Physicochemical and phytochemical characteristics of exotic Cungap red coconut

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Abstract. “Cungap” red (CR) coconut is an exotic coconut that has specific characters, i.e. the husk contains high antioxidant components. The study aimed to evaluate the physicochemical and phytochemical characteristics of CR coconut (husk, kernel, and water). Tender and mature CR coconut fruits were collected from farmers at Sukarena Village, Ciomas District, Serang Regency, Banten Province. The mature nuts were evaluated for the physicochemical characteristics (moisture, protein, ash, fat and fatty acids profile). Vitamins and minerals were measured from the young coconut water. Anthocyanin and β-carotene were analysed from the tender nuts (husk, meat, and water). The results showed that CR kernel contained 8.35% of water, 2.02% of ash, 7.13% of protein, and 60.09% of fat. The medium-chain fatty acids were mainly from the coconut kernel fat (52.55%). Lauric acid was the major fatty acid (45.89%). The Majority of minerals (calcium, phosphorus, potassium, and magnesium) contained in the coconut water; potassium content was the highest (289.95 mg/100 ml). The β-carotene content in the husk and kernel were 18.43/100g and 1.28 mg/100g, respectively. Also, the anthocyanin contents in the husk, kernel, and coconut water were 8.01 mg/100 g, 1.5 mg/100 g, and 0.8 mg/100 g, respectively. The study implies that CR coconut is potential as anthocyanin, β-carotene, and mineral sources for human health.

Keywords: anthocyanin, β-carotene in coconut, mineral, antioxidant

1. Introduction

“Cungap” red (CR) coconut is an exotic coconut which has a unique characteristic. The external appearance of the husk varies from pink to light purple, meanwhile, the majority of coconut husks are brown. The identification of the CR coconut variety has been studied since 2013 by the Indonesian Palm Crops Research Institute (IPCRI) collaborated with Bogor Agriculture Institute (IPB) and the Plantation Office of Banten Province. Further evaluations of the specific character of the CR coconut were carried out for 3 years during 2014-2017 in the form of cooperation between the Regional Government of Banten Province through Plantation Office of Serang Regency and IPCRI of Indonesian Agricultural Agency for Research and Development (IAARD) [1]. The CR coconut has been officially released as a superior coconut variety in 2019 by the Indonesian Ministry of Agriculture.

The CR coconut is classified as an exotic coconut type because it has a unique red physical character of the husk. Local people generally used the CR coconut for medical uses. The existence of specific characters and their use for health cause the selling value of the CR fruit becomes higher in the market,
i.e. Rp. 20,000/nut. The CR coconut plants can be found in many coconut gardens in Sukarena Village, Ciomas District, Serang Regency, Banten Province. The color of the coconut husk will change with increasing of the coconut fruit maturity. Based on the red color of the husk, we assumed that it contains some phytochemicals such as anthocyanin and carotene.

An anthocyanin is a group of red to blue pigments that are widespread in plants. Anthocyanins are classified as pigments called flavonoids which generally dissolved in water. Flavonoids are phenolic compounds, such as flavonoids, phenolic acids, tannins, and lignans. In plants, flavonoids are very useful for inhibiting fungal pathogens and cell damage. This compound when consumed will provide a very good function because it can play a role in treating cancer and heart disease [2]. Coconut husk is a source of anthocyanins. Anthocyanin content in the green coconut fibers is 8.34 mg/100 g [3]. Four types of anthocyanins are found in a green coconut husk [3]. Coconut husk is one of the potential sources of natural antioxidants and the total phenol content in coconut fiber is 32.24 mg GAE/g and its radical scavenging capacity is 119.96 mM TE/g [4].

The other compound that may contain in the CR coconut husk is carotene. Carotene is the bioactive component in the carotenoid group. Carotenoid is a vital compound for human health as a main dietary source of vitamin A [5]. Carotenoids have been classified based on their structures into carotenes (carotenoids that contain only carbon) and xanthophylls (carotenoids that contain oxygen). Although there are approximately 60 carotenoids found in the human diet, however, only a few carotenoids identified as having provitamin A activity, such as alpha-carotene, beta-carotene, gamma-carotene, and beta-cryptoxanthin. Beta-carotene has the highest vitamin A activity compared to the other provitamin A carotenoids. Beta-carotene has twice the vitamin A activity as alpha-carotene or beta-cryptoxanthin [6,7]. The consumption of carotenoid-rich foods, such as fruits and vegetables, has been associated with decrease risk of developing certain types of cancer. Carrot consumption modifies cholesterol absorption and bile acid excretion and increases antioxidant status and these effects could be interesting for cardiovascular protection [8].

