Physicochemical properties of Kebumen Entog Dwarf coconut

I Maskromo, S Karouw*, D S Pandin, W M Mahayu, B Santosa and J C Alouw

Indonesian Palm Crops Research Institute Jl. Raya Mapanget PO Box 1004, Manado, North Sulawesi, Indonesia

*Email: steivie_karouw@yahoo.com

Abstract. Kebumen Entog Dwarf coconut is one of the superior coconut varieties with characteristics of early bearing, large fruit size and sweet water. The study was conducted to determine the physicochemical properties of fruit and water of Kebumen Entog Dwarf coconut. Evaluation was carried out to measure the mineral content of coconut water, water content, ash, protein, and fat, the content of fatty acids and amino acids of fruit flesh. The fruits of Nias Yellow Dwarf, Mapanget Tall, Tenga Tall and KHINA-1 Hybrid were also evaluated. The analysis was carried out at the Laboratory of PT. Saraswati Indo Genetec, Bogor. The results showed that potassium and phosphorus content in water of young nut of Kebumen Entog Dwarf coconut fruit were higher than these in Nias Yellow Dwarf. The young kernel contained of 49.52% fat, 3.94% moisture, 3.78% ash, and 7.64% protein. The mature kernel of Kebumen Entog Dwarf contained of 63.20% fat, 5.9% moisture, 1.72% ash, and 5.24% protein. The medium chain fatty acids (caproic, caprilic, capric and lauric acids) in young and mature nuts was 43.12% and 51.07%, respectively. Fifteen types of amino acids in kernel of mature kernel was also detected. Dominant amino acids in coconut flesh were glutamic acid (1.28%), arginine (0.71%) and aspartic acid 0.45%.

Keywords: coconut meat, coconut water, medium chain fatty acids, amino acids

1. Introduction

Kebumen Entog Dwarf is one of the national superior coconut varieties that was released in 2018. Identification of the Kebumen Entog Dwarf coconut plant has been started since 2001 by the Agriculture and Food Agency of Kebumen Regency. Further evaluation of the specific character had been carried out from 2013 to 2017 in the form of collaboration between the Regional Government of Kebumen Regency through the Agriculture and Food Agency of Kebumen Regency with Indonesian Palm Crops Research Institute (IPCRI), Indonesian Agricultural Agency for Research and Development (IAARD) [1].

Kebumen Entog Dwarf is an early bearing coconut plant that has round fruit, large size, light green, with straight stems, and stiff-shaped leaves. Kebumen coconut fruit is usually used as young coconut fruit, harvested and marketed in Kebumen region and its surroundings, especially in Yogyakarta, where tourism centers are growing very rapidly. The price of young fruit of Kebumen Entog Dwarf is higher than that of young coconuts from other local coconuts. Its water is sweeter compared than other varieties. Coconut water is consumed directly and commonly used as a sports drink.

Young coconut fruit has high of nutritional value, from its kernel which contains essential fatty acids and amino acids for human body. Coconut water contains sugar, important vitamins and various types
of minerals and use as medicine for certain diseases [2]. It can also maintain human health [3] and as a alternative media for microorganism and plants [4]. Potassium was the main mineral in coconut water of three types coconut such as Sri Lanka Tall, Malayan Yellow Dwarf and Hybrid coconut [5] and in tender coconut water [6].

The Kebumen Entog Dwarf almost has the same property as tall coconut. The mature fruit also uses a raw material for coconut oil, coconut milk and desiccated industries. Its utilization for industries must be supported by information of the important nutrition such as fat, protein, ash and water of the coconut flesh. The mature kernel contained fatty acids and amino acids which are beneficial for human health. Their saturated fatty acids, dominated by medium chain fatty acids (MCFA) which are easily burned to obtain rapid energy. Some studies have proved the beneficial effects of MCFA for human being and claimed it as functional food. Lauric acid, the main MCFA in oil extracted from the coconut meat has antiviral, antibacterial and antiprotozoa properties [7]. It will be metabolized by the body into monolaurin. The monolaurin has the ability as an antimicrobial, better than antibiotics [8].

