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COMPOSITION AND POTENCY OF YOUNG COCONUT WATER FOR HEALTH (COCOS NUCIFERA L.): A SYSTEMATIC REVIEW

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ABSTRACT

Introduction: Young coconut water (Cocos nucifera L.) is a liquid produced by the endosperm of coconut fruit that has clear color and sweet taste. Young coconut water is rich in nutrients that have the potential for the health of the human body, such as potassium, sodium, and calcium content. Apart from these ingredients, there are several ingredients found in the results of other studies. **Purpose**: The purpose of this systematic review was to identify and discuss the potential content of young coconut water for health. **Methods**: The method used is a literature study from related articles obtained from the electronic database Science Direct and Google Scholar. **Results**: The results of the 7 selected articles indicate that young coconut water contains vitamins, sugars, amino acids, and minerals. **Discussion**: These contents play a role in hematopoiesis, thereby preventing anemia. The content of vitamin C can fight free radicals and prevent urolithiasis in the kidneys. Glucose content can balance blood sugar levels. The content of amino acids in the form of L-arginine plays a role in the body's antioxidant system. Its mineral content which resembles body fluids is able to maintain the body's osmotic pressure. **Conclusion:** So, it can be concluded that young coconut water has a lot of potential for health.

Keywords: Young coconut water and nutritional composition

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INTRODUCTION

Coconut (Cocos nucifera L.) is a plant that is commonly found in tropical and sub-tropical regions. Coconut belongs to the Arecaceae (Palmae) family and belongs to the monocotyledon plant group. The biggest producers are Indonesia, the Philippines, and Malaysia (Halim et al., 2018). Coconut can grow to 30 m or 98 ft tall, with pinnate leaf 4-6 m or 13-20 ft long (Aniekpeno et al., 2019). Coconut is generally processed into coconut milk or coconut oil and used in food processing.

Almost all parts of coconut can be used for daily life, especially the fruit. Coconuts take an average of 11-12 months to ripen. During this period, the fruit can be divided into three categories based on the chemical composition of the water, immature or young (6–8 months); mature (9–11 months); and overripe or mature (12 months or more). The volume and composition of coconut water for each fruit was found to be maximum at the age of 6-9 months (Burns et al., 2020). In old coconut fruit, the meat can be processed into coconut milk. Whereas in the young coconut, the meat and water can be consumed directly. The water produced by coconuts is generally clear, sweet, and watery. Coconut water at 190 DAP (day after pollination) will provide moderate acidity and sufficient sweetness while coconut meat from 225 DAP is suitable for producing coconut virgin oil because it has a much higher amount of fat compared to other ripeness (Mahayothee et al., 2015). Young coconuts have been used for a hundred years for various purposes, such as offerings, banquets for guests, and for relieving thirst. Coconut water is also often used empirically as an antitoxin in poisoning therapy, preventing dehydration, and as a drink in diabetic patients. However, the nutritional content and the underlying mechanism have not been studied

The purpose of this systematic review is to

explore the nutritional content and the young coconut water potency for heath.

METHOD

Articles used in this systematic review were obtained from electronic databases published in Science Direct and Google Scholar with publication years from 2011 to 2021. The keywords used in journal searches were "young coconut water" (nutritional value or nutritional composition) and "health benefits". The criteria for the articles used are research articles published in the last 10 years, in English, accessible or downloadable in full text, and discussing the nutritional composition of young coconut water and its health benefits.

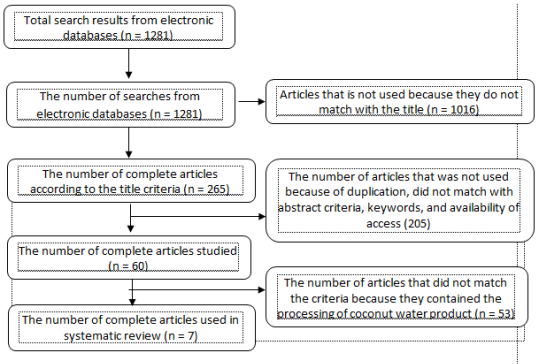

Chart 1. Research Flowchart

The number of articles obtained from Science Direct was 51 and Google Scholar amounted to 1230. The article filtering was carried out with criteria based on titles and resulted in 265 articles. Re-filtering was carried out by reviewing duplication and criteria based on abstracts, keywords, and availability of access to the full article content. The screening yields a complete 60 articles that can be studied. After the review, there were several articles that did not match the criteria because they discussed the processing of coconut water products. The number of articles that match the criteria are used on this systematic review is 7 articles.

