RESEARCH ARTICLE OPEN ACCESS

# Characteristic of Dahlia Bulbs Flour by Various Colors of Dahlia (Dahlia variabilis) Flowers

*Rina Yenrina, Tuty Anggraini, Diana Sylvi, Dwi Putri Sugiarti
*Faculty of Agricultural Technology, Andalas University, Limau Manis Campus-Padang 25163. West Sumatera, Indonesia*
*Corresponding author: Rina Yenrina*

**ABSTRACT**
Dahlia bulb is a carbohydrate source, and conversion from the bulb form into the powder form can facilitate the utilization of dahlia bulbs. The physicochemical properties of bulbs that have been used as flour from various colors of dahlia flower have not been tested. The aim of this research was to identify the physicochemical characteristics of flour produced by red, yellow, and purple dahlia bulbs. This study used an explorative design with 3 dahlia flower color treatments (red, yellow, and purple) and 3 replications. The water content, ash content, fat content, protein content, antioxidant activity, dietary fiber, amylose content, quantitative analysis of saponin, yield, color, gelatinization temperature, and water and oil absorption of dahlia bulbs flour were evaluated. The physical analyses of the dahlia bulb flour consisted of yield (12.72-18.35%), color (yellow and reddish yellow), gelatinization temperature (31.0-32.8°C), water absorption (1.569-2.460 g/g), and oil absorption (1.689-1.839 g/g). In addition, chemical analyses identified the water content (12,24-14,14%), ash content (2,77-3,53%), protein content (3.81-4.40%), fat content (0.69-0.77%), antioxidant activity (33.33-33.77%), amylose (0.45-0.60%), dietary fiber (1.65-6.30%), and saponin (negative). The dahlia flower color variation contributes to the physicochemical characteristics of the resulting dahlia bulbs flour

***Keywords*: *Dahlia Bulb Flour, Dahlia Flower Colors, Characteristic***

---

Date of Submission: 19-09-2017 Date of acceptance: 30-09-2017

---

## I. INTRODUCTION

Dahlia (Dahlia variabilis) is one of many plants found in the highlands of Indonesia. This plant has beautiful flowers, with three or more petal plates. The shape of the flowers is round, and the edges are jagged, with a bulge appearing on the petal. The flower comes in various colors, including bright red, pink, yellow, and orange[1].

Dahlia has a high development potential in West Sumatera Province, and a number of cities in West Sumatera, such as Bukittinggi and Agam Regency, have called themselves "The City Of Dahlia" to develop the potential of these biological resources [2].Until recently, dahlia plants in Indonesia have been cultivated as ornamental plants. Dahlia flowers are used as cut flowers, bulbs that still have stems are used as seeds and bulbs that do not have stem are thrown away.

It is now known that the dahlia bulbs contain inulin as a carbohydrate source. Dry dahlia bulbs contain inulin, which makes up 65-75% of the total carbohydrates in the plant. Due to the large amount of inulin in the dahlia bulb, dahlia has the potential to be processed into fructose sugar and fructooligosaccharide. Fructose is a natural sweetener and is 2.5 times sweeter than sucrose (Haryani, Siti, and Saryono, 2013)[3].

Dahlia bulbs are in demand as a processed food ingredient. The conversion from the bulb form into a powder form can facilitate the utilization of dahlia bulbs in processing as a semi-finished material and can also improve its shelf life.

Based on phytochemical tests that have been performed by Suryadi (2007)[4], the bulbs of red dahlia flower contain flavonoids, phenolic, and saponin.
Dahlia with red flowers that have been grown on inceptisols (Sukabumi) have a higher inulin content than do purple, yellow or white flowers. However, the physicochemical properties of bulbs that have been used as flour from various dahlia flower colors have not been tested [5]. Based on the above background, the author intended to conduct a study entitled **"Characteristic of Dahlia Bulbs Flour by Various Colors of Dahlia (Dahlia variabilis) flowers"**

