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ADDITION OF MALTODEXTRIN CONCENTRATION TO ANTHOCYANIN CHARACTERISTICS AND LEVELS IN THE MANUFACTURE OF NATURAL DYES FROM THE SKIN OF RED DRAGON FRUIT (HYLOCEREUS POLYRHIZUS)

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Abstract

Synthetic dyes in food products can cause health problems. One alternative that can be done is to reduce the consumption of colored food products or switch to using natural dyes. The use of red dragon fruit is only limited to the fruit, while the skin of the red dragon fruit is still untapped and disposed of as waste. The skin of red dragon fruit (Hylocereus polyrhizus) contains anthocyanin pigments of the cyanidin-3-glucoside type which can be used as natural dyes. The dyes in powder form have a long shelf life. The addition of maltodextrin as filler is expected to improve the characteristics of the natural dyes produced. The purpose of this study was to determine the characteristics, anthocyanin levels and shelf life of red dragon fruit peel dye. The making of red dragon fruit peel dye was done by first extracting it with a maceration technique using a water solvent: citric acid 5% (1: 1) for 24 hours. Maltodextrin was added to the filtrate with a concentration of 5%; 10%; 20%; and 30% of the total volume of the solution, while the drying temperature was carried out at 28 ° C and 13 ° C. The resulting natural dyes were then tested for total yield, pH, moisture content, solubility, color intensity, anthocyanin levels by UV-Vis spectrophotometry, and organoleptic. Selected natural dyes were then tested for Total Plate Numbers (ALT) and their shelf life was determined using the Accelerated Shelf Life Testing (ASLT) method. The results showed that natural dyes with a concentration of 30% maltodextrin at 13 ° C were the selected dyes and had the best characteristics. The total yield analysis resulted was 11.30%; pH measurement of 4.24; water content of 1.03%; solubility of 98.08%; color intensity L value of 59.41; a value of 33.44; and the b value of -7.78. The results obtained from the analysis of anthocyanin levels were 15.0290 ppm. The total plate number test obtained is 2.1 x 102 colonies / gram with a storage life of 282 days.)

Keywords: red dragon fruit skins, anthocyanins, maltodextrins, natural dyes.

1. INTRODUCTION

Food coloring is a type of food additive that is used to support the appearance of an ingredient or food product so that it looks more attractive. Consumption of chemicals in the long term can cause health problems. The use of synthetic dyes in a wide variety of food products has resulted unconsciousnessn consumers in consuming the food product. The number of dyes consumed is increasing, thus endangering the health of consumers. Therefore, natural dyes are needed as an alternative to using synthetic dyes (Cosmas, 2016). The skin of red dragon fruit (Hylocereus polyrhizus) contains anthocyanin pigments which can be used as natural dyes. According to Supiyanti (2010), the red color of the red dragon fruit peel is produced from anthocyanin pigments with the type of cyanidin-3-glucoside. The same thing was stated by Ratna (2016) in her research looking for optimization of anthocyanin uptake from red dragon fruit skin as a natural coloring in food. Many food coloring preparations are available in concentrate form. However, the dye preparations in concentrate form have relatively short shelf life and stability. Therefore, it is necessary to prepare food coloring in powder form so that the resulting color is more stable and can be stored for a longer period of time. To maintain the stability of the pigment so that it is protected from light and air, fillers are needed in the manufacturing process.

2. METHODS

The materials used in this study were red dragon fruit peel, citric acid, maltodextrin, aqua dest, 0.2 N HCl, sodium acetate, silica gel, saturated solution, salt NaOH, KI, NaCl, KCl, $BaCl_2$. The tools used include a blender, knife, beaker, measuring cup, refrigerator, oven, desiccator, funnel, dropper, filter paper, porcelain cup, watch glass, analytical balance, stirring rod, aluminum foil, measuring flask, pH meter, chromameter. -400, and UV-Vis spectrophotometer.

2.1 Treatment of Samples

The skin of the red dragon fruit is cleaned, cut into small pieces, then blended and macerated with the addition of distilled water and 5% citric acid with a 1:1 ratio of material and solvent for 24 hours before the liquid extract is filtered. The process is repeated three times. The red dragon fruit extract was added with

Volume 01, Number 01, Juni 2021, Page 06-10
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maltodextrin with a variation of 5% concentration, 10%, 20%, and 30% of the total solution and then dried in various temperatures (13°C and 28°C).

