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HEALTH BENEFITS OF TENDER COCONUT WATER (TCW)

Siti Thomas Zulaikhah

Department of Public Health, Faculty of Medicine, UNISSULA, Semarang, Central Java, Indonesia.

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Correspondence to Author:

Siti Thomas Zulaikhah

Department of Public Health,
Faculty of Medicine, UNISSULA,
Semarang, Central Java, Indonesia.

E-mail: sitithomas@unissula.ac.id

ABSTRACT: This review summarizes the health benefits of Tender Coconut Water (TCW). TCW is a natural, healthy, nutritious drink from coconut tree widely grown in tropical countries. Indonesia is the larger country with the largest coconut growing country in the world. The active compounds in TCW include methionine, L-arginine, cytokines, selenium, vitamin C, and Zn, Mn and Cu. L-arginine is present in TCW significantly reduce the free radical generation, TCW Also contains vitamin C that significantly reduces lipid peroxidation when Introduced in rats. L-arginine was able to increase glutathione peroxidase (GPx) activity in rat exposed to plumbum. Cytokinin is a potent antioxidant against free radical-induced cell damage. Selenium is one of the micronutrients that form the enzyme GPx. Methionine is an amino acid containing sulfur that can be used as a source of thiols and plays a role in the synthesis of glutathione. The TCW of 5-7 months of age is about 500-750 mL; depending on the maturity and varieties of coconut. The older the coconut, the less water it contains.

INTRODUCTION: Foods containing natural antioxidants can be used as a strategy to reduce morbidity and mortality especially due to oxidative stress¹ and the prevalence of degenerative diseases². Coconut water is a natural, healthy, nutritious drink from coconut palm trees widely grown in tropical countries. Indonesia is the largest coconut growing country in the world³. TCW has a therapeutic effect^{4, 5}, containing various nutrients such as minerals, vitamins, antioxidants, amino acids, enzymes and growth hormones⁶. Recent studies have shown that TCW is rich in L-arginine, a free form amino acid, and vitamin C, which can prevent heart disease and lipid peroxidation^{4, 7}. Also, TCW also contains various important compounds for the body, such as magnesium, potassium, calcium, selenium, methionine, zinc, iodine, manganese, boron, molybdenum and phyto-hormone such as auxin, cytokines, gibberellins^{4, 8}.

L-arginine can be used for the therapy and reduce the effects of heavy metal poisoning⁹. Treatment with L-arginine was able to increase GPx activity in mice exposed to plumbum (Pb)¹⁰. Cytokinin is a potent antioxidant against free radical-induced cell damage⁸. Selenium is one of the micronutrients that form the GPx enzyme. Methionine is an amino acid containing sulfur that can be used as a source of thiols and plays a role in the synthesis of glutathione. The water content in a tender coconut of 5-7 months of age is about 500-750 mL and depends on the maturity and varieties of coconut^{11, 12}.

The finding of Bhagya *et al.*,⁴ proved that tender coconut water could reduce oxidative stress and improve antioxidant status characterized by decreased MDA levels, increased levels of antioxidant enzymes such as SOD, CAT, and GPx in mice fed fructose diet. Loki and Rajamohan showed that TCW has a beneficial effect, significantly lowering MDA levels and increasing levels of antioxidant enzymes such as SOD, CAT and GPx in carbon tetrachloride-induced rats (CCl₄)¹³. Similar research conducted by Anurag and Rajamohan³⁴ proved that tender coconut water

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improves mitochondria and provides protection against isoproterenol (free radical) induced damage. Zulaikhah *et al.*, the study showed that TCW could lower total cholesterol (TC), low-density lipoprotein (LDL) and triglycerides (TG) levels and decrease high-density lipoprotein (HDL)¹⁴. The results of subsequent studies in human demonstrated that TCW could increase the antioxidant enzyme superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), decrease lipid peroxidation, and prevent oxidative stress in the traditional gold miners exposed to mercury¹⁵.

