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**RESEARCH ARTICLE**

# TENDER COCONUT WATER – NATURES ELIXIR TO MANKIND

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**ABSTRACT**

Tender coconut water is a refreshing drink with electrolytes (ionic mineral) similar to human plasma. This refreshing drink is filled with many healthy natural nutrients which can enhance the body's metabolism and immunity and is used more as a health supplement. The important significant and useful components in coconut water are cytokinins. The potential anti-cancer properties of specific cytokinins could bring encouraging and novel perspectives in finding cures for the different types of cancers. The recent discovery of other medicinal values of coconut water signifies a good potential in improving human health. Coconut water has recently caught on among athletes, health freaks and urbanites in many developed countries. An increasing international demand for this product could be a highly positive issue for thousands of Asian small farmers. The mineral composition and reasonable total sugar content make coconut water a natural isotonic sports drink.



## INTRODUCTION

Coconut plant has long been recognized as a valuable source of various commodities for human life, the water of tender coconut technically the liquid endosperm, is the most nutritious wholesome beverage that the nature has provided for the people of the tropics to fight the sultry heat (Khan, 2003).

The nut is the most marketable part, the inner part of the nut (endosperm) has two edible parts: a white kernel and a clear liquid: coconut water (Alexiaprades *et al*., 2012). The cavity within the kernel contains coconut water (Figure – I) this part begins to form as a gel when the coconut is 5 to 6 months old, becomes harder and whiter as coconut matures, and the inside is filled with coconut water (Oliveria *et al*., 2003). An immature coconut between six to nine months contains about 750 ml of water that eventually becomes the flesh (FAO, 2005). The coconut fruit takes 11 to 12 months to reach maturity. During the fifth month the kernel begins to form a thin layer of jelly around the inside of the endosperm or shell. The shell encloses the tender water, a clear sweet liquid. At this time the water is under pressure. During the ripening process, the pressure is released and the water is partially replaced by the kernel. Little by little, the kernel grows and replaces the water by cells storing lipids. Its composition changes as the nut grows (Jayalekshmy, 1986). At full maturity (12 months) coconut water represents between 15% and 30% of the weight of the nut. The amount of coconut water that can be harvested from each nut is about 300ml but depends to a great extent on the stage of maturity and on the variety of coconut.

Coconut water has been extensively studied since its introduction in the 1940s. In its natural form, it is a refreshing and nutritious beverage which is widely consumed due to its beneficial properties (Sandhya and Rajamohan, 2008; Asian and Pacific coconut community (APCC) 1994; Seow and Gwee 1997; Campbell-flack *et al*., 2000).

### Multitude Uses of Tender Coconut Water (TCW)

#### *Religious Symbol*

As it is a sterile and pure liquid, coconut water has been recognized as a religious symbol for a long time. In Asia and especially in India, TCW is offered as ceremonial gifts and serves as purification media at traditional events (Rethinam and Kumar, 2001). In India one of the most common offerings in a temple is a coconut. Coconut plays a vital role in all puja rituals. It is pure, clean and health giving and endowed with several properties. It is also offered on occasions like weddings, festivals, the use of a new vehicle, bridge, house etc. It is offered in the sacrificial fire whilst performing *homa*. The coconut is broken and placed before the Lord. It is later distributed as *prasaada*. The marks on the coconut are even thought to represent the three eyed Lord Shiva and therefore it is considered to be a means to fulfill our desires.

#### *Natural Beverage*

Coconut water or coconut juice is a sweet refreshing drink taken directly from the inner part of coconut fruits (Steiner and Desser, 2008). TCW is consumed by thousands of inhabitants of tropical regions. It is healthy, nutritious and most agreeable drink (Marikkar and Madurapperuma, 2012). The demand for tender coconut water is spiralling rapidly as people are realising the health benefits it offers. This refreshing drink is filled with many healthy natural nutrients which can enhance the body's metabolism and immunity and is used more as a health supplement (Poduval, 2012).

