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Additions Concentration of Encapsulant on Biang Clone Purple Sweet Potatoes "Chips" As Natural Dye Powder

Marleen Sunyoto, Hari Hariadi, Bambang Nurhadi, Agung Karuniawan*

Food Technology and Agriculture Science Major, Faculty of Agriculture, Universitas Padjadjaran, Jl. Raya Bandung-Sumedang KM 21, 45363, West Java, Indonesia; marleen.sunyoto@unpad.ac.id; raden_harie@yahoo.com; bnhnur@gmail.com;
*Corresponding author: agung.karuniawan@unpad.ac.id; Telp: +62 812 1469 4288;

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Abstract: The purpose of this study was to obtain maltodextrin with the appropriate concentration of purple sweet potato anthocyanin extract to produce natural dye powder preparations with the best physical and chemical characteristics. The research method used is Experimental Method) by using Group Random Design (GRD). The experiment consisted of three treatments and each was repeated four times, with the treatment obtained in cassava purple with a concentration of 35.4 mg/100gr anthocyanin extract. The next stage was to determine the best concentration of maltodextrin Consisting of four treatments and each repeated three times. The anthocyanin pigment powder of purple sweet potato with various treatments of maltodextrin concentration addition gave a significant effect on the soluble time, and yield, but did not give a significant effect on the total of anthocyanin, hygroscopicity and solubility. The treatment 10% of maltodextrin concentration addition resulted in best characteristic with total anthocyanin of 48.43 mg / L, color intensity L* (brightness) of 37.86, a* (redness) of 43.66, b* (yellow) of 21.68, water content of 5.56%, hygroscopicity of 11.62%, solubility of 97.13%, soluble time of 159 seconds, pH value of 3.04, and yield of 31.38%. The resulting anthocyanin powder shows that the anthocyanin pigment powder of purple sweet potato with the maltodextrin concentration addition has the potential to serve as a natural dye powder for food and beverages.

Keywords: Anthocyanin; Purple sweet potatoes; Encapsulation

1. Introduction

The use of natural dyes will be developed continually because they are classified as safer and does not cause side effects than synthetic dyes. In the FDA's list, the natural dyes belong to the "uncertified color additives" because they do not require a certificate for the level of chemical purity. One type of natural pigment that can be used as food coloring is anthocyanin. In recent years, public concern about the safety of synthetic pigments led to increasing interest in the development of food colorants from plant tissues, especially from some edible sources [1].

Anthocyanin is a natural pigment that gives the color of red, blue, and violet. Anthocyanin sources are found in fruits, vegetables, flowers, and various types of plants. As a group of natural, water-soluble and nontoxic pigments, anthocyanins are widely distributed in plant world and display a variety of colors from orange to purple [1]. Anthocyanin compounds can function as antioxidants and free-radical capture, thus contributing to prevent aging, cancer, and degenerative diseases such as arteriosclerosis. In addition, anthocyanins also have antimagnetic and ant carcinogenic properties against mutagens and carcinogens that present in foodstuffs and their dairy products, preventing liver dysfunction, antihypertensive, and lowering blood sugar levels antihyperglycemic [2]. From some agricultural commodities, one of the highest anthocyanin contents is obtained from purple sweet potatoes.

According to [3], the content of anthocyanin pigments in purple sweet potatoes is greater than other sweet potato varieties that could reach 923, 65 mg / 100 g of ingredients. Purple sweet potato is a food crop that is widely available in all corners of Indonesia. Purple sweet potatoes are easily cultivated that can grow on various types of soils, high productivity with a relatively short planting period for about 3 to 6 months and require less fertilizer [4]. In Indonesia sweet potatoes are usually stored at first to get a sweeter one [4].

The anthocyanin from purple sweet potato can be obtained by extracting the material from its flesh or skin. Extraction is the process of withdrawing the active component of a solid and/or liquid mixture by

Using a particular solvent. The extract is a concentrated preparation that is obtained by extracting an active

substance using a suitable solvent, then all or almost all solvents are evaporated and the remaining mass or powder is treated in such a way as to fill up the standard that has been set by the Minister of Health Republic of Indonesia [5].

Natural pigment such as anthocyanins that have been extracted, having some drawbacks that are instability when they are left longer and influenced by the external factors like temperature, pH, and light. One way to maintain the stability of anthocyanin pigments is by coating which uses a coating material known as encapsulation. The excess of dyes that have been encapsulated in powder form includes low water content, longer-shelf-life, practical use, easy handling, transportation, and storage [6].

Encapsulation is a process of coating the core of particles in the form of liquid, solid or gas with a special filler so that the core of particles has the physical and chemical features [7]. Encapsulation aims to protect the sensitive of active ingredient towards damage due to oxidation, loss of nutrients, protecting flavor, aroma, and pigment and increasing the solubility [8].

Process of anthocyanin dye powder preparation can be done by using the encapsulation method of a combination of coating materials and a suitable dryer [9]. Drying of materials containing useful components such as anthocyanins requires coating materials. The coating material is used to provide protection to the core material and maintain the color pigment of physical and chemical factors.

As for food processing, this stability may allow the colored products a consistent quality during shelf life. Thus, PSP is a good source for the preparation of anthocyanin-based food colorant. Acidified methanol and ethanol are commonly used to extract anthocyanins from plant tissues [10]. Coating on the anthocyanin encapsulation process aims to maintain the stability of anthocyanins.