## II. MATERIAL AND METHODS

### Materials and Tools

The materials used in this study were dahlia flower bulbs from red, yellow and purple dahlia flowers obtained from Jorong Kubu Ketaping, Jorong Kubu Tanjung Nagari Kubang Putih and Jorong Parik Putuih, Ampek Angkek and Matur Subdistricts, Agam District in West Sumatera. The chemicals used in this study were sodium metabisulfite ($Na_2S_2O_5$), NaOH, HCl, $H_3BO_3$, $H_2SO_4$, N-Hexan, methanol, DPPH, 95% ethanol, iodine solution, acetic acid, acetone, ADF solution, and aquades. The tools used were sieves, knives, basins, trays, aluminium foil, scales, desiccator, kjeldahl pumpkin, distillation device, measuring flask, burette, oven, Soxhlet extraction tool, distillation tools, Erlenmeyer, cup, amylograph brabender, waterbath, hunterlab color, spectrophotometer, centrifuge, centrifuge tube, fat pumpkin, filter paper, hot plate, 100 ml powder flask, glass cup, test tube, blast furnace, 10 ml measuring cup, dropper pipette and other glassware.

**Research Design**

The method used in this study was explorative and consisted of three replications. The treatment used dahlia bulbs with 3 dahlia flower colors (yellow, purple, and red) from Agam Regency that were made into flour. The physicochemical properties of each of the dahlia bulbs flour were tested.

**Research Implementation**

**Making Dahlia Bulb Flour (Sulistyo, 1992)[6] methods with modification**

The steps to make dahlia bulb flour were as follows:
1. Wash, peel, and thinly slice 1 kg of dahlia bulb using a stainless steel knife.
2. Soak thinly sliced dahlia bulbs with 0.5% sodium metabisulphite solution of material weight.
3. Dry with a cabinet dryer at 50-60 °C. Stop drying if the bulb is easily broken.
4. Mill and sieve the dried bulbs with an 80 mesh sieve, and place the resulting flour into an airtight package for analysis.

**Observations**

**Raw material**

The observations of the raw materials identified the water and ash contents[7], protein content using the micro kjeldahl method[8], fat content[8], antioxidant activity using the DPPH method[9], dietary fiber analysis[7] and a quantitative saponin test[10].

**Dahlia Bulb Flour**

Observations of dahlia bulb flour included yield[11], color (*Hunter lab*), gelatinization temperature (*Brabender Amylograph)*, water absorption[12], oil absorption [13], water content[7], ash content[7], protein content using the micro kjeldahl, fat content using the soxhlet method[8], antioxidant activity using the DPPH method[9], amylose and dietary fiber[7], and a quantitative saponin test[10].

## III. RESULTS AND DISCUSSION

**Chemical Properties Analysis**

**Water content**

The results of the water content analysis on dahlia bulbs and dahlia bulb flour are shown in Figure 1. Water content is one of the parameters that greatly affects the resistance to damage caused by microbes and insects. Thus, when making flour, a drying process is performed to reduce the water content and thereby inhibit the microbial growth and enzyme activity, which can damage the flour[14].

Based on the analysis of 3 dahlia bulbs from 3 different flower colors, the highest water content was found in the purple dahlia bulb at 80,90%, and the lowest water content was in the yellow dahlia bulb at 78,01%. The water content analysis results were not greatly different from those of Mangunwidjaja et al. (2014)[15], at 79.90%. The presence of water means less solid material, so a high moisture content results in a low yield value. The water content in dahlia bulb flour from the 3 flower colors ranged from 12.24% to 14.14% and has met the flour quality standard, which is a maximum of 15% in the SNI of cassava flour[16].

**Ash Content**

Ash content in the dahlia bulbs and dahlia bulb flour from the 3 colors are shown in Figure 2. Based on the ash content analysis, the purple flowers has the highest ash content at 0.74%, while the yellow flowers have the lowest ash content at 0.65%. The ash content is much lower than in Mangunwidjaja et al. (2014)[15], in which the ash content was 3,83%. These results are also not much different from the ash content in other types of bulb flour such as ganyong (*Canna discolor)* bulb, suweg (*Amorphophallus paeoniifolius)*, coconut bulbs and gembili (*Dioscorea esculenta* L), with values ranging from 2.87-3.81%[17]. Quantitatively, the ash content in flour and comes from minerals in fresh bulbs, the use of fertilizers, and soil and air contamination during processing (Soebito, 1988)[18]. The ash content in dahlia bulb flour increased from the ash content in the raw material, which can be seen in Figure 2 because the soaking process used to make the dahlia bulb flour used sodium metabisulphite solution ($Na_2S_2O_5$). According to Rahman (2007)[19], the increased ash content in flour is caused by the mineral content in Na and S in the sodium metabisulphite solution ($Na_2S_2O_5$).