As reported by previous studies, coconut kernel is a good source of saturated fatty acids. The major fatty acid in fat extracted from coconut kernel is lauric acid. The lauric acid, as a member of Medium Chain Fatty Acids (MCFA), extracted from coconut kernel is 46.64-48.03 % [9]. Lauric acid is found to increase body endogenous oxidation by changing the composition of the adipose tissue through altered endogenous availability. The capability of MCFA to increase endogenous fat oxidation could have implications in the reduction of adipose tissue mass by increasing adipose tissue mobilization [10,11].

However, to the best of our knowledge, no literature exists on the physicochemical and phytochemical properties of CR coconut. The objectives of the study were to evaluate the physicochemical and phytochemical (anthocyanin and β-carotene) characteristics of kernel and water of Cungap red coconut.

2. Materials and methods
Cungap red coconut fruits were collected from farmers at Sukarena Village, Ciomas District, Serang Regency, Banten Province, Indonesia. They were categorized into tender and mature coconuts. All reagents and chemicals used were of analytical grade.

The moisture, fat, protein, and ash of the coconut kernel were analysed by AOCS methods. Minerals (manganese, iron, magnesium, calcium, potassium, phosphorus and chlorine) and vitamins (ascorbic acid, niacin, biotin) contents in the CR coconut water were analysed by atomic absorption spectroscopy [12]. The analysis of the fatty acids profile was carried out using gas chromatography (GC). Anthocyanin and β-carotene contents were measured by a High-Performance Liquid Chromatography (HPLC) [13].
3. Results and discussion

3.1. The proximate and fatty acids profile

The physicochemical characters (water, fat, protein, ash, and carbohydrate) of mature Cungap red (CR) coconut kernel were presented in Table 1.

Table 1. The physicochemical characters of mature Cungap red coconut kernel

| Component     | Present study | Mapanget | India |
|---------------|---------------|----------|-------|
| Water         | 8.35          | 8.48     | 4.30  |
| Ash           | 2.02          | 1.87     | 1.40  |
| Protein       | 7.13          | 9.46     | 10.20 |
| Fat           | 60.09         | 58.21    | 59.80 |
| Carbohydrate  | 22.24         | 21.99    | 24.30 |

The major compounds of the kernel were fat (60.09%), followed by carbohydrate (22.24%), water (8.35%), and ash (2.02%). The fat, ash, and carbohydrate contents in the CR coconut kernel were slightly higher compared to a normal coconut Mapanget Tall variety from Indonesia, whereas the protein and water were lower [14]. The physicochemical properties of the CR kernel were also slightly different from an Indian coconut variety [15]. The fat, water, and ash contents of CR kernel were higher, while carbohydrates and protein were lower. The results indicated that the physicochemical characters (water, ash, protein, and carbohydrate) of the CR coconut were slightly different from normal coconut varieties.

Lauric acid was the main fatty acid of fat in the mature CR coconut kernel accounted for 45.89% (Table 2). The medium-chain fatty acids were the largest proportion found in coconut meat (52.55%), followed with the total unsaturated fatty acids (13.97%), and linolenic fatty acid (0.21%). In comparison, the dominant fatty acid in the coconut oil from Indian Kerala region was lauric acid (C12) (45.51%) [16], whereas in the coconut kernel from the Mysore region of India were lauric acid (49.61%), capric acid (C8) 4.8%, and caprylic acid (C10) 5.8% [17]. The fatty acid profile of the coconut oil samples sold at commercial market in Malaysia and Indonesia was lauric acid (C12) (46.64 to 48.03%), followed by myristic acid (C14 ) 16.23-18.90%. The results indicated that the CR coconut is a good source of medium chain fatty acids.