Based on the description above, it is necessary to investigate the effect of adding precise concentration

of maltodextrin to produce anthocyanin pigment powder from purple sweet potatoes with good characteristic, which has high total of anthocyanin, short solubility time, high solubility percentage, high yield, and low hygroscopicity so it can be used as a natural dye [10].

2. Material and Methods

The materials used in this experiment were purple sweet potato of local sweetener sweet potato varieties with 4.5 months of harvest period obtained from Ciparanje Jatinangor. The supporting materials used were distilled water, tartaric acid, and maltodextrin. The chemicals used for the analysis were distilled water,

Potassium chloride buffer solution (0.025 M) pH of 1, a sodium acetate buffer solution (0.4 M) pH of 4.5, and concentrated HCl. The tools used include analytical scales, gas stove, basin, cage, knife, cutting board, vacuum oven, filter cloth, silicone plastic mold, and dryer blower. Tools used for analysis: filter paper, desiccator, analytical scales, rotary evaporator, UV-Vis spectrophotometer, aluminum plate, magnetic stirrer, centrifugation device, PSA, crushed, cuvette, stir bar, 100 ml of beaker glass, 5 ml, 10 and 25 ml of measuring flasks, glass vials. The research consisted of two stages, namely (1) preliminary research, (2) main stage research

2.1. Preliminary Research

Preliminary research was conducted as follows:

The use of purple sweet potato obtained from the harvest was analyzed the content of the composition. The analysis of purple sweet potato was chemical composition (moisture content, starch content, protein content, fat content, fiber content, reducing sugar content, and total of anthocyanin).

2.2. Main Stage Research

The stages of producing dye preparations which are detailed as follows:

1) Material Preparations

The raw material used was dried purple sweet potato. Dried purple sweet potato was obtained by drying fresh purple sweet potato using an electric oven at 50ºC for 12 hours. After that, weighing on the sample used.

2) Extraction (Maceration Method)

The extraction was performed by using a liquid-solid method of maceration for 24 hours at ± 25 ° C in a darkened room. Once weighed, purple sweet potatoes were soaked in acidified distilled water using 1% of tartaric acid to pH of 2. Comparison of the material and solvent was 1: 5 (w / v).

3) Vacuum Filtration

The obtained solution was filtered with a filter vacuum that had been dialed using a filter cloth to prevent any dregs or solids from the anthocyanin extract of purple sweet potato.

4) The Approaching

The approaching extract of purple sweet potato was carried out with vacuum rotary evaporator at 40 ° C and 25 inHg for 2 hours.

5) The addition of Maltodextrin

The anthocyanin extract of purple sweet potato was added with maltodextrin according to the treatment of 10%, 20%, 30% and 40% (w / v) from the concentrating extract and then stirred until completely mixed using a magnetic stirrer.

6) The Drying

The drying of purple sweet potato anthocyanin extract was done by using a vacuum oven at 40 ° C ± 2 ° C, vacuum pressure of 25 inHg, for ± 16 hours until all the ingredients were completely dry.

7) Size Reduction

Size reduction was done by using the grinder.

8) Sifting

The powder was sifted with an 80 mesh sieve so it had a same size.

9) Packaging and Sample Storage before Characteristics Testing

The result of the powder preparation was blended until smooth and then tested the total of anthocyanin content, yield, solubility, soluble time of pH, water content, color intensity, and hygroscopicity level.

3. Results and Discussion

3.1. Physic chemistry of Purple Sweet Potato Analysis

Before being used in anthocyanin extraction, purple sweet potato was firstly done proximate analysis towards its composition, including water content, fat, protein, ash, carbohydrate, reducing sugar, pH, color intensity, and total of anthocyanin because the chemical component which was found in superior purple sweet potato of Unpad with longest storage of crops that affected the total of anthocyanin content produced. The results data of chemical analysis of purple sweet potato will be used as input data of the chemical composition of the local sweetener purple sweet potato varieties and the highest total of anthocyanin results used in the next stage of anthocyanin extraction. The chemical analysis results are shown in Table 1.

Table 1. Chemical Analysis Results of Local Sweetener of Purple Sweet Potato

Chemical and Physical Features	Average
Water Content (%wb)	64,60± 0.82
Ash Content (%db)	6.11± 0.77
Starch Content (%db)	43.73± 0.21
Sugar Reduction (%db)	4.16± 0.48
Fat Content (%db)	1.64± 0.52
Protein Content (%db)	16.25± 0.67
Crude Fiber Content (%db)	2.71± 0.86
Anthocyanin Content (mg/L)	97,18± 0.92

In analysis result of purple sweet potato that had been performed, known that water content of superior purple sweet potato varieties of unpad has been appropriate with Indonesian National Standard (11) the specification requirement of water content in 64% - 65% and water content in superior purple sweet potato varieties of unpad in 64,67%.

The water content of foodstuff is the total amount of water contained in foodstuffs that can be water-dispersed on macromolecular colloidal surfaces, free water, physically and chemically bound water. The fiber content was produced in superior purple sweet potato varieties of unpad has been suitable with Indonesian National Standard [11] a maximum limit of fiber content at 2 - 3%, with the result of chemical analysis of local varieties of sweetener with fiber content at 1%.

3.1.1 The Total of Anthocyanin

The treatment of various maltodextrin concentrations purple sweet potato addition gave a significantly different effect to the total of anthocyanin pigment powder produced. The analysis result of total anthocyanin pigment powder can be seen in Table 2.

Table 2. The Influence of Maltodextrin Concentration Addition towards Total of Anthocyanin (mg/L) Pigment Powder of Purple Sweet Potato.

