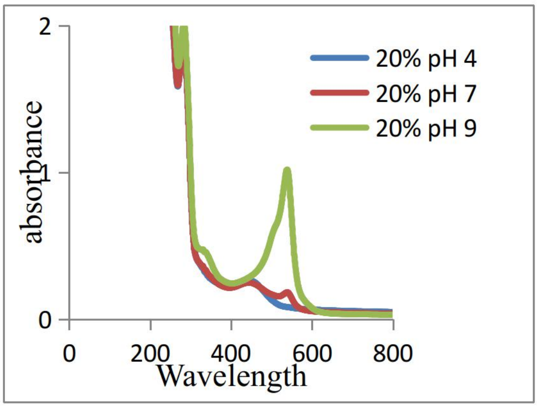

Figure 4. Graph of spectrophotometric scanning results at 20% maltodextrin content against pH difference.

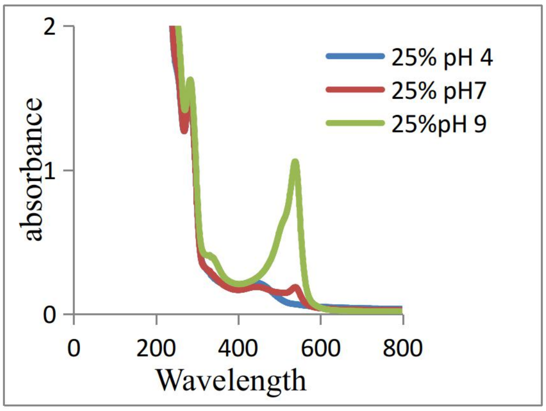

Figure 5. Graph of spectrophotometric scanning results at 25% maltodextrin content against pH difference.

From the observation of the graph and the absorbance value obtained, there is a decrease in the absorbance value, along with an increase in the concentration of maltodextrin. This is because the total brazilien contained in the product is also decreasing, with more and more maltodextrin concentrations being added.

From the observation of the color of the dye of the wood, after it is raised its pH until it reaches an alkaline pH, it shows a color that increasingly becomes purplish-red, with increasing pH (the more alkaline). From the observation of the graph, it shows that the higher the pH (base) there is an increase in color retention and an increase in absorbance in the pigment, but after that, the absorbance pattern tends to decrease. This suggests that brazilien pigment is unstable at alkaline pH.

This is in accordance with (Adawiyahdan Indriati, 2003) who provides information, that brazilein contained in wood extracts is low instability. The stability of brazilein pigment is influenced by pH, temperature and heating, ultraviolet rays, oxidizers and reduction, and metals. At pH 2-5 the pigment brazilein is yellow while at pH 6-7 it is red, and at pH 8 and above it is purplish-red. . This is also due to the presence of chemical compounds that have the property of being able to change and react to certain temperature conditions in an acid-base environment. In these conditions, chemical compounds can react or decompose into other types of compounds or new compounds appear that give a different color from their initial conditions. It can be concluded that the absorbance with an increase in the concentration of maltodextrin with an increase in pH is inversely proportional, the higher the concentration of maltodextrin, the less absorbance (less stable), but the higher the pH used, the more the absorbance value will increase (stable).

b. Color Stability Test based on Heating Temperature

Spectrophotometric scanning analysis was performed using UV-Vis spectrophotometry at a wavelength of 200-800 nm which obtained the chart trend as shown.

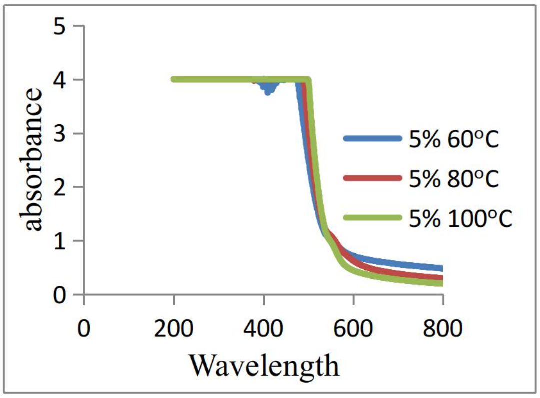

Figure 6. Graph of spectrophotometric scanning results at 5% maltodextrin content

