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THERAPEUTIC POTENTIAL OF COCONUT (*COCUS NUCIFERA L.*) WATER IN DISEASE CONDITIONS

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ABSTRACT

Coconut water is a natural, healthy, nutritious drink from coconut palm trees widely grown in tropical countries. It is a natural source of several important nutrients like minerals, vitamins, antioxidants, amino acids, enzymes and growth hormones. Coconut water has beneficial effect in various disease conditions. It has therapeutic properties such as antioxidant, antidiabetic, cardioprotective, kidney stone prevention, anti-inflammatory. Coconut water can be beneficial in conditions like diarrhea. It can be used as rehydration therapy. Other benefits include feeding baby with intestinal disorders, oral rehydration, preventing body chillness, preventing prickly heat, eliminating rash caused by chicken pox, measles etc., killing the worms, good drinks in case of cholera, diuretics, treating kidney and urethral stones, preventing urinary tract infections, intravenous injection in case of emergency, detoxification of toxins in cases of poisoning, a tonic for the elderly and the sick, and urinary tract antiseptics. In spite of above therapeutic properties coconut water can also be used for the development of a symbiotic functional drink. Coconut water can be processed by adding probiotic and prebiotic characteristics with sensory acceptance and adequate preservation characteristics. Probiotic, prebiotic and symbiotic foods may be beneficial in the prevention and management of nutrition and health. In the present study attempts have been made to summarize the therapeutic properties of coconut water in disease conditions. Thus modification in our life styles, taking nutritious foods and adding coconut water in our daily diet may be beneficial in keeping good health and managing chronic diseases and other disease conditions. Although more controlled studies involving humans are needed to confirm many of these qualities, the research to date is encouraging. Further, extensive clinical studies on coconut water using human subjects in disease conditions can prove useful in prevention and management of diseases of diverse nature. Such studies may also be significant in understanding biochemical mechanism of action of coconut water and increasing our knowledge on this original tropical juice.

Keywords: Coconut water; Vitamins; Amino acids, Mineral salts; Therapeutic properties

INTRODUCTION

In the present era of growing environmental pollution due to rapid industrialization, changes in life style, environmental degradation and excessive use of pesticides ,herbicides and other toxic chemicals in production of food materials are threatening the life of human beings and posing health hazards resulting into causation of dreadful diseases and chronic disorders like cardiovascular diseases, liver diseases, kidney diseases, cancer, diabetes, neurodegenerative disorders, AIDS, rheumatoid arthritis , osteoarthritis,, respiratory diseases , obesity, etc. In addition to above diseases, we are always surrounded by a large number of pathogenic bacteria circulating in the environment and they produce infectious diseases as we get exposed. [1] We have seen the COVID 19 epidemics throughout the world and unimagined health scenario. Presently even in developed countries the situation due to COVID 19 has not improved and COVID infections / COVID like symptoms are still prevailing. In this situation, our immune system is being compromised and our important organs like heart, kidney, liver, lung and brain are

always at risk. Although allopathic systems of medicine have been useful in treatment of these dreaded diseases but long term use of these medicines has been found to produce adverse reactions in patients. Thus our modern systems of medicine may have no permanent cure for these diseases.

Probiotic, periodic and symbiotic foods have been found beneficial in the prevention and management of nutrition and health as suggested by many research studies. Modifications in life styles followed by taking probiotic, prebiotic and symbiotic foods may be better strategies to manage chronic ailments and other diseases. Research studies have demonstrated that foods containing natural antioxidants can be used as a strategy to reduce morbidity and mortality especially due to oxidative stress [2] and the prevalence of degenerative diseases. [3]

Coconut is the fruit of coconut palm (*Cocus nucifera*), also known as coconut, coconut palm, adiavan or Indian palm, and belongs to the Arecaceae family. It is a palm tree native to the eastern tropical regions, grown in Asia, America and Africa. [4] Coconut water is the liquid found in the center of a young, green coconut. It helps nourish the fruit. As the coconut matures, which takes around 10–12 months, some of the liquid remains while the rest ripens into the solid white flesh known as coconut meat. Coconut water typically comes from young coconuts about 6–7 months of age, though it's also found in mature fruit. An average green coconut provides about 1/2–1 cup of coconut water. Coconut water contains 94% water and very little fat. It should not be confused with coconut milk, which is made by adding water to grated coconut meat. Scientific studies have shown that coconut milk contains about 50% water and is quite high in fat .One cup (240 ml) contains 60 calories, as well as Carbs (15 grams), Sugar(8 grams), Calcium: 4% of the daily value (DV), Magnesium: 4% of the DV ,Phosphorus: 2% of the DV, Potassium: 15% of the DV. Since coconut water deteriorates rapidly when exposed to sunlight, this drink is widely consumed as a contemporary in tropical areas.