Treatment	Total of Anthocyanin (mg/L)
A: 10% of Maltodextrin (w/v)	48.43 ± 0.42 [a]
B: 20% of Maltodextrin (w/v)	43.70 ± 1.05 [b]
C: 30% of Maltodextrin (w/v)	38.55 ± 2.37 [c]
D: 40% of Maltodextrin (w/v)	34.79 ± 3.79 [d]

Description: Average of treatment that marked with the same letter is not significantly different According to Duncan Test at level of 5%.

The results showed that a different range 10% of maltodextrin concentrations affected the total of anthocyanin pigment powder of purple sweet potato. According to [9], maltodextrin has a lower heat resistance so that in a small amount cannot protect the pigment of anthocyanin maximally. This caused the pigment of anthocyanin was degraded. Besides heat, the pH value can affect the anthocyanin levels that contained in the pigment powder.

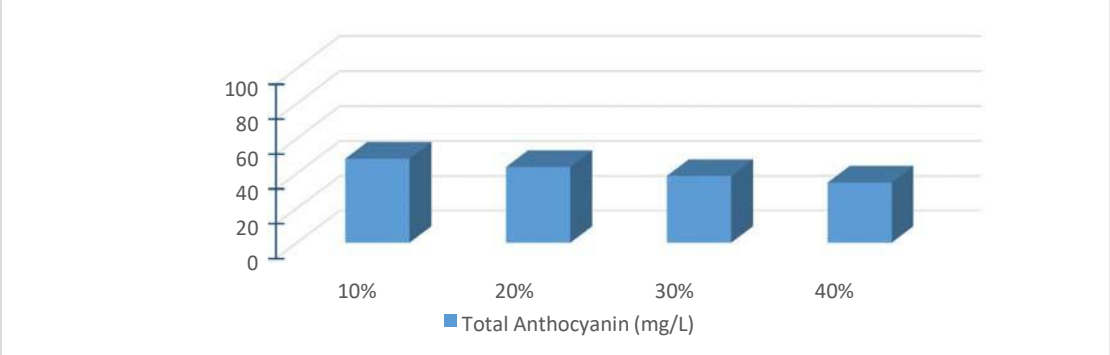

Figure 1. Based on the results of statistical analysis in the appendix shows that there was a real effect on the total of anthocyanin pigment powder parameters of purple sweet potato. This suggests that the addition 10%-40% of maltodextrin affects the total of anthocyanin obtained, suggesting that the higher concentration of maltodextrin was added, the total of anthocyanin concentration pigment of the encapsulated produced decreases. According to [12], the addition of maltodextrin to the anthocyanin extract of the purple sweet potato may increase the total of the dried solids thus possibly reducing the anthocyanin content in the material. The total anthocyanin pigment powder of the purple sweet potato ranges from 34.79% - 48.43%.

3.1.2. Color Intensity

Based on the result of variance test, the various maltodextrin concentrations addition treatment had a real effect on the color intensity of L* (brightness). The results of the brightness analysis (L*) anthocyanin pigment powder of the purple sweet potato can be seen in Table 3.

Table 3. The Influence Maltodextrin Concentration Addition towards Color (L*) of Anthocyanin Powder Pigment of Purple Sweet Potato

Treatment	**Color (L*)**
A : 10% of Maltodextrin (w/v)	37.86 ± 12.17 ^{a}
B : 20% of Maltodextrin (w/v)	42.52 ± 11.13 ^{ab}
C : 30% of Maltodextrin (w/v)	51.50 ± 10.46 ^{abc}
D : 40% of Maltodextrin (w/v)	54.22 ± 9.28 ^{cd}

Description: Average of treatment that marked with the same letter is not significantly different according To Duncan Test at level of 5%.

Based on the results of the variance test, the various maltodextrin concentrations addition did not significantly affect the value of a*. The analysis result of a* anthocyanin pigment powder of purple sweet potato can be seen in Table 4.

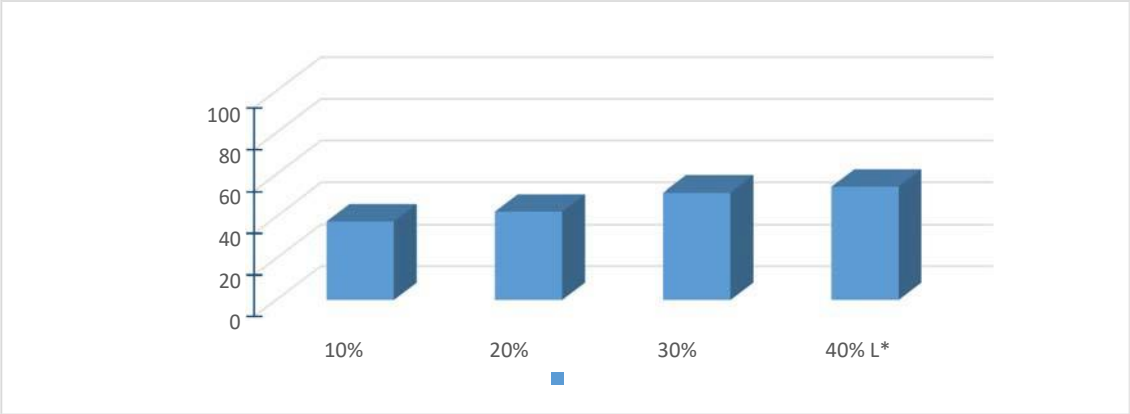

Figure 2. The result of Duncan test at level of 5% towards the brightness parameter (L*) of anthocyanin pigment powder of purple sweet potato shows that the 40% addition of maltodextrin concentration showed a higher brightness (L*) value compared with treatment of 10%, 20% and 30% addition of maltodextrin concentration. This shows that the addition of more maltodextrin treatment can increase the brightness value (L*) of anthocyanin pigment powder of purple sweet potato. This result is in line with [13] observation where the 30% addition of maltodextrin concentration resulted in higher brightness (L*) rather than the treatment of 10% addition of maltodextrin concentration.