**Protein Content**

The red dahlia bulb contained more protein than did the yellow and purple dahlia bulbs at 0.70% (Figure 3). The protein content was lower than the value of Mangunwidjaja *et al*. (2014)[15], which was 5,92%. The protein content in dahlia bulbs flour was higher than the protein content in the dahlia bulbs due to the decrease in water during the drying process. In accordance with the opinion of Buckle *et al*. (1987)[20], the protein content may be affected by the decrease in water content in the drying process. A high protein content in flour is desirable; this is related to the use of flour. If the flour is high in protein, then the application does not need any substitute material[17].

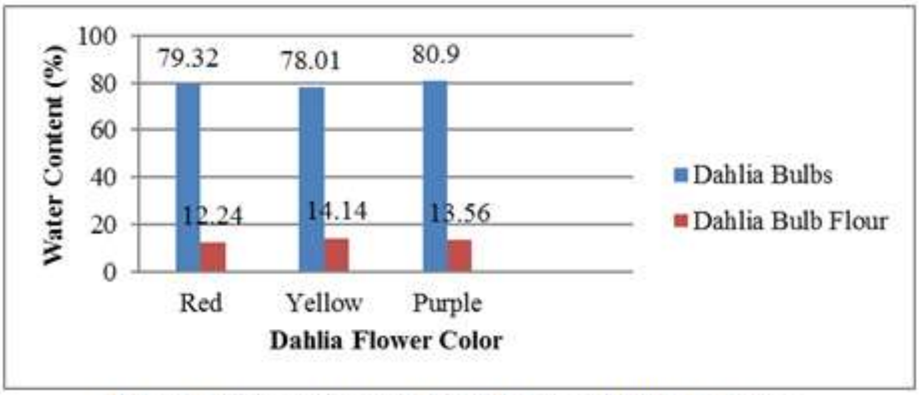


**Figure 1.** Water Content of Dahlia Bulbs and Dahlia Bulb Flour

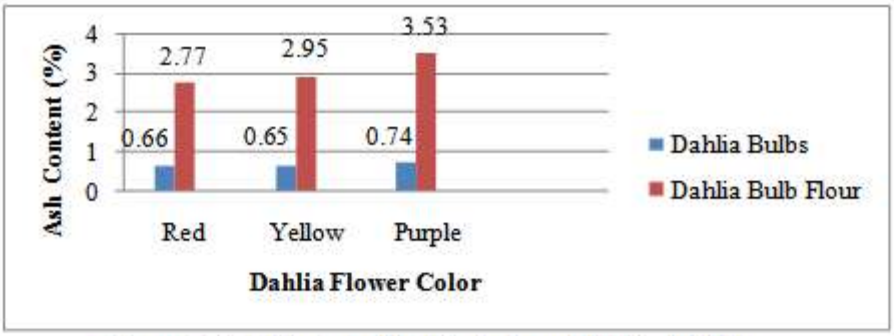


**Figure 2.** Ash Content of Dahlia Bulbs and Dahlia Bulb Flour

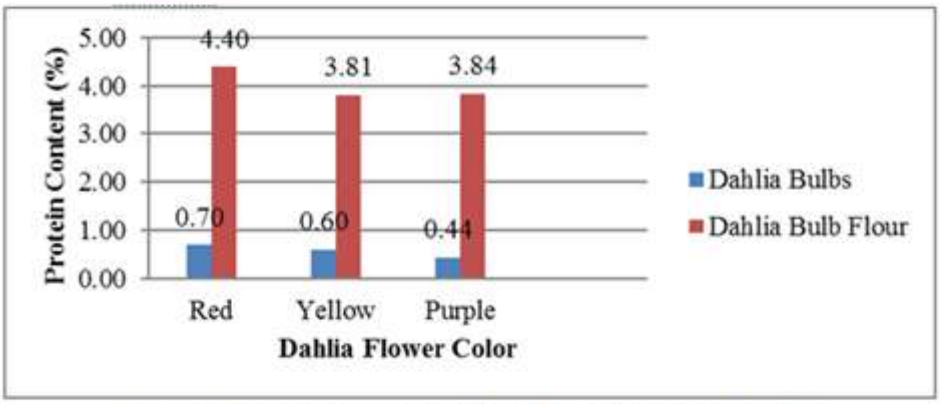


**Figure 3.** Protein Content of Dahlia Bulbs and Dahlia Bulb Flour

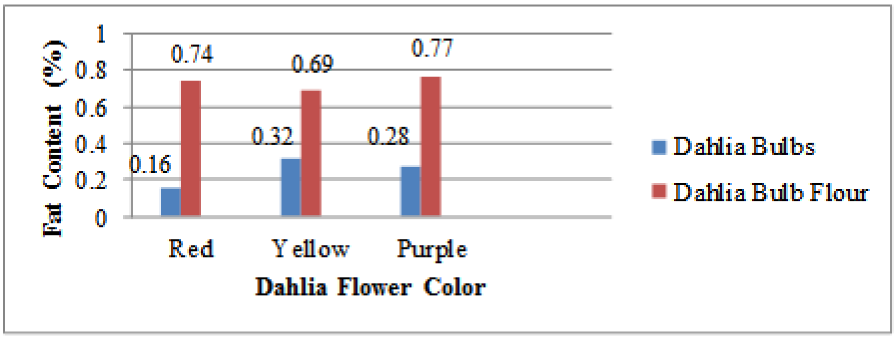


**Figure 4.** Fat Content of Dahlia Bulbs and Dahlia Bulb Flour

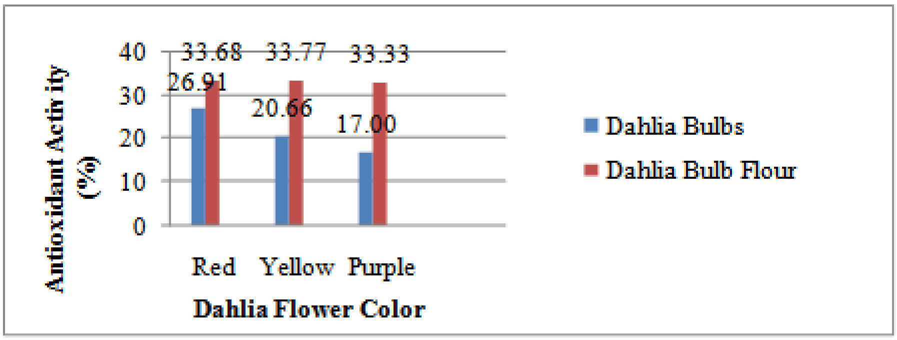