Coconut water is a natural, healthy, nutritious drink from coconut palm trees widely grown in tropical countries. [5] Coconut water with the presence of several nutrients has been found to exhibit therapeutic effect. [6,7] Coconut water is the liquid found in young coconuts and a natural source of several important nutrients like minerals, vitamins, antioxidants, amino acids, enzymes and growth hormones. [8] Studies have shown that coconut water contains important compounds such as L-arginine, vitamin C, magnesium, potassium, calcium, selenium, methionine, zinc, iodine, manganese, boron, molybdenum and phytohormones such as auxin, cytokines, gibberellins useful for human health . [6, 9,10] Thus coconut water has enormous health benefits. Coconut water can be consumed directly from green coconuts or bought in bottles. Attempts have been made to summarize the therapeutic properties of coconut water in disease conditions of diverse nature.

THERAPEUTIC PROPERTIES

Antioxidant activity

Free radicals are unstable molecules produced in the cells during metabolism. Their production increases in response to stress or injury. When there are too many free radicals, the body enters a state of oxidative stress, which can damage the cells and increase disease risk. Research on animals has shown that coconut water contains antioxidants that may help modify free radicals so they no longer cause harm. The study conducted in mice fed fructose diet indicated that coconut water has ability to reduce systolic pressure, lower triglyceride and free fatty acids and it can reduce MDA levels as a parameter of lipid peroxidation, and increased antioxidant enzyme activity. [6] Other studies have shown that coconut water can reduce the oxidative stress induced by isoproterenol (ISO) and exhibit antithrombotic effects. [9] Experimental studies conducted in mice as animal model showed that coconut water has a positive effect on mitochondrial activity and it can protect cells from free radical damage in isoproterenol-induced mice. [11] A study conducted on CCl_4-induced rats as animal model revealed that coconut water can lower the levels of MDA and increase antioxidant enzymes SOD, CAT, GPx . [12] Besides above few more studies on animal model have revealed that coconut water has significant antioxidant activity.[13,14, 15,16]

Antidiabetic activity

Research studies have shown that coconut water can lower blood sugar levels and improve other health markers in animals with diabetes .An experimental study conducted on rats as animal model revealed that 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) . In above study, it has also been observed that coconut water has ability to increase insulin levels and liver glycogen concentrations and reduce glycated hemoglobin levels in diabetic rats. In addition, elevated levels of liver function enzymes markers like alkaline phosphatase, serum glutamate oxaloacetate transaminase, and serum glutamate pyruvate transaminase in diabetic rats were 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. [16] Thus, it can be said that coconut water maintained better blood sugar levels than the control group. Coconut water had lower levels of hemoglobin A1c, indicating better long-term blood sugar control and coconut water reduced blood glucose. More studies are needed to confirm these effects in humans. However, another added blood sugar benefit of coconut water is that it's a good source of magnesium, which may increase insulin sensitivity and decrease blood sugar levels in people with type 2 diabetes and prediabetes.

Cardioprotective activity

Research studies have shown that high density lipoprotein (HDL) has ability to prevent cardiovascular disorders like ischemic stroke, myocardial infarction. [15] An experimental study carried out in rat as animal model, where myocardial infarction was induced in rats, showed that coconut water exhibits cardioprotective effects. [17] Another experimental study where myocardial infarction was induced by isoproterenol, revealed that coconut water exhibits protection against the induction of myocardial infarction and decreases mitochondrial lipid peroxidation . [16] Studies have shown that coconut water has ability to low triglyserides and free fatty acids levels. [6] Interestingly another studies revealed that coconut water can reduce total cholesterol, triglycerides and LDL and can reduce HDL. [15,16] Research studies have indicated that coconut water can lower systolic blood pressure. [6] Another study has shown that coconut water (300 ml) administered twice a day for 14 consecutive days can lower systolic blood pressure, but not the diastolic blood pressure. [18] Coconut water can decrease blood pressure in primary hypertensive patients. In an experimental study it has been observed that the systolic and diastolic blood pressure (BP) of experimental group decreased by 10.5 mm Hg and 6.8 mm Hg respectively suggesting that consumption of coconut water can decrease blood pressure in primary hypertensive patients. [19] One of the reasons coconut water may be connected to lowered blood pressure is its impressive potassium content (500mg of potassium in 8 ounces). Potassium has been shown to lower blood pressure in people with high or normal blood pressure. While there is some evidence that coconut water may be good for heart health, more research centering on humans needs to be done.