Table 4. The Influence of Maltodextrin Concentration Addition towards Color (a*) of Anthocyanin Pigment Powder of Purple Sweet Potato.

Treatment	Color (a*)
A : 10% of Maltodextrin (w/v)	43.66 ± 1.45^{a}
B : 20% of Maltodextrin (w/v)	38.39 ± 0.91^{b}
C : 30% of Maltodextrin (w/v)	35.41 ± 2.24^{bc}
D : 40% of Maltodextrin (w/v)	32.62 ± 2.11^{cd}

Description: Average of treatment that marked with the same letter is not significantly different according to Duncan Test at level of 5%.

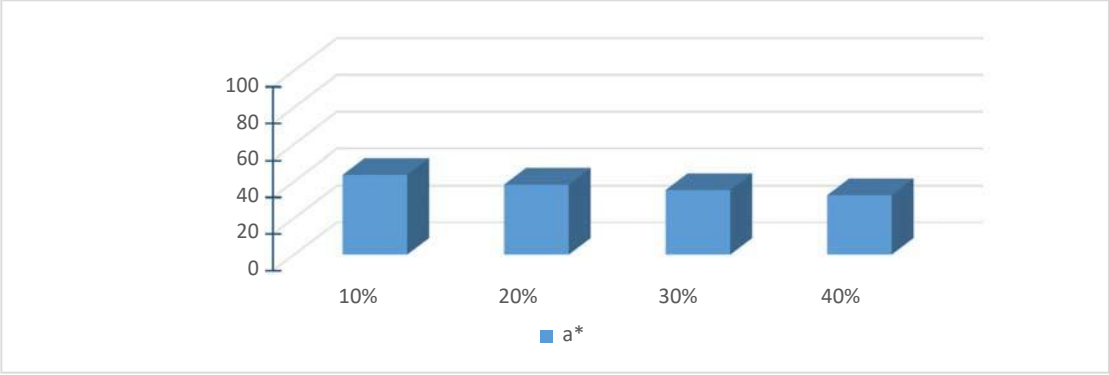

Figure 3. Based on the results of statistical analysis, the intensity of red (a*) shows a significantly different effect on anthocyanin pigment powder of purple sweet potato. This suggests that the 10% -40% addition of maltodextrin affected the (a*) values that obtained from the anthocyanin pigment powder of purple sweet potato. The value of (a*) anthocyanin pigment powder of purple sweet potato that is ranged from 32.62 - 43.66.

The results showed that the range of different concentrations 10% of maltodextrin affected the intensity of red color from the anthocyanin pigment powder of purple sweet potato. The red color was

produced on this powder dye came from the anthocyanin pigments that contained in purple sweet potato. According to [12], the highest red color intensity of powder dye shows the amount of anthocyanin pigment that contained in it was also high.

Table 5. The Influence of Maltodextrin Concentration Addition towards Color (b*) of Anthocyanin Pigment Powder of Purple Sweet Potato.

Treatment	Color (b*)
A: 10% of Maltodextrin (w/v)	21.69 ± 1.68 a
B: 20% of Maltodextrin (w/v)	18.64 ± 0.84 b C:
30% of Maltodextrin (w/v)	15.75 ± 1.38 c D: 40%
of Maltodesxtrin (w/v)	12.47 ± 0.60 d

Description: Average of treatment that marked with the same letter is not significantly different according To Duncan Test at level of 5%

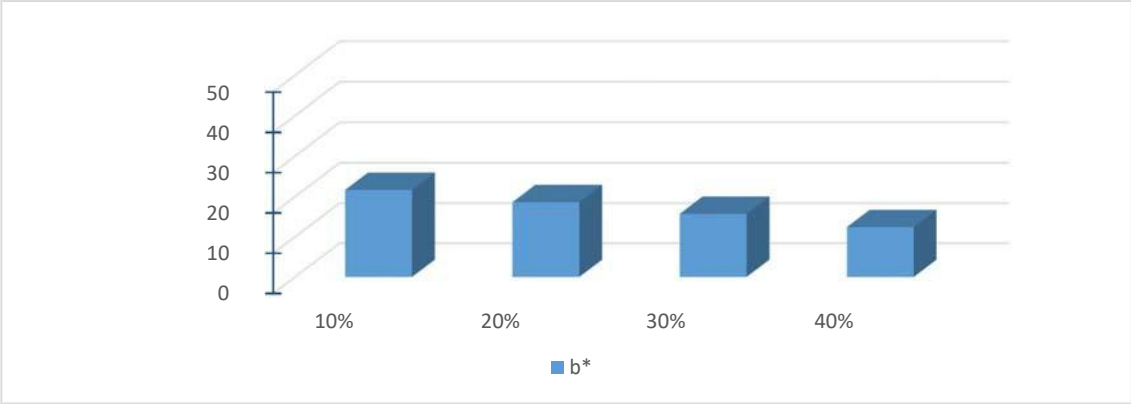

Figure 4. Based on the result of statistic calculation towards the average shows that various treatment of maltodextrin concentration addition gave significantly different effect on the value of b* of anthocyanin pigment powder of purple sweet potato. All treatments of maltodextrin addition either concentration 10%, 20%, 30%, and 40% showed a tendency to decrease the value of b* along with the enhancement of maltodextrin used.

