Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(4): 3420-3429
Received: 25-05-2018
Accepted: 30-06-2018

Hari Hariadi
Student of Food Techonology and Agriculture Science Major, Faculty of Agriculture Padjadjaran University, Jatinangor, Indonesia,

Marleen Sunyoto
Lecturer of Techonology and Agriculture Science Major, Faculty of Agriculture Padjadjaran University, Jatinangor, Indonesia

Bambang Nurhadi
Lecturer of Techonology and Agriculture Science Major, Faculty of Agriculture Padjadjaran University, Jatinangor, Indonesia

Agung Karuniawan
Lecturer of Techonology and Agriculture Science Major, Faculty of Agriculture Padjadjaran University, Jatinangor, Indonesia

Correspondence
Agung Karuniawan
Lecturer of Techonology and Agriculture Science Major, Faculty of Agriculture Padjadjaran University, Jatinangor, Indonesia

Comparison of phytochemical characteristics pigmen extract (Antosianin) sweet purple potatoes powder (*Ipomoea batatas* L) and clitoria flower (*Clitoria ternatea*) as natural dye powder

Hari Hariadi, Marleen Sunyoto, Bambang Nurhadi and Agung Karuniawan

Abstract
The purpose of our study was to obtain a comparison of anthocyanin pigment powder of butterfly pea and purple sweet potato with the best phytochemical characteristics. 10% addition of maltodextrin concentration in the butterfly pea resulted in the best characteristic with total of antosianin 53.02 mg / L, color intensity L * (brightness) of 51.72, a * (redness) of 23.50, b * (yellow) of 8.42, water content of 2,87% hygroscopicity of 8.33%, 97.33% of solubility, 187 seconds of soluble time, pH value of 2.93, and yield of 51.63%. For comparison the resulting 10% maltodextrin concentration in purple sweet potato with total anthocyanin of 48.43 mg / L, color intensity L * (brightness) of 37.86, a * (redness) of 43.66, b * (yellowish) of 21.68, water content of 5.56%, hygroscopicity of 11.62%, 97.13% of solubility, 159 seconds of soluble time, pH value of 3.04, and 31.38% of yield.

Keywords: anthocyanin, butterfly pea, maltodextrin, purple sweet potatoes

Introduction
The butterfly pea (*Clitoria ternatea* L.) is a kind of plant which originally from central of South America and has spread throughout the tropics, especially Southeast Asia including Indonesia. The butterfly pea that has been cultivated is originally from Aceh and harvested after three months. The butterfly pea naturally can grow in an open area such as forests, shrubs, river banks, grown on trees and fences and includes in the family of legume (leguminous) so that can be cultivated more (Dalimartha, 2008) [17].

The easy-growing and safe-to-eat are the characteristics of the butterfly pea that makes it to be utilized enormously. The result of flower extraction can be used as an alternative of natural dye preparations for food and beverage. The blue color in the butterfly pea signifies the existence of plant pigments, namely anthocyanin. According to Winarno and Lakshmi (1986), the colors of anthocyanin pigments are red, blue, and violet which are usually found in flowers, fruits, and vegetables. Anthocyanin is a class of flavonoid compounds and the largest natural pigment group in plants. According to Vankar and Srivastava (2010), the content of anthocyanin in fresh butterfly pea is 227.42 mg / kg of flower. In addition to giving color to plants, other benefits of anthocyanin is as a source of antioxidants.

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 (George *et al* in Ai Mahmudatussa'adah 2014). Sweet potatoes are usually stored before they are consumed or processed. The change of sensory features during storage is very important, and the alteration might be desirable or undesirable (van Oirschot *et al*., 2003). In Indonesia sweet potatoes are usually stored at first to get a sweeter one (Ai Mahmudatussa'adah. 2014)

The process of dye extraction must use an appropriate method with the material features (pigment source) in order to be produced a high rendement and pigment stability. The method that used to extract the pigment of anthocyanin from butterfly pea and the purple sweet potato is the extraction with the maceration method. Extraction can be done by using a suitable solvent with the polarity of substance that will be extracted. The pigment of anthocyanin is extracted using aquadest solvent and tartaric acid. The solvent serves to dissolve the pigment and determine the quality of the result of anthocyanin extraction (Moulana *et al*., 2012).

The result of dye preparations from the process of extraction is a liquid concentrate-shaped that has disadvantage of short-shelf life of extract (Tama *et al*., 2014). Natural pigments such as anthocyanin has some disadvantages that is the unstability if it is left in a long term and influenced by external factors such as temperature, pH, and light. Based on the above, it is necessary to do some research in the making of preparations dye powder from anthocyanin extract of butterfly pea and purple sweet potato. The Excess of dyes in powder form include low water content, longer-shelf life, practical use, easy handling, transport and storage (Gonnissen *et al*., 2008) [28].

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 include low water content, longer-shelf life, practical use, easy handling, transportation, and storage (Gonnissen *et al*., 2008) [28].

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 have the physical and chemical features (Kim and Morr, 1996) [31]. Encapsulation aims to protect the sensitive of active ingredient towards damage due to oxidation, loss of nutrients, protecting flavor, aroma, pigment and increasing the solubility (Versich, 2000).

Maltodextrin is one of the starch derivatives produced from the process of partial hydrolysis by an α-amylase enzyme that have a Dextrose Equivalent (DE) value of less than 20. Maltodextrin is effectively used as an anthocyanin pigment coating agent because it has higher solubility, lower hygroscopicity, strong binding strength, capable of forming films, assisting the dispersion process, and inhibiting crystallization. According to Sadeghi *et al*. (2008), maltodextrin is cheaper than other major edible hydrocolloids.

Based on the description above, it is necessary to do some research to investigate the effect of adding the exact concentration of maltodextrin to produce anthocyanin pigment powder from the butterfly pea and the purple sweet potato with a good characteristic, which has a high total of anthocyanin, short solubility time, high solubility percentage, high yield, and low hygroscopicity that can be used as a natural dye.