Table 2. The fatty acid composition on fat of mature Cungap red coconut kernel

| Fatty Acid | % |
|------------|---|
| C8:0       | 2.75 |
| C10:0      | 3.91 |
| C12:0      | 45.89 |
| C14:0      | 12.51 |
| C16:0      | 16.17 |
| C18:0      | 3.26 |
| C18:1      | 8.13 |
| C18:2      | 5.63 |
| C18:3      | 0.21 |
| Total MCFA | 52.55 |
| Total USFA | 13.97 |
3.2. Mineral and Vitamin Contents
The minerals and vitamins content on the young fruit of CR coconut water was presented in Table 3. The vitamin C (ascorbic acid) and biotin (B7) content of CR coconut water were 0.18 mg/100 ml and 5.31 mg/100 ml, respectively. The CR coconut water contained 7 types of minerals and 4 of them are the main minerals that are needed for human health, such as calcium, phosphorus, potassium, and magnesium. Potassium was the highest concentration in the CR water, i.e. 289.95 mg/100 ml, whereas manganese and iron were 0.29 mg/100 ml and 0.03 mg/100 ml, respectively. The potassium concentration in this study was higher compared to study of Appaiah et al. [15] i.e. 249.6-256.2 mg/100 g. Therefore, the CR coconut water is a good source of mineral especially potassium.

| Vitamin/Mineral | Results |
|-----------------|---------|
| Vitamin (mg/100 ml) |         |
| Ascorbic acid | 0.18    |
| Biotin (B7) | 5.31    |
| Mineral |         |
| Mn (mg/L) | 0.29    |
| Fe (mg/100 ml) | 0.03    |
| Mg (mg/100 ml) | 31.04 |
| Ca (mg/100 ml) | 30.45 |
| K (mg/100 ml) | 289.95 |
| P (mg/L) | 33.01 |
| Cl (mg/ml) | 179.27 |

3.3 Phytochemical (β-carotene and anthocyanin) Content
The phytochemical (β-carotene and anthocyanin) content of Cungap red coconut compared to local tall coconut were presented in Table 4. The β-carotene and anthocyanin were evaluated in husk, kernel and water of the mature nut.

| Coconut varieties | β-carotene mg/100 g | Anthocyanin mg/100 g |
|-------------------|---------------------|---------------------|
| Cungap red coconut |                     |                     |
| - husk            | 18.43               | 8.01                |
| - kernel          | 1.28                | 1.5                 |
| - water           | nd                  | 0.8                 |
| Local tall coconut |                    |                     |
| - husk            | 13.48               | 6.88                |
| - kernel          | 1.02                | 1.21                |
| - water           | nd                  | 0.51                |

Note: nd, not detected
The β-carotene on the husk of CR coconut and local coconut Tall varieties were 18.43 mg/100g and 13.48 mg/100g, respectively. However, the CR coconut kernel contained small amount of β-carotene (1.28 mg/100 mg). The local Tall coconut having β-carotene on husk and kernel around 13.48 and 1.02 mg/100 g, respectively. The β-carotene in both of Cungap red and local Tall coconut husk were higher compared to the carotene in tomatoes Rumba variety in Poland [18]. Also, the carotene in organic and non-organic tomatoes were 12.52 and 15.43 mg/100 g, respectively, whereas the β-carotene contents were 0.23 and 0.20 mg/100 g, respectively. Carrot, the most popular root vegetable known the main dietary source for carotene contained 101.08 mg/100 mg of carotene and 71.58 mg/100 g of β-carotene [19]. There is no β-carotene detected both in the CR coconut water of Cungap red husk and local coconut Tall variety because it is a soluble fat.

The CR coconut also contained anthocyanin around 8.01 mg/100 g in the husk, 1.5 mg/100 g in the coconut kernel, and 0.8 mg/100 g in the coconut water. This result was in line with the previous study that the anthocyanin content in green coconut fiber was 8.34 mg/100 g [3]. As a comparison, the anthocyanin content in the dark purple sweet and light purple sweet potatoes were 61.85 mg/100 g and 3.51 mg/100 g, respectively. The anthocyanin on the CR coconut husk was higher than that of the light purple sweet potato.