### Growth Medium for microorganisms and plants

Coconut water is widely used in the plant tissue culture industry, growing fungus and other microbes (Renato *et al*., 2009; Verdeil *et al*., 2002; Ang and Yong, 2005 and Arditti,

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2008). The extensive use of coconut water as a growth-promoting component in tissue culture medium formulation can be traced back to more than half a century ago, when Overbeek *et al*. first introduced coconut water as a new component of the nutrient medium for callus cultures in 1947. In few such studies, coconut water was used as a complete medium for microbial growth Oloke and Glick, 2006). Unagul *et al*. (2007) demonstrated the supplementation of coconut water to yeast extract-diluted seawater medium for the production of docosahexaenoic acid (DHA), which was 50% higher than that of non-supplemented media.

**Biocatalyst**

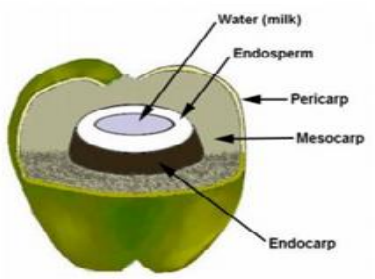
Coconut water appears to be able to support the synthesis of proteins from recombinant DNA vectors (Bustamante, 2004). Filtered coconut water from young Brazilian coconut displayed high reductase activity at ambient temperatue in a series of aliphatic and aromatic aldehydes and ketones, suggesting that coconut water is probably still under used in the organic synthesis research field (Da Fonseca *et al*., 2009).

**Nutritional Importance of Tender Coconut Water**

The nutritional composition of TCW is affected by several factors which include maturity state, soil, and environmental conditions (Goh and Koren; 2008). A study conducted in Brazil demonstrated that physical properties of coconut water were affected by varying nitrogen and potassium application (Jean *et al*. 2009).

**Figure –I**

**Cross Section of Coconut (Cocos Nucifera) Fruit**




Coconut water in its envelope is sterile and composed of both organic and inorganic compounds which play a vital role in aiding the human body antioxidant system (Evans and Halliwell, 2001). Inorganic ions are required for normal cellular function and are critical for enzyme activation, bone formation, hemoglobin function, gene expression, and the metabolism of amino acids, lipids and carbohydrates (Institute of Medicine, 2000).

Campbell-flack *et al*. (2000) state that, coconut water contains a variety of inorganic ions and these ions contribute to the therapeutic value inherent in coconut water. This basic ion composition of coconut can replenish the electrolyte of the human body excreted through sweat such as sodium, potassium, magnesium, and calcium. It can serve as rehydration drink. The concentration of these electrolytes in coconut water generate an osmotic pressure similar to that observed in the body without disturbing homeostasis. TCW comprises of 95.5% water, 4% sugars, 0.1% fat, 0.02% calcium, 0.01% phosphorous, 0.5% iron, considerable amounts of amino acids, mineral salts, vitamin B complex, vitamin C and cytokines etc. (Vigliar *et al*., 2006). Other components in TCW include sugars, sugar alcohols, lipids, amino acids, nitrogenous compounds, organic acids and enzymes (Santoso *et al*., 1996; USDA, 2009). The nutrient composition of TCW is presented in Table I.

**Table – I** Nutrient Composition of Tender CoconutWater

| Components | Amount per 100ml |
|---|---|
| Water | 95.5% |
| Protein | 0.1% |
| Fat | < 0.1% |
| Mineral Matter | 0.4 % |
| Carbohydrate | 4.0% |
| Calcium | 0.02% |
| Phosphorus | < 0.01% |
| Iron | 0.5mg |

Source : Ranasinghe et al. (2003)

The characteristic flavor of tender coconut is contributed by delta lactones. Sugars in the form of glucose and fructose form an important constituent of TCW. When the tender nut is 7-8 months old, the nut water gives the appropriate balance between reducing sugars and sucrose The concentration of sugar steadily increases from 1.5% to about 5.5%, in the early months of maturation and then slowly falls reaching about 2 percent at the stage of full maturity (12 months). In the early stage, sugars are in the form of glucose and fructose (reducing sugars) and sucrose (non reducing sugar) appears only in later stages which increases with the maturity while the reducing sugars fall. On a percentage basis coconut water is 94.5 % water. The rest would contain: protein 0.15 to 0.55 %, fat 0.1%, ash 0.46%, carbohydrates 4.4%. TCW contains small amounts of protein. The percentage of arginine, alanine, cystine and serine in the protein of tender coconut water is higher than those in cow's milk (Markose and Poduval 2009). Table II indicates the physicochemical characteristics and chemical composition of coconut water at different stages of maturity.