A. Type (Varieties) of Coconut: There are distinct varieties of coconut, but in general, it can be divided into two groups namely:

- ✓ Dwarf coconut is a variety of coconut that yield nuts after 4-6 years of planting, for example, examples ivory coconut (Eburnia variety), coconut king (Regia), and king Malabar (Preciosa) and quail (Pumila).
- ✓ The deep coconut is a new coconut that yields fruit after reaching the age of 15 years after

planting, the height of the tree can reach 30 meters for examples green coconut (Viridis), red coconut (Rubescens)

Hybrids are the inter-varietal crosses between deep dwarf coconut.

B. Coconut morphology:^{11, 12} Coconut trees can grow up to \pm 30 m and live for 70 years. Coconuts grow in clusters and usually 1 side bunches 5 to 12 pieces. An adult coconut tree usually produces a new cluster every month or about 12 bunches per year. A productive coconut tree can produce 100-140 coconuts per year³¹.

Coconut (*Cocos nucifera* Linn.), shaped like an egg or ellipse, varies in size, There are several varieties, different varieties have slightly different flavors. It consists of a network of fibrous outer layers called coconut husk (mesocarp) that covers a hard layer called a shell (endocarp). In the shell, there is a nucleus (endosperm) which is believed to be the most important part of the coconut. Below are examples of the morphology of types of green coconut (*Vidity viridis*) of ordinary type and 'wulung.'



FIG. 1: WULUNG GREEN COCONUT



FIG. 2: ORDINARY GREEN COCONUT

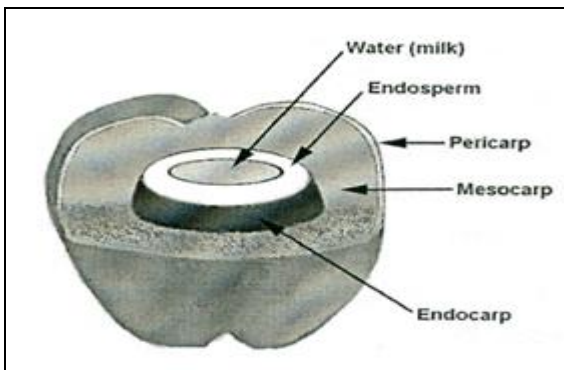


FIG. 3: MORPHOLOGY OF COCONUT^{11, 12}

The nutrition, taste, size, texture, water and coconut flesh depend on coconut varieties and fruit maturity

level, to achieve maximum maturity level takes between 12 - 13 months. After 6-7 months, coconut

has a soft, thin, jelly-like meat (endosperm) and can be eaten with a spoon. At the age of 10-12 months, it is referred to as mature coconut where the amount of water becomes reduced by about 15-30% from the weight of the fruit or about 300 mL, has a layer of hard and thick meat, and the taste becomes less sweet^{11, 12}. The growth of coconut fruit based on age 2 is presented in Fig. 2.

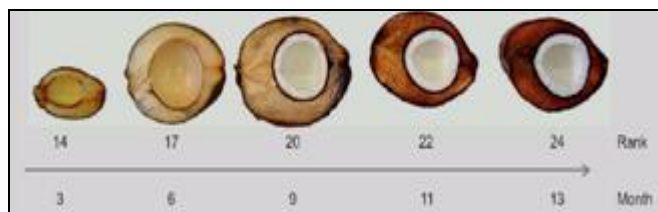


FIG. 4: COCONUT GROWTH BASED ON AGE¹⁶

TCW is called the “fluid of life,” referred to as the Coconut Water Tender (TCW), where tender means soft flesh like jelly¹¹. The total water and sugar content reach a maximum when the coconut is between 6-7 months of age, at this age coconut water have the sweetest and delicious taste. The content of water and sugar will be reduced with increasing age of coconut maturity^{11, 12, 16}.

TCW is the most nutritious healthy drink from a palm tree, is a natural isotonic drink that has content similar to our body's blood plasma¹¹. The content of macro and micronutrients found in tender coconut water can lower lipids, protect the heart and liver^{17, 18}. The content of nutrients of TCW is influenced by the age of fruit maturity, soil nutrient content and environmental conditions¹².