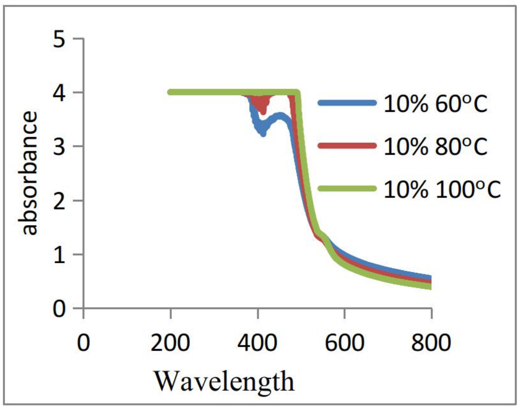

Figure 7. Graph of spectrophotometric scanning results at 10% maltodextrin content

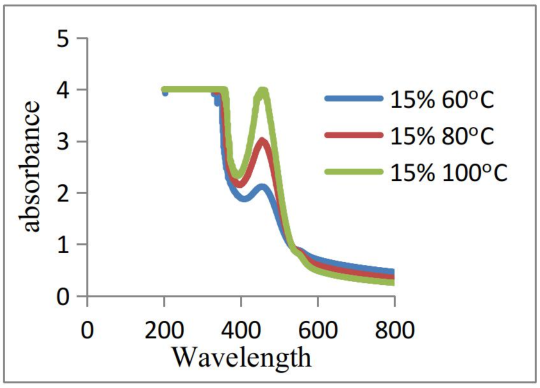

Figure 8. Graph of spectrophotometric scanning results at 15% maltodextrin content

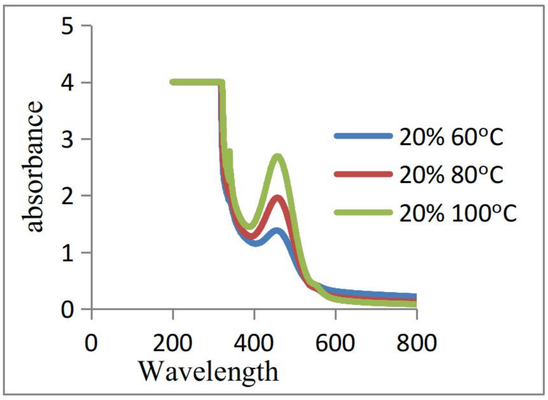

Figure 9. Graph of spectrophotometric scanning results at 15% maltodextrin content

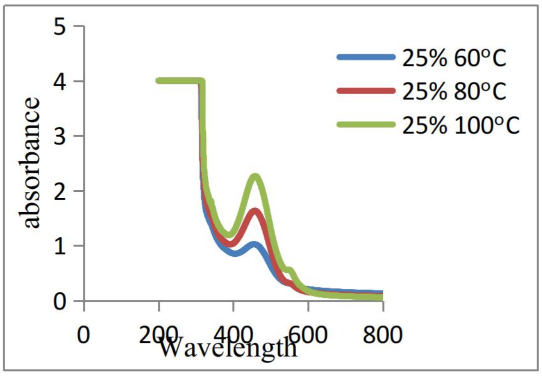

Figure 10. Graph of spectrophotometric scanning results at 5% maltodextrin content

Based on the graph above, shows that the higher the temperature used in heating, the more the absorbance value produced increases. This is the same as the research conducted by (Titiek Pujilestari and Irfa'ina Rohana Salma, 2017) The higher the temperature, the higher the absorbance value will be, and the absorbance results obtained in the study range from 0.3038-2.1921 with temperatures of 50°C, 75°C, and 100°C. This is strengthened by research

(Rahmadani, 2015) which provides information that secang wood extract experiences an increase in absorbance value, along with the higher heating temperature.