**Figure 5.** Antioxidant Activity of Dahlia Bulbs and Dahlia Bulb Flour

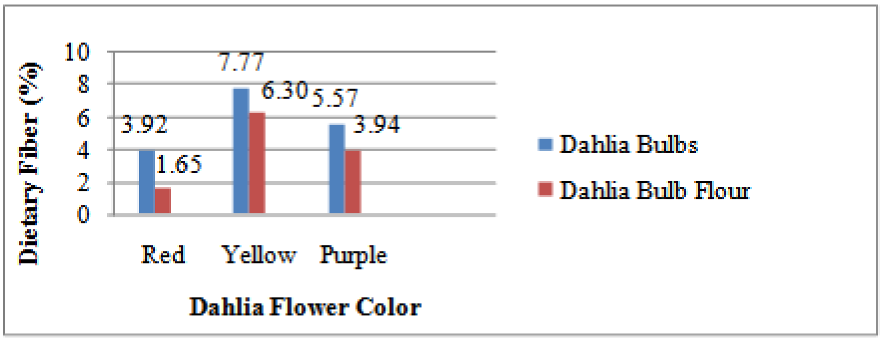


**Figure 6.** Dietary Fiber of Dahlia Bulbs and Dahlia Bulb Flour

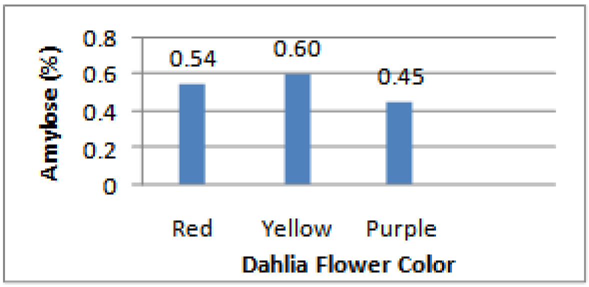


**Figure 7.** Amylose of Dahlia Bulb Flour

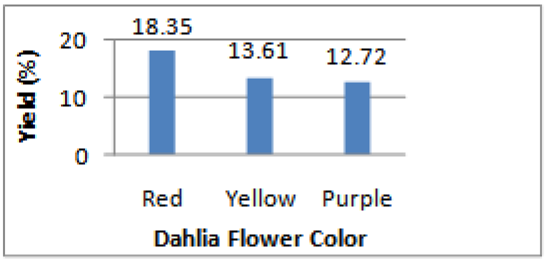


**Figure 8.** Yield of Dahlia Bulb Flour

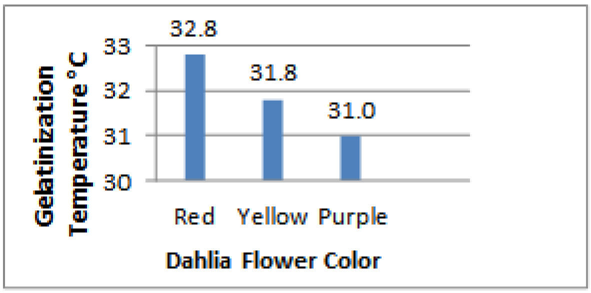


**Figure 9.** Gelatinization Temperature of Dahlia Bulb Flour

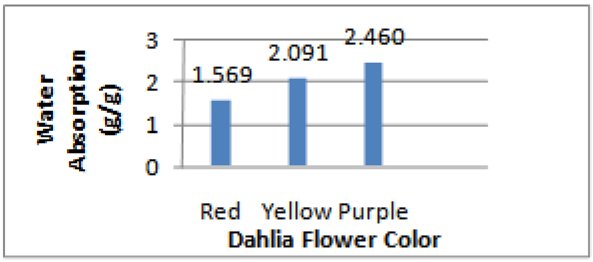


**Figure 10.** Water Absorption of Dahlia Bulb Flour

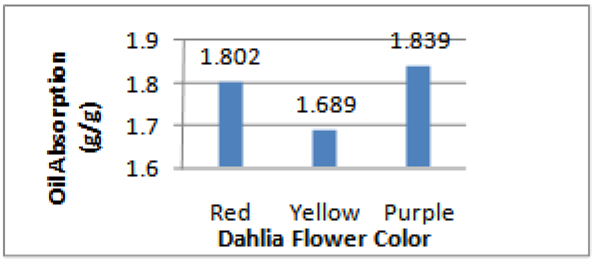


**Figure 11.** Oil Absorption of Dahlia Bulb Flour

**Table 1.** Qualitative Saponin Analysis of Dahlia Bulbs and Dahlia Bulb Flour

| Bulbs Type | Saponin |
|---|---|
| Red Dahlia Bulbs | + ( Positive ) |
| Yellow Dahlia Bulbs | + ( Positive ) |
| Purple Dahlia Bulbs | + ( Positive ) |
| Red Dahlia Bulb Flour | - ( Negative) |
| Yellow Dahlia Bulb Flour | - ( Negative) |
| Purple Dahlia Bulb Flour | - ( Negative) |

**Table 2**. Color Analysis of Dahlia Bulb Flour

| Flours Type | Hunter Scale | | | °*hue* |
|---|---|---|---|---|
| | L | a | B | |
| Red Dahlia Bulb Flour | 81,55 | -0,34 | 19,14 | 90,86 |
| Yellow Dahlia Bulb Flour | 76,94 | 0,16 | 20,09 | 89,54 |
| Purple Dahlia Bulb Flour | 74,09 | 0,63 | 18,86 | 88,08 |

**Fat Content**

The fat content analysis of the dahlia bulbs and dahlia bulb flour are shown in Figure 4. The fat content in the dahlia bulb flour ranged from 0,69-0,77%. The highest fat content was found in the yellow dahlia bulb at 0,32%, and the lowest fat content was found in the red dahlia bulbs at 0.16%. These values were lower than the fat content in Mangunwidjaja *et al.* (2014)[15], at 1.39%. The fat content of dahlia bulb flour was higher than that of white sweet potato flour at 0.53% and lower than those of yellow and purple sweet potato flour at 0.91 and 0.81%, respectively[21].

The fat content of dahlia bulb flour was lower than that of dahlia bulbs because of the use of sodium metabisulphite ($Na_2S_2O_5$) solution during the soaking process. According to Rahman and Perera (1998)[22] the sulfite process can cause tissue cells to become perforated, which is suspected to cause the fat to split into the fatty acids that are detected during the fat content analysis. Similar to the water content, a high fat content is less favorable during flour storage because it may cause rancidity.