Our objectives was to obtain a comparison of anthocyanin pigment powder of butterfly pea and purple sweet potato to produce natural dye powder preparations with the best physical and chemical characteristics.

Material and Methods

The materials that used in the making of preparations dye powder were the petals of butterfly pea (*Clitoria ternatea* L.) obtained from Aceh varieties. The additional materials used were aquadest, 5% of tartaric acid, and maltodextrin DE 10-12, while the materials used for the analysis were potassium chloride (KCl), hydrochloric acid (HCl), sodium acetate, sodium chloride, methanol, buffer solutions pH 4, and buffer solution pH of 7.

The tools that used in this research were rotary evaporator, vacuum oven, CM-5 spectrophotometer, pH meter, UV-Vis spectrophotometer, vacuum filter, aluminum plate, porcelain cup, measuring cup, chemical glass, analytical balance, grinder, silicon, test tube, measuring teapot, magnetic stirrer bar, spatula spoon, measuring flask, cup, cuvette, desiccator, plastic packaging, filter paper, volume pipette and ballet.

The method of research that used was an Experimental Method (Experimental Method) by using Group Random Design (RAK). The experiment consisted of four treatments and each was repeated three times.

The research consisted of two stages, namely First Research (Sweetener of Purple Sweet Potato) and Second Research (Butterfly Pea).

First Research

The stages of making dye preparations in detail are as follows:

1. Materials Preparation

The raw materials that used were dried petals of purple sweet potato. Purple sweet potato was obtained by drying fresh purple sweet potatoes using an electric oven at 50ºC for 12 hours. After that, weighing on the sample used.

2. Extraction (Maceration Method)

The extraction was performed 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 aquades using 5% of tartaric acid to pH to 2. Comparison of the material and solvent is 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 Concentration

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

5. The Maltodextrin Addition

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 result and then stirred until completely mixed using a magnetic stirrer.

6. Drying

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

7. Size Reduction

Size reduction was done 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.

Second Research

The second implementation in making anthocyanin dye powder with the treatment was determined based on preliminary trial implementation, that were 10%, 20%, 30%, and 40% (b / v) addition of maltodextrin. The process of preparation of powder dye butterfly pea using Budiarti's method (2013) which was modified.

Modifications were made towards raw materials and drying process. Budiarti's observation (2013) using rosella flowers as the main raw material, while in this observation the raw materials that used were the flower of the telang. Then, the process of drying the original product using a spray dryer was modified using a vacuum oven. Stages of making of dye preparations which are detailed as follows:

1. Materials Preparation
The raw materials that used were petals of dried butterfly pea. Dried Telang flowers were obtained by drying fresh butterfly pea using an electric oven at 60ºC for 5 hours. After that, weighing on the sample used.

2. Extraction (Maceration Method)
The extraction was performed using a liquid-solid method of maceration for 24 hours at ± 25 ° C in a darkened room. After weighing, the flower of telang was soaked in acidified aquades using 5% of tartaric acid until reaching pH of 2. Comparison of material and solvent is 1: 8 (w / v).

3. Vacuum Filtration
The obtained solution was filtered with a filter vacuum that had been dialed using a filter cloth to avoid the dregs or solids in the anthocyanin extract of the butterfly pea.

4. The Concentration
The concentration of the flower extract was carried out with a vacuum rotary evaporator at 40 ° C. and a pressure of 25 inHg for 2 hours.

5. The Maltodextrin Addition
The anthocyanin extract of butterfly pea extract was added by 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. Drying
Drying of anthocyanin extract of butterfly pea 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 using the grinder.

8. Sifting
The powder is sieved with an 80 mesh sieve so it has a same size.

9. Packaging and Sample Storage before Characteristics Testing
Criteria of observation that will be observed were Physical Characteristics (Color Intensity, Hygroscopicity, Soluble Time, Solubility), Chemistry (Total of Anthocyanin, Water Content, pH), Yield.
The dye powder preparations of butterfly pea are packaged in metalize plastic by the addition of food grade absorber into the package which is then carried out by the closing of the packing with the sealer. The packaging is stored in a sealed container with storage in a dry place and room temperature.

Results
Determining The Type of Material That Has The Most Anthocyanin Pigment From The Butterfly Pea
Implementation: The butterfly pea was extracted by aquadest solvent and 5% of tartaric acid addition for maceration (immersion) for 24 hours. Furthermore, the flower extract was carried out of concentration by using rotator evaporator and obtained 50% of extract from the initial volume. The concentration process was carried out at a temperature of 40^{o}C. The extract of concentrated pigment was obtained then calculated the total of anthocyanin extracted from the material by measuring the absorbance using UV-Vis spectrophotometer.
Result: Quantitatively, the type of butterfly pea that are fresh and dried which each has been extracted, has total of anthocyanin as described in the following Table. Table of Observating Results Measurement of Absorbance Type of Butterfly Pea Flower and Total of Anthocyanin.
Based on the results of the total anthocyanin test of dried flowers were chosen because it has a greater total of anthocyanin rather than fresh flowers.
Chemistry Analysis of Purple Sweet Potato From The Duration of Storage 1-3 Days After Harvesting
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: Composition of Local Purple Sweet Potato Unpad Chemical Properties of BIANG

Chemical Properties	BIANG
Moisture content (%wb)	64,87
Ash content (%db)	6.35
Starch content (%db)	45.43
Reducing sugar (%db)	4.33
Fat content (%db)	1.71
Protein content (%db)	16.88
Crude fiber content (%db)	2.82
Anthocyanin (mg/100gr)	19,45
Antioxidant Activity (mg/L)	3971.133

Source: personal documentation (2017)

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 (1998) with 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 (Narulitta, 2013).
The fiber content was produced in superior purple sweet potato varieties of unpad has been suitable with Indonesian National Standard (1998) with 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%.

The Total of Anthocyanin
Treatment of various maltodextrin concentrations addition gave a significantly different effect to the total of anthocyanin pigment powder of butterfly pea and purple sweet potato that was produced. T he analysist result of anthocyanin pigment

powder of butterfly pea and purple sweet potato can be seen in Table 2.

