Chemical Analysis of Antosianin and Vitamine C in Red Cabbage Juice Variety Hibrida, Indonesia

Muhammad Abdul Rauf[1], Budiyanti Wiboworini[2] and Paramasari Dirgahayu[3]
[1]Postgraduate Student of Clinical Nutrition Sciences, Universitas Sebelas Maret, Surakarta, Indonesia
[2]Department of Nutrition, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia
[3]Department of Parasitology, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia

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Abstract: Red cabbage is a type of *Brassica* which is still seldom known to the public. Until now, its use has been limited to the preparation of salads without knowing the nutrition content. Earlier studies reported that red cabbage ethanol extract has a very high antioxidant activity with an IC50 of 44.64 ppm, but the making of the extract is relatively difficult for the public to implement. The aim of this study was to analyse the content of red cabbage juice varieties hibrida in terms of anthocyanin and vitamin C concentrations. Chemical analysis for anthocyanin and vitamin C was conducted in the food analysis laboratory in Politeknik Negeri Jember in May 2022 using theSpektrofotometri UV-Vis and Ph differential. The analytical results show that from 100 grams of red cabbage varieties hibrida obtain 60 ml in juice form and has an anthocyanine (284 1.414%) and vitamin C (62.05 0.198%) chemical concentration, The yield is greater than that of other varieties. In conclusion, red cabbage juice varieties hibrida had relatively high contains of anthocyanin and vitamin C chemicals compared with other white cabbage varieties and had potential health benefits.

1 INTRODUCTION

Cabbage (*Brassica oleracea L.)* is a sub-tropical annual plant that belongs to the vegetables of the *Brassicaceae* or *Cruciferae* family (Gerszberg, 2018). Cabbage production in Indonesia is limited in highland areas. Some famous cabbage producers are Punten (Malang), Rowosari (Jember), Girirejo (Magelang), Lembang and Argalingga (Paat dkk, 2013). Referring to Statistics Indonesia and the Directorate General of Horticulture data concerning Indonesian Seasonal Vegetables and Fruits, the total national production of cabbage in 2017 reached 1,442,624 tons from a planted area of 90,838 ha and there was a decline of 0.9% to 1,407,930 tons in 2018. This was due to a reduction in planted area to 66,110 ha. Cabbage production in Indonesia covers some common varieties including Grand 11, KK-cross, New Summit, Green Hero, Green Coronet, and Investors (Marliah dkk, 2013).

Red cabbages varietes hibrida are one of the agricultural products which are still limited in Indonesia (Marliah *et al*., 2013). The production is relatively low due to the lack of community knowledge of this vegetable (Wahyuni, 2018). Besides, the use of red cabbage in this country is only limited to salted vegetables and salads. The production and health benefits of red cabbage have not been famous in the community. (Siska and Cresentiana, 2021).

Red cabbage has a high content of nutrients such as protein, carbohydrates, fat, calcium, phosphorus, iron, and vitamins A, B1, and C that are useful for daily nutritional needs (Kementrian kesehatan RI, 2018). Besides, red cabbages also contain polyphenols and high antioxidants (Shama, et al., 2012 Podsędek, et al., 2014; Ghareaghajlou et al., 2018).

Research on the antioxidant content of red cabbage was conducted by Wahyuni (2018) who reported that the ethanolic extract of red cabbage had a very strong antioxidant activity with an IC50 of 44.64 ppm. Another research by Rosalia et al. (2021) found that red cabbage extract powder had a fairly high antioxidant activity of 84.69%. However, creating the extract is relatively difficult for the public. Thus, consuming it in the form of juice is easier to recommend. Besides, juices provide more antioxidants such as anthocyanin compounds and vitamin C because because it does not do the heating

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and drying process (Huang *et al*., 2017; Siska & Crescentiana, 2021)

On the other hand, there is no research focusing on the compounds of red cabbage juice from varieties hibrida that have the potential to contain anthocyanins and vitamin C. However, Siska (2021) measured the vitamin C content in red cabbage juice from local varieties of Magelang with variations in storage time. The content of these substances can be utilized as empirical proof that red cabbage juice varietes hibrida can be used for health benefits. Based on this context, the purpose of this study is to measure the total anthocyanin and vitamin C content of red cabbage juice from varietes hibrida as a preliminary and fundamental study before performing the experiment to establish the possible advantages for disease prevention or treatment.