Kidney stone prevention activity

Drinking enough fluids is important for kidney stone prevention. Although plain water is a good choice, studies suggest that coconut water might be even better. Kidney stones are created when calcium, oxalate, and other compounds combine to form crystals in urine. These crystals can then form tiny stones. While some people are more susceptible than others, kidney stones affect about 12% of the world's population .In a study in rats with kidney stones, coconut water prevented crystals from sticking to the kidneys and other parts of the urinary tract. It also reduced the number of crystals formed in the urine. In other study researchers found that coconut water increased the urination of potassium, chloride, and citrate in individuals without kidney stones, meaning coconut water might help flush out the system and keep the likelihood of stones low. [20] Early research suggests that water from coconuts may help prevent kidney stones by reducing

crystal and stone formation. However, more studies have to be done specifically involving humans.

Anti-inflammatory activity

The study conducted on animal model has shown that coconut water possesses analgesic and anti-inflammatory properties in a duration-dependent manner. The analgesic property was demonstrated on the basis of thermal nociception in the test models of 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 is able to prevent inflammation. [21]

Diarrhea Therapy

Studies have shown that coconut water is useful in treatment of child and adult diarrhea, gastroenteritis, short-term intravenous hydration and gastrointestinal tract infections.[20] The presence of strong and selective reductase, polyphenol oxidase peroxidase in coconut water may be responsible for producing this property .

Rehydration therapy

The recent epidemic of cholera on the Pacific Ocean atoll of Tarawa, Gilbert Islands renewed interest in the use of coconut water as a rehydration fluid. A study was conducted where fifty-one samples of coconut water from Tarawa were analyzed 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. The study revealed that 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 table 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. [22] It has been found that medical resources routinely used for intravenous hydration and resuscitation of critically ill patients may be limited in remote regions of the world. In this critical situation, physicians have had to improvise with the available resources, or simply do without. A study has reported the successful use of coconut water as a short-term intravenous hydration fluid for a Solomon Island patient, a laboratory analysis of the local coconuts, and a review of previously documented intravenous coconut use.[23]

Hemostasis activity

Research studies have demonstrated that coconut water can be used as short-term intravenous hydration and resuscitation fluid. Studies have been conducted to investigate the effect of coconut water on plasma coagulation *in vitro*. In this clinical study, either coconut water or physiological saline was added to citrated plasma of eight healthy volunteers and coagulation capability of diluted plasma was evaluated by thrombelastography. The results of this study revealed that replacement of up to 50 % of citrated plasma by coconut water or physiological saline did not influence initiation of coagulation as indicated by split point and reaction time, respectively and strength offibrin clot as expressed by maximum amplitude (MA) of thrombelastography recording dose dependently declined in both groups . It was also found that replacing 50 % of citrated plasma by coconut water or physiological saline reduced MA by 39% and 32%, respectively. The study concluded that the influence of coconut water on hemostasis does not differ from the effect caused by an identical volume of physiological saline. [24]

DISCUSSION

The coconut palm has been considered the tree of life. It' s every part such as roots, husk, leaves, inflorescence and fruit can be utilized. [25] The fruit of the dwarf coconut palm, particularly the green dwarf coconut palm, are cultivated for their liquid content, whereas the fruit of the giant coconut palm and the hybrids are cultivated for their albumin, which can be used *au naturelle* or processed into grated dried solids or coconut milk. [26] Flavor varies depending on the stage of maturation of the fruit. Coconut water is the juice of the endosperm found within the cavity of the

coconut, which begin to form around 2 months after the natural opening of the inflorescence. According to research studies it has been found that coconut water accounts for 25% of the weight of the fruit, and its basic composition is 95.5% water, 4% carbohydrates, 0.1% fat, 0.02% calcium, 0.01% phosphorous, 0.5% iron, in addition to amino acids, vitamin C, B complex vitamins and mineral salts. [25]

