FOODSCITECH
Food Science and Technology Journal

Analysis of Beta-Carotene Content Differences in Cempedak (*Artocarpus champaden* Lour.) Jam using Traditional and Carbides Fruit Ripening Methods

Dwi Nur Aini Dahlan[1*]

[1]Faculty of Tarbiyah and Teacher Training, Islamic State Institute of Samarinda,
Jalan H. A. M. Rifaddin, Samarinda 75251
[*]Email : ai3_nii@yahoo.com

ABSTRACT'

Cempedak fruit is one of the fruits that contain beta-carotene. Its ripening technique is estimated to impact the content of beta-carotene in the fruit after being processed into jam. The purpose of this research is to find out the correct type of ripening to produce the best quality cempedak jam that contains positive beta-carotene. Beta-carotene testing uses UV-Vis spectrophotometry. Data were analysed using the One Way Anava test on SPSS Statistics 21. The results showed that there were significant differences in the beta-carotene content between cempedak jam using traditional ripening with cempedak jam which was ripened by carbide. The beta carotene content of cempedak jam that has been traditionally ripened (average value: 0.42) has a higher beta-carotene content than cempedak jam that has been ripened by carbide (average value: 0.22).

Keywords: *Cempedak; beta-caroten content; Cempedak jam*

INTRODUCTION

Carotenoids are natural pigments in plants that are mainly contained in fruits and vegetables that generates colours such as orange, yellow, red, and dark green. The colour seen in fruits and vegetables is caused by the conjugated double bonds of carotenoids that absorb light (Hock-Eng *et al*. 2011). The more conjugated double bonds, the more concentrated the color of the carotenoids leads to red (Heriyanto, 2009).

β-carotene is one of the simplest forms of carotenoids, which has the molecular formula of C_40H_{56}. β-carotene has 11 double bonds, where β-carotene can bind to chlorophyll and xanthophyll in fruits and vegetables that will absorb light in the light spectrum. Orange-coloured fruits and vegetables have high β-carotene content (Hock-Eng *et al*. 2011). β-carotene is very unstable in the air because it can be oxidised and also unstable to light and heat because it can isomerise into a more unstable form of cis β-carotene.

Cempedak fruit is a fruit that contains beta-carotene. The results of Leong and Sui's research (2002) cempedak fruit contains 126 x 19.1 mg/100 g of antioxidants. Research shows that foods containing antioxidants such as vitamin C and β-carotene can prevent diabetes mellitus (Arifin and Delvita, 2007), night blindness, and various cancers (Englberger *et al.* 2008), especially lung cancer. Cempedak (*Artocarpus champaden* Lour.) Is a tropical fruit plant of the Moraceae family that has high economic value. Cempedak fruit has a distinctive taste, aroma, and shape. It also contains a high nutritional content (Tetty, 2011). Cempedak fruit is included in climateric fruit.

Many people are generally have a positive attitude towards this fruit and make it their favourite. Therefore, Cempedak's processed products are in high demand. One of the processed Cempedak product that still needs further analysis is the jam. The jam itself is a semi-solid processed food product made from a mixture of fruit and sugar. The purpose of jam processing is to increase the variety of products, extend fruit's shelf-life, and increase economic value (Pandiangan, 2017). The jam-making process is a complicated process due

ISSN 2622-1985 (print) | ISSN 2622-4127 (online)
DOI: 10.25139/fst.v0i0.2108

to several variables are required to optimise the final product. Based on the Indonesian Industrial Standards (SII) No. 173, the standard requirements for jam quality are a maximum of 35% water content, a minimum of 0.5% insoluble solids, a maximum of 0.7% pectin content, a maximum of 55% sugar content, preservative content 50 mg/kg negative acetic acid, positive fruit fiber, free from harmful metals (Hg, Pb, As), normal odour, and normal taste (Patent No. 374: 2008, 2008).

Unripen fruit cannot be used in making jam due to its low pectin content (Sidauruk, 2011). The criteria for fruit that can be processed into jam are ripe, no signs of rotting, and have enough pectin and acid to produce high-quality jam. Fruit ripening can be done in two ways, which are natural ripening and human-assisted ripening (with the addition of fruit ripening triggers) (Dewi, 2014). One of the human-assisted methods of fruit maturation is the ripening method.

Fruit ripening in the horticulture field is a deliberate treatment by humans to accelerate the process of fruit ripening by storing specific bulk of picked fruits in a relatively closed environment. Ripening fruit is only successful in accelerating maturation for climacteric fruit groups (PS, 1998). Cempedak fruit is one of the climactic fruit, so it is usually harvested when it is still in the raw state and will ripe after storage. To fulfil the large market need for Cempedak in, specific ripening technology is required to ensure fruit maturity in a large quantity.