2 MATERIALS AND METHOD

This quantitative research used laboratory experiments. The material in this study was local red cabbage obtained from hydroponic farming in Rowosari Village, Sumberjambe Sub-district, Jember District. The seeds used were a group of hybrid varieties.

This research used analytical balance, Slow Juicer, measuring flask, test tube, UV-Vis spectrophotometer, Thermo Scientific Genesys, vortex mixer, pH meter, filter paper, shaker, rotating evaporator, and general laboratory equipment adapted to the work procedure. The chemical compounds used in the analysis were 95% ethanol, ascorbic acid, and HCl 1%. The sample preparation process up to the determination of analysis can be seen below :

2.1 Sample Selection

The sample was at a maturity level with a harvest period of 63 days. The selected sample was from the best red cabbage appearance.

2.2 Juicing

Red cabbages were cleaned and washed using running water and then they were cut into pieces and homogenized. The pieces of red cabbage were weighed carefully with an average weight of 50 grams and then mashed with a slow juicer at 100 rpm. The final result was red cabbage juice with a slightly thick liquid texture.

2.3 Sample Preparation

The measurement of anthocyanin and vitamin C levels was performed in the Food Laboratory of Jember State Polytechnic in May 2022. Previously, red cabbage juice was filtered using a vacuum filtration technique and the volume of the filtrate was measured. Red cabbage juice filtrate was pipetted 10.0 mL and then centrifuged for 3 minutes at 3000 rpm. The clear supernatant from the centrifugation was used for the Anthocyanin and Vitamin C test solutions.

2.4 Analysis of Anthocyanin Content

A total of 2 ml supernatant was pipetted and dissolved into 100 ml of a mixture of 95% ethanol and 1% HCl and then homogenized. Then, it was analyzed using a UV-vis spectrophotometer with a wavelength of 535 nm (Bridgers *et al*., 2010). The anthocyanin content of the sample may be estimated using the calculation:

$$\text{Concentration} = \frac{\text{absorbance x dilution factor}}{98{,}2} \text{ (mg/100gr)}$$

2.5 Analysis of Vitamin C Content

A total of 2 ml supernatant was pipetted into a 50 ml volumetric flask and then added with distilled water up to the mark and then homogenized. Then, it was analyzed using a UV-Vis spectrophotometer with a wavelength of 592 nm. Measurement of vitamin C levels was carried out using distilled water as a blank and a standard solution in the form of ascorbic acid (Pratama dkk, 2018).

3 RESULTS AND DISCUSSIONS

This research aims to identify the content of anthocyanin and vitamin C compounds in the red cabbage juice from a hybrid variety. The first step was selecting the red cabbage aged 63 days after harvest as that age has a good maturity level and there is no reduction in nutritional content (Murtiwulandari dkk, 2020). The red cabbage was washed with running water and then the cabbage was cut and juiced with a slow juicer at a speed of 100 rpm to avoid damaging the fiber (Siska & Crescentiana, 2021).

Table 1 showed that 100 grams of red cabbage produced an average of 60 ml of juice. In this research, there was no addition of water due to the relatively high content of water in red cabbage, namely 89.62% (Putri dkk, 2018).

Table 1: The outcome of blending red cabbage juice.

Sample	Berat	Jus kubis	Menghasilkan
Kubis merah	100 gram	60 ml	60 %

The experimental analysis of chemical compounds was started by filtering the red cabbage juice with a vacuum pump technique to get the maximum filtrate volume in a shorter time. Fine particles in the filtrate that still escaped the filtering process were precipitated by centrifugation to obtain a clear supernatant. Then, the supernatant obtained was used as a test solution for Anthocyanin and Vitamin C content (Phatake and Dharmadhikari, 2015).

Experimental analysis of the measurement of anthocyanin chemical compounds used the UV-Vis spectrophotometric differential pH with a wavelength of 535 nm based on Bridgers et al, (2010) where the method could produce the highest anthocyanin extract. Some theories explain that anthocyanin compounds have functional properties with greater stability in acidic conditions, while in neutral and alkaline solutions anthocyanins are unstable. Therefore, anthocyanin extraction was recommended under acidic conditions (Alappat and Alappat, 2020). In this research, the type of acidification used in the extraction of anthocyanins was 1% HCl. Some previous research showed that 1% HCl was the most effective type of acidifier as it could denature plant cell membranes and dissolve anthocyanin compounds out of cells. Based on the results of the research, the average total anthocyanin concentration obtained was 284 ± 1.414 mg/100 g (Showed in table 2).