The intensity of the yellow color on the anthocyanin pigment powder of purple sweet potato tends to decrease as the enhancement of maltodextrin concentration added. The decreasing of yellow intensity is due to the amount of maltodextrin concentration became higher causing an enhancement of total solids in the anthocyanin pigment powder of purple sweet potato.

3.1.3. Water Content

The treatment of maltodextrin concentration addition gave a significantly different effect on the water content of anthocyanin pigment powder of purple sweet potato produced. The analysis result of the water content of anthocyanin pigment powder of purple sweet potato can be seen in Table 6.

The average result showed that 40% of maltodextrin addition resulted in the lowest water content compared with the 30%, 20%, and 10% of maltodextrin addition. It shows that the maltodextrin concentration addition can decrease the water content of anthocyanin pigment powder of purple sweet Potato. These results are also aligned with [14] research in the production of mulberry effervescent powders whereby the higher number of added maltodextrins will enhance the total solids in the dried material so that the resulting water content will be lower. Water content of anthocyanin pigment powder of purple sweet potato showed the result which tended to decrease along with the increasing of maltodextrin concentration addition. This decreasing of water content due to maltodextrin can enhance the total solids in a material. According to [15], the product that was added maltodextrins, its water

content will evaporate faster because maltodextrins have a simple molecular structure so that bound and free water can be easily removed in the drying process.

Table 6. The Influence of Maltodextrin Concentration Addition towards Water Content (%) of Anthocyanin Pigment Powder of Purple Sweet Potato.

Treatment	Water Content (%db)
A : 10% of Maltodextrin (w/v)	5.56 ± 0.26 [a]
B : 20% of Maltodextrin (w/v)	4.64 ± 0.12 [b]
C : 30% of Maltodextrin (w/v)	4.24 ± 0.13 [c]
D : 40% of Maltodextrin (w/v)	3.72 ± 0.18 [d]

Description: Average of treatment that marked with the same letter is not significantly different according to Duncan Test at level of 5%.

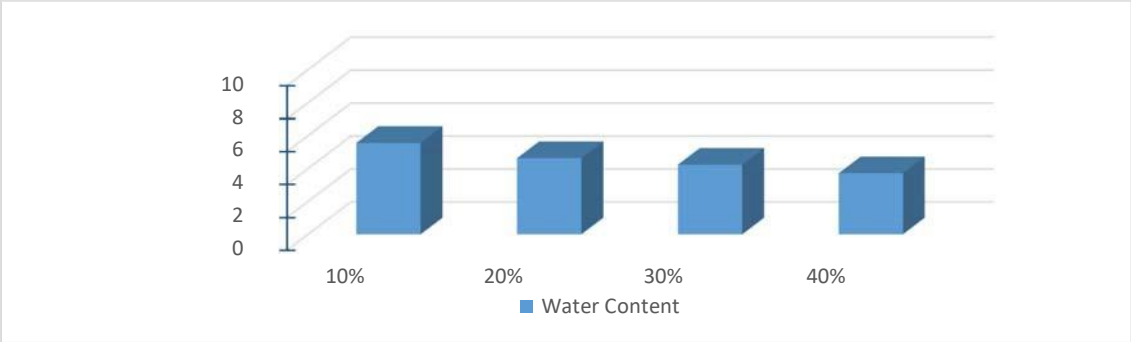

Figure 5. The result of the statistical test with Duncan test at level of 5% indicated that the anthocyanin pigment powder of purple sweet potato with various treatment of maltodextrin concentration addition gave a significant effect on water content. Water content of anthocyanin pigment powder of purple sweet potato with treatment 10% addition of maltodextrin concentration gave a significantly different effect towards the treatment of other maltodextrin addition concentrations.

3.1.4. Hygroscopicity

The treatment of maltodextrin concentration addition had no significant effect on the hygroscopicity level of anthocyanin pigment powder of purple sweet potato. The hygroscopicity analysis resulting of anthocyanin pigment powder of purple sweet potato can be seen in Table 7.

Table 7. The Influence of Maltodextrin Concentration Addition Towards Hygroscopicity (%) of Anthocyanin Pigment Powder of Purple Sweet Potato.

Treatment	Hygroscopicity (%)
A : 10% of Maltodextrin (w/v)	11.62 ± 0.62 [a] B :
20% of Maltodextrin (w/v)	11.70 ± 0.56 [b] C : 30%
of Maltodextrin (w/v)	12.75 ± 0.78 [c] D : 40% of
Maltodextrin (w/v)	13.23 ± 1.01 [d]

Description: Average of treatment that marked with the same letter is not significantly different according to Duncan Test at level of 5%.