According to Kaleka (2013), harvested unripened fruits still carry out physiological processes of producing ethylene gas and carbon dioxide in increasing amounts until the fruit enters the ripening process. Various methods of ripening fruits that have been commonly done are the traditional way such as using leaves, slightly lacerate the fruit, or left in a specific temperature and place, or using non-traditional method by using 1 gram of CaC carbide to produce 349 ml of acetylene which will be used in the ripening process by replacing ethylene which is produced directly by fruits (Suryanegara, 2012). Ripening fruit by using carbide tends to be faster compared to other ripening materials (Arif, A.B., Wahyu D, Enrico S, 2014). In addition, Cempedak jam that ripened by carbide resulted in more exciting colours and textures fruit than the one from with the traditional ripening method. Ripening in the conventional way results in a better flavour and colour of cempedak jam, compared to the carbide-ripened Cempedak jam (Dahlan, 2018).

Based on the description above, it is necessary to make further comparisons in Cempedak fruit ripening method. This research will determine the quality of Cempedak jam before producing it in large quantities. The purpose of this research is to find out the right type of fruit ripening method to produce Cempedak jam that contains the most beta-carotene.

METHODS

Time and place of analysis

The analysis was conducted in June 2019 at the Mulawarman Postgraduate Laboratory in Samarinda, East Kalimantan.

Jam making method

Cempedak fruit is peeled, washed, and then weighed with a dose. Every 100 g of the fruit is mixed with 10 grams of sugar and 0.1 grams of citric acid. The flesh then blended with a temperature of 60-80°C for 5 minutes then cut into small pieces and finely blended. Afterwards, the mashed fruit then cooked in a pan and mixed with sugar. During the cooking process, Cempedak porridge then continuously stirred until it thickens and the colour turns

brown. After being brown, the cempedak mixture is given with citric acid (1 gram) and stirred until evenly distributed. After the mixture has thickened, the cempedak jam is cooled and put into a sterilised bottle.

Beta-carotene content test

Beta-carotene content test on this research used UV-Vis spectrophotometry.

Data analysis

Analysis of the data obtained will be processed using One Way Anava. The testing is assisted with the SPSS Statistics 21 application.

RESULTS AND DISCUSSIONS

To determine the effect of Cempedak fruit ripening on beta-carotene content in cempedak jam, normality test was performed. Normality distribution test can be seen in Table 1.

Table 1. Test for normality distribution of beta-carotene content

Ripening Type	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Traditional	.211	3	.	.991	3	.817
Carbide	.253	3	.	.964	3	.637

Statistical results from the SPSS application show that the significance value of the traditional ripening method is 0.817, while the carbide ripening method is 0.637. This concludes that both significance values are higher than 0.05, which means the data are normally distributed.

Based on the obtained results, the homogeneity test is conducted to see the variant of data. Test data variants can be seen in Table 2.

Table 2. Test of the variant data of beta-carotene content in Cempedak jam

Levene Statistic	df1	df2	Sig.
2.882	1	4	.165

The significance value of the data variant indicates the number of 0.165, which is higher than 0.05. It can be concluded that the two ripening group variance of traditional ripening and carbide ripening are the same so that the requirement of homogeneity test for one-way ANOVA has been fulfilled. One-way ANOVA test was carried out to see the different types of ripening in the crude fibre content in a jam. One-way ANOVA test results are stated in Table 3

Table 3. ANOVA test for beta-carotene content in Cempedak jam

	Sum of Squares	df	Mean Square	F	Sig.
Between groups	.187	1	.187	96.862	.001
Within groups	.008	4	.002		
Total	.195	5			

FOODSCITECH, Vol. 2 No. 2 December 2019
ISSN 2622-1985 (print) | ISSN 2622-4127 (online)
DOI: 10.25139/fst.v0i0.2108

ANOVA statistical analysis results show the significance value of 0.001. Due to the less than 0.05 significance value, the Ho is rejected. The statistical test result means that there are significant differences in the content of beta-carotene between Cempedak jam of traditional ripening method and carbide ripening method. The average content of beta-carotene in Cempedak jam can be seen in Figure 1.

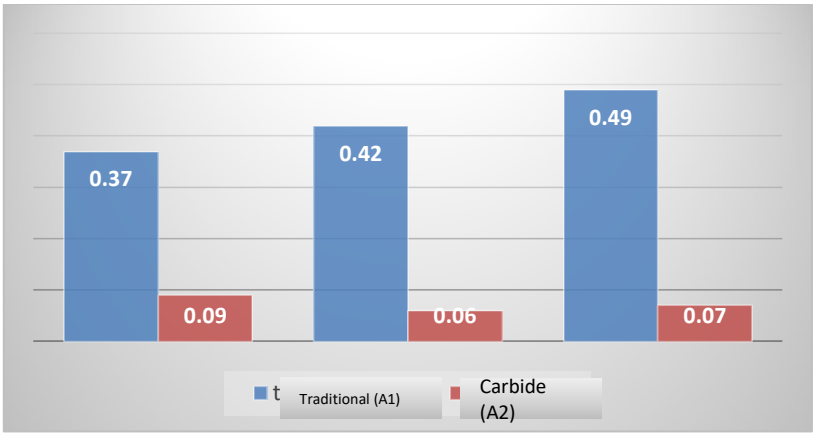

Figure 1. The average value of each test in the beta-carotene content of Cempedak jam.