Table 2: Test results for anthocyanin content.

Sample	Unit	Results	Average
Red Cabbage Juice	mg/100gram	280 ± 1,410	284 ± 1,414
	mg/100gram	288 ± 1,418	

Then, for the experimental analysis, the measurement of chemical compounds of vitamin C in the supernatant sample of red cabbage juice was read on a UV-Vis spectrophotometer with a wavelength of 592 nm (Pratama dkk, 2018). In the repetition test of the vitamin C content, there was a decrease in the amount of content which is not too significant. This was estimated because the analysis process involved temperature and heating factors (Igwemmar *et al.,* 2013). This is in line with Jens, (2019) that Vitamin C can be damaged by air, prolonged heating, alkalis, and enzymes. Besides, vitamin C is easily oxidized when exposed to air, and this reaction is accelerated by heat, light, alkali, enzymes, oxidizing agents, and copper (Cu) and iron (Fe) catalysts.

The unstable nature of Vitamin C causes it to be easily oxidized when it hits the air (oxygen) and is accelerated by heat, resulting in a decrease in the amount of content (Gamboa *et al.,* 2013). Vitamin C is easily oxidized as its compounds contain a very reactive hydroxyl (OH) functional group, and with the presence of an oxidizing agent, the hydroxyl group is oxidized to a carbonyl group. The oxidation process is hindered when vitamin C is in a highly acidic state or at low temperatures. Vitamin C compounds are stable in dry conditions (Jens *et al.,* 2019). Based on the results of the study, the average total vitamin C content obtained was 62.50 ± 1.301 mg/100 g (showed in table 3).

Table 3: Test results for Vitamin C content.

Sampel	Unit	Results	Average
Red Cabbage Juice	mg/100gram	62,96 ± 2,404	62,50 ± 1,301
	mg/100gram	62,05 ± 0,198	

The findings in this study showed that the analysis of anthocyanin and vitamin C compounds in red cabbage was higher than in cabbage from other varieties. As a comparison, the results of this study are different from previous research conducted by Putri *et al* (2018) that 100 grams of red cabbage obtained from the Gang Baru Market, Semarang with a harvest age of 1 month contained 37.07 mg/100 grams of anthocyanin compounds. The difference in the number of anthocyanin compounds is predicted due to the age of the red cabbage which is more suitable with the harvest age of 60-70 days so that the red color is an indicator of the anthocyanin content is maximized (Murtiwulandari dkk, 2020). Besides, testing the differential pH method under acidic conditions caused the higher anthocyanin content (Bridgers *et al*, (2010); Alappat and Alappat, 2020).

This is in contrast with A'ini et al (2021) who examined red cabbages from the plantations of the Sawit hamlet, Girirejo, and Magelang. The vitamin C content of red cabbage juice in this research was slightly lower than the previous research which reported the highest yield of 63.92 mg/100 grams in 3 repetitions. The differences in Vitamin C content with the previous research is predicted due to differences in temperature and heating factors (Igwemmar *et al.,* 2013). This was the same with the second repetition of the test in this research. Moreover, it is predicted due to the geographical location of the plant. (Maryam dkk, 2015).

Moreover, this research found that the vitamin C content in red cabbage juice was higher than in previous studies by Chun et al, (2004). The previous research revealed that the vitamin C content of red cabbage obtained from the local market around the University of Hawaii was 57.1 mg/100gram. Differences in vitamin C levels are also thought to be caused by different geographical locations and analytical methods. This present research used UV-Vis spectrophotometric analysis, while previous research used the less accurate iodometric titration method..

Some theories explain that anthocyanin and vitamin C compounds can act as antioxidants where their role can provide health effects to humans (Kaźmierczak *et al.,* 2020; Cruz *et al.,* 2016). Anthocyanins and vitamin C are micronutrients that have the potential for some enzyme reactions. Besides, they also act as antioxidants that prevent oxidative stress damage caused by free radicals (Veber *et al.,* 2020; Amini *et al*., 2021). Some previous research has reported the relationship of antioxidants with reduced oxidative stress, oxidative stress-related diseases such as diabetes mellitus, hyperuricemia, and hypercholesterolemia which can be inhibited due to their antioxidant and anti-inflammatory activities in repairing oxidative damage (Verzola *et* al., 2014; Kim, 2019; Veber *et al.,* 2020).