RESULT

Young Coconut Water

Young coconuts are aged six to eight months after endocarp formation and harvested when the water volume reaches the maximum (Halim et al., 2018). Coconut water is a clear, nutritious liquid obtained from coconut endosperm (Giri et al., 2018). Young coconut water contains low calories, mineral salts, vitamins, amino acids, and carbohydrates in the form of sugar. Young coconut water acts as an excellent natural isotonic and it works in rehydration and electrolyte replacement (Praia, 2020). Nutrients from coconut water are obtained from the seed apoplasm (surrounding cell walls) and transported through the plasmodemata (the relationship between the cytoplasm of adjacent cells) into the endosperm (Kathiravan et al., 2014).

Young coconut water has low calories and fat but it's rich in sugar, vitamins, amino acids, and minerals. Its contents make young coconut water as an alternative drink to increase body ions (Giri et al., 2018). Drink products from young coconut water are now widely commercialized and used as drinks to restore energy (Prado et al., 2015).

The composition of young coconut water

Young coconut water contains many components that are beneficial for the human body. The sugar content in coconut water is very high so it is useful for increasing blood glucose after physical activity (Table 1). The content of vitamins, amino acids and minerals in young coconuts is also important for fulfilling the body's needs (Table 2).

The benefits of young coconut water contents

The results of the analysis from four research articles in Table 3 indicate that the specific composition of young coconut water has a role in several diseases. Sugar extraction from the three samples used in the Anselme et al. (2018) study has a low glycemic index which is good for consumption by diabetics. This research involved 15 young adult volunteers, from age 18 to 39 years who previously fasted for 12 hours and then the subjects were blood drawn after 5 minutes of arrival. Next, each subject consumed 50 g of anhydrous glucose dissolved in 250 mL of mineral water. Postprandial glucose was collected and studied for 2 hours, 15 minutes each during the first hour and then every 30 minutes during the 2nd hour. The calculation of the glycemic index of the three types of sugar uses the Boun method. The glycemic index classifies foods according to the level of blood glucose they produce when consumed. After ingestion of anhydrous glucose, brown and white sugar from coconut water, there was an increase in blood glucose in all study subjects. This increase in blood sugar is caused by the assimilation and digestion of ingested sugar. The glycemic index in brown sugar is higher than in white sugar because it is more hyperglycemic.

In the research of Zulaikhah et al., (2019), coconut water was given to samples of male Wistar rats induced by lead (Pb) at a dose of 8 mL / 200 gBW/day for 4 weeks showed an

increase in hematocrit, hemoglobin, and erythrocytes. This indicates that coconut water can prevent anemia. This is because lead (Pb) is a heavy metal that can trigger the formation of Reactive Oxygen Species (ROS), causing oxidative stress and cell disruption in the hematopoietic stem which causes a decrease in the levels of hematocrit, hemoglobin and erythrocytes.

Research by Gandhi et al., (2013) shows that consumption of coconut water prevents urolithiasis and the development of oxidative stress in the kidneys. This study used a sample of mice which were divided into 3 groups. Group I: normal rat diet (control). Group II: normal rat diet + 0.75% ethylene glycol (EG) mixed with tap water for 7 weeks ad libitum. Group III: normal rat diet + 0.75% EG + 10% coconut water for 7 weeks ad libitum. The rats were put into the cage, then the urine sample was taken for 24 hours. The urine collection was performed to compare calcium oxalate crystallization in the 3 groups. On sample observations under microscope polarization, no crystal deposition was observed in control or group I animals, whereas group II mice showed abundant CaOx crystal deposition. Group III experienced a drastic decrease in the number of urine crystals.