C. TCW's Composition: The measurement of the composition of TCW identified by Laboratorium Penelitian dan Pengujian Terpadu (LPPT) and the chemical laboratory MIPA of Universitas Gajah Mada Yogyakarta with KLT and HPLC method. Examined the type of coconut water is the ordinary green coconut water and green coconut water wulung (*Viridis variety*) in the range 5 to 7 months, where coconut water is commonly called coconut water (coconut milk tender).

D. Health Benefits of TCW for Health:

1. Natural Isotonic Drinks: High potassium in coconut water is necessary for maintaining osmotic pressure inside and outside the cell. The living cell membrane is a semi-permeable membrane. When a cell is placed in a solution with higher osmotic

pressure (hypertonic), then the water in the cell will come out so that the cell is wrinkled and this process is called plasmolysis. In contrast, if the cell is placed in a solution of lower osmotic pressure (hypotonic), then the water from outside will enter the cell and will cause the cell to swell, and this process is called plasmolysis¹⁹. To keep the cells from being lay sided the osmotic pressure must be the same or isotonic. Coconut water called "water of life in various place in the world because of efficacy treatment. Coconut water is called a natural isotonic drink because of the electrolyte content such as sodium and potassium contained in it¹¹. TCW can be used as ready to drink food product having natural health beneficial nutrients²⁰.

TABLE 1: COCONUT WATER COMPOSITION (*VIRIDIS VARIES*)

Component Components	Type of Green Coconut (<i>Viridis</i>)	
	Wulung	Ordinary
Vitamin C (Ascorbit Acid) (mg/l)	32.50	32.50
Amino acid (µg/mL)		
- L- Aspartic	115.60	30.81
- L-Glutamic	56.65	28.90
- L- Glutamine	<0.05	6.32
- L-Threonine	25.15	13.40
- L-Glycine	19.01	16.08
- L-Arginine	12.68	12.63
- L-Alanine	22.18	22.97
- L-Tyrosine	23.57	9.95
- L-Thryptophan + L-Methionine	<0.13	235.22
- L-Valine	13.27	11.83
- L-Phenylalanine	12.68	8.80
- L-Isoleucine	10.10	11.48
- L-Leucine-	19.61	17.80
- L-Lycine-	23.77	26.22
- L-Histidine + Serine	47.34	26.41
Mineral (mg/Kg)		
- Cu (Cuprum)	<0.02	0.40
- Fe (Iron)	6.00	0.39
- Mg (Magnesium)	146.16	74.24
- Mn (Mangan)	0.23	2.50
- Zn (Zink)	2.20	0.83
- Na (Natrium)	560.03	24.22
- K (Potassium)	6.31	2908.46
- P (Phospor)	8.76	94.43

Source: LPPT and Chemical Laboratory of MIPA UGM

2. Prevents Oxidative Stress: According to Bhagya *et al.*, TCW can reduce systolic pressure, lower triglyceride and free fatty acids. Mice with a fructose diet treated with TCW reduced MDA levels as a parameter of lipid peroxidation and increased antioxidant enzyme activity.

The conclusions of this study indicate that tender coconut water therapy can effectively reduce the occurrence of oxidative stress and improve the antioxidant status in mice fed fructose diet ⁴. Prathapan & Rajamohan showed that TCW significantly reduced the oxidative stress induced by isoproterenol (ISO) and exerted significant antithrombotic effects ⁷. Anurag ²¹ showed that tender coconut water has a positive effect on mitochondrial activity and protects cells from free radical damage in isoproterenol-induced mice ²¹. TCW is a rich of L-arginine, and vitamin C. Free radical generation can be reduced due to L-arginine, vitamin C acts as a powerful antioxidant to peroxidative tissue damage. L-arginine can inhibit the generation of ROS and lipid peroxidation ⁴. Loki & Rajamohan reported that tender coconut water was able to lower levels of MDA and increase antioxidant enzymes SOD, CAT, GPx, in CCl₄-induced rats ¹³. Zulaikhah & Sampurna proves that tender coconut water can prevent oxidative stress due to mercury exposure the traditional gold miners ²².