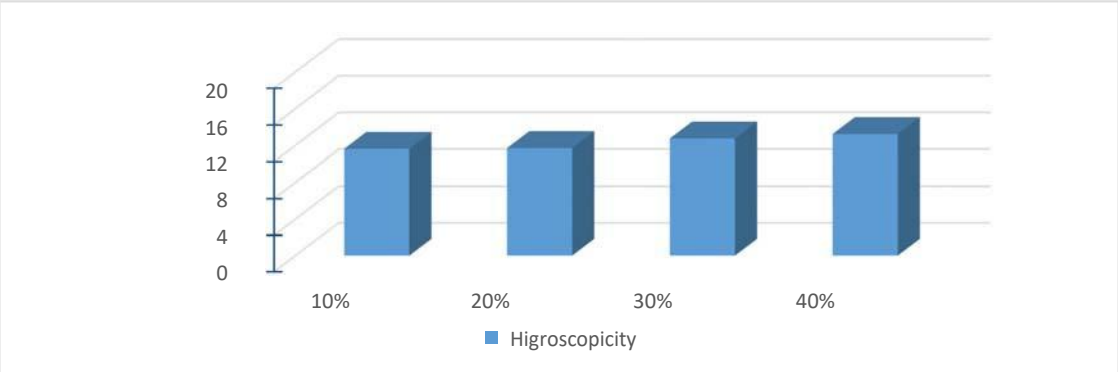

Figure 6. Based on the statistical analysis on that, it shows that there was a significantly different effect on the hygroscopicity level of anthocyanin pigment powder of purple sweet potato. This suggests that the maltodextrin addition affects the degree of hygroscopicity obtained from the anthocyanin pigment powder of purple sweet potato.

The hygroscopicity rate of anthocyanin pigment powder of purple sweet potato is ranged between 11.62% - 13.23%.The results showed that the range of different concentrations 10% of maltodextrin affected the degree of hygroscopic anthocyanin pigment powder of purple sweet potato. According to [16], this is because maltodextrin has a low hygroscopicity that affects the affinity between water and other compounds in the product. The features of maltodextrin include rapid dispersion, high solubility, and low hygroscopic features.

Hygroscopicity level is the ability of the material to absorb water vapor from the surrounding environment until the material is no longer able to absorb water. According to the classification issued by the [17].

3.1.5 Solubility

The addition of maltodextrin concentration treatment did not significantly affect the solubility of anthocyanin pigment powder of purple sweet potato. The solubility analysis resulting of the anthocyanin pigment powder of purple sweet potato can be seen in Table 8.

Table 8. The Influence of Maltodextrin Concentration Addition towards Solubility (%) Anthocyanin Pigment Powder of Purple Sweet Potato.

Treatment	**Solubility (%)**
A : 10% of Maltodextrin (w/v)	97.13 ± 0.25 [a] B :
20% of Maltodextrin (w/v)	98.13 ± 0.15 [b] C : 30%
of Maltodextrin (w/v)	98.27 ± 0.06 [c] D: 40% of
Maltodextrin (w/v)	98.53 ± 0.21 [d]

Description: Average of treatment that marked with the same letter is not significantly different according to Duncan Test at level of 5%.

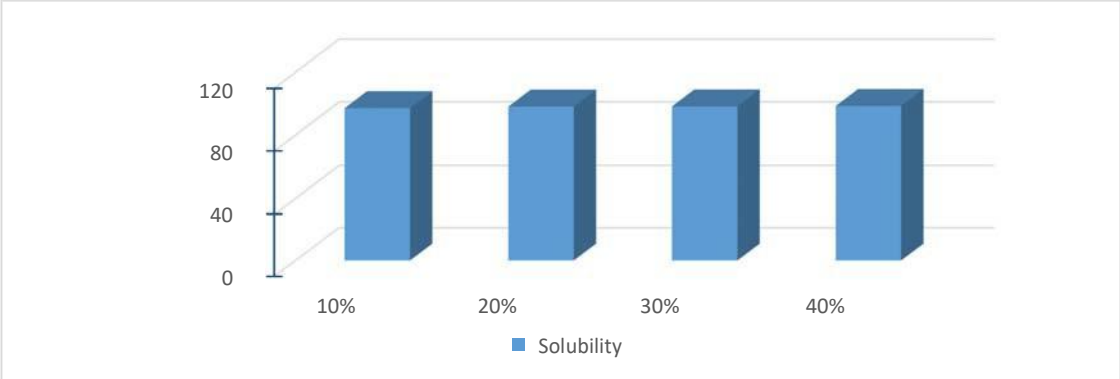

Figure 7. The result of statistical test with Duncan test at level of 5% indicated that the various treatment of maltodextrin concentration addition had a significantly different effect on the solubility of anthocyanin pigment powder of purple sweet potato. This suggests that the addition of maltodextrin affects the solubility resulting from the anthocyanin pigment powder of purple sweet potato. The solubility value of anthocyanin pigment powder of purple sweet potatoes ranged between 97.13% - 98.53%.

The results showed that the range of different concentration 10% of maltodextrin influenced anthocyanin pigment powder of purple sweet potato solubility. According to [18], the anthocyanin pigment powder of purple sweet potato's solubility value was also influenced by its water content. According to [18], high-moisture powder products will easily form the clots that cause the breakdown of bonds between particles to last longer so that the product's ability to dissolve will be lower.

Solubility is the maximum ability of a solute to be soluble in a particular solvent and formed a homogeneous solution. A high degree of solubility is a desirable feature of a powdered product. According [19], good value of powder solubility is 92-99%. The higher solubility value indicated that the quality of powdered product is better because it will facilitate for its use.

3.1.6 Soluble Time

The treatment of maltodextrin concentration addition had a real significant effect on the soluble time of anthocyanin pigment powder of purple sweet potato produced. The soluble time analysis resulting of anthocyanin pigment powder of purple sweet potato can be seen in Table 9.