**Table - II**Physicochemical and Chemical Composition of Coconut Water at Different Stages of Maturity

| Quality parameters | Maturity Stage | |
|---|---|---|
| | 7-8 months | 8-9 months |
| Soluble solids (Brix) | 5.08 | 6.10 |
| pH | 4.83 | 5.29 |
| Glucose (g/100ml) | 2.4 | 2.9 |
| Fructose | 2.1 | 2.5 |
| Sucrose | - | 0.4 |
| Total sugar | 5.0 | 6.3 |
| Potassium Calcium | 198.7 | 215.8 |
| Calcium | 14.5 | 11.5 |
| Magnesium | 4.6 | 5.1 |
| Chloride | 144.6 | 157.4 |

(Pumer *et al*. (2001); Anurag and Rajamohan ( 2003) have also said that tender coconut water contains most of the minerals such as potassium, sodium, calcium, phosphorous, iron, copper, magnesium etc. Out of all the major minerals present, potassium plays an important role in the characteristic taste of tender nut water. Coconut water has cardioprotective effect in experimental myocardial infarction induced in rats and this was probably attributed to the rich mineral in coconut water especially potassium. The potassium and magnesium ions are higher than that of the extracellular fluids (ECF) making it a good source of electrolytes for the body. Also the calcium content is slightly higher than the ECF. Coconut water is a major source of calcium to the body, in addition intake of coconut water by infants can help prevent nutritional

rickets. It is important to note that in exclusive breast feeding after the fourth month, calcium is gradually reduced from the colostrums, thus regular intake of coconut water by nursing mothers helps to meet up the calcium requirement of the baby.

TCW contains both ascorbic acid and vitamins of B group. The concentration of ascorbic acid ranges from 2.2 to 3.7 mg per 100ml, which gradually diminishes as the kernel surrounding the water begins to harden. Coconut water also contains folate also known vitamin B9. It was identified in the late 1930s as the nutrient required in reducing anemia in pregnancy which also help to prevent mitochondrial toxicity induced by methanol metabolites (Jackson *et al*. 2004). The amount of B Vitamins present in TCW is presented in the following table – III

**Table – III Vitamin Content of TCW**

| Vitamins | Value |
|---|---|
| Nicotinic acid | 0.64 µg/ml |
| Pantothenic acid | 0.52 µg/ml |
| Biotin | 0.02 µg/ml |
| Riboflavin | <0.01 µg/ml |
| Folic acid | 0.003 µg/ml |
| Thiamin | traces |
| Pyridoxine | traces |

**Therapeutic Uses of TCW**

Coconut water has been called the "fluid of life" due to its medicinal benefits such as oral rehydration, treatment of childhood diarrhea, gastroenteritis and cholera (Kuberski 1980, Carpenter *et al*., 1964). Fife (2008), has also stated that coconut water is useful in preventing and relieving many health problems including dehydration, constipation, digestive disturbances, malnutrition, fatigue, heatstroke, boils, diarrhea, kidney stones, osteoporosis, urinary tract infections, and sterility. Whenever someone is sick, coconut water is usually part of the treatment to nourish the patient back to health. Interestingly, modern medical science is now confirming the effectiveness of coconut water for many of these conditions. Coconut water improves blood circulation, helps dilate blood vessels, improves blood flow, and reduces plaque formation. Coconut water also contains certain forms of dietary fiber and amino acids that help moderate sugar absorption and improve insulin sensitivity.

