

## Therapeutic use of coconut water

### O uso terapêutico da água de coco

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#### ABSTRACT

This paper is a review about therapeutic use of coconut water. We began with its chemical composition, pointing that it is rich in antioxidants, potassium, calcium, carbohydrates, and poor in sodium. The antioxidant activity from coconut water is of interest as a potential natural food antioxidant additive, a nutraceutical. When coconut water is used in hypertensive people, this brought about a large decrease in blood pressure, including increased frequency in urination suggest a possible diuretic action. Additionally, in all cases of persons consuming coconut water on a regular basis an increase in the plasma level of potassium is observed. This would be a contributing factor in the decreases in blood pressure, suggesting a potassium sparing natriuretic. Some time trial tests as the measure of exercise performance have determined the efficacy of coconut water and other beverages on enhancing hydration and performance following dehydrating exercise. In conclusion, coconut water can be used in cases of hypertension, rehydration in sports, together with early refeeding, as a home glucose electrolyte oral rehydration solution in the early stages of mild diarrhoeal disease, despite not having a balanced electrolyte composition. However, it should not be used in patients with severe diarrhoea, or in patients who are severely dehydrated and/or in whom renal function is impaired. Further studies should be conducted to better understand the effects of coconut water as a therapeutic agent.

**Key words:** Coconut water. Electrolytes. Antioxidants. Hypertension. Dehydration.

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#### CHEMICAL COMPOSITION OF COCONUT WATER

Brazil is the fourth largest producer of coconut, representing 5% of world production, while for water consumption is the largest producer of coconut in the world<sup>1</sup>. Northeastern has 85.6% of the Brazilian culture with acreage in 2002 of approximately 280,835 ha (Statistical Yearbook of Brazil, 2004). In northeastern

Brazil, the coconut finds favorable environment to their full productive potential and vegetative growth, favoring its expansion in this region. Approximately 90,000 ha correspond to dwarf variety, of which less than 50% were in actual production in 2005. Domestic production, which in 1999 was 280 million coconuts, may have reached, in 2005, one billion fruits. With this expansion, an increase in the consumption of coconut water, a little over 1% to 5% over the consumption of soda. The expansion of industrialization also reflects the large increase in production dwarf coconut variety suitable for the production of water and, in this perspective, the coconut tree has been established as one of the most important permanent fruit tree.

Coconut water is a natural drink, low in calories, with pleasant taste, known worldwide and highly appreciated throughout Brazil, mainly in the coastal regions<sup>2,3</sup>, been used for centuries, to quench the thirst, instead of water, and also to reestablish electrolytes in cases of dehydration<sup>4</sup>. The electrolytes are inorganic salts of sodium, potassium or magnesium or complex organic molecules, very important to the electrolyte balance of humans<sup>5</sup>. Being good source of potassium, chloride and calcium, coconut water can be a good indication for treatment in specific situations where the content of these electrolytes need to be increased<sup>6</sup>.

In fruits harvested coconut undergoing organic manure, the electrolyte composition of coconut water was determined on specimens collected in Northeastern Brazil, with seven months since the inflorescence until harvest<sup>7</sup>. Data are summarized in table 1.

Table 1 – Electrolyte composition of coconut water

ANALYSIS	ELECTROLYTE VALUES (Organic manure)
Na (mg/100 mL)	9.17
K (mg/100 mL)	173.50
Fe (mg/100 mL)	0.15
Mn (mg/100 mL)	0.4
Ca (mg/100 g)	47.98
Mg (mg/100 mL)	15.01
P (mg/100 g)	3.92