Until now, there are no information yet about the physichochemical properties of Kebumen Entog Dwarf fruit. Hence, the study was conducted to determine the physichochemical properties of fruit and water of Kebumen Entog Dwarf coconut. Some superior varieties were also evaluated in this research such as Mapanget Tall, Tenga Tall, Nias Yellow Dwarf and Khina-1 Hybrid

2. Materials and methods
The fruits of Kebumen Entog Dwarf coconut were collected from farmers at Bojongsari village, Alian District, Kebumen Regency, Central Java Province, Indonesia. Meanwhile the fruits of other varieties such as Nias Yellow, Mapanget Tall, Tenga Tall and KHINA-1 Hybrid were harvested from Mapanget Experimental Garden, one of the experimental garden of Indonesian Palm Crops Research Institute (IPCRI), located in Talawaan District, North Minahasa Regency, North Sulawesi Province, Indonesia. They were categorized into young coconut and mature coconut. All reagents and chemicals used were of analytical grade.

The moisture, fat, protein and ash of coconut kernel were analysed by AOCS method. Minerals (manganese, iron, magnesium, calcium, potassium, phosphorus and chlorine) and vitamins (ascorbic acid, niacin, biotin) content of coconut water were measured by atomic absorption spectroscopy. Fatty acids profile was anized using gas chromatography (GC). Amino acids profile was detected by high performance liquid chromatography (HPLC).

3. Results and discussion

3.1. Mineral and vitamin content of kebumen entog dwarf and yellow nias dwarf coconut
The minerals and vitamins content in young coconut water of Kebumen Entog Dwarf and Nias Yellow Dwarf coconut varieties were presented in Table 1. The data shows that, water of Kebumen Entog Dwarf contains vitamin C (ascorbic acid) and biotin (B7). Ascorbic acid content of both varieties were almost similar. Whereas biotin of Nias Yellow Dwarf was slightly higher compared to Kebumen Entog Dwarf. B vitamins are water-soluble and is very important as an active components in cellular reaction [9].

The water of these varieties contained 7 types of minerals and 4 of them are the main minerals that are needed by the body, namely calcium, phosphorus, potassium and magnesium. Mineral and their salts are useful for keeping the body system [10]. The content of 2 types of minerals, potassium and phosphorus in coconut water of Kebumen Entog Dwarf was higher than Nias Yellow Dwarf. Potassium was the major mineral and chlorine is the second highest mineral in coconut water. Potassium is a minor components that play a role to maintain heart and muscles. Chlor was an important electrolyte to maintain of blood volume, blood pressure, and pH of body fluids. Manganese, iron, magnesium, calcium, and phosphorus were present in lower concentration. The results was in line with Appaiah et al. (2015) who reported that potassium in young coconut water reach to 249.6-256.2 mg/100 g [11].

The potassium content in water of Kebumen Entog Dwarf and Nias Yellow Dwarf were 144.3 mg/100 ml and 137.58 mg/100 ml, respectively. The chemical composition of coconut fruit, including its water,
is affected by variety [4]. Potassium was the main mineral contained in the water of three types of coconut such as Sri Lanka Tall, Malayan Yellow Dwarf and Hybrid coconut [5]. Thus, we consider that coconut water of Kebumen Entog Dwarf was good source of mineral especially potassium.

### Table 1. Vitamins and minerals composition of young coconut water of Kebumen Entog Dwarf and Nias Yellow Dwarf

| Vitamin/Mineral   | YKNYD | YKKED |
|-------------------|-------|-------|
| **Vitamin (mg/100 ml)** |       |       |
| Ascorbic acid     | 1.28  | 1.3   |
| Niacin (B3)       | ND    | ND    |
| Biotin (B7)       | 7.17  | 6.23  |
| **Mineral**       |       |       |
| Mn (mg/L)         | 1.38  | 0.96  |
| Fe (mg/100 ml)    | 0.1   | 0.08  |
| Mg (mg/100 ml)    | 11.66 | 7.97  |
| Ca (mg/100 ml)    | 32.2  | 21.64 |
| K (mg/100 ml)     | 137.58| 144.3 |
| P (mg/L)          | 17.72 | 64.06 |
| Cl (mg/ml)        | 123.74| 104.32|

Note: ND not detected, YKKED Young kernel of Kebumen Entog Dwarf, YKNYD Young kernel of Nias Yellow Dwarf

3.2. The composition of kernel of some coconut varieties in different stages of maturity

The data of moisture, fat, protein, ash, and carbohydrate content of young coconut kernel of Kebumen Entog Dwarf and Yellow Nias Dwarf coconut varieties were presented in Table 2. Ash content decreased with the maturity which proved by the ash content of Kebumen Entog Dwarf and Yellow Nias Dwarf kernel. The ash content of Kebumen Entog Dwarf and Yellow Nias Dwarf young kernel were 3.78 % and 3.20%, respectively. It tend to decrease in mature kernel of Kebumen Entog Dwarf and Yellow Nias Dwarf around 1.72% and 2.61%, respectively. The ash content of coconut decreased with the stages of maturity [11]. The moisture content of kernel of some coconut varieties was low, due to it put into the oven to reduce the water before analysed. The protein content was also decreased with the maturity.