The results of the analysis of chemical compounds of anthocyanins and vitamin C of red cabbage juice from the varietes hibrida showed a fairly high result compared to several types of red cabbage of other varieties such as the research of Putri et al (2018) which used red cabbage from other varieties obtained from the Gang Baru market, research conducted by Chun et al (2014) which used other varieties of red cabbage from the local market University of Hawaii. Therefore, for the continuation of the potential use of red cabbage juice in the prevention or therapy for a disease, it is necessary to conduct preclinical research the determination of the appropriate dose of this variety.

4 CONCLUSION

Red cabbage juice from Varietes Hibrida contains many anthocyanins and vitamin C, that is 284 mg/100g and 62.05 mg/100g in comparison with other varieties. This difference in the amount of content is influenced by several factors, namely the age of harvest in the samples used, the geographical location of each sample and the type of analysis used in determining the amount of content. However, due to the high nutritional content of red cabbage juice, which has the potential for health benefits, preclinical study is required to determine the effectiveness of its nutritional content.

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REFERENCES

Alappat, B., & Alappat, J. (2020). Anthocyanin Pigments: Beyond Aesthetics. *Molecules (Basel, Switzerland)*.

Amini L., Chekini R., Nateghi M. R., Haghani H., Jamialahmadi, T., Sathyapalan T., and Sahebkar, A. 2021. The Effect of Combined Vitamin C and Vitamin E Supplementation on Oxidative Stress Markers in Women with Endometriosis: A Randomized, Triple-Blind Placebo-Controlled Clinical Trial. *Pain research & management.*

Badan Pusat Statistik (BPS). 2017. *Statistik Tanaman Sayuran dan Buah-buahan Semusim Indonesia.* Badan Pusat Statistik Jenderal Hortikultura.

Badan Pusat Statistik (BPS). 2018. *Statistik Tanaman Sayuran dan Buah-buahan Semusim Indonesia.* Badan Pusat Statistik Jenderal Hortikultura.

Bridgers, E. N., Chinn, M. S., Truong, V. D. 2010. Extraction of anthocyanins from industrial purple-fleshed sweetpotatoes and enzymatic hydrolysis of residues for fermentable sugars. *Journal Industrial Crops and Products*.

Chun, O. K., Smith, N., Sakagawa, A., & Lee, C. Y. (2004). Antioxidant properties of raw and processed cabbages. *International journal of food sciences and nutrition*,

Cruz, A.B.; Pitz, H.d.S.; Veber, B.; Bini, L.A.; Maraschin, M.; Zeni, A.L.B., 2016. Assessment of bioactive metabolites and hypolipidemic effect of polyphenolic-rich red cabbage extract. *Pharm. Biol*.

Gamboa, S. J., Cristina Soria, A., Pérez-Mateos, M., Carrasco, J. A., Montilla, A., & Villamiel, M. (2013). Vitamin C content and sensorial properties of dehydrated carrots blanched conventionally or by ultrasound. *Food chemistry*.

Gerszberg A. (2018). Tissue culture and genetic transformation of cabbage (Brassica oleracea var. capitata): an overview. *Planta*.

Ghareaghajlou N., Hallaj-Nezhadi S., and Ghasempour Z. 2021. Red cabbage anthocyanins: Stability, extraction, biological activities and applications in food systems. *Food chemistry*.

Huang, G., Mei, X., & Hu, J. (2017). The Antioxidant Activities of Natural Polysaccharides. *Current drug targets*.

Igwemmar, N. C., Kolawole, S. A., & Imran, I. A. 2013. Effect Of Heating On Vitamin C Content Of Some Selected Vegetables. *International Journal of Scientific & Technology Research*.

Jens, L., & Tveden-Nyborg, P. (2019). The Pharmacokinetics of Vitamin C. *Nutrients*.

Kaźmierczak, B. J., Boguszewska, K., Adamus-Grabicka, A., & Karwowski, B. T. (2020). Two Faces of Vitamin C-Antioxidative and Pro-Oxidative Agent. *Nutrients*.