There has been considerable interest in finding sources of natural antioxidants, especially from fruits and vegetables which have provided a measure of protection against the process of oxidative damage in the human cells<sup>8</sup>. Antioxidant compounds from plants, particularly flavonoids and other polyphenols, have been reported to inhibit the propagation of free radical reactions, and to protect the human body from disease<sup>9</sup>. Moreover, antioxidant activities have been associated with acids<sup>10</sup>, aromatic compounds<sup>11</sup>, and esters. Coconut water also has antioxidant properties<sup>12</sup>. These properties has been verified mainly in the coconut water *in natura*, and it decreases drastically with the use of thermal treatments, or the actions of acids or alkaline on coconut water, and with the degree of maturation of the fruits<sup>13</sup>. Fonseca et al<sup>14</sup> studied the composition of antioxidants in coconut water in

green coconut from Northeast Brazil. Many compounds were identified and were characterized as esters (58.3%), ketones (33.5%), and diols (8.0%), representing 99.8% of the total extract. The major constituents were *n*-propyl ethanoate (53.5%) and 4-methylpentan-2-one (29.0%). The butane-1,3-diol was identified, and is an important chiral synthon for various optically active compounds, such as azetidinone derivatives leading to penem and carbapenem antibiotics<sup>15</sup>. The ester *n*-propyl ethanoate appeared in 53,5% and the ketone 4-methylpentan-2-one was also present in 29%. In addition, the aldehyde furfural was shown to be present in the percentage of 14.5%<sup>14</sup>.

Alcohols, ketones, lactones, aldehydes, and esters having short carbon chains were detected in the essential oil of the coconut water, and are probably responsible, in part, for the aroma of coconut water. In addition, the ester *n*-propyl ethanoate is one of the compounds responsible for its flavor.

The antioxidant activity of these fractions from coconut water is of interest as a potential natural food antioxidant additive, nutraceutical, and requires further evaluation.

The levels of selenium found in the samples of coconut water and coconut milk indicate that these foods may be useful as sources of selenium readily available to the population.

Selenium is an essential element which can be toxic to humans and animals depending on the concentration in which it is administered. Its deficiency is responsible for cardiomyopathies, muscular dystrophy and reproductive disorders in several animal species. The amount found in human blood is 100 ng/ml, but this may vary depending on the age, medical factors, and region in which the individual lives. The concentration of selenium is dependent on soil conditions, method of preparation of food. Fruits and vegetables are poor sources of selenium and also a significant fraction of the element is lost during the cooking. The coconut can be a good source of minerals in the diet, being a product cheap and abundant in tropical regions, as is the case in northeastern Brazil. Coconut water is used as a tasty and nutritious drink and coconut milk is a key ingredient in the preparation of desserts, drinks and sauces. However, from a nutritional standpoint, coconut used in food has received intense study. The analysis of chemical components is limited and restricted to certain constituents, so that the composition of coconut water and pulp, depends on factors such as the variety of palm tree, maturation degree and nature of the soil in which the fruit grew. The levels of selenium found in the samples of coconut water and coconut milk (21.0 mg/L and 25 mg/L respectively) indicate that these foods may be useful as sources of selenium readily available to the population<sup>16</sup>.

## **ARTERIAL HYPERTENSION**

World Health Organization estimates<sup>17</sup> that over 30% of the adult population in the many countries are affected by arterial hypertension. Research has also shown

that compared to Caucasians, persons of African descent in the USA and Caribbean are twice as likely to develop hypertension, to do so at an earlier age and have a more severe degree of the disorder<sup>18</sup>. The more dangerous side effects associated with chronic high blood pressure include increase risk of heart attacks, heart failure, stroke and kidney damage. While there have been significant improvements in the global treatment of hypertension, a number of these treatments are found to be less effective in patients of African ancestry.

Presently, the coconut tree flourishes in all tropical territories. In many tropical countries the coconut water is consumed as a refreshing drink. Although there are no claims that coconut water is useful for the treatment of any specific diseases, it is a widely held view among Caribbean people that the water of the young coconut is beneficial to the kidneys. Scientific analysis has shown that coconut water is comparatively poor in sodium ions but the concentration of potassium ions is more than twice that of sodium<sup>19</sup>. Overall, five of the seven subjects (71%) receiving coconut water showed significant decreases in the systolic pressure. Also for this group, the diastolic pressure decreased significantly for 29% of the subjects. In contrast, systolic pressure increased by as much as 7 mm Hg, while the diastolic increased slightly or remained unchanged for those receiving the commercial bottled water. These results suggest that coconut water if taken on a regular basis, exert haemodynamic properties. It appears, however, that this drink exert a greater effect on the systolic than on the diastolic blood pressure<sup>20</sup>. A number of other interesting observations that are possibly linked emerged from this study. Firstly, it does appear that there is a relationship between the magnitude of the decrease in blood pressure and the volume of drink consumed. During preliminary investigations in which three bottles of coconut water (900.00 ml) were consumed per day, a number of persons reported that they urinated with increased frequency; as both factors had influenced compliancy, a smaller volume, two bottles per day may be effective. When the allocation is increased from two to three bottles per day, this brought about a large decrease in blood pressure. The latter observation coupled to the increased frequency in urination suggest a possible diuretic action.