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

Treatment	Total Of Anthocyanin	
	Butterfly Pea	Purple Sweet Potato
10% of Maltodextrin	53.02 ± 1.11 a	48.43 ± 0.42 a
20% of Maltodextrin	47.17± 1.25 b	43.70 ± 1.05 b
30% of Maltodextrin	43.97± 2.93 c	38.55 ± 2.37 c
40% of Maltodextrin	40.91± 1.25 d	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%.

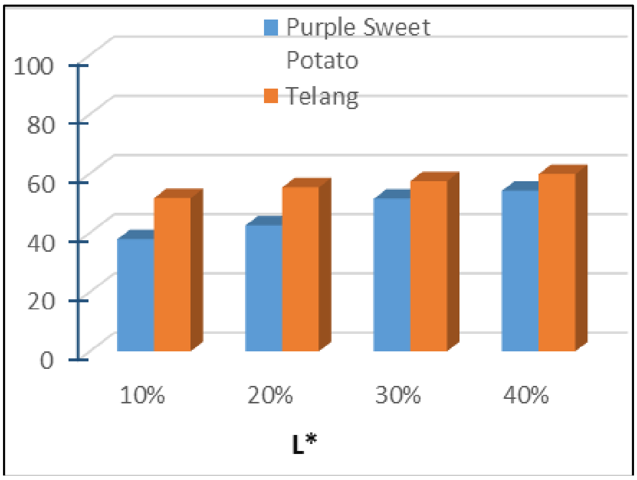

Fig 1: The Influence of Maltodextrin Concentration Addition towards Total of Anthocyanin (mg / L) Pigment Powder of Butterfly Pea and Purple Sweet Potato

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 butterfly pea. This shows that the 10% -40% of maltodextrin addition affected the total of anthocyanin that obtained from the anthocyanin pigment powder of butterfly pea. The total anthocyanin pigment powder of butterfly pea that produced are ranged from 40.91% - 53.02%The observation result shows that the range of difference 10% of maltodextrin concentration influenced the total of anthocyanin pigment powder of butterfly pea. According to Yuliana *et al*. (2014), the addition of maltodextrin to the anthocyanin extract of the butterfly pea may increase the total of the dried solids thus possibly reducing the anthocyanin content in the material.

The heat from the drying process also affected the total of anthocyanin that contained in the pigment powder. According to Sholikin *et al*. (2012) in production of red dadap flower extract showed the observation results where the lower level of anthocyanin caused by a high pH value.

According to Ernawati (2010) [21], maltodextrin has a lower heat resistance so that in a small amount can not 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.

Color Intensity

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

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

Treatment	Color (L*)	
	Butterfly Pea	Purple Sweet Potato
10% of Maltodexrin	51.72 ±0.64a	37.86 ± 12.17 a
20% of Maltodexrin	55.36±0.42b	42.52 ± 11.13 ab
30% of Maltodexrin	57.44 ±0.40c	51.50 ± 10.46 abc
40% of Maltodexrin	59.81±0.41d	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%.

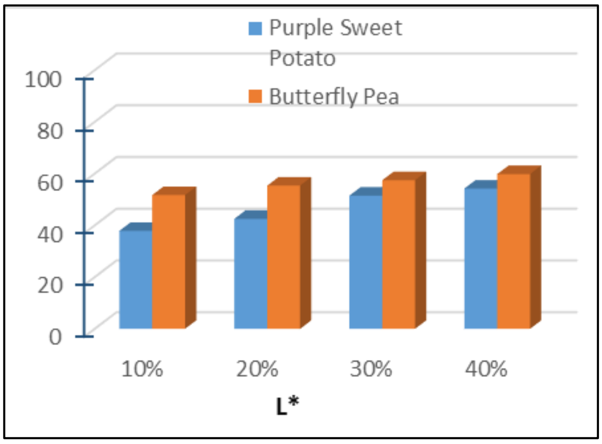

Fig 2: The Influence Maltodextrin Concentration Addition towards Color (L *) of Anthocyanin Powder Pigment of Butterfly Pea And Purple Sweet Potato

The result of Duncan test at level of 5% towards the brightness parameter (L *) of anthocyanin pigment powder of butterfly pea and 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 anthocyanine pigment powder of butterfly pea and purple sweet potato. This result is in line with Muqoddas (2016) observation where the 30% addition of maltodextrin concentration resulted in higher brightness (L *) rather than the treatment of 10% addition of maltodextrin concentration. The brightness of the anthocyanin pigment powder of butterfly pea and the purple sweet potato showed a tendency to increase as the enchancement concentration of maltodextrin was added. This enhancement of brightness value is due to the number of maltodextrin concentrations are higher causing an increasing the amount of polysaccharides so that the color of the pigment powder will become brighter (Yuliana *et al*., 2014).

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 butterfly pea and purple sweet potato can be seen in Table 4.

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

Treatment	Color (a*)	
	Butterfly Pea	Purple Sweet Potato
10% of Maltodexrin	23.50 ±0.45a	43.66 ± 1.45 a
20% of Mltodexrin	20.86 ± 1.48b	38.39 ± 0.91 b
30% of Maltodexrin	18.81 ± 1.16 c	35.41 ± 2.24 bc
40% of Maltodexrin	17.23 ± 0.56 d	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%

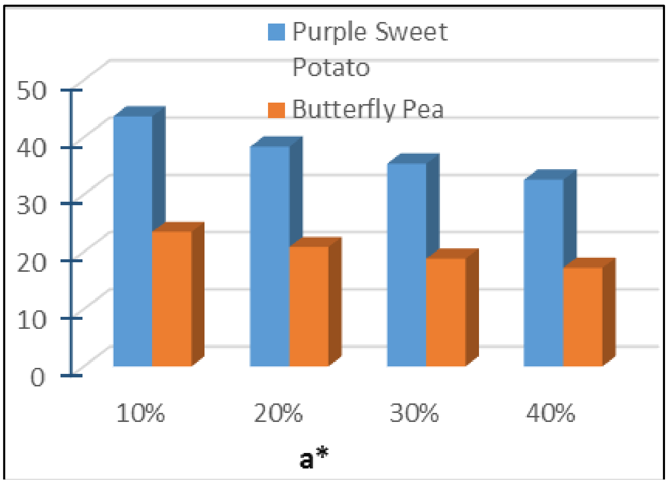

Fig 3: The Influence of maltodextrin concentration addition towards color (a *) of anthocyanin pigment powder of butterfly pea and purple sweet potato