The following are some of the nutritional compositions that are mostly contained in young coconut water from the results of the analysis from four other research articles that are used and supporting references, namely:

Vitamin

Young coconut water contains B vitamins, namely nicotinic acid or B3 (0.64 µ g / mL), pantothenic acid or B5 (0.52 µ g / mL), biotin (0.02 µ g / mL), riboflavin or B2 (< 0.01 µg / mL), folic acid (0.003 µ g / mL), trace amounts of thiamine or B1, and pyridoxine or B6 (DebMandal and Mandal, 2011). Young coconut water also contains vitamin C (15 mg / 100 mL) which can prevent the formation of lipid peroxidase so that the oxidation process in blood cells can be prevented [Table 4]. Vitamin C also acts as a protective cell against damage caused by free radicals and increases the absorption of iron in the body (Zulaikhah et al ., 2019).

Amino acid

Young coconut water is rich in nutrients including essential amino acids, such as lysine, leucine, cysteine, phenylalanine, tyrosine, histidine, and tryptophan (Rukmini et al., 2017). According to Joseph et al., (2019), amino acids not only contribute to the buildup of energy but also produce lymphocytes or white blood cells which help improve immune function. Lymphocytes can improve digestion and absorption of nutrients. According to Zulaikhah (2019), one type of amino acid, L-arginine, can be used to reduce the effects of heavy metal poisoning and plays an important role in the human body's antioxidant system [Table 4].

Mineral

The contents of organic and inorganic ions in young coconut water plays an important role in the antioxidant system of the human body, such as normalizing cell function, increasing antioxidant activity, increasing bone formation, increasing hemoglobin, gene expression, metabolizing amino acids, fats and carbohydrates (Zulaikhah, 2019). The high amount of potassium makes young coconut water as a natural hydrating drink that can be used as an alternative to commercial isotonic drinks (Halim et al., 2018). The electrolyte concentration in young coconut water produces an osmotic pressure similar to that observed in blood and does not affect plasma coagulation. High amounts of potassium in young coconut water are reported to reduce blood pressure (DebMandal and Mandal, 2011). According to Joseph et al., (2019), young coconut water is an indispensable source of calcium and can balance the calcium levels in the body thereby preventing nutritious rickets [Table 4]. Young coconut water also contains electrolytes that maintain the body's osmotic pressure and can be used as intravenous fluids in an emergency (Zulaikhah, 2019). Young coconut water also has an important role in the treatment of diarrhea because it has a unique composition, namely to hydrate individuals and protect the digestive tract from various infections (Prado et al., 2015).

Sugar

Young coconut water is also known as a source of sugar that can be used to replace blood plasma in emergency surgical operations (Aniekpeno et al., 2019). According to Joseph et al., (2019), the glucose content of young coconut water is slightly lower than fasting blood sugar levels (blood sugar levels obtained after not eating food for 8 hours) so it is good for diabetics [Table 4]. Apart from contributing to the sweet taste of young coconut water, sugar is also important as a source of ergogenic aid as it is the main source of energy for humans. Sugar is needed for immediate glycogen recovery and energy replenishment when people do an intense activity (Halim et al., 2018). Oral bacterial metabolism can be prevented by mannitol or one of the sugar alcohols contained in young coconut water.

DISCUSSION

According to Bhagya et al., young coconut water can reduce systolic pressure. Other research from Farapti et al., proved that 300 ml of fresh coconut water was given twice a day for 14 consecutive days to reduce systolic blood pressure, but not diastolic blood pressure. However, in the study of Gullapalli et al., it was stated that consumption of young coconut water can reduce blood pressure in patients with primary hypertension. The experimental group's systolic and diastolic blood pressure decreased by 10.5 mm Hg and 6.8 mm Hg, respectively. (Zulaikhah, 2019).

Young coconut water is useful for helping diabetics balance blood sugar so as to reduce swelling in the hands and feet of sufferers. In fact, young coconut water consumption also helps to control diabetes by having a positive impact on hormones that control blood sugar in the body. Hence, the rise in blood sugar levels slows down and helps lower glycemic cravings. Coconuts are also known to induce rapid digestion and have a positive impact on other symptoms related to intestinal and digestive disorders. (Zulaikhah, 2019). The results of research from Anselme et al., (2018) show that brown and white sugar from young coconut water are classified as foods with a low glycemic index. White sugar has a glycemic index 2 to 3 times lower than brown sugar. Therefore, consumption of white sugar from young coconut water can be recommended for diabetics who must pay attention to sucrose. In addition, these two categories of sugar are suitable for consumption by healthy people who are at risk of developing diabetes.