2.2 Characteristics of Dyes

The characteristic tests of the red dragon fruit skin dye were carried out with the main parameters observed are color, aroma, taste, and texture. Moreover, the researchers also tested the chemical characteristics, such as water content, solubility, pH, and total anthocyanin level. Samples that had physical and chemical characteristics were then tested for organoleptic by the panelists to get the most preferred dye. The microbiological characteristic carried out was the Total Plate Figures (ALT). Meanwhile, the critical water content approach method is used for shelf life.

2.3 Water Content Test

Water content in food products is a factor that can affect the quality of a product. The principle of measuring the water content in natural dyes is by evaporating the water in the natural dye of red dragon fruit skin by heating, then weighing it to a constant weight, which means that all the water has been evaporated. In the test, the sample homogenized into the dish is weighed, put in an oven at 105^0C, and dried for 3 hours. After which, it cooled in a desiccator for 30 minutes. After cooling, the plates containing the sample are weighed to a fixed weight.

2.4 Solubility Test

The filter paper was heated in 1.0, and for the second sample, 10 ml of pH 4.5 solution was used, then it was taped with distilled water until the limit mark. The absorbance of each solution was measured at a maximum wavelength of 700 nm. Total anthocyanin content (TAC) is calculated with the following formula: oven at 105°C for 15 TAC = × BM × DF × 1000 minutes, cooled in a desiccator, then weighed the empty weight. The natural dyes dissolved in the water before filtered with filter paper. The filter paper was heated in an oven at 105°C for 2 hours, cooled in a desiccator for 15 minutes, then weighed.

2.5 pH Measurement

The natural dyes were dissolved in 100 ml of water. Then, the color solution was checked using a pH meter by immersing the electrode in the test sample until the pH meter shows a steady reading. Anthocyanin Concentration Determination total determined by weighing 1 gram of dye as many times into different 50 ml volumetric flasks. In the first sample used 10 ml of pH solution where TAC (mg/100g); A is the final absorbance; Ɛ is molar absorptivity (26,900 L (mol. cm) –1); BM is the molecular weight of cyanidin-3- glucoside (449.2 g / mol); DF is the dilution factor; l is the thickness of the cuvette (1 cm).

2.6 Organoleptic Test

The test was performed using a favorite number 1 to 7, representing the panelists' preferences. The organoleptic test was carried out in two ways, the rating test and the ran testing. Total Plate Figures (ALT) Weighed the sample, then diluted to the level of dilution as needed. Dipipettes 1 ml each from each dilution and duplicate. PCA media was poured into the petri dish containing the sample, homogenized. Left to freeze, put the petri dish in an inverted position into an incubator at 30ºC for 72 hours.

2.7 Measurement, Initial Moisture

The moisture content determination is a gravimetric principle by drying the dishes in an oven at a temperature of approximately 105 °C for one hour. Then cooled in a desiccator for about 15 minutes and weighed (W1). A total of 2 grams of sample (W2) in a cup is put in an oven at 105 ° C for 3 hours until it reaches a constant weight of the plate containing the sample is cooled in a desiccator and then weighed (W3). Mc measurement, Moisture Critical The critical moisture content is the moisture content when the product has not met the acceptance criteria (physically damaged). Products stored at 25° C and RH 75% saturated NaCl were observed every 24 hours until the products coagulated. Then the moisture content of the product is measured using the same method as the initial moisture content measurement. Measure Measurement, Moisture Equilibrium The vacuum chamber is prepared first, which has been filled with a saturated salt solution. The salts used are NaOH, NaCl, KI, KCl, $BaCl_2$, which represent various RH conditions. Before being put into the vacuum chamber, the sample was measured by weight. The weighed sample is then put into a vacuum chamber so that the sample and the solution do not touch each other.

2.8 Determination of Isothermal Sorption Model

The value of Me, together with aw, is included in Chen Clayton, Henderson, Hasley, Caurie, and Oswin's sorption isothermic equation models. The five isothermic sorption equation models were evaluated for the Mean Relative Deviation (MRD). If the MRD value <5, the isothermic sorption model can describe actual or very precise circumstances. If 5 <MRD <10, then the model rather accurately describes the situation actually, and if MRD> 10, then the model does not accurately describe the true condition.

2.9 Permeability Determination of Packaging

Permeability packaging is specified by using a desiccant in the form of silica gel. The silica gel is put in a cup then covered with packaging to be specified permeability to water vapor. Silica gel and saucer, which has been closed packaging then

Volume 01, Number 01, Juni 2021, Page 06-10
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weighed to measure the initial weight and then put in a closed jar containing NaCl.