Heating temperature, ultraviolet light, the presence of oxidizers and reduction, as well as the addition of metals affect stability and result in the degradation of brazilien pigments (Maharani, 2003). Based on the absorbance results obtained, it shows that brazilien pigment is still stable at heating temperatures up to 100°C. This is because this brazilien pigment undergoes a decomposition temperature of > 130°C and the melting point of the brazilien pigment at a temperature of 150°C. So that below that temperature the pigment is still in a stable condition.

The addition of maltodextrin concentration also affects the brazilien pigment, the higher the concentration of maltodextrin used, the less the total brazilien contained in the natural dye product of the sapwood, thereby reducing the absorbance value produced. It is also supported by maltodextrin which can be soluble in water, including hot water, because in stability testing against this temperature, the sample was previously dissolved in aquades, before going through a heating process, so that its function in encapsulating and maintaining the content in the dye powder of secang wood, including brazilien is reduced.

Moisture Content

Water content is one of the most important components in determining the quality and shelf life of a product or food ingredient. Based on the results of fingerprint analysis of water content at the level of 5%, it is known that the difference in maltodextrin concentration has a significant effect on water content. The average moisture content with the addition of maltodextrin can be seen in table 4 as follows.

Table 4. The average moisture content of the secang wood dye powder with the addition of maltodextrin

Treatment	**Moisture Content (%) ± SD**	
A (addition of maltodextrin 5%)	6,33 ± 0,28	a
B (addition of maltodextrin 10%)	6,83 ± 0,28	ab
C (addition of maltodextrin 15%)	7,33 ± 0,288	bc
D (addition of maltodextrin 20%)	7,50 ±2,56	cd
E (addition of maltodextrin 25%)	8,00 ±0,50	d
KK = 4,39%		

From Table 4 it can be seen that the moisture content of natural dye powder of sapwood ranges from 6.33% - 8.00%. The lowest moisture content was obtained at treatment A (5% addition of maltodextrin) with a value of 6.33%. While the highest water content was obtained in the E treatment (25% addition of maltodextrin) with a value of 8.00%. From the table, it shows that the higher the concentration of maltodextrin added, the higher the water content produced. This is in accordance with the research of Raharjo (2016) which provides information that the more concentration of maltodextrin added, the higher the water content in the instant powder drinks of the secang wood produced, research on the addition of maltodextrin was also carried out by Yuliawati (2015) on instantaneous drinks of sacred leaves that provide the same information, namely an increase in the moisture content of the product due to the increase in maltodextrin concentration. The increase in water content in the secang wood coloring powder is caused because maltodextrin acts as a filler in the manufacture of natural dye powder of secang wood which has an influence on the product, related to the nature of maltodextrin itself, which can bind the free moisture content to a material (Hui, 2002). research on the addition of maltodextrin was also carried out by Yuliawati (2015) on instantaneous drinks of sacred leaves that provide the same information, namely an increase in the moisture content of the product due to the increase in maltodextrin concentration. The increase in water content in the secang wood coloring powder is caused because maltodextrin acts as a filler in the manufacture of natural dye powder of secang wood which has an influence on the product, related to the nature of maltodextrin itself, which can bind the free moisture content to a material (Hui, 2002). This is reinforced by the fact that maltodextrin is hygroscopic (can absorb water). The high proportion of maltodextrin addition causes the number of hydroxyl groups to increase so that it can bind more water from the environment (Yuliawaty and Susanto, 2015). Thus, the large proportion of maltodextrin results in the re-absorption of moisture increasing. The moisture content of the natural dye powder of the wood produced is following SNI 01-3709-1995, which has a maximum moisture content of 12.00%.

Antioxidant Activity

Antioxidants function as electron donors for compounds that are radical and compounds that are classified as Reactive Oxygen Species (ROS) (Anggraini, 2017). Antioxidant activity is analyzed based on its ability to capture radical scavenging activity. Testing the antioxidant activity of sapwood raw materials was carried out by the method of capturing DPPH free radicals (1,1-diphenyl-2-picrylhydrazil) expressed with IC50 values (Inhibitory Concentration 50).