Other results<sup>20</sup> should propel further investigations and open the way for studies that are simpler to interpret. In spite of the need for much more experimentation, one other factor appears to give further support to the diuretic theory. In all cases examined to date all persons consuming coconut water on a regular basis showed an increase in the plasma level of potassium. A number of animal and human studies<sup>21-23</sup> have pointed to an inverse relationship between potassium levels and blood pressure. It would be reasonable therefore to assume that the observed increase in plasma potassium would be a contributing factor in the decreases in blood pressure. The increase in plasma potassium, coupled to the reports of increased urination, appear to suggest the action of a potassium sparing natriuretic.

Pehowich *et al*<sup>24</sup> showed that coconut oil contained mostly medium rather than long chain fatty acids and therefore with moderate use might reduce susceptibility rather

than being a risk factor for coronary heart disease. That study confirmed earlier findings which indicated that coconut water, unlike the other edible components of coconut, have an extremely low lipid content<sup>19</sup>. This latter finding would suggest that coconut water consumption is very unlikely to be a risk factor for coronary heart disease. On the basis of these findings it would seem that coconut water probably may be excellent as a complement for the treatment of hypertension.

## **HYDRATION IN SPORTS**

Dehydration can develop when the body fluid losses exceed fluid intake, and it often occurs during exercise, heat stress, restricted fluid intake, or any combination of these. Marginal dehydration (loss of > 2% body weight) can compromise aerobic exercise performance, particularly in hot weather conditions, and may disturb fluid and electrolyte balance<sup>25,26</sup>. Thus, maintaining a hydrated state prior to physical activity is important not only for optimizing performance but also for ensuring health and safety. Further, when an individual becomes dehydrated during exercise, an adequate fluid supply is necessary to maintain fluid balance and physiological homeostasis. Rehydration should be readily performed after any bout of intense exercise. In some cases, however, an individual may start exercise already in a dehydrated state, such as when an opportunity for full rehydration is not available<sup>27</sup>. Thus, many studies have focused on optimal methods of maintaining a hydrated state before, during, and after a bout of exercise<sup>28</sup>. Rehydration is a function of the volume of fluid consumption relative to the volume of fluid losses following dehydration. The goal of rehydration is full replacement of any fluid and electrolyte deficits resulting from a previous event<sup>29</sup>. Successful rehydration can be achieved by applying appropriate rehydration methods using an adequate supply of fluids. Such a method depends on the speed with which rehydration must be accomplished as well as the magnitudes of the fluid and electrolyte deficits.

Favorable palatability is also recommended to promote voluntary intake of fluids. Fluid palatability is influenced by several factors, including flavoring, electrolyte contents, and fluid temperature<sup>30,31</sup>. The preferred beverage temperature is often between 15 and 21°C. However, the overall rating of palatability seems to depend on individual preference and culture. Athletes have been shown to prefer and drink greater volumes of cool water compared to water at or above ambient temperature<sup>32</sup>.

Knowledge is very limited regarding studies with use of natural drinks such as coconut water which contains sodium, chloride, potassium and glucose as a rehydration fluid. Coconut water however, has been used as an oral rehydration in patients with diarrhea to replace fluid loss from the gastrointestinal tract<sup>33</sup>. and in an extreme situation in short-term intravenous hydration in a patient<sup>34</sup>. Saat et al<sup>35</sup> studied the effectiveness of fresh young coconut water, and carbohydrate-electrolyte beverage compared with plain water for whole body rehydration and blood volume