**Antioxidant Activity**

The antioxidant activity analysis on dahlia bulbs and dahlia blub flour are shown in Figure 5. Based on a phytochemical test of the dahlia bulb performed by Suryadi (2007)[4], the dahlia bulb contains flavonoids, phenolic and saponin. Based on an analysis of dahlia bulbs, the highest antioxidant activity of 26.91% was found in red dahlia bulbs, and the lowest, 17.00%, was found in purple dahlia bulbs. Further, the antioxidant activity on dahlia bulbs obtained ranged from 33.33% to 33.77%.

The antioxidant activity of dahlia bulb flour increased compared with that of the bulb, as raw material shown in Fig. 5. This was due to the use of sodium metabisulphite solution when making the flour; the flour allegedly contained a sulphite residue that increased the antioxidant activity of the flour. According to Syarief and Irawati (1988)[23], sulfur dioxide can function as an antioxidant.

**Dietary Fiber**

The results of a dietary fiber analysis of both dahlia bulbs and dahlia bulb flour are given in Figure 6. Based on the analysis, the 3 colors of dahlia flowers had different dietary fiber contents. The highest dietary fiber content was found in the yellow dahlia bulb, at 7,77%, and the lowest value was found in the red dahlia bulb at 3,92%. Meanwhile, in dahlia bulb flour, the highest dietary fiber was found in yellow dahlia bulb flour at 6.30%, and the lowest dietary fiber was found in red dahlia bulb flour at 1.65%.

**Amylose**

The amylose content of dahlia bulbs and dahlia bulb flour is shown in Figure 7. Based on the analysis, the amylose content of dahlia bulbs flour ranged from 0.45-0.60%. The amylose content in dahlia bulbs was lower than that in the flour from various bulbs, such as the ganyong (*Canna discolor)* bulb, suweg (*Amorphophallus paeoniifolius)*, coconut bulbs and gembili (*Dioscorea esculenta* L) with values of 18.6, 19.2, 23.6, and 23.2%, respectively. During the amylose analysis, the iodized flour solution did not change color to blue but instead turned brown. This finding proves that there is a low amylose content in dahlia bulb flour.

The amylose and amylopectin levels play a significant role during the gelatinization retrogradation process and further determine the characteristics of the starch paste (Jane et al. 1999)[24].

**Saponin**

The qualitative test of saponin on dahlia bulbs and dahlia bulb flour is shown in Table 1. The dahlia bulbs formed foam during the shaking process with a height of 0.5-1 cm, demonstrating that the dahlia bulbs Contains saponins. Meanwhile, dahlia flour did not form foam, proving that dahlia bulb flour does not contain saponins. This occurs because saponin is reduced and even lost during the drying process. Because the drying process eliminates water, water-soluble compounds are also lost during the process. According to Suharto. et al., (2012)[25], saponin compounds have physical properties that are easily soluble in water and will cause foam upon shaking.

**Physical Properties Analysis**

**Yield**

The yields of dahlia bulb flour from 3 different flower colors of dahlia flowers are shown in Figure 8. The yield of red bulb flour was the highest, at 18.35%, and those of yellow and purple bulb bulbs were 13.61% and 12.72%, respectively. The yield of dahlia bulb flour is lower than those of other bulbs' flour, such as purple sweet potato flour based on Ambarsari (2009)[21], which had a yield of 26,50%.

The low yield occurs because dahlia bulbs contain a high crude fiber content. According to research results by Mangunwidjaja (2014)[15], dahlia bulbs contain 8.06% crude fiber, so it is difficult to crush and does not pass during sieving when an 80 mesh sieve is used.

**Color**

The color analysis results are shown in Table 2. The highest L* value, 81,55, was found for red dahlia bulb flour, which that means that red dahlia bulb flour was brighter than were yellow and purple dahlia bulb flour. However, looking directly, there was no significant difference in the brightness of each flour.

Based on the °hue value, the flour had a yellow reddish color for yellow and purple dahlia bulb flour and a yellow color for red dahlia bulb flour. However, the flour was brownish yellow, and there was no significant color difference in each flour.