Based on the results of statistical analysis, the intensity of red (a *) shows a significantly different effect on anthocyanine pigment powder of butterfly pea and purple sweet potato. This suggests that the 10% -40% addition of maltodextrin affected the a * values that obtained from the anthocyanine pigment powder of butterfly pea and the purple sweet potato. The value of a * antocyanin pigment powder of butterfly pea is ranging from 17.23 to 23.50. While 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 butterfly pea and purple sweet potato. The red color was produced on this powder dye came from the anthocyanin pigments that contained in butterfly peas and purple sweet potato. According to Yuliana *et al*. (2014), 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 Butterfly Pea And Purple Sweet Potato.

Treatment	Color (b*)	
	Butterfly Pea	Purple Sweet Potato
10% of Maltodextrin	8.42 ± 0.45a	21.69 ± 1.68 a
20% of Maltodextrin	7.67 ± 1.48 b	18.64 ± 0.84 b
30% of Maltodextrin	6.21 ± 1.16 c	15.75 ± 1.38 c
40% of Maltodextrin	5.87 ± 0.56 d	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%.

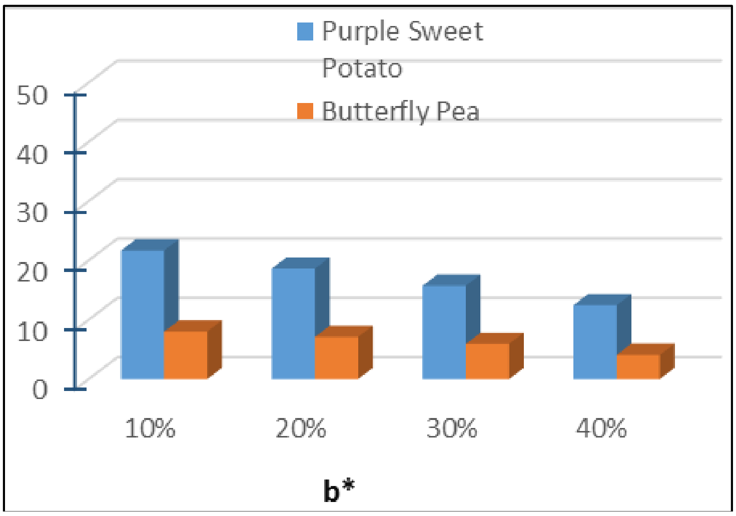

Fig 4: The Influence of maltodextrin concentration addition towards color (b *) of anthocyanin pigment powder of butterfly pea and purple sweet potato

Based on the result of statistic calculation towards the average shows that various treatment of maltodextrin concentration addition gave significantly different effect to the value of b * of anthocyanin pigment powder of butterfly pea and sweet potato. All treatments of maltodextrin addition either concentration 20%, 25%, 30%, and 35% showed a tendency to decrease the value of b * along with the enchancement of maltodextrin used. The intensity of the yellow color on the anthocyanine pigment powder of butterfly pea and the purple sweet potato tend to decrease as the enhancement of maltodextrin concentration added. The decreasing of yellow intensity is due to the amount of maltodextrin concetration became higher causing an enhancement of total solids in the anthocyanin pigment powder of butterfly pea and purple sweet potato. This result is in line with the Muqoddas (2016) observation where the lower b * values are due to the increasing of maltodextrin concentration of antocyanine pigment powder of the banana pouch.

Water Content

The treatment of maltodextrin concentration addition gave a significantly different effect to the water content of anthocyanine pigment powder of butterfly pea and sweet potato produced. The analysis result of water content of anthocyanine pigment powder of butterfly pea can be seen in Table 6.

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

Treatment	Water Content	
	Butterfly Pea	Purple Sweet Potato
10% of Maltodextrin	2.87 ± 0.12a	5.56 ± 0.26 a
20% of Maltodextrin	2.73 ± 0.12 ab	4.64 ± 0.12 b
30% of Maltodextrin	2.60 ± 0.10bc	4.24 ± 0.13 c
40% of Maltodextrin	2.43 ± 0.06 d	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%.

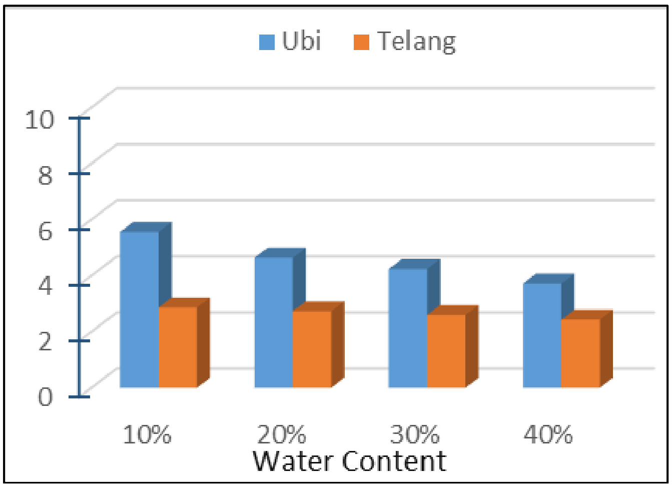

Fig 5 The Influence of Maltodextrin Concentration Addition towards Water Content (%) of Anthocyanin Pigment Powder of Butterfly Pea and Purple Sweet Potato.

The result of statistical test with Duncan test at level of 5% indicated that the anthocyanin pigment powder of butterfly pea and purple sweet potato with various treatment of maltodextrin concentration addition gave a significant effect towards water content.