Kementerian Kesehatan Republik Indonesia, 2018, *Tabel Komposisi Pangan Indonesia, Kementerian Kesehatan Republik Indonesia*, Jakarta

Kim, S.-K., Choe, J.-Y.,Park, K.-Y., 2019. TXNIP-mediated nuclear factor-κB signaling pathway and intracellular shifting of TXNIP in uric acid-induced NLRP3 inflammasome. *Biochem. Biophys.*

Marliah, A., Nurhayati, N., & Riana, R. (2013). Pengaruh varietas dan konsentrasi pupuk majemuk terhadap pertumbuhan dan hasil tanaman kubis bunga (Brassica oleracea L.). *Jurnal Floratek*.

Maryam, A.St., Baits, M., Kalsum, U., 2015. Perbandingan Aktivitas Antioksidan Ekstrak Etanol Daun Sirsak (Annona Muricata L.) Berdasarkan Tempat Tumbuh Dengan Metode Peredaman DPPH. *Jurnal Fitofarmaka Indonesia.*

Meng, S., Liu, Z., Zhao, X., Fan, B., Liu, H., Guo, M., & Hao, H. (2021). Efficient corrosion inhibition by sugarcane purple rind extract for carbon steel in HCl solution: mechanism analyses by experimental and *in silico* insights. *RSC advances*.

Murtiwulandari, M., Panahan, DTM, Haloho, M., Kinasih, R., Tanggara, LHS, Hulu, YH, Agaperesa, K., Khristanti, NW, Kristiyanto, Y., Pamungkas, SS, Handoko, YA, & Anarki, GDY (2020). Pengaruh suhu penyimpanan terhadap kualitas hasil panen komoditas Brassicaceae. *Teknologi Pangan : Media Informasi Dan Komunikasi Ilmiah Teknologi Pertanian.*

Paat, F. J., Pelealu, J., & Manueke, J. (2012). Produksi kubis dan persentase serangan Crocidolomia pavonana pada beberapa pola tanam kubis. *Eugenia*.

Phatake, Y.B., and Dharmadhikari, S.M. 2015. Studies On Production of Prodigiosin from Serratia marcescens and Statistical Optimization of Production Process by Using PBD. *IJPRBS.*

Podsędek, A., Redzynia, M., Klewicka, E. and Koziołkiewicz, M., 2014. Matrix effects on the stability and antioxidant activity of red cabbage anthocyanins under simulated gastrointestinal digestion. *BioMed Research International,*

Pratama, M., Aminah, Mas'ud, R.A., 2018, Efektivitas Pemanfaatan Potensi Senyawa Fenolik Kubis Ungu (Brassica Oleraceae var.capitata. L) secara Instrumen UV-Vis, *Jurnal Fitofarmaka Indonesia*,

Putri A.S., Kristiani E. i. B., & Haryati S., 2018. Kandungan Antioksidan pada Kubis Merah (Brassica oleracea L.) Dan Aplikasinya Pada Pembuatan Kerupuk. *METANA*.

Rosalia, N. W., Yuliana. R.S.,*, Franciscus S.P.,2021. Penambahan Bubuk Ekstrak Kubis Merah (Brassica Oleraceae Var. Capitata F. Rubra) Sebagai Sumber Antioksidan dan Pewarna Alami pada Cheesecake, *Jurnal Teknologi Pertanian*.

Shama, S.N., Alekhya, T., and Sudhakar, K. 2012. Pharmacognostical and phytochemical evaluation of Brassica oleracea Linn var. capitata f. rubra (the red cabbage). *Pharmacology and Biology*.

Siska N.I., & Crescentiana E.D.,, 2021, Analisi Kadar Vitamin C Kubus Merah (Brassica oleracea L. var capitata) Yang Dibuat Jus dengan Varian Lama Penyimpanan. *Jurnal Ilmiah Ibnu Sina*.

Veber. B., Camargo. A., Dalmagro. A. P. P., Bonde. H. L., Magro Debora D. Dal, Lima Daniela D., & B. Zeni A. L ., 2020. Red cabbage (Brassica oleracea L.) extract reverses lipid oxidative stress in rats. *An Acad Bras Cienc*

Verzola D., Ratto E., and Villaggio B., 2014. Uric acid promotes apoptosis in human proximal tubule cells by oxidative stress and the activation of NADPH oxidase NOX 4. *PLoS One*

Wahyuni, D.I., 2018, *Uji Aktivitas Ekstrak Etanol dan Ekstrak Etil Asetat Kubis Ungu (Brassica oleracea L.) dalam Menurunkan Kadar Gula Darah Mencit Jantan*, Tesis, Universitas Sumatera Utara.