**Gelatinization Temperature**

The initial gelatinization temperature is the temperature when viscosity begins to rise. The gelatinization temperature of dahlia bulb flour is shown in Figure 9. The amylose content of the dahlia bulb flour was so low that it likely caused the gelatinization temperature to be low when compared to the gelatinization temperature of other bulb flours. According to Imanningsih (2012)[26], the gelatinization temperature of flour and starch flour is influenced by the amylose and amylopectin content. High amylose starch requires higher temperatures to gelatinize the starch. Otherwise, flour with high amylopectin has rapid gelatinization and low gelatinization temperatures.

**Water Absorption**

The water absorption index is used to measure the ability of the flour to absorb water and is determined by centrifugation. The water absorption obtained from dahlia bulb flour, as shown in Figure 10. Based on research that has been performed on the water absorption of dahlia bulb flour, the highest water absorption is found in purple dahlia bulb at 2.460 g / g, while the red dahlia flour has the lowest water absorption at 1.569 g / g. A high amylose content is one factor that can increase water absorption, but a small amylose content in dahlia bulb flour can be seen in Figure 10. Thus, the lower water absorption compared with that of the other bulbs flour was influenced by the existence of fiber, particularly because fiber can easily absorb water.

**Oil Absorption**

The mixture of oil and starch will affect the physical properties of starch, as oils and fats can form complexes with amylose that inhibit granular swelling, which makes the starch difficult to gelatinize (Fennema, 1985)[27].

As shown in Figure 11, the oil absorption of dahlia bulb flour from the 3 different flower colors ranged from 1.689-1.839 g / g, where the highest value was found in purple dahlia bulbs and the lowest value was found in yellow dahlia bulbs. According to Fennema, 1985[27], the oil absorption for various bulb flours ranged from 1.58-2.98%, whereas that for bulb starch flour ranged from 0.97 to 2.34 g / g.

Oil absorption is related to the water absorption and protein structure, where in minor components of gluten (lipids and polysaccharides), the proportion of different gluten protein groups and the balance of hydrophilic glutinous properties lead to differences in the water and oil absorption capacities [27].

## IV. CONCLUSION

1. Physical characteristics of dahlia bulb flour from 3 flower colors are as follows: yield (12,72-18,35%), color (yellow and reddish yellow), gelatinization temperature (31,0-32,8 ° C), water absorption (1,569-2,460 g / g), and oil absorption (1,689-1,839 g / g).
2. The chemical characteristics of dahlia bulb flour from 3 flower colors are as follows: water content (12.24-14.14%), ash content (2.77-3.53%), protein content (3.81-4.40%), fat content (0.69-0.77%), antioxidant activity (33.33-33.77%), amylose (0.45-0.60%), dietary fiber (1.65-6, 30%), Saponin (negative).
3. Variations in dahlia flower color contribute to the physicochemical characteristics of the resulting dahlia bulb

**Significance Statement**

This research indicates that dahlia bulb flours from flowers of different colors have various physicochemical properties**.** Based on the research results, it is suggested that future work focus on using dahlia bulb flour in food products, according to the physicochemical properties of the resulting flour.

## REFERENCES

[1] Mattjik, N.A. Budi daya bunga potong dan tanaman hias. IPB Press, Bogor. 2010.

[2] Rista, Y. Bukittinggi the city of dahlia. Komunitas Pecinta Bukittinggi Berbunga. http://faceofindonesia.com/forum/2741/bukittinggi-city-dahlia. 2011.

[3] Haryani, Y.M., Siti and S. Saryono. Parameter non spesifik aktivitas antibakteri ekstrak metanol dari umbi tanaman dahlia (Dahlia variabilis). Jurnal Penelitian Farmasi Indonesia 1(2) . 2013 : 43-46.

[4] Suryadi, A.E. 2007. Ekstraksi dari uji aktivitas antimikroba ekstrak umbi dahlia (Dahlia variabilis). FMIPA Universitas Riau. Pekanbaru. 2007.

[5] Iskandar, Y.M.,S. Pudjiraharti. and R.Diah. kandungan inulin dari umbi dahlia sp yang ditanam pada jenis tanah vertisol, inceptisol dan andisol. Pusat Penelitian Kimia. Lembaga Ilmu Pengetahuan Indonesia. Jakarta.2014

[6] Sulistyo, S.T. Produksi sirup fruktosa dari inulin umbi dahlia dalam reaktor sinambung unggun terkemas menggunakan enzim inulase imobil. Fateta. IPB. Bogor. 1992.