The picture above shows that the Cempedak jam of the conventional ripening method scores 0.37 on the first test, 0.42, and 0.49 on the replication test II and III, respectively. The total value of the overall beta-carotene of all replications was 1.28, with an average value of 0.42. Cempedak jam from the carbide-ripened fruit obtained test scores of 0.09 on the first test and 0.06 and 0.07 on the replication II and III respectively. The total value of the total beta-carotene of all tests was 0.22, with an average value of 0.07. Thus, the value of beta-carotene content in traditionally-ripened Cempedak jam is averagely higher than the carbide-ripened Cempedak jam.

Overall, the results of the research showed the different beta-carotene content in Cempedak jam with different ripening method. This indicates that the quality of Cempedak jam can meet the jam's minimum quality standard as stated in SII No. 137 of 1978 (the positive indication of β-carotene). Beta-carotene is an organic compound and is classified as a terpenoid. It is a red-orange pigment that is contained in plants and fruits very much. This compound is thought to have many functions that are not possessed by other compounds (Subawati, 2009). Beta-carotene has a high antioxidant content that can protect plants and microorganisms from the damaging sunbeam (Parwata, Ratnayani, dan Listya, 2010).

The results of this research indicate that there is a significant difference between the content of beta-carotene in Cempedak jam using carbide-ripened and traditional ripening method. The content of beta-carotene in Cempedak jam from the carbide-ripened source tends to be less than the traditionally-ripened Cempedak. This is proven in Cempedak jam's colour from the carbide-ripened fruit, which appears brighter because the amount of beta-carotene influences its colour. It is in accordance with research conducted by Dahlan (2018), which states that Cempedak jam from the carbide-ripened fruit produces brighter colour compared to the traditionally-ripened and the naturally ripe Cempedak.

Ripening fruit with the addition of carbide can accelerate the maturation of the fruit but can cause rising temperatures in cempedak fruit so it can fade the colour. During the process of ripening acceleration of the fruit, the respiration rate will increase. This increase

causes the fruit to lose water content from its flesh. When the ripening process occurs, there will be a sudden increase in CO_2, and then when the fruit is nearing maturity or the maturity period has passed, respiration activity will decrease (Winarno, *et al*. 2002). Ottaway (1999) states that the stability of carotenoids which beta-carotene contains is the same as vitamin A, which is sensitive to oxygen, light, and acidic media. Hock-Eng *et al*. (2011) asserts that the characteristic of β-carotene which is easily oxidised when exposed to air is due to the conjugated 11 double bonds. Besides, β-carotene is also very unstable when exposed to light and heat at temperatures over 60^o C. Then, this compound later changes into a more unstable form of cis β-carotene because of isometric changes.

CONCLUSION

Based on the analysis and discussions, it can be concluded that the beta-carotene content of Cempedak jam from the traditionally ripened fruit is higher the one originated from carbide-ripened fruit. Cempedak jam from the traditionally-ripened fruit has an average value of 0.42, while the average beta-carotene content of Cempedak jam from the carbide-ripened fruit is 0.22.

ACKNOWLEDGMENTS

The author would like to thank the Mulawarman Postgraduate Laboratory in Samarinda, East Kalimantan for providing space during the research.

REFERENCES

Pandiangan,A., Hamzah, F. dan Rahmayuni, 2017, Pembuatan Selai Campuran Buah Pepaya Dan Buah Terung Belanda. Jom fakultas pertanian, volume 4 no 2. Riau

Arif, A.B., Wahyu D, Enrico S, Suyanti dan Setyadjit. 2014. Optimization of Ripening Technology in Cempedak Fruit (*Artocarpus champeden*). Journal infromatika pertanian. Vol 23 no 1 juni 2014: 35-46

Arifin, H., Delvita, V., Almahdy, 2007, Pengaruh Pemberian Vitamin C Terhadap Fetus Mencit Diabetes, Jurnal Sains dan Teknologi Farmasi, 12(1), 32-40.

Dahlan, DNA. 2018. The Influence of Cempedak (*Artocarpus champaden* Lour.) Ripening Variation on Organoleptic Properties of Jam Produced. Int. J. Curr. Res. Biosci. Plant Biol. Vol. 5(6), 58-65.