In fact, the oil of the kernel increased with the maturity. Young kernel of Kebumen Entog Dwarf and Nias Yellow Dwarf contained 49.52 % and 39.04% of fat, respectively and increased to 63.20% and 54.51%, respectively in mature nut. The oil content of mature coconut is higher compared to young coconut [12].

Young kernel of Kebumen Entog Dwarf coconut contained fat content higher compared to Nias Yellow Dwarf. The mature nut of Kebumen Entog Dwarf coconut also having higher fat content than Mapanget Tall, Tenga Tall and KHINA-1. Fat content of mature nut of Kebumen Entog Dwarf was around 63.20% compared to Mapanget Tall, Tenga Tall and Khina-1 were 62.74%, 60.75% and 56.84%, respectively. Based on these data, it can be concluded that meat of Kebumen Entog Dwarf was the good source of fat. It is suitable as raw materials for processing of commercial products such as dessicated coconut (DC) and coconut oil. The meat of Kebumen Entog Dwarf has the advantage of being a raw material for DC because of its low protein content. This is because protein is a component that plays a role in the browning process which causes a decrease in DC quality. Therefore, in DC processing the browning process must be avoided. In the extraction of oil from coconut meat, protein is a component that influence in the formation of bonds between water and oil in coconut meat. The low protein content
will further facilitate the extraction of oil from coconut meat in the oil processing with dry or wet extraction.

Table 2. The composition of kernel of some coconut varieties in different stages of maturity

| Coconut varieties | Moisture | Ash (%) | Protein | Fat    |
|-------------------|----------|---------|---------|--------|
| YKKED             | 3.94     | 3.78    | 7.64    | 49.52  |
| YKNYD             | 4.70     | 3.20    | 10.32   | 39.04  |
| MKKED             | 5.9      | 1.72    | 5.24    | 63.20  |
| MKNYD             | 6.12     | 2.61    | 7.38    | 54.51  |
| MKMT              | 6.02     | 1.94    | 6.93    | 62.74  |
| MKTT              | 6.18     | 1.74    | 7.61    | 60.75  |
| MKKH-1            | 6.65     | 2.18    | 6.67    | 56.84  |

Note: YKKED Young kernel of Kebumen Entog Dwarf, YKNYD Young kernel of Nias Yellow Dwarf, MKKED Mature kernel of Kebumen Entog Dwarf, MKNYD kernel of Nias Yellow Dwarf, MKMT Mature kernel of Mapanget Tall, MKTT Mature kernel of Tenga Tall, MKKH-1 Mature kernel of KHINA-1 Hybrid

3.3. Fatty acids composition of some coconut varieties in different stages of maturity

The fatty acids composition of fat in kernel of some coconut varieties in different stages of maturity was showed in Table 3. The data showed that lauric acid was the main fatty acid and ranged from 29.21 to 42.92%. The results in this study was similar to lauric acid content of commercial coconut oil [13] and Indian coconut [14]. The young kernel of Kebumen Entog Dwarf containing higher lauric acid reached 35.94%, meanwhile young kernel of Nias Yellow Dwarf was only 29.21%. Medium chain fatty acids (C6-C12) in young kernel of Kebumen Entog Dwarf is relatively higher reached to 43.12% and in young kernel of Nias Yellow Dwarf as much as 34.1%. Medium chain fatty acids found in high proportion in coconut meat. In young coconut meat there is also a small amount of long chain unsaturated fatty acids in mature coconut meat, namely arachidat, behenat, erukat and lignocerate with a percentage of 0.04-0.11%.

Mature kernel of Kebumen Entog Dwarf contains lower lauric acid than in Tenga Tall and Khina-1 Hybrid coconut, but was higher than Nias Yellow Dwarf coconut and in Mapanget Tall. The levels of medium chain fatty acids in Entog Kebumen Dwarf Coconut consisting of caproic, caprilic, capric, and lauric acids reached 51.07%, higher than Nias Yellow Dwarf coconut only 48.52%, but lower than Mapanget Tall (55.25%), Tenga Tall (53.4%) and Khina-1 Hybrid (53.36%).