restoration during a 2 h rehydration period following exercise-induced dehydration. They found that although blood volume restoration was better with coconut water, it was not statistically different from carbohydrate-electrolyte beverage and plain water. Cumulative urine output was similar in all trials. There was no difference at any time in serum Na<sup>+</sup> and Cl<sup>-</sup>, serum osmolality, and net fluid balance among the three trials. Urine osmolality decreased after 1 h during the rehydration period and it was lowest in the plain water trial. Plasma glucose concentrations were significantly higher compared with plain water ingestion when coconut water and carbohydrate-electrolyte beverage were ingested during the rehydration period. Coconut water was significantly sweeter, caused less nausea, fullness and no stomach upset and was also easier to consume in a larger amount compared with carbohydrate-electrolyte beverage and plain water ingestion. They concluded that ingestion of fresh young coconut water, a natural refreshing beverage, could be used for whole body rehydration after exercise. As coconut water has limited amount of Na, sodium-enriched coconut water has been used with good results. Ismail et al (2007) concluded that ingesting sodium-enriched coconut water was as good as ingesting a commercial sports drink for whole body rehydration after exercise-induced dehydration but with better fluid tolerance<sup>36</sup>. Kalman et al (2012) compared coconut water and a carbohydrate-electrolyte sport drink on measures of hydration and physical performance in exercise-trained men. They concluded that all tested beverages are capable of promoting rehydration and supporting subsequent exercise. Little difference is noted between the four tested conditions with regard to markers of hydration or exercise performance in a sample of young, healthy men. Additional study inclusive of a more demanding dehydration protocol, as well as a time trial test as the measure of exercise performance, may more specifically determine the efficacy of coconut water and other beverages on enhancing hydration and performance following dehydrating exercise<sup>37</sup>.

## **DEHYDRATION**

Fagundes Neto et al (1993) reported the chemical composition of coconut water during its maturation. Composition was measured at 5, 6, 7, 8, 9, 10, 11 and 12 months maturation. Concentrations of sodium and glucose, and the osmolality values showed great variation throughout maturation. The concentration of sodium remained constant between the 5th and 7th months (mean 2.9 mEq/l), but increased after the 8th month (mean 12.5 mEq/l). The concentration of glucose remained constant between the 5th and 8th months, but abruptly decreased after the 9th month. Osmolality followed the variation of the glucose concentration averaging 377.3 mOsm/l up to the 8th month, then decreasing to 310.3 mOsm/l after the 9th month. The study showed great variability in coconut water composition during maturation of the fruit. In no instance did the coconut water contains sodium and glucose concentrations of potential value as an oral rehydration solution<sup>38</sup>.

Nevertheless, the 1979 epidemic of cholera on the Pacific Ocean atoll of Tarawa, Gilbert Islands, renewed interest in the use of coconut water as a rehydration fluid. Fifty-one samples of coconut water from Tarawa were analysed for a variety of constituents to assess its potential usefulness in the oral and parenteral rehydration of patients with cholera and other severe forms of gastroenteritis. Compared to oral rehydration fluids known to be effective in cholera, coconut water was found to have adequate potassium and glucose content, however was relatively deficient in sodium, chloride and bicarbonate. The addition of salt to the coconut water is suggested to compensate for the sodium and chloride deficiency. In areas of the world where coconuts are plentiful, the advantages of sterility, availability and acceptability make coconut water theoretically feasible for the oral rehydration of patients with severe gastroenteritis when conventional fluids are unavailable<sup>39</sup>.

Coconut water has been evaluated as rehydration fluid in diarrhea. Oral rehydration has been recommended to replace the fluid loss from gastrointestinal tract. The final conclusions of some works have indicated that the ingestion of fresh coconut water from young fruit could be recommended for this purpose. Adams and Bratt (1992) evaluated coconut water as a home glucose electrolyte solution for well-nourished children with mild diarrhoea. They described the chemical composition of coconut water by type and age of coconut (*Cocos nucifera*). The results suggested that young coconut water can be used, together with early refeeding, as a home glucose electrolyte oral rehydration solution in the early stages of mild diarrhoeal disease, despite not having a balanced electrolyte composition. However, it should not be used in patients with severe diarrhoea, or in patients who are severely dehydrated and/or in whom renal function is impaired<sup>40</sup>.

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