The present study showed that the CR coconut is a good source for β-carotene and anthocyanin. The further is required to extract β-carotene and anthocyanin from the CR coconut. The consumption of both anthocyanin and carotenoid-rich foods is useful for human health because it could cure cancer and heart diseases [2]. Also, antioxidant is important for protecting the body from cardiovascular and metabolism of cholesterol, and bile acids [8]. Consumption of “coconut husk tea” is good as an anti-diabetes and hypoglycemia [20]. Ezquenazi et al. (2002) reported that, coconut husk extract has a capability as an anti-inflammatory, anti-cancer and traditional treatment for diarrhea [21].

4. Conclusions

The exotic Cungap red coconut kernel contained 8.35% of water, 2.02% of ash, 7.13% of protein, and 60.09% of fat. The medium-chain fatty acids were found the largest proportion in the fat of coconut kernel (52.55%) followed with lauric acid (45.89%). The Cungap red coconut is rich in minerals, especially potassium in the coconut water (289.95 mg/100 ml), β-carotene (18.43 mg/100g) in the husk and kernel (1.28 mg/100 g), as well as anthocyanin (8.01 mg/100 g) in the husk, kernel (1.5 mg/100 g), and coconut water (0.8 mg/100 g). The study implies that Cungap red coconut is potential as anthocyanin, β-carotene, and mineral sources for human health.

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References

[1] Anonim 2019 Kementerian Pertanian Usulan Pelepasan Varietas Kelapa Cungap Merah. (Manado: Balai Penelitian Tanaman Palma)
[2] Ignat I, Volf I and Popa V I 2011 Food Chem. 126 1821.
[3] Anggriani R, Ain N and Adnan S 2017 J. Tek. Pertanian 18 163.
[4] Rodiah M H, Nur Asma Fhadhila Z, Kawasaki N, Noor Asiah H and Aziah M Y 2018 Pertanika J. Trop. Agr. Sci. 41 441.
[5] Donhowe E and Kong F 2014 Food Biprocess Tech 7 318.
[6] Weber D and Grune T 2012 Mol. Nutr. & Food Res. 56 251.
[7] Haskell M J 2012 Am J Clin. Nut. 96 1193S.
[8] Nicolle C, Cardinault N, Aprikian O, Busserolles J, Grolier P, Rock E, Demigne C, Mazur A, Scalbert A, Amouroux P and Remesy C 2003 Eur. J. Nutr. 42 254.
[9] Marina A M, Che Man Y B and Nazimah S A H 2009 J. Am. Oil Chem. Soc. 86 301.
[10] Binnert C, Pachiaudi C, Beylot M, Hans D, Vandermander J, Chantre P, Riou J P and Laville M 1998 *The Am. J. Clin. Nutr.* 67 595.

[11] Papamandjaris A A, White M D, Raeini-Sarjaz M and Jones P J H 2000 *Intern. J. Obesity* 24 1158.

[12] Anonim 1998 SNI 01-3554-1998 Jakarta.

[13] Apriyantono A, Fardiaz D, Puspitasari N L, Sedarnawati and Budiyanto S 1989 *Analisis Pangan* PAU Pangan dan Gizi IPB Bogor.

[14] Karouw, S and Santosa B 2018 *Buletin Palma* 19 33.

[15] Appaiah P L, Sunil L, Prasant Kumar P K and Gopala Khrisna A G 2015 *J. Food Sci. Technol.* 52 5196.

[16] Nevin K G and Rajamohan T 2006 *Food Chem.* 99 260.

[17] Bhatnagar A S, Prasanth Kumar P K, Hemavathy J and Gopala Krishna A G 2009 *J. Am. Oil Chem. Soc.* 86 991.

[18] Hallmann E, Lipowski J, Marszalek K, Rembialkowska E 2014 *Plants Foods Hum. Nutr.* 68 171.

[19] Zulaeman A, Keeler L, Giraud D W, Wehling R L and Driskell J A 2001 *J Food Sci.* 66 1257.

[20] Victor E and Jeroh E 2018 *J. Med. and App. Bios.* DOI: 10.13140/RG.2.2.14402.27844.

[21] Esquenazi M D, Miranda W M M, Rodrigues H M, Tostes J B F and Rozental S 2002 *Res Microbiol* 153 647.