2.10. Estimated Shelf Life

All parameters measured and defined in the previous stage are integrated into the Labuza equation [2].

$$\Theta = [\text{In (Me-Mi)} / \text{(Me-Mc)}] / [k / x. (A / Ws). Po / b)$$

3. RESULTS AND DISCUSSION

3.1. Rendement

Based on the study results, the yield at drying temperatures of 13°C and 28°C tended to increase with the increasing concentration of maltodextrin in the red dragon fruit peel extract. According to the authors in Ref. [3], an additional amount of maltodextrin will lead to a higher yield. The highest yield was obtained at a drying temperature of 28°C with 30% maltodextrin is 11.47%, while the highest yield at a drying temperature of 13°C with 30% maltodextrin is 11.30%.

3.2. Physical Characteristics

Based on the study results, the higher the maltodextrin concentration was added, the brighter the color was. Natural dyes dried at 13° C are more stable than natural dyes dried at 28°C. Drying at 13°C produces a smoother dye texture compared to drying at 28°C. The drying process at 28°C produces a hard enough dye, difficult to destroy, resulting in a coarse powder. The addition of maltodextrin concentration does not affect natural dyes' taste after being diluted with water beforehand. Therefore, the taste does not interfere when applied to drinks.

3.3. pH Measurement

pH measurements were carried out on red dragon fruit skin dye to determine the effect of adding maltodextrin on the acidity of the natural dyes obtained. The highest pH value at a drying temperature of 13°C with the addition of 30% maltodextrin is 4.24, while the highest pH value is at a drying temperature of 28°C with 30% maltodextrin at 4.06. From the research results, the higher the concentration of maltodextrin is added, the pH value will increase. The result is consistent with a previous study conducted by the authors in Ref. [3], which states that the higher the maltodextrin concentration, the resulting pH tends to increase.

3.4. Water Content Test

From the water content test, the additional maltodextrin concentration in red dragon fruit peel extract produced natural dyes with little water content. Further shows that the addition of maltodextrin will reduce water content.

3.5. Solubility Test

From the test, it was found that maltodextrin affects the solubility of natural dyes. The more maltodextrin concentration, the higher the solubility. The result was due to the water-soluble properties of maltodextrin. From the research results, the highest solubility obtained was the addition of 30% maltodextrin with a drying temperature of 13°C and 28°C, namely 98.08% and 92.21%.

3.6. Color Test

Color measurements were carried out on natural dye powders that were produced using a chromameter-400. The parameters observed were brightness (L), red intensity (a), and yellow intensity (b). The results showed that the brightness of natural dye powders increased with the addition of maltodextrin concentrations. The addition of 30% maltodextrin has the highest brightness value, namely 59.41 at a drying temperature of 13° C.

3.7. Anthocyanin Level Test

Anthocyanin levels were tested using the pH difference method. The pH solution used is KCl with a pH of 1 and sodium acetate with a pH of 4.5. Based on the analysis, the highest anthocyanin content was found at 5% maltodextrin with a drying temperature of 28° C at 19.6212 ppm, while the lowest anthocyanin content was the addition of maltodextrin with a drying temperature of 28° C at 10.4368 ppm. The measurement results showed that anthocyanin levels decreased with increasing concentration of maltodextrin. The result is similar to the authors in Ref. [4], which concluded that the higher the fillers' addition, the lower the total pigment obtained.

3.8. Organoleptic Test

The result of the powder color parameter rating test shows that the most preferred red dragon fruit skin dye is a natural dye with the addition of 10% maltodextrin at 13° C drying temperature, while the most preferred solution color is a natural dye with the addition of 30% maltodextrin at 13°C drying temperature. C. Rating-test result parameter texture shows that natural dyes with the addition of maltodextrin 20% at a drying temperature of 13° C have a value of 4.45, which is the highest value of other natural dyes.

3.9. Microbiological Characteristics

Microbiological analysis is performed as an indicator of food sanitation or an indicator of food safety. Microbiological testing carried out on natural dyes of red dragon fruit skin includes the Total Plate Number (ALT) test. This method can describe the microbiological quality of foodstuffs. The high ALT value indicates many microorganisms that can endanger consumers [5]. Plate Number The total natural dye for red dragon fruit peel, is 2.1 x 102 colonies/ gram.

Volume 01, Number 01, Juni 2021, Page 06-10
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3.10. Determination of Shelf Life

Through the equation derived by Labuza [2] regarding shelf life, there are several factors to determine shelf life using the critical water content approach. These factors are the initial moisture content of the product (Mi), the critical moisture content (Mc), the equilibrium moisture content (Me), the bottled water vapor permeability constant (k / x), the ratio of the packaging area to the dry weight of the product (A / Ws). , the saturated water vapor pressure under storage conditions (Po) and the slope (slope) of the isothermic sorption curve (b).