The results proved that, the oil extracted from young and mature nuts, contained high proportion of lauric acid (C12). It is classified as a medium chain saturated fatty acid (MCFA). The MCFA is a fatty acid that has 6-12 carbon atoms. The advantage of MCFA in the digestive process compared to unsaturated fatty acids is the faster metabolic process, so that faster energy is produced [15]. The MCFA has very good benefits for health because has antiviral, antibacterial and antiprotozoa properties [7]. Lauric acid when consumed will be metabolized by the body into monolaurin. Monolaurin has the ability as an antimicrobial, better than antibiotics [8].

3.4. Amino acids composition of mature kernel of Kebumen Entog Dwarf and some coconut varities

The data showed that, the 5 varieties of coconut contains 10 types of essential amino acids and 5 types of non essential amino acids (Table 4). Essential amino acids are amino acids that are needed in metabolic processes but cannot be synthesized by the body, so they must be obtained from food consumed. Essential amino acids contained in young and mature coconut meat are histidine, threonine, arginine, methionine, valine, phenylalanine, tyrosine, isoleucine, leucine and lysine. There are 3
dominant amino acids in the mature coconut meat of Kebumen Entog Dwarf namely glutamic acid, arginine and aspartic acid of 1.28%, 0.71% and 0.45%, respectively. These results almost similar to composition of Thailand coconut meat which contained glutamic acid as major amino acid [16]. Another study also evaluated the Indonesian coconut meat and found the glutamic acid content reach to 1.22% [17]. It is known that glutamic acid has an important function as a neurotransmitter, so it is very important for brain health and improved memory function. Arginine plays an important role as a precursor in cell reaction and keeping blood pressure

**Table 3.** The fatty acid composition in kernel of some coconut varieties at different stages of maturity

| Fatty Acid (%) | YKKED | YKNYD | MKKED | MKNYD | MKMT | MKTT | MKKH-1 |
|----------------|-------|-------|-------|-------|------|------|--------|
| C6:0           | 0.25  | 0.2   | 0.44  | 0.46  | 4.26 | 0.50 | 0.50   |
| C8:0           | 3.85  | 2.6   | 4.92  | 4.70  | 5.49 | 5.60 | 5.60   |
| C10:0          | 3.08  | 2.09  | 3.86  | 3.58  | 4.22 | 4.38 | 4.38   |
| C12:0          | 35.94 | 29.21 | 41.85 | 39.78 | 41.28| 42.92| 42.88  |
| C14:0          | 19.75 | 0.81  | 21.03 | 21.80 | 20.92| 19.41| 20.65  |
| C16:0          | 14.67 | 17.69 | 12.50 | 13.26 | 11.59| 11.59| 11.71  |
| C18:0          | 2.87  | 3.74  | 4.05  | 5.04  | 3.39 | 4.95 | 4.34   |
| C18:1          | 15.07 | 18.58 | 9.27  | 8.93  | 6.94 | 8.69 | 7.94   |
| C18:2          | 4.29  | 4.65  | 1.83  | 2.33  | 1.52 | 1.82 | 1.87   |
| C18:3          | 0.01  | 0.01  | ND    | ND    | ND   | ND   | ND     |
| C20:0          | 0.11  | 0.13  | ND    | ND    | ND   | ND   | ND     |
| C20:1          | 0.08  | 0.12  | 0.04  | 0.04  | 0.04 | 0.06 | 0.05   |
| C22:0          | ND    | 0.05  | 0.02  | 0.02  | 0.01 | 0.02 | 0.02   |
| C22:1          | 0.04  | 0.01  | ND    | ND    | ND   | ND   | ND     |
| C24:0          | 0.09  | 0.12  | 0.07  | 0.05  | 0.03 | 0.05 | 0.05   |

Note: ND not detected, YKKED Young kernel of Kebumen Entog Dwarf, YKNYD Young kernel of Nias Yellow Dwarf, MKKED Mature kernel of Kebumen Entog Dwarf, MKNYD kernel of Nias Yellow Dwarf, MKMT Mature kernel of Mapanget Tall, MKTT Mature kernel of Tenga Tall, MKKH-1 Mature kernel of KHINA-1 Hybrid