According to (Nathania, Maarisit, Potalangi, and Tapehe, 2020) IC 50 is the magnitude of the concentration of solution needed to inhibit free radicals by 50%. Antioxidant activity is categorized as very strong, if the IC50 value is less than the value of 50 ppm, the strong category ranges from 50 to 100 ppm, the less category ranges from 100 to 250 ppm, and the weak ranges from 250 to 500 ppm. Based on the classification of antioxidant activity strength categories stated in IC50 in this study, the products produced ranged from strong to fewer categories. Shafwatunida (2009) in Sufiana and Harlia (2012) says that phytochemical tests show that sapwood contains chemical compounds from the group of alkaloids, flavonoids, and saponins. Phytochemical compounds that act as antioxidants in secang wood are brazilin and flavonoids. Widowati (2011) states that secang wood extract also contains high levels of terpenoids. The high antioxidant activity of secang wood extract is also thought to be due to the content of terpenoids, such as monoterpenes and diterpenes. The presence of antioxidants can change the color of the DPPH solution from purple to yellow (Dehpour Ebrahimzadeh, Fazel, and Mohammad, 2009).

Based on the results of fingerprint analysis of water content at a level of 5%, it is known that the difference in maltodextrin concentration has a significant effect on antioxidant activity. The average antioxidant activity with the addition of maltodextrin can be seen in table 5 as follows.

Table 5. The average solubility of the secang wood dye powder with the addition of maltodextrin

Treatment	**IC 50 rated ± SD**	
A (addition of maltodextrin 5%))	17,80 ± 0,94	a
B (addition of maltodextrin 10%)	52,84 ± 0,36	b
C (addition of maltodextrin 15%))	128,39 ± 1,17	c
D (addition of maltodextrin 20%))	197,82 ± 0,81	c
E (addition of maltodextrin 25%))	215,41 ± 0,80	d
KK= 0,32 %		

From Table 5, it can be seen that the antioxidant activity of natural dye powders of secang wood with various levels of maltodextrin concentrations ranges from 17.80 to 215.41. The lowest antioxidant content was obtained at the E treatment (25% Maltodextrin addition) with a value of 215.41. While the highest antioxidant was obtained in treatment A (5% Addition of Maltodextrin) with a value of 17.80. The data above shows that antioxidant activity tends to decrease along with the increase in maltodextrin concentration. This is to research conducted by (Raharjo, 2016) regarding the addition of maltodextrin concentrations in the manufacture of instant sawdust drinks, where the antioxidant value obtained decreases, along with the increase in maltodextrin concentration. This is caused by the increasing number of fillers (maltodextrin), which will increase the total number of ingredients that do not contain antioxidants so that the percentage of total antioxidants in the measured natural dye powder of sapwood will be lower and the measured antioxidants will be less.

According to (Senobroto et al., 2011) maltodextrin as an encapsulated ingredient can withstand the release of antioxidants as long as it has not undergone a hydration process by water. During the hydration process, the water will dissolve the encapsulating layer to facilitate the dissolving process in water so that it can release antioxidants and dissolve in water. At this time antioxidants will appear according to the characteristics of the natural product, it also supports the reduction of antioxidants in the product, apart from the total amount of solids containing antioxidants is reduced because it is replaced by total maltodextrin solids that do not contain antioxidants. If the IC50 value is smaller then the antioxidant ability is greater (Senevirathe et al.,2006). Based on the classification of antioxidant activity strength categories stated in IC50 in this study, the products produced ranged from strong to fewer categories.

CONCLUSION

Based on the research that has been carried out and has also been analyzed, the following conclusions can be drawn:

1. The treatment of the addition of maltodextrin to the natural dye powder product of secang wood has a significant effect on the yield, moisture content, color analysis, antioxidants, and solubility of the natural dye powder product of the sapwood.
2. The best characteristics of the natural dyeing powder product of secang wood with the addition of maltodextrin are the addition of 5% maltodextrin (treatment A) with an amendment of 18.33%, °Hue 39.58 solubilities of 87.33%, and the antioxidant activity expressed in IC 50 which is: 17.80 ppm, as well as maltodextrin which is stable to various pH and temperature treatments.

CONFLICT OF INTEREST

The authors had no conflict of interest

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