3.11. Initial Moisture Content (Mi) and Critical Water Content (Mc)

Initial moisture content and critical moisture content are the first parameters that need to be measured in estimating shelf life. The initial water content (Mi) obtained was 0.02017 g H_2O/g solid. Red dragon fruit skin coloring is hygroscopic (easy to clot), so it is determined that the point of damage is based on critical water content (Mc). The critical water content (Mc) of natural dyes is determined by observing every 24 hours until the product is coagulated, then the water content is analyzed in the same way as the initial moisture content measurement. The Mc value for natural dyes is 0.1150 g H_2O / g solid.

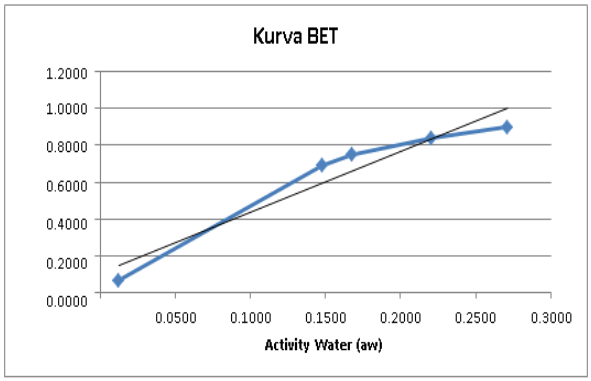
3.12. Equilibrium Moisture Content (Me)

The equilibrium moisture content (Me) was determined to obtain an isothermic sorption curve. The equilibrium water content can be determined by conditioning the red dragon fruit peel dye under various RH conditions using a saturated salt solution at 28ºC. The equilibrium moisture content obtained from each experiment is plotted with the aw or RH value of the environment, thus forming a curve called an isothermic sorption curve. Dry foodstuffs have a sigmoid-shaped water isothermic sorption curve [2]. The curve on red dragon fruit skin dye is sigmoid in shape but not perfect.

3.13. Isothermic Sorption Model

The results of the analysis of the water sorption isothermic curve were put in several model mathematical equations, namely from Hasley, Chen-Clayton, Henderson, Caurie and Oswin. Model math equations that used modified to the equation of the line form. The chosen equation model is the model that gives the smallest MRD value, where this value shows that the Hasley equation model can describe the entire isothermic sorption curve of red dragon fruit peel dye accurately (MRD <5). BET determination

The single-layer moisture content can be determined using the Brunauer-Ermet-Teller (BET) equation. To determine the moisture content of the single layer BET, a linear regression curve was created connecting aw with [aw / (1-aw) Me].



Based on the research results, the slope is 0.2805, and the intercept is -0.0182. If the slope and intercept data are included in the formula, a single layer water content of 3.81% is obtained. Drying natural dyes to or less than 3.81% will increase the shelf life of the dye.

Determination of Packaging Permeability. Permeability of materials packaging is necessary to determine a shelf life ingredient the packaged material and the deterioration criteria for the packaged material. In this study, the packaging that will be determined for its permeability to water vapor is aluminum foil. The packaging permeability obtained was 0.2573 g / m^2.day.mmHg.

3.14. Estimated Shelf Life

The shelf life of a product in packaging can be predicted based on the diffusion or absorption theory by or from the product [2]. Shelf life is determined based on several factors in the critical moisture content approach. The theory is described in a mathematical equation as follows:

$$\Theta = [In (Me-Mi)/(Me-Mc)] / [k/x. (A/Ws). Po/b)$$

Storage of red dragon fruit peel dye, the packaging size used is 20 cm x 10 cm, so the surface area of the package is 0.02 m2. The weight of red dragon fruit skin dye per package is 50 grams. From the calculation of the shelf life, red dragon fruit peel dye packed with aluminum foil has a shelf life of 282 days or about 9 months.

4. CONCLUSIONS

In this study, it can be concluded that the best addition of maltodextrin concentration is 30% with a drying temperature of 13 ° C. Characteristics of natural dyes, namely yield of 11.30%; pH measurement of 4.24; water content of 1.03%; solubility of 98.08%; color intensity L value of 59.41; a value of 33.44; the b value is -7.78, and the anthocyanin content is 15 ppm, so it can be used as a natural food coloring. The shelf life of natural red dragon fruit skin coloring is 282 days in aluminum foil packaging. In making natural red dragon fruit skin dye, other methods need to be used in

Volume 01, Number 01, Juni 2021, Page 06-10
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the drying process. It is necessary to analyze the shelf life using other types of packaging.

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