The average result showed that the 40% of maltodextrin addition resulted 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 anthocyanine pigment powder of butterfly pea and purple sweet potato. These results are also aligned with Utomo's (2013) 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 butterfly pea and 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.

One of the maltodextrin's features is that being able to bind the free water content of a material so that the addition of an increasingly high maltodextrin can decrease the water content of the product (Hui, 1992). According to Ramadhia *et al.* (2012), 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.

The results showed that water content of anthocyanin pigment powder was between 2.43% - 2.87% and purple sweet potato 3.72% - 5.56%. The feature of anthocyanin pigment powder of butterfly pea and purple sweet potato was expected as natural dye preparation that is anthocyanin pigment powder of butterfly pea and purple sweet potato with lower water content. The percentage of water content from the observation result with 10%-40% maltodextrin concentration addition has been appropriate with the standard powder beverage product which has a maximum water content limit of 3% based on Indonesian Standard National 01-4320-1996.

Water content is one of the important parameters for powder-shaped products because it will affect the stability and storage of products. The dye anthocyanin preparations in powder form are hygroscopic (easily to absorb water) that their storage should be in low permeability containers and in tight packaging. The absorption of water vapor by the powder product can increase water content and cause clumping of the product. According to Buckle *et al.* (1987), the product in the form of its water content should be reduced below 5%. This is because if the powder product has a high water content will be more susceptible to damage due to the growth of bacteria and fungi.

Hygroscopicity

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

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

Treatment	Hygroscopicity	
	Butterfly Pea	Purple Sweet Potato
Maltodextrin 10%	8.33 ± 0.25a	11.62 ± 0.62 a
Maltodextrin 20%	7.33 ± 0.32b	11.70 ± 0.56 b
Maltodextrin 30%	6.53 ± 0.25c	12.75 ± 0.78 c
Maltodextrin 40%	5.20 ± 0.10d	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%

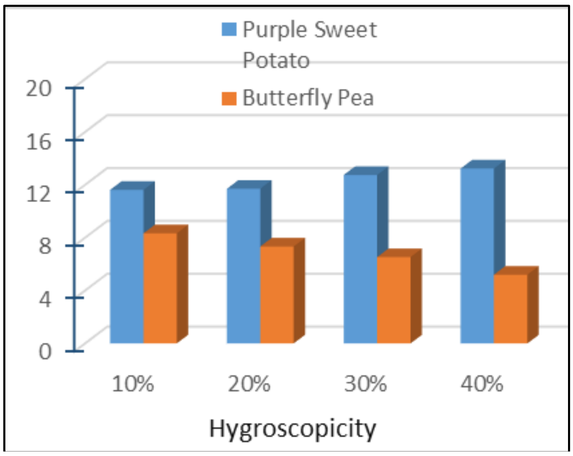

Fig 6: The Influence of Maltodextrin Concentration Addition Towards Hygroscopicity (%) of Anthocyanin Pigment Powder of Butterfly Pea Flower and Purple Sweet Potato.

Based on the statistical analysis on that, it shows that there is a significantly different effect on the hygroscopicity level of anthocyanine pigment powder of butterfly pea and purple sweet potato. This suggests that the maltodextrin addition affects the degree of hygroscopicity obtained from the anthocyanine pigment powder of butterfly pea and the purple sweet potato. The hygroscopicity rate of anthocyanine pigment powder of butterfly pea is ranged between 5.20% - 8.33% and purple sweet potatoes ranged from 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 butterfly pea and purple sweet potato. According to Hui (1992), the features of maltodextrin include rapid dispersion, high solubility, and low hygroscopic features. The statement is also supported by Costa *et al*. (2014), this is because maltodextrin has a low hygroscopicity that affects the affinity between water and other compounds in the product.

Solubility

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

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

Treatment	Solubility	
	Butterfly Pea	**Purple Sweet Potato**
10% of Maltodextrin	97.33 ± 0.31 a	97.13 ± 0.25 a
20% of Maltodextrin	98.03 ± 0.06 b	98.13 ± 0.15 b
30% of Maltodextrin	98.20 ± 0.10 c	98.27 ± 0.06 c
40% of Maltodextrin	98.43 ± 0.06 d	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%.

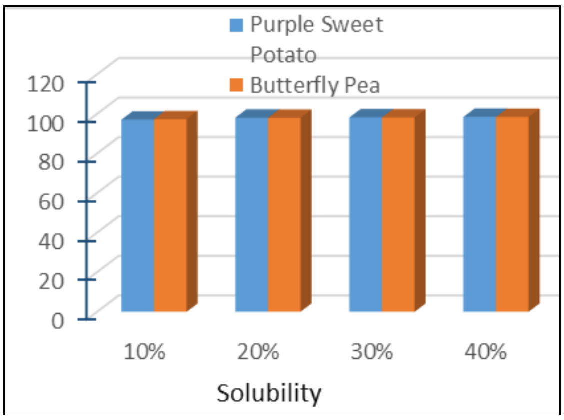

Fig 7: The Influence of Maltodextrin Concentration Addition towards Solubility (%) Anthocyanin Pigment Powder of Butterfly Pea Flower and Purple Sweet Potato.

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 butterfly pea and sweet potato. This suggests that the addition of maltodextrin affects the solubility resulting from the anthocyanine pigment powder of butterfly pea. The solubility value of anthocyanin pigment powder of butterfly pea is ranged between 97.33% - 98.43% and purple sweet potatoes ranged between 97.13% - 98.53%

The results showed that the range of different concentration 10% of maltodextrin influenced anthocyanine pigment powder of butterfly pea and purple sweet potato solubility. According to Retnaningsih and Tari (2014), maltodextrins are oligosaccharides composed of several glucose molecules attached to hydrogen bonds which are highly soluble in water and rapidly dispersed. The hydroxyl group in maltodextrin causes a high degree of solubility of a powder product.

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 to Chen (2008) cited Cindy (2015), good value of powder solubility is 92-99%.