3. Antioxidant Activity: TCW can increase levels of antioxidant enzymes; Muhammad *et al.*, reported that Coconut water vinegar has helped to attenuate acetaminophen-induced liver damage by restoring antioxidant activity and suppression of inflammation ¹³. The study of Zulaikhah *et al.*, proved that the administration of TCW 450 mL/day for 30 days increased SOD and GPx levels in traditional gold miners exposed to mercury ¹⁵. Agbafar *et al.*, the study stated that coconut water could increase the levels of SOD and GPx ²³. Some evidence points toward an antioxidant action of coconut water. Thus, administering coconut water (6 mL/100 g of body weight) to female rats intoxicated with carbon tetrachloride recovered the action of antioxidant enzymes SOD and CAT (catalase) levels and decreased lipid peroxidation. Coconut water is also rich in L-arginine, which significantly reduces the generation of free radicals and has antioxidant activity, as well as ascorbic acid, which decreases lipid peroxidation in rats ²⁹.

4. Lipid peroxidation Activity (Reduces MDA Levels): Signs of lipid peroxidation include MDA levels. The content of organic and inorganic ions in tender coconut water plays an important role in the antioxidant system of the human body can

normalize cell function, increase antioxidant activity, increase bone formation, increase hemoglobin, gene expression, amino acid metabolism, fat and carbohydrate ¹². TCW can also be used to protect the heart and prevent peroxidation ^{4, 7}. Zulaikhah *et al.* proved that the administration of 450 mL/day of TCW 30 days lowers MDA levels in traditional gold miners exposed to mercury ¹⁵. Loki & Rajamohan reported that TCW was able to decrease MDA levels in CCl₄-induced rats ¹³. Agbafar *et al.*, studies suggest that coconut water is capable of lowering MDA levels as lipid peroxidation markers ²³. Lima *et al.*, Show administering coconut water (6 mL/100 g of body weight) to female rats intoxicated with carbon tetrachloride recovered the action of decreased lipid peroxidation ²⁹.

5. Improve Lipid Profile: According Bhagya *et al.*, tender coconut water lower triglyceride and free fatty acids ⁴ is supported by Zulaikhah *et al.*, showing that TCW lower total cholesterol, triglyceride levels, LDL levels and increase HDL levels ¹⁴. The findings of Agbafar *et al.*, showed that coconut water can reduce total cholesterol, triglycerides, and LDL and can reduce HDL ²³. TCW could also reduce total cholesterol, LDL, and triglyceride levels in serum. Administering coconut water (4 mL/100 g body weight) in male rats counteracted the increases in these substances promoted by cholesterol feeding ²⁹.

6. Improve Blood Pressure: According to Bhagya *et al.*, TCW can lower systolic pressure ⁴. The finding of Farapti *et al.* proved that fresh tender coconut water 300 ml administered twice a day for 14 consecutive days to lower systolic blood pressure, but not the diastolic blood pressure ²⁴.

TCW is useful for preventing dehydration, reducing swelling in the hands and feet, protecting against cancer, helping the blood sugar balance of diabetics, providing ionic mineral resources, increasing digestion, helping to relieve constipation, reducing the risk of heart disease, improving blood circulation, lowering blood pressure high, helps prevent atherosclerosis, prevents abnormal blood clotting, has anti-aging properties, restores strength and elasticity to the skin, reduces wrinkles and sagging skin, as an antioxidant, enhances immune function ^{8, 11, 25}.

Research Gullapalli *et al.*, states that the consumption of coconut water is decreased in the blood pressure in primary hypertensive patients. The systolic and diastolic blood pressure (BP) of the experimental group decreased by 10.5 mm Hg and 6.8 mm Hg respectively ²⁶.

7. Cardioprotective Activity: Epidemiological studies suggest that high levels of HDL can prevent heart disease (cardiovascular diseases) such as ischemic stroke, myocardial infarction ²³. Anurag and Rajamohan showed that coconut water has a cardioprotective effect in experimental myocardial infarction induced in rats ¹⁸. An important biological action of coconut was demonstrated using an experimental model of myocardial infarction induced by isoproterenol in rats. Feeding these animals with TCW protected against the induction of myocardial infarction and decreased mitochondrial lipid peroxidation ²⁹.