In some countries coconut water is used as a solution for oral hydration, as part of the daily diet and as a protein supplement when nutritional deficits are intense. During the Second World War, coconut water was even used instead of saline solution during emergency surgeries. [25]Research studies have revealed that coconut water can be used for intravenous rehydration [27,28] and electrolyte replacement in a wide range of situations.[29, 30, 31] Few research studies have compared the chemical composition of coconut water with teas, [32] still soft drinks, [31] carbonated soft drinks,[31,32] isotonic drinks [33] and oral rehydration solution (ORS). [34] There are a small number of studies that have related the composition of coconut water to the stage of maturation of the coconut [30,35] or with the region where the coconut palms grow (coastal or inland). [30,36]

Coconut water is the liquid found in young coconuts and a natural source of several important nutrients like minerals, vitamins, antioxidants, amino acids, enzymes and growth hormones.[8] Studies have shown that coconut water contains important compounds such as L-arginine, vitamin C, magnesium, potassium, calcium, selenium, methionine, zinc, iodine, manganese, boron, molybdenum and phytohormon such as auxin, cytokines, gibberellins useful for human health .[6, 9, 10] Thus coconut water has enormous health benefits. Research studies have suggested that coconut water has beneficial effect in various disease conditions. It has therapeutic properties such as antioxidant, antidiabetic, cardioprotective, kidney stone prevention, anti-inflammatory. Coconut water can be beneficial in conditions like diarrhea. It can be used as rehydration therapy. Coconut water has been used successfully in various parts of the world for oral rehydration, treatment of childhood diarrhea, gastroenteritis and cholera [37, 38] and contains organic and inorganic compounds that play a vital role in helping the antioxidant system of the human body. [39] It has also been found that coconut water can prevent oxidative stress in traditional gold miners exposed with mercury. [40] Other health benefits include feeding baby with intestinal disorders, oral rehydration, preventing body chillness , preventing prickly heat, eliminating rash caused by chicken pox, measles etc., killing the worms, good drinks in case of cholera, diuretics, treating kidney and urethral stones, preventing urinary tract infections, intravenous injection in case of emergency, detoxification of toxins in cases of poisoning, a tonic for the elderly and the sick, and urinary tract antiseptics. [13] In spite of above therapeutic properties coconut water can also be used for the development of symbiotic functional drink. A recent study has revealed that coconut water can be processed by adding probiotic and prebiotic characteristics with sensory acceptance and adequate preservation characteristics. [41] Many studies suggest that probiotic, prebiotic and symbiotic foods may be beneficial in the prevention and management of nutrition and health.

The biochemical mechanism of action of coconut water in disease conditions is still poorly understood. It can be assumed that a large number of nutritional components , important chemical compounds and bioorganic substances like as Auxins , Cytokinins , Vitamins, Sodium , Potassium, Magnesium , Phosphorous, Calcium, Iron, Sugar, Copper , Chlorides , Amino acids like alanine, arginine, cysteine, serine , aspartic acid, glutamic acid, histidine, leucine, lysine, proline, phenylalanine, and tyrosine , which play significant role in maintaining human health and immune system of the body, present in coconut water may be responsible for producing therapeutic effect in disease conditions. Mostly the therapeutic actions of coconut water have been investigated using animal model and limited studies have been carried out on human subjects. More studies on human subjects are needed to confirm many of these therapeutic properties of coconut water and to understand its biochemical mechanism of action.

CONCLUSION

Coconut (*Cocos nucifera L.*) water is an ancient tropical beverage whose popularity on the international market has been continuously increasing in recent years. Coconut water is the liquid found in young coconuts and a natural source of several important minerals and nutrients . Coconut water is a delicious, electrolyte-filled, natural beverage that may benefit our heart, moderate our blood sugar, help improve kidney health, and keep our body refreshed and hydrated after a workout and beneficial in other disease conditions . Thus modification in our life styles, taking fresh nutritious foods and adding coconut water in our daily diet may be beneficial in keeping good health and managing chronic diseases and other disease conditions. Although more controlled studies involving humans are needed to confirm many of these qualities, the research to date is encouraging. Further, clinical studies on coconut water using human subjects in disease conditions can prove useful in understanding biochemical basis of action of coconut water and increasing our knowledge on this original tropical juice and developing coconut water as therapeutics for prevention and treatment of varieties of chronic diseases including cancer for which our modern system of medicine has no permanent cure.

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