Table 9. The Influence of Maltodextrin Concentration Addition towards Soluble Time (s) of Anthocyanin Pigment Powder of Purple Sweet Potato

Treatment	Solubility (%)
A : 10% of Maltodextrin (w/v)	97.13 ± 0.25 [a]
B : 20% of Maltodextrin (w/v)	98.13 ± 0.15 [b]
C : 30% of Maltodextrin (w/v)	98.27 ± 0.06 [c]
D : 40% of Maltodextrin (w/v)	98.53 ± 0.21 [d]

Description: Average of treatment that marked with the same letter is not significantly different according to Duncan Test at level of 5%.

The statistical analysis showed that the 40% of maltodextrin addition showed the faster soluble time compared to the 30%, 20%, and 10% of maltodextrin addition. This shows that the maltodextrin concentration addition can decrease the soluble time of purple sweet potato anthocyanin pigment powder. This is in line with [20] where the 30% of maltodextrin concentration addition resulted in a lower soluble time of coconut sugar powder than the 10% of maltodextrin concentration addition.

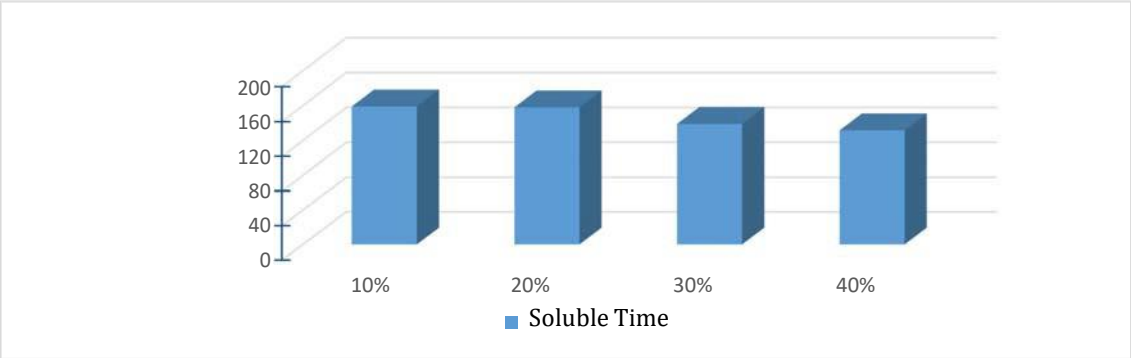

Figure 8. The result of Duncan test showed that the anthocyanin pigment powder of purple sweet potato with a variety of maltodextrin concentration addition treatment gave a significant effect on the soluble time. The soluble time of purple sweet potato anthocyanin pigment powder with the 10%, 20% of maltodextrin concentration addition did not give any significant effect. However, the 10%, 30% of maltodextrin concentration addition gave a significantly different effect. Likewise, concentrations of 30% and 40%.

3.1.7. PH

Treatment of maltodextrin concentration addition did not significantly affect pH value of anthocyanin pigment powder of purple sweet potato. The pH analysis resulting of anthocyanin pigment powder of purple sweet potato can be seen in Table 10.

Table 10. The Influence of Maltodextrin Concentration Addition towards pH of Anthocyanin Pigment Powder of Purple Sweet Potato.

Treatment	pH
A : 10% of Maltodextrin (w/v)	3.04 ± 0.04 [a]
B : 20% of Maltodekstrin (w/v) C	3.14 ± 0.04 [b]
: 30% of Maltodextrin (w/v)	3.26 ± 0.11 [c]
D : 40% of Maltodextrin (w/v)	3.37 ± 0.07 [d]

Description: Average of treatment that marked with the same letter is not significantly different according to Duncan Test at level of 5%.

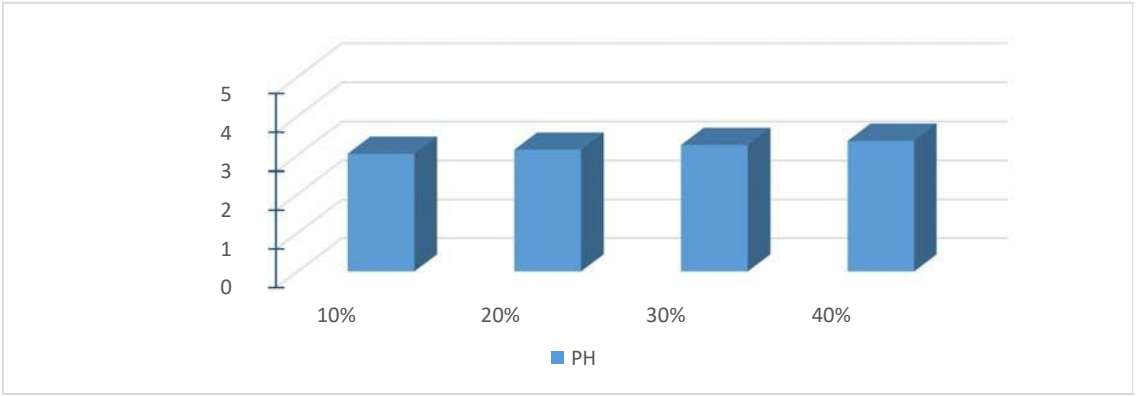

Figure 9. Based on the results of statistical analysis, it shows that there was a real effect on pH value parameter of anthocyanin pigment powder of purple sweet potato. This suggests that the addition of maltodextrin affected pH value of anthocyanin pigment powder of purple sweet potato. The pH value resulted of the anthocyanin pigment powder of purple sweet potatoes ranging from 3.04 to 3.37.