Soluble Time

The treatment of maltodextrin concentration addiotion had real significant effect on the soluble time of anthocyanine pigment powder of butterfly pea and purple sweet potato produced. The soluble time analysis resulting of anthocyanine pigment powder of butterfly pea and 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 Butterfly Pea Flower and Purple Sweet Potato.

Treatment	Soluble Time	
	Butterfly Pea	**Purple Sweet Potato**
10% of Maltodextrin	187 ± 3.51 a	159 ± 5.00 a
20% of Maltodextrin	155 ± 2.61 b	158 ± 17.58 ab
30% of Maltodextrin	145 ± 3.00 c	139 ± 12.29 c
40% of Maltodextrin	133 ± 3.06 d	132 ± 8.74 cd

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

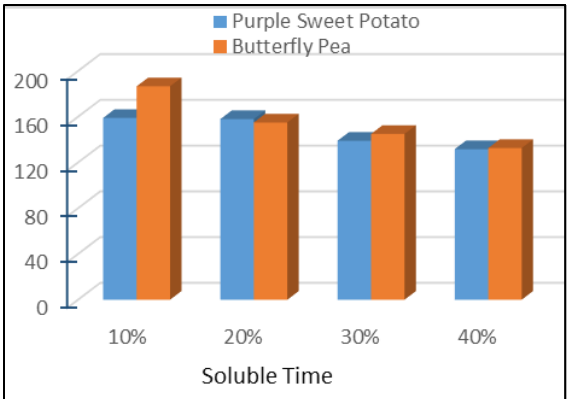

Fig 8: The Influence of Maltodextrin Concentration Addition towards Soluble Time (s) of Anthocyanin Pigment Powder of Butterfly Pea Flower and Purple Sweet Potato.

The result of Duncan test showed that the anthocyanin pigment powder of butterfly pea and purple sweet potato with a variety of maltodextrin concentration addition treatment gave a significant effect on the soluble time. The soluble time of anthocyanin pigment powder of butterfly pea and purple sweet potato with the 10%, 20%, 30% and 40% of maltodextrin concentrations addition gave a significantly different effect. The statistical analysis showed that the 40% addition of maltodextrin showed faster solubility time compared to the 30%, 20%, and 10% addition of maltodextrin. It shows that the addition of maltodextrin concentration can decrease the soluble time of anthocyanine pigment powder of butterfly pea and purple sweet potato.

The soluble time of anthocyanin pigment powder of butterfly pea and purple sweet potato showed that the result tended to decrease with enhancing the maltodextrin concentration addition. Decreasing of soluble time along with increased treatment of maltodextrin concentration addition can be interpreted that the soluble time of anthocyanin pigment powder of butterfly pea and purple sweet potato is faster. This decreasing of soluble time due to maltodextrin is a filler material that has a fast solubility rate because it is easily soluble in water. According to Hui (1992), the properties of maltodextrins are easily dispersed and have high solubility and binding power.

Matodextrin is a filler material with high solubility value. The increased solubility rate is due to the higher surface area in the powdered product so that the particles on the pigment powder that are in contact with water will be more. An enhancement in the surface area of the pigment powder causes the powder to wet more quickly and dissolve completely (Hui, 1992).

The results showed that the soluble time of anthocyanin pigment powder of butterfly pea was between 133-187 seconds and purple sweet potatoes ranged from 132-159. Properties of anthocyanin pigment powder of butterfly pea were expected that have the fastest soluble time. The fastest soluble time indicates that the quality of the resulting powder product is better because it will facilitate the application of foodstuffs.

pH

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

Table 10: The Influence of Maltodextrin Concentration Addition towards pH of Anthocyanin Pigment Powder of Butterfly Pea Flower and Purple Sweet Potato.

Treatment	pH	
	Butterfly Pea	Purple Sweet Potato
10% of Maltodextrin	2.93 ± 0.10 a	3.04 ± 0.04 a
20% of Maltodextrin	3.03 ± 0.06ab	3.14 ± 0.04 b
30% of Maltodextrin	3.07 ± 0.05bc	3.26 ± 0.11 c
40% of Maltodextrin	3.11 ± 0.02d	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%.

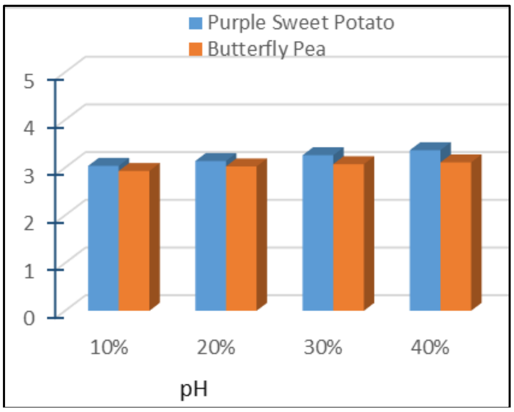

Fig 9: The Influence of Maltodextrin Concentration Addition towards pH of Anthocyanin Pigment Powder of Butterfly Pea Flower and Purple Sweet Potato.

Based on the results of statistical analysis, it shows that there was a real effect on pH value parameter of anthocyanin pigment powder of butterfly pea and purple sweet potato. This suggests that the addition of maltodextrin affected pH value of anthocyanin pigment powder of butterfly pea and purple sweet potato. The pH value resulted of the anthocyanin pigment powder of butterfly pea is ranged between 2.93-3.11 and purple sweet potatoes ranging from 3.04 to 3.37.

The results showed that the range of different concentration 10% of maltodextrin influenced the pH value of anthocyanine pigment powder of butterfly pea and purple sweet potato. The use of raw materials with the same characteristics and drying process with the same time caused pH value of anthocyanin pigment powder butterfly pea and purple sweet potato between treatment were really different.

The pH value was influenced by the acid content that contained in the anthocyanin pigment powder. The acid used during the butterfly pea extract maceration process was tartaric acid with a concentration of 5% and purple sweet potato with concentration of 1%.

According to Jackman and Smith (1996), the 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. 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 pigments at lower pH can be applied to acidic products, such as soft drinks, sweets, sauces, pikel, canned food or beverages (Fennema, 1996).