CONCLUSION

Young coconut water is one part of the coconut that is produced when it is 5-9 months old depending on the type. Young coconut water contains many nutrients, namely vitamins, minerals, amino acids, and sugars. These contents play a role in hematopoiesis, thereby preventing anemia. One of the vitamins contained, namely vitamin C, can fight free radicals and prevent urolithiasis in the kidneys. Young coconut water is widely used as a natural isotonic drink because its electrolyte content in the form of minerals can maintain the body's osmotic pressure. The amino acid content in young coconut water in the form of L-arginine plays a role in the body's antioxidant system. The sugar content in young coconut water is good for diabetics because it is identified to contain a low glycemic index and balance blood sugar levels. Based on these nutritional content, young coconut water is a good drink for not only people with certain diseases but also healthy people.

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Table 1. Sugar content in young coconut water aged <6 months (Burns et al., 2020).

Sugar content in coconut water	
Total sugar (g / 100 mL)	2.9
Sucrose (g / 100 mL)	0.08
Glucose (g / 100 mL)	2.18
Fructose (g / 100 mL)	2.29
Glucose / fructose ratio (g / 100 mL)	0.95
Reducing sugar (g / 100 mL)	1.02

Table 2. Vitamin, amino acids and minerals in young coconut water (Zulaikhah, 2019).

Component	Type of Green Coconut (Viridis)
Vitamin C (Ascorbit Acid) (mg / L)	32.50
Amino acids (µg / mL)	
- L- Aspartic	30.81
- L-Glutamic	28.90
- L- Glutamine	6.32
- L-**Threonine**	13.40
- L-Glycine	16.08
- L-Arginine	12.63
- L-Alanine	22.97
- L-Tyrosine	9.95

- L-Thryptophan + - L-Methionine	235.22
- L-Valine	11.83
- L-Phenylalanine	8.80
- L-Isoleucine	11.48
- L-Leucine-	17.80
- L-Lycine-	26.22
- L-Histidine + Serine	26.41
Mineral (mg / Kg)	
- Cu (Cuprum)	0.40
- Fe (Iron)	0.39
- Mg (Magnesium)	74.24
- Mn (Manganese)	2.50
- Zn (Zink)	0.83
- Na (Sodium)	24.22
- K (Potassium)	2908.46
- P (**Phosphor**)	94.43

Source: LPPT and Chemistry Laboratory of MIPA UGM

Table 3. Comparison of the Role of Coconut Water in Several Diseases

No.	Reference	Destination	Sample	Intervention	Indicator Variables	Result
1.	Anselme et al., 2018	Evaluated the glycemic index of coconut water sugar from three coconut varieties.	A total of 15 young adult volunteers **with a range aged** 18-39 years old are in good **condition**.	Subjects fasted for 12 hours before the research session began. After 5 minutes of arrival, the subjects had their fasting blood sugar taken. Furthermore, each subject consumed a reference diet in the form of 50 g of anhydrous glucose dissolved in 250 mL of mineral water.	Brown sugar and white sugar are extracted from several types of coconut water, namely WAT (West African Tall), MYD (Malaysian Yellow Dwarf), and PB121 + (Port-Bouet 121 enhanced) and control sugar (Glucose Anhydrous).	**Brown and** white sugar of coconut sugar **are** classified as food with a low glycemic index. In addition, the glycemic index of white coconut water sugar is 2-3 times lower than sugar red. Palm sugar (MYD) is more hyperglycemic than hybrid (PB121 +) which is more hyperglycemic than palm sugar (WAT). Thus, controlled consumption of coconut water sugar can be a good sugar for health and suitable for diabetics because it increases slightly postprandial glucose.
2.	Zulaikhah et al., 2019	Investigated the effects of coconut water on preventing lead-induced anemia in mice.	A total of 18 male white rats *Wistar* strain.	The samples were divided into 3. Group K1 as a control, group K2 was given lead feed (10 mg/day/rat), **and group** K3 was given coconut water (8 mL / 200 g BW / day) orally.	Coconut water, which is 5-7 months old, has a soft, thin, chewy texture like endosperm and is edible using a spoon. The dose given is 8 ml / 200gr BW / day.	Provision of young coconut water (8 mL / 200gr rat body weight / day for 4 weeks) can increase the levels of hematocrit, hemoglobin and erythrocytes ($p < 0.05$). **The provision** of young coconut water has been shown to prevent anemia as indicated by an increase in the levels of hematocrit, hemoglobin, and erythrocytes in male *Wistar* strain rats induced by lead.
3.	Gandhi et al., 2013	Evaluated the effects of coconut	A total of 18 male *Wistar* rats weighing	Group I (control) was given standard rat feed. Group II,	Fresh coconut water, 0.75% ethylene	Treatment with coconut water inhibits the deposition of crystals

