

Cocos Nucifera Water: Therapeutic Benefits and Sickle Cell Anaemiaa Review

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Abstract:- Coconut water (*Cocos nucifera* L.) is regarded as the most valuable refreshing beverages that is excellent for electrolytes replenishment and is packed with variety of health benefits. Coconut fruit has high nutritional, therapeutic and commercial value and is recently being worked as a process of hydrating the cells. The high medium of potassium ion is studied as a possible mechanism to stop the enzyme Na / K-ATPase in the membrane of HbS, thus enabling potassium ion as an important higher ions moving out of the cell and sodium, water and chloride coming in to account for the water intake or sickling reversal process. Coconut water activate a resistance to osmotic pressure on the red cell membrane, thus decreasing the level of destruction of the cells. Cells with rise in red cell polymerization concentration are popular features of sickle cell disease and this is as a result of lack of the electrolytes-potassium, sodium and chloride from the red cell. The polymerization is as an outcome of dehydration, pressure and low oxygen tension which causes a shift in the balance of potassium, sodium, chloride and water and this leads to polymerization of the haemoglobin causing the crises of the sickle cell disease. The antisickling effectiveness of coconut (*Cocos nucifera*) water in sickle cell anaemia is reviewed to ascertain the ability of the minerals present in coconut water to stop sickle cell haemoglobin polymerization mechanism. Also reviewed are the minerals such as magnesium, zinc, arginine, potassium, chloride, iron and the antioxidant vitamins which are found to be potent inhibitors of sickle cell haemoglobin polymerization.

Keywords:- Sickle Cell Disease, *Cocos nucifera* water, Coconut, erythrocytes, anaemia.

I