Storage of anthocyanin pigment powder of butterfly pea can also affect the pH value. The anthocyanin pigment powder of butterfly pea must be stored in a vaporous, air-tight container. This is because oxygen can accelerate the degradation of anthocyanins in the pH range at 2-4 (Markakis, 1982). This opinion is also supported by Nurulhida (2012) which stated that pigment powder with low water content stored in moisture-proof packaging will have a lower pH value.

Yield

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

Table 11: The Influence of Maltodextrin Concentration Addition Towards Yield (%) of Anthocyanin Pigment Powder of Butterfly Pea Flower and Purple Sweet Potato.

Treatment	Yield	
	Butterfly Pea	Purple Sweet Potato
10% of Maltodextrin	51.63 ± 1.99 a	31.38 ± 0.13 a
20% of Maltodextrin	53.70 ± 2.29b	38.37 ± 0.18 b
30% of Maltodextrin	56.03 ± 1.51c	44.16 ± 0.34 c
40% of Maltodextrin	58.50 ± 3.01cd	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%.

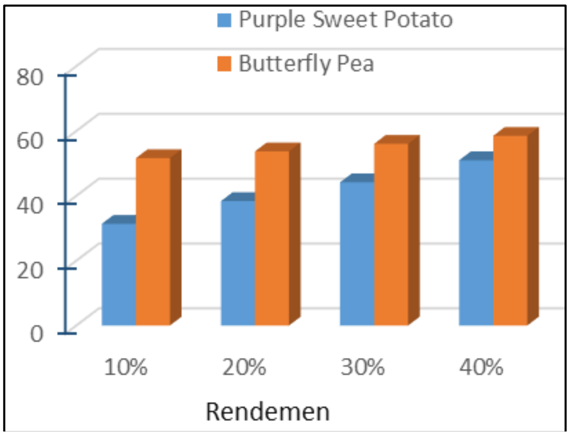

Fig 10: The Influence of Maltodextrin Concentration Addition Towards Yield (%) of Anthocyanin Pigment Powder of Butterfly Pea Flower and Purple Sweet Potato.

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 statistic analysis showed that the 40% addition of maltodextrin concentration resulted 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 Muqoddas (2016) observation where the 30% addition of maltodextrin concentration towards the anthocyanin pigment powder of banana pouch produces a higher yield rather than the 10% addition of maltodextrin concentration.
The yield content of the anthocyanin pigment powder showed that the results tended to enhance along with the increasing of maltodextrin concentration addition. According to Masters (1979) quoted Warsiki (1993), the increasing value of yield due to the maltodextrin addition can increase the total solids of the dried material.

Conclusions
The anthocyanin pigment powder of butterfly pea with various treatments of maltodextrin concentration addition gives an effect on water content, soluble time, and yield, but it does not give significant effect on total of anthocyanin, hygroscopicity, solubility, and pH value.
The treatment of maltodextrin concentration addition of 10% produced the best characteristic with total anthocyanin of 53.02 mg / L, color intensity L * (brightness) of 51.72, a * (redness) of 23.50, b * (yellow) of 8.42, water content of 2,87%, hygroscopicity of 8.33%, 97.33% of solubility, 187 seconds of soluble time, pH value of 2.93, and yield of 51.63%. For comparison, anthocyanin extract powder from butterfly pea without addition of 5% tartaric acid resulted in blue color with anthocyanin content ranged from 21.76 to 26.42 mg / L.
The anthocyanin pigment powder of purple sweet potato with various treatments of maltodextrin concentration added significant effect on color intensity (a *) and (b *) water content, solubility time, yield, total of anthocyanin, hygroscopicity, solubility, and pH value. But it does not give a real effect to the color intensity (L *).
The treatment of 10% addition maltodextrin concentration resulted the 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%, 97.13% of solubility, 159 seconds of soluble time, pH value of 3.04, and yield of 31.38%.
The observation results on the various treatments and the type of materials used showed that the anthocyanin pigment powder of butterfly pea with the treatment of the 10% addition maltodextrin concentration was potentially applied as a natural dye preparations for food and beverage as the best treatment

Acknowledgment
The authors are grateful to Dr.Sc.Agr. Agung Karuniawan, Ir., M.Sc.Agr, protuber team for funding the research work and providing purple sweet potatoes varieties and Research Center for providing also facilitating the laboratory work.

Recommended Reviewers
1. Prof. Dr. Eng. I Made Joni. M.Si. Physic Lecture, Universitas Padjadjaran.
2. Yana Cahyana STP., DEA.,Ph.D Food techlogist Lecture, Universitas Padjadjaran.
3. Dr. Sandi Darniadi., MT Research and development post-harvest department, Bogor.
4. Prof. Ir. Tarkus Suganda, M.Sc., Ph.D. Agriculture Lecture,Universits Padjadjaran

Reviewer's reason: The reviewers are experts in raw material, anthocyanin extraction, food chemistry and Phytochemical