Intensity of anthocyanin color will be stable at the lower pH of 2-3. Anthocyanin has a form of flavilium cation which is the most stable and colored form at lower pH According to [21]. The pH value in this observation is ranged from 2.93-3.11, which means it is still in accordance with the pH range to maintain the stability of anthocyanin pigments. A stable anthocyanin pigment at lower pH Can be applied to acidic products, such as soft drinks, sweets, sauces, pickle, canned food or beverages [22].

3.1.8 Yield

The treatment of maltodextrin concentration addition had significant effect oardsn the yield of anthocyanin pigment powder of purple sweet potato. The yield value analysis resulting of anthocyanin pigment powder of purple sweet potato can be seen in Table 11.

Table 11. The Influence of Maltodextrin Concentration Addition towards Yield (%) of Anthocyanin Pigment Powder of Purple Sweet Potato.

Treatment	Yield (%)
A : 10% of Maltodextrin (w/v)	31.38 ± 0.13 [a]
B : 20% of Maltodextrin (w/v)	38.37 ± 0.18 [b]
C : 30% of Maltodextrin (w/v)	44.16 ± 0.34 [c]
D : 40% of Maltodextrin (w/v)	50.97 ± 0.34 [d]

Description: Average of treatment that marked with the same letter is not significantly different according to Duncan Test at level of 5%.

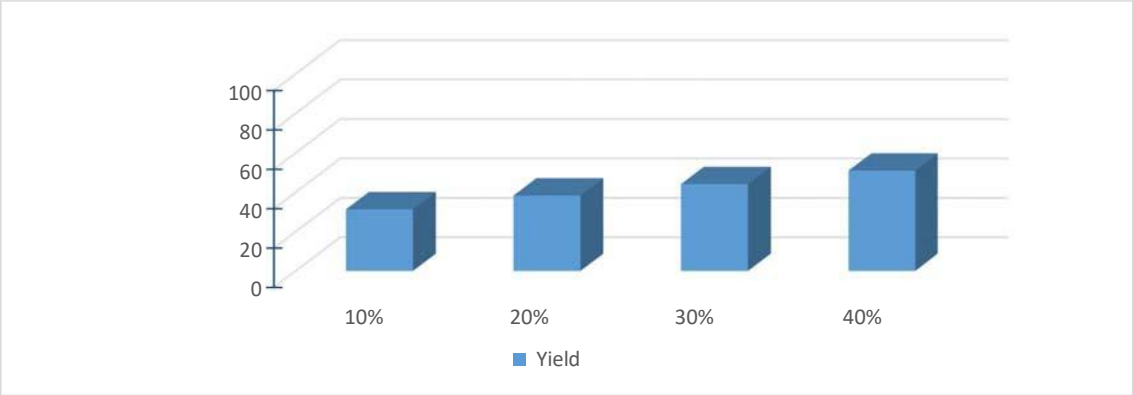

Figure 10. The result of statistical test with Duncan test at level of 5% indicated that the anthocyanin pigment powder of purple sweet potato with various treatment of maltodextrin concentration addition gave a real effect towards the yield.

The result of statistical analysis showed that the 40% addition of maltodextrin concentration resulted in higher yield compared with treatment 10%, 20%, and 30% addition of maltodextrin concentration. This shows that the addition of maltodextrin treatment can increase the yield value. This is in line with the [13] observation where the 30% addition of maltodextrin concentration on the anthocyanin pigment powder of banana pouch produces a higher yield rather than the 10% addition of maltodextrin concentration. It was also reinforced by [23] which stated that temperature is one of the decisive factors in the drying process. In addition, the nature of the dried material such as initial water content and product size will affect the drying process.

Increase in the value of yield due to the addition of maltodextrin may increase the total solids of the dried material. Maltodextrin is sweet, white-shaped sugar with water-soluble properties, capable of protecting the Capsules from oxidation, increasing the yield, has a relatively low viscosity,

and has an affordable price [24]. Purple sweet potato after being in the form of concentrate and powder dye was done by PSA Analysis to know the size of particles that exist in the concentration and powder.

Table 12. The PSA Analysis Result of Purple Sweet Potato Biang Clone.

Chemical and Physical Features	Average Size
Concentration (μm)	0.5
Powder Preparation (μm)	0.8

Figure 11. Purple sweet potato powder (**a**) addiction maltodekstrin 10%, (**b**) addiction maltodekstrin 20%, (**c**) addiction maltodekstrin 30%, and (**d**) addiction maltodekstrin 40%.

4. Discussion

It is necessary to do some implementation, the effect of blanching, and the stability of the anthocyanin pigment powder of purple sweet potato in foodstuffs to determine the dosage of appropriate dye powder on food.

5. Conclusions

The anthocyanin pigment powder of purple sweet potato with various treatments of maltodextrin concentration addition gave significant effect on color intensity (a*) and (b*) water content, solubility time, yield, total anthocyanin, hygroscopicity, solubility, and pH value. But it did not give a real effect to the color intensity (L*).

The treatment 10% of maltodextrin concentration addition resulted in best characteristic with total anthocyanin of 48.43 mg/L, color intensity L* (brightness) of 37.86, a* (redness) of 43.66, b* (yellow) of 21.68, water content of 5.56%, hygroscopicity of 11.62%, solubility of 97.13%, soluble time of 159 seconds, pH value of 3.04, yield of 31.38% and 10% of maltodextrin concentration PSAs addition 0.4 nm, 0.8nm of Powder.

The results of the various parameters showed that the anthocyanin pigment powder of purple sweet potato with the maltodextrin concentration addition was potentially applied as a natural dye powder for foods and beverages.

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