The important significant and useful components in coconut water are cytokinins, which are class of cytochromes (Miller *et al*., 1955). The first cytokinins $N^6$-furfuryladenine (kinetin) was isolated from an autoclaved sample of herring sperm DNA in 1955 (Letham, 1963). These cytokinins showed anti-ageing, anti-carcinogenic and anti-thrombotic effects. (Rattan and Clark, 1994; Sheu *et al*., 2004). Beside anti-ageing and anti-cancer effects, kinetin has effective anti-platelet properties and may be a potential therapeutic agent for treating arterial thrombosis. Kinetin inhibits platelet aggregation in human platelets when stimulated by an agonist (Barciszewski *et al*. 2007) and could therefore help to prevent blood clots (Heo *et al*., 2002).

Dolezal, (2006) has also stated that coconut water is the richest natural dietary source of cytokinins. Researchers have suggested the possibility that consuming a rich source of cytokinins, such as coconut water, may produce an anti-aging effect on the body, reducing risk of developing degenerative and age related diseases. In regulating cell growth, aids in the growth of normal cells while cancerous cells are programmed to die, preventing them from growing and spreading.

It has long been belief that coconut water can cure disease and ensure good health. Coconut water has been extensively studied since its introduction to the scientific community in the 1940s. In its natural form, it is a refreshing and nutritious beverage which is widely consumed due to its beneficial properties to health, some of which are based on cultural/traditional beliefs (Janick and Paull, 2008; Sandhya and Rajamohan, 2008)

In the Indian Ayurvedic medicine, tender coconut was described as "unctuous, sweet, increasing semen, promoting digestion and clearing the urinary path (Rethinam and Kumar, 2001). Coconut water is traditionally prescribed for dysuria, gastritis, burning pain of the eyes, indigestion, hiccups or even expelling of retained placenta. In case of emergency in remote regions and during World War II, coconut water was used as a short term intravenous hydration and resuscitation fluid (Campbell-Falck *et al*., 2000 and Pummer *et al*., 2001). TCW is one of the first oral post operative food soon after a patient is removed from parenteral feeding.

Coconut water has long been known for its therapeutic effect on the urinary and reproductive systems. It is reported to clear-up bladder infections, remove kidney stones, and improve sexual vitality. Medical research has shown that the consumption of coconut water can be very effective in dissolving kidney stones. Macalalag (1987), Director of the Urology Department of the Chinese General Hospital in the Philippines, says that coconut water has demonstrated its effectiveness in patients suffering from kidney and urethral stones. He reports that consuming coconut water only two to three times a week results in a significant reduction in stone size and expulsion, eliminating the need for surgery.

Coconut water resembles blood plasma in its contents. Its successful intravenous use has been documented (Falck *et al*., 2000). During the Pacific War of 1941-45, coconut water was siphoned directly from the nut to wounded soldiers for emergency plasma transfusions (FAO 2005). It is believed that coconut water could be used as an important alternative for oral rehydration and even so for intravenous hydration of patients in remote region due to its electrolyte content (Pumer *et al*. 2001). Coconut water may also offer protection against myocardial infarction (Anurag and Rajamohan, 2003).

In Jamaica coconut water is known as a heart tonic and is used to strengthen the heart and improve circulation. Research bears this out. Animal studies show that coconut water consumption improves the ratio of good cholesterol to bad and reduces plaque formation in arteries, thus reducing risk of heart attack and stroke. High blood pressure is one of the primary risk factors associated with heart disease and stroke. The minerals potassium and magnesium are known to help reduce high blood pressure. Human studies show that coconut water, which is a good source of both of these minerals, is effective in reducing high blood pressure and increasing circulation (Alleyne *et al*., 2005). Studies also demonstrate that coconut water consumption reduces the risk of heart failure in heart disease patients (Shah *et al*., 2005). The evidence is so convincing that the FDA allows coconut water to carry the claim that it "may reduce the risk of high blood pressure and stroke (Rattan, 1994).