[7] Yenrina, R., Yuliana and D. Rasjmida. Metode analisa bahan pangan. Unand Press. Universitas Andalas. Padang. 2011

[8] AOAC. Official method of analysis association of analytical chemist. Assosiatioon Official Analysis Chemist. Washington DC. USA: 1995

[9] Huang, Yu-Ching, Yung-Ho and Shao, Yi-Yuan. Effect of genotype and treatment on the antioxidant activity of sweet potato in Taiwan. Food Chemistry 98 (2005) 529-538.

[10] Simanjuntak and S. Megawati. 2008. Ekstraksi dan fraksinasi komponen ekstrak

daun tumbuhan senduduk (Melastoma malabtahricum) serta pengujian efek sediaan krim terhadap penyembuhan luka bakar. Universitas Sumatera Utara, Medan. 2008

[11] Muchtadi, T.R., and Sugiyono. Petunjuk laboratorium ilmu pangan dan bahan pangan. PAU. Pangan dan Gizi, Institut Pertanian Bogor. Bogor. 1992.

[12] Sudarmadji S., B. Haryono and Suhardi. Prosedur analisa bahan makanan dan pertanian. Liberty press. Yogyakarta. 1997.

[13] SNI 01- 2891 – 1992, Cara uji makanan dan minuman. Jakarta. Badan Standarisasi Nasional. Jakarta.

[14] Fardiaz, Mikrobiologi pangan 1. Gramedia Pustaka Utama, Jakarta. 1989.

[15] Mangunwidjaja, D., Mulyorini, R., and Reni. Pengaruh konsentrasi enzim dan waktu hidrolisis enzimatis terhadap mutu frukto-oligosakarida dari inulin umbi dahlia (Dahlia pinnata). E-jurnal Agroindustri Indonesia. 2014. Vol 3, No 2 .

[16] SNI 01- 2997 – 1992, Cara uji tepung singkong. Jakarta. Badan Standarisasi Nasional. Jakarta.

[17] Richana, N., and C.S. Titi. Karakteristik sifat fisikokimia tepung umbi dan tepung pati dari umbi ganyong, suweg, ubi kelapa dan gembili. Jurnal Pascapanen 1(1) 2004:29-37.

[18] Soebito, S. Analisis farmasi. Gadjah Mada University Press. Yogyakarta. 1988.

[19] Rahman, A.M. Mempelajari karakteristik kimia dan fisik tepung tapioka dan mocaf (Modifief cassava flour) sebagai penyalut kacang pada produksi kacang salut. Fateta. IPB. Bogor. 2007.

[20] Buckle, K.A., Edwards, R.A., Fleet,G.H., and Wooton, M. Ilmu Pangan. UI Press. Jakarta.1987

[21] Ambarsari, I., Sarjana and C. Abdul. Rekomendasi dalam penetapan standar mutu tepung ubi jalar. Jurnal Standardisasi Vol 11 (3) 2009 : 212-219.

[22] Rahman, M.S. and Perera, C.O. Heat pump dehumidifier drying of food. trends atmosphere. International Journal of Food Properties 1(3) 1998: 197-205.

[23] Syarief, R. and A .Irawati. pengetahuan bahan untuk industri pertanian. Medyatama Sarana Perkasa, Jakarta. 1988.

[24] Jane, J.,Y.Y. Chen, L.F. Lee., A.E. McPherson., K.S.Wong., M. Radosavljevics., and T. Kasemsuwan. Effect of amylopectin brain chain length and amylose content on the gelatinization and pasting properties of Starch. Cereal Chem. 76(5). 1999: 625-637.

[25] Suharto, M., A.Hosea, and J.E. Jovie, M.D. Isolasi dan identifikasi senyawa saponin dari ekstrak metanol batang pisang ambon (Musa paradisiaca ). Unsrat. Manado. 2012.

[26] Imanningsih, N. Profil gelatinisasi beberapa formulasi tepung-tepungan untuk pendugaan sifat pemasakan. Jurnal Penelitian Gizi Makanan. 35(1) 2012: 13-22

[27] Fennema, O.R. Food chemistry. Marcel Dekker Inc. New York. 1985.

Rina Yenrina. “Characteristic of Dahlia Bulbs Flour by Various Colors of Dahlia (Dahlia variabilis) Flowers.” International Journal of Engineering Research and Applications (IJERA) , vol. 7, no. 9, 2017, pp. 32–39.