	water as a prophylactic agent in experimentally-induced nephrolithiasis in a mouse model.	between 150 g - 170 g were divided randomly into three groups.	animals were given 0.75% ethylene glycol mixed with tap water. Group III was given coconut water in addition to ethylene glycol. The treatment lasted for 7 weeks. Then the samples were placed in a polypropylene cage **at** a room temperature of 25 ± 1° C with alternative lighting and darkness for 12 hours and lasted 7 weeks.	glycol, and tap water.	in the kidney tissue and reduces the number of crystals in the urine. Coconut water also acts as a protection against impaired kidney function and the development of oxidative stress in the kidneys. The results showed that coconut water has the potential to be a candidate for phytotherapy against urolithiasis.

Table 4. Comparison of Composition and Benefits of Young Coconut Water

No.	Reference	Destination	Nutritional Composition	Potential or Benefits
1.	Zulaikhah, 2019	Summarizing the health benefits of young coconut water is a natural, healthy and nutritious drink from coconut trees that are widely grown in tropical countries.	Vitamin C: 32.50 mg / L L-Arginine: 12.63 µ g / mL Na (Sodium): 24.22 mg / Kg K (Potassium): 2908.46 mg / Kg P (**Phosphor**): 94.43 mg / Kg Mg (Magnesium): 74.24 mg / Kg	- Natural isotonic drink, because the content of electrolytes such as sodium and potassium plays a role in maintaining the osmotic pressure inside and outside the cell - It plays an important role in the antioxidant system of the human body and can reduce the effects of heavy metal poisoning due to the content of L-arginine - Vitamin C significantly reduces the formation of free radicals
2.	Joseph, et al., 2019	Uncovering the potential of young coconut water as an antihyperglycemic agent and **its** parts having antidiabetic activity.	Malic acid Citric acid Calcium Glucose	- Inhibits the growth of microorganisms such as yeast and bacteria - Can balance calcium levels in the body so as to prevent nutritious rickets - Suppress the increase in blood glucose levels by reducing intestinal absorption and facilitate absorption into cells
3.	DebMandal and Mandal, 2011	Identifying coconuts in the context of health promotion and preventive efforts to prevent several diseases.	Calories: 17.4 / 100 g Vitamin B3: 0.64 µ g / mL, Vitamin B5: 0.52 µ g / mL Biotin: 0.02 µ g / mL	- The electrolyte concentration of young coconut water produces an osmotic pressure similar to that observed in blood and does not affect plasma coagulation - The high amount of potassium (K) in young coconut water

Vitamin B2: <0.01 µ g / mL Vitamin B1 Vitamin B6 Vitamin C: 15 mg / 100 mL Folic acid: 0.003 µ g / mL K: 290 mg% Na: 42 mg% Ca: 44 mg% Mg: 10 mg% P: 9.2 mg% L-arginine: 30 mg / dL	is reported to lower blood pressure - Young coconut water was found to remove toxins in cases of mineral poisoning and aids in the rapid absorption of drugs - The free amino acids and L-arginine in young coconut water significantly reduce the formation of free radicals - The content of vitamin C can reduce lipid peroxidation - Young coconut water has a cardioprotective effect on heart attacks because it is rich in mineral ion content, especially potassium (K).