References
1. Al F, Ferawati dan, R Arqomah. Ekstraksi Zat Warna dari Kelopak Bunga Rosella (Studi Pengaruh Konsentrasi Asam Asetat dan Asam Sitrat). Jurnal Teknik Kimia. Universitas Sriwijaya, Palembang, 2013; 1:19.
2. AOAC. Official Methods of Analysis of The Association of Official Analytical Chemist. Penerbit Inc. Arlingtong, Virginia, 1999.
3. A-sun K, Thumthanaruk B, Lekhavat S, dan Jumnongpon R. Effect of Spray Drying Conditions On Physical Characteristic Of Coconut Sugar Powder. International Food Research Journal University of Technology North Bangkok, Bangkok, 2016, 23(3).
4. Anwar E. Pemanfaatan Maltodextrin Dari Pati Singkong Sebagai Bahan Penyalut Lapis Tipis Tablet. Universitas Indonesia, Depok, 2002.
5. AOAC. Official Methods of Analysis of The Association of Official Analytical Chemist, 14 th ed. AOAC, inc Arlington. Virginia, 1984.
6. Azkiya U. Hubungan Penambahan Anti Kempal Trikalsium Fosfat (TCP) dengan Karakteristik Bubuk Pigmen Antosianin Ubi Jalar Ungu Terenkapsulasi. Skripsi. Fakultas Teknologi Industri Pertanian. Universitas Padjadjaran. Jatinangor, 2013.
7. Badan Standarisasi Nasional. SNI Serbuk Minuman Tradisional, 1996. (SNI-014320-1996).
8. Barbosa-Canovas GV, E Ortega-Rivas, P Juliano, dan H Yan. Food Powders (Physical Properties, Processing, and Functionality). Kluwer Academic/Plenum Publishers, New York, 2005.
9. Budiarti Y. Kajian Penurunan Aktivitas Antioksidan pada Pembuatan Serbuk Instan Berbasis Rosella (Hibiscus sabdariffa Linn) (Skripsi). Fakultas Teknologi Industri Pertanian. Universitas Padjadjaran, Jatinangor, 2013.
10. Buckle KA, RA Edwards, GH Fleet, dan M, Wooton. Ilmu Pangan. Penerjemah: Hadi Purnomo dan Adiono. UI-Press, Jakarta, 1987.
11. Carreto NDD, Filho,ESM, Pesson FKA, dan Meirells, AJA. Water Activity of Aqueous Solutions of Ethylene Oxide-Propylene Oxide Block Copolymers and Maltodextrins. Brazilian Journal of Chemical Engineering, 2009.
12. Chafid A, dan Kusumawardhani G. Modifikasi Tepung Sagu Menjadi Maltodextrin Menggunakan Enzim Alfa Amylase (Skripsi). Fakultas Teknik. Universitas Diponegoro, Semarang, 2010.
13. Chandrayani E. Mikroenkapsulasi Oleoresin Biji Pala dengan Menggunakan Sukrosa Sebagai Bahan Penyalut (Skripsi). Fakultas Teknologi Pertanian. Institut Pertanian Bogor, Bogor, 2002.
14. Cindy I. Pengaruh Berbagai Konsentrasi Maltodextrin Terhadap Karakteristik Serbuk Minuman Fungsional Hantama (Hantap Madu) (Skripsi). Universitas Padjadjaran, Jatinangor, 2015.

15. Cook BG, Pengelly BC, Brown SD, Donnelly JL, Eagles DA, Franco MA. *et al*. Tropical Forages. Brisbane (Australia): CSIRO, DPI&F (Qld), CIAT and ILRI, 2005.
16. Costa JP, EMFF Rocha, dan JMC Costa. Study of The Physicochemical Characteristic of Sousop Powder Obtained by Spray Drying. Food Sci, Technol, Campinas. Universidade Federal do Ceara, Brasil. 2014; 34(4):663-666.
17. Dalimartha S. Atlas Tumbuhan Obat Indonesia. Jilid 5. Hal 86-87, Jakarta, 2008.
18. Desrosier NW. Teknologi Pengawetan Pangan. Penerjemah: M. Muljohardjo. UI-Press, Jakarta, 1988.
19. Dubey R, TC Tsami, dan B Rao. Microencapsulation Technology and Preparation. Journal Defence Science. 2009; 59(1):82-95.
20. Elbe JHV, dan Schwartz TJ. Colorants. Marcell Dekker, New York, 1996.
21. Ernawati S. Stabilitas Sediaan Bubuk Pewarna Alami Dari Rosela *(Hibiscussabdariffa* L.) yang Diproduksi dengan Metode Spray Drying dan Tray *Drying (Skripsi). Fakultas Teknologi Pertanian.* Institut Pertanian Bogor, Bogor, 2010.
22. Ernita C. Mikroenkapsulasi Oleoresin Biji Pala dengan Menggunakan Sukrosa Sebagai Bahan Penyalut (Skripsi). Fakultas Teknologi Pertanian. Institut Pertanian Bogor, Bogor, 2002.
23. Fellows JP. Food Processing Technology: Principles and Practise. 2ndEd.Woodhead Publ, Lim. England, Cambridge, 2000.
24. Fennema OR. Food Chemistry 3th Edition, Marcel Dekker Inc., New York, 1996.
25. Fiana RM, WS Murtius, dan A Asben. Pengaruh Konsentrasi Maltodextrin Terhadap Mutu Minuman Instan Dari Teh Kombucha. Jurnal Teknologi Pertanian Andalas Vol. 20. Universitas Andalas, Padang, 2016.
26. Garzon GAW, dan Wrolstad RE. The Stability of Pelargonidin-Based Anthocyanidin At Varying Water Activity. Food Chemistry. GEA Niro Research Laboratory. 2005. Analytical Method,. 2001; 75(2):185-196.
27. Giusti MM, dan RE Wrolstad. Characterization and Measurement of Anthocyanins by UV-Visible Spectroscopy. John Willey and Sons, Inc, 2001.
28. Gonnissen Y, Remon JP, dan Vervaet C. Effect of Maltodextrin and Superdisintegrant in Directly Compressible Powder Mixtures Prepared Via Co-Spray Drying. European Journal of Pharmaceutics and Biopharmaceutics. 2008; 68:277-282.
29. Gradinaru G, Biliaderis CG, Kallithraka S, Kefalas P, dan Garciaviguera C. Themal Stability of Hibiscus sabdariffa L. Anthocyanins in Solution and in Solid State: Effects of Copigmentation and Glass Transition, Food Chem. 2003; 83:423-436.
30. Harahap N, dan A Hasairin. Analisis dan Pemanfaatan Bunga Kembang Sepatu *(Hibiscus rosa-sinensis) Sebagai* Zat Warna Alami Pada Makanan Cenil. Jurnal Biosains, FMIPA UNIMED. 2015; 1:3.
31. Harborne JB. Metode Fitokimia Penuntun Cara Menganalisis Tumbuhan,Terjemahan. Padmawiyata, K. dan Soediro. ITB, Bandung. Hal, 1996, 69-94.