The presence of L- Arginine (300mg/L) in coconut water could have a cardioprotective effect through its production of nitric oxide, which favours vasorelaxation (Anurag *et al*., 2007). A similar hypolipidemic effect of coconut water and lovastain was detected in rats fed with cholesterol enriched diet (Sandhya *et al*., 2008). Concerning nutraceuticaleffects coconut water reduced histopathologicl changes in the brain induced by hormonal imbalance in menopausal women (Radenahmad *et al*., 2009).

TCW is high in electrolyte content and has been reported as an isotonic beverage due to its balanced electrolytes like sodium and potassium that help restore losses of electrolytes through skin and urinary pathways. Coconut water was claimed as a natural contender in the sports drink market with its delicate aroma, taste and nutritional characteristics together with the functional characteristics required in a sports drink (FAO, 2005).

The medicinal property of TCW listed by Coconut Development Board is as follows:

- Good for feeding infants suffering from intestinal disturbances.
- Oral rehydration medium
- Contains organic compounds possessing growth promoting properties
- Keeps the body cool
- Application on the body prevents prickly heat and summer boils and subsides the rashes caused by small pox, chicken pox, measles, etc.
- Kills intestinal worms
- Presence of saline and albumen makes it a good drink in cholera cases
- Checks urinary infections.
- Excellent tonic for the old and sick
- Cures malnourishment.
- Diuretic
- Effective in the treatment of kidney and urethral stones
- Can be injected intravenously in emergency case.
- Found as blood plasma substitute because it is sterile, does not produce heat, does not destroy red blood cells and is readily accepted by the body.
- Aids the quick absorption of the drugs and makes their peak concentration in the blood easier by its electrolytic effect.
- Urinary antiseptic and eliminates poisons in case of mineral poisoning.

**Packed Tender Coconut Water**

The Coconut Development Board (CDB) in collaboration with the Defence Food Research Laboratory (DFRL), Mysore has developed a technology for preservation and packing of tender coconut water in pouches and aluminum cans. The DFRL, Mysore has succeeded in retention of its flavour when packed in pouches/aluminum cans for a period of three months under ambient conditions and six months under refrigerated conditions. The product has acclaimed consumer acceptance throughout the country. TCW in tetra pack technology has also been established recently in Tamil Nadu. The products are available in both domestic and international markets. Major exporters of the product are Philippines, Indonesia, Malaysia and Thailand (Muralidharan and Jayashree, 2003). Reports have indicated that coconut water has now become the fastest growing new beverage category in the US and is expected to be replicated in many other countries. Coconut water has recently caught on among athletes, health freaks and urbanites in many developed countries. An increasing international demand for this product could be a highly positive issue for thousands of Asian small farmers (Jordana, 2000). The mineral composition and reasonable total sugar content make coconut water a natural isotonic liquid. The characteristics of coconut water make it an ideal rehydrating and refreshing drink after physical exercise (Seat *et al*., 2002).

## CONCLUSION

Coconut water, being a refreshing beverage, provides important health benefits. The chemical components which contribute to its bioactivity are essential to the plant industry, biotechnology and biomedical fields. Undoubtedly, cytokinins are currently the most important components in coconut water. The potential anti-cancer properties of specific cytokinins could bring encouraging and novel perspectives in finding cures for the different types of cancers. The recent discovery of other medicinal values of coconut water signifies a good potential in improving human health. Better insights and understanding of the functions and properties of the individual components of coconut water will, therefore, help us to better utilize this marvellous and multidimensional liquid with special biological properties from nature. India having ranked third in area and production among 86 coconut growing countries, processing of coconuts into value added products promotes commercial value to the farmers. Coconut water remains a traditional and under used resource which could thus be considered as an exotic beverage by most people living far from the coconut production area. Consuming TCW in nut shell has rolled over and it is now available in attractive containers and plastic bottles which are convenient to carry, this will appeal the consumers and definitely mark a place by beating the soft drinks. Adopting new technologies for packing TCW provides local and international demand thereby benefiting both producers and consumers.

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