8. Anti-inflammatory Effects: The anti-nociceptive and anti-inflammatory effects observed in this study, like other biological properties of coconut water, may be due to its unique composition of sugars, vitamins, minerals, amino acids, and cytokinin acids. This reduces threshold in both lactating and adult rats. This anti-inflammatory potential of coconut water may be linked descriptively with inhibiting prostaglandin production, thereby reducing inflammation and pain. The results of the study show that coconut water possesses analgesic and anti-inflammatory properties in duration-dependent manner. The analgesic property was demonstrated from thermal nociception in the test models of the hot plate and tail immersion, and chemical nociception in formalin-induced paw licking and acetic acid-induced writhing tests. Anti-inflammatory effect was evaluated using the same test model of carrageenan-induced paw edema. Coconut water can prevent inflammation ²⁷.

9. Diarrhea Therapy: Coconut water is rich enzyme systems include very effective and selective reductase, polyphenol oxidase (PPO) and peroxidase (POD). These are involved in its development of a brownish color when it is exposed to air for a long time. Based on its content and properties, coconut water has been used in the treatment of child and adult diarrhea, and

gastroenteritis as well as for urinary stone dissolution, short-term intravenous hydration and protecting against gastrointestinal tract infections ²⁸.

9. Antidiabetic Activities: The effects of mature coconut water were also evaluated and compared with glibenclamide in alloxan-induced diabetic rats. Treatment of diabetic rats with lyophilized mature coconut water (1000 mg/kg body weight) or glibenclamide (0.6 mg/kg body weight) reduced blood glucose levels (129.23 ± 1.95 and 120 ± 2.3 mg/dL, respectively) when compared with the untreated control (275.32 ± 4.25 mg/dL). Coconut water also increased insulin levels and liver glycogen concentrations and reduced glycated hemoglobin levels in diabetic rats. Also, elevated levels of liver function enzymes markers like alkaline phosphatase, serum glutamate oxaloacetate transaminase, and serum glutamate pyruvate transaminase in diabetic rats was significantly reduced upon treatment with mature coconut water. It was also observed that diabetic rats showed altered levels of blood urea, serum creatinine, and albumin, and the albumin/globulin ratio was significantly reversed by treatment with mature coconut water and glibenclamide ²⁹.

9. Increase Hemoglobin Levels: Tender coconut water is effective to reduce the parasitemia index and increase hemoglobin levels in mice inoculated Swiss PBA, but the effect in human malaria is not confirmed and need further investigation ³⁰.

Another Benefit: The Coconut Development Board (CDB) states that TCW can be utilized to:

- a. Feeding baby with intestinal disorders,
- b. Oral rehydration,
- c. Preventing body chillness
- d. Preventing prickly heat, eliminating rash caused by chicken pox, measles, *etc.*
- e. Killing the worms,
- f. Good drinks in case of cholera,
- g. Diuretics,
- h. Treating kidney and urethral stones,
- i. Preventing urinary tract infections,
- j. Intravenous injection in case of emergency,
- k. Detoxification toxins in cases of poisoning,
- l. A tonic for the elderly and the sick, and
- m. Urinary tract antiseptics ¹².

TCW contains an electrolyte fluid that maintains the body's osmotic pressure can be used as an intravenous fluid in an emergency. In case of emergency in remote regions of the world and during World War II, coconut water was used as a short-term intravenous hydration and resuscitation fluid,²⁷ TCW was used as a substitute for fluids and nutrients at the time of the babies suffering from diarrhea in Vietnam¹¹.

CONCLUSION: Experimental studies involving human and animals showed that TCW could be used to prevent oxidative stress, Antioxidant activity, Lipid peroxidation Activity, Improve Lipid Profile, Blood Pressure, Cardioprotective activity, Anti-inflammatory effects, Diarrhea Therapy, Increase hemoglobin levels, Antidiabetic activities and Antithrombotic Activities, etc.

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