Englberger, L., Schierle, J., Kraemer, K., Aalbersberg, W., Dolodolotawake, U., Humphries, J., Graham, R., Reid, A. P., Lorens, A., Albert, K., Levendusky, A., Johnson, E., Paul, Y., Sengebau, F., 2008, Carotenoid and mineral content of Micronesian giant swamp taro (Cyrtosperma) cultivars, JFCA, 21, 93-106.

Heriyanto, 2009, Karotenoid (Beta-karoten), (online), (http://repository.usu.ac.id/ bitstream/123456789/20091/4/karotenoid(beta-karoten).pdf,

Hock-Eng, K., Prasad, K. N., Kin-Weng, K., Jiang Y., dan Ismail, A., 2011, Carotenoids and Their Isomers: Color Pigments in Fruits and Vegetables, J. Molc., 16, 1710- 1738.

Kaleka, N. 2013. Commercial Bananas. Arcita Publisher. Surakarta. first edition

Leong L. P dan G. Shui. 2002. An Investigation Of Antioxsidant Capacity of Fruit in Singapore Markets. Food Chemistry. 76: 69-75

Lubis Z, Ikhwal A, dan Ginting S. 2014. Pengaruh Konsentrasi Pektin dan lama penyimpanan terhadap mutu selai nanas lembaran. Jurnal Rekayasa Pangan dan Pertanian. 2019, Vol 4 no 4

ISSN 2622-1985 (print) | ISSN 2622-4127 (online)
DOI: 10.25139/fst.v0i0.2108

Nair,S. dan Z. Singh, 2003. Pre-storage ethrel dip reduces chilling injury enhances respiration rate, ethylene produsction and improves fruit quality of „Kensington" mango. Food, Agriculture & Environment.1(2) : 93-97

Ottaway, P.B. 1999. The Technology of Vitamins in Food. Aspen Publisher, Inc. Garthersburg. Marryland.

Parwata, O.A., Ratnayani, K., Listya, A. 2010. Aktivitas antiradikal bebas serta kadar betakaroten pada madu randu(*Ceiba pentandra*) dan madu kelengkeng (*Nephelium Longata* L), jurnal Kimia 4 vol 1 januari 2010:54-62. ISSN 1907-9850.

Febriani, R., Kuswanto, K.R., Kurniawat, L. 2018. Karakteristik Selai Fungsional Yang Dibuat Dari Rasio Buah Naga Merah (*Hylocereus polyhizus*)-Jambu Biji Merah (*Psidium guajava*)-Nanas Madu (*Ananas comosus*) Dengan Variasi Penambahan Gula. Jurnal Ilmiah Teknologi dan Industri Pangan UNISRI, Vol. 2, No. 1: 46-52. ISSN 2502-9347.

Sidauruk, M. 2011. Studi Pembuatan Selai Campuran Dami Nangka (*Artocarpus heterophyllus*) Dengan Belimbing Wuluh (*Averrhoa blimbi* L). Skripsi. Fakultas Pertanian, Universitas Padang.

SNI. 2008. Selai buah. SNI 374: 2008. Jakarta: BADAN STANDARISASI NASIONAL.

Septi Erlinda Dewi . 2014. Perbandingan Kadar Vitamin C , Organoleptik dan Daya Simpan Selai Buah Tomat (*Lycopersicum wsculentum*) dan Pepaya (*Carica papaya*) yang ditambahkan Gula Pasir. Fakultas Keguruan dan Ilmu Pendidikan Universitas Muhammadiyah Surakarta.

Subawati, Reni Kusumaningtyas dan Leenawaty Limantara, 2009, Isomerisasi dan Oksidasi Senyawa Karotenoid dalam Buah Kelapa Sawit Selama Pengolahan CPO, Indonesian Journal of Chemistry, Vol 9 No 1: 48 - 53

Suryanegara, 2012. Traditional Fruit Diving Using Gamal Leaf (Glircidia Maculata), Dapdap, Gerombong And Carbit. http://wayansuryanegara.blogspot.co.id/2012/04/pengeraman-buah-secara tradisional.html. accessed on 20 March 2018

Tetty, NAH. 2011. The influence of comparative concentration of sucrose and cempedak juice (*artocarpus integer* (tunb.) Merr.) On quality of candy jelly during on storage periode (Essay). Faculty of Technobiology of Biology Program. Atma Jaya University Yogyakarta

Tim penulis PS. 1998. Agribusiness of Fruit Plants. Jakarta: Niaga Swadaya. ISBN 9794-8919

Winarno, F.G., Fardiaz. S dan Fardiaz, D. 2002. Pengantar teknologi pangan. Jakarta. PT gramedia.

Winarno, FG. 2002. Kimia Pangan dan Gizi. Jakarta: Gramedia