**Table 4.** Amino acid profile in mature kernel of some coconut varieties

| Amino acid     | MKMT (%) | MKTT (%) | MKKH-1 (%) | MKKED (%) | MKNYD (%) |
|----------------|----------|----------|------------|-----------|-----------|
| Glycine        | 0.25     | 0.34     | 0.33       | 0.35      | 0.25      |
| Alanine        | 0.30     | 0.37     | 0.36       | 0.38      | 0.26      |
| Arginine       | 0.72     | 1.24     | 1.06       | 1.09      | 0.71      |
| Aspartic acid  | 0.54     | 0.66     | 0.56       | 0.61      | 0.45      |
| Glutamic acid  | 1.50     | 1.83     | 1.65       | 1.69      | 1.28      |
| Phenylalanine  | 0.26     | 0.44     | 0.04       | 0.38      | 0.26      |
| Histidine      | 0.11     | 0.18     | 0.16       | 0.17      | 0.12      |
| Isoleucine     | 0.20     | 0.25     | 0.24       | 0.27      | 0.19      |
| Leucine        | 0.38     | 0.47     | 0.47       | 0.51      | 0.37      |
| Lysine         | 1.57     | 0.34     | 0.34       | 0.38      | 0.27      |
| Proline        | 0.20     | 0.26     | 0.27       | 0.27      | 0.19      |
| Serine         | 0.28     | 0.4      | 0.4        | 0.43      | 0.28      |
| Threonine      | 0.22     | 0.32     | 0.3        | 0.32      | 0.22      |
| Tyrosine       | 0.07     | 0.14     | 0.12       | 0.13      | 0.08      |
| Valine         | 0.31     | 0.38     | 0.39       | 0.41      | 0.3       |

Note: ND not detected, MKKED Mature kernel of Kebumen Entog Dwarf, MKNYD kernel of Nias Yellow Dwarf, MKMT Mature kernel of Mapanget Tall, MKTT Mature kernel of Tenga Tall, MKKH-1 Mature kernel of KHINA-1 Hybrid
4. Conclusion
The young kernel of Kebumen Entog Dwarf contained of 49.52% fat, 3.94% moisture, 3.78% ash, and 7.64% protein. The mature one contained of 63.20% fat, 5.9% moisture, 1.72% ash, and 5.24% protein. The medium chain fatty acids (caproic, caprilic, capric and lauric acids) in young and mature nuts was 43.12% and 51.07%, respectively. That also detected 15 types of amino acids in kernel of mature kernel. The dominant amino acids in coconut meat are glutamic acid (1.28%), arginine (0.71%) and aspartic acid 0.45%.

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References
[1] Balai Penelitian Tanaman Palma. 2018 Usulan Pelepasan Varietas Kelapa Genjah Entog Kebumen (Manado : Balai Penelitian Tanaman Palma) p 79
[2] DebMandal M and Mandal S 2011 Asian and Pacific J. Trop. Med. 241
[3] Victor E 2013 Advances in Agri., Sci. and Eng. Research 3 718
[4] Prades A, Dornier M, Diop N and Pain J P 2012 Fruits 67 87
[5] Solangi A H and Iqbal M Z. 2011 Pakistan J Botany 43 357
[6] Haseena M, Basturi Bai K V and Padmanabhan S 2010 J. Food Sci. Technol. 47 686
[7] Enig M E 1999 APPC’S XXXVI session and 30th Anniversary Pohnpei Federated States of Micronesia
[8] Vermén M Verallo-Rowell 2017 The 2nd Int Conf. on Coconut Oil (Bangkok: Thailand) pp 15-8
[9] Jean, W H, Yong L G, Yan F N and Swee N T 2009 Molecules 14 5144
[10] Njoku P C and Ohia C C 2007 J. Nutrition 6 616
[11] Appaiah P L, Sunil L, Prasant Kumar P K and Gopala Khrisna A G 2015 J. Food Sci. Technol. 52 5196
[12] Bawalan D 2017 The 2nd Int. Conf. on Coconut Oil Bangkok Thailand, 15-18 March 2017
[13] Marina A M, Che Man Y B and Nazimah S A H 2009 J. Am. Oil Chem. Soc. 86 301
[14] Bhatnagar A S, Prasanth Kumar P K, Hemavathy J and Gopala Krishna A G 2009 J. Am. Oil Chem. Soc. 86 991
[15] Marten B, Pfeuffer M and Schrezenmeir 2006 Int. Dairy J. 16 1374
[16] Patil U and Benjakul S 2017 Food Hydrocolloids 69 220
[17] Karouw S and Santosa B 2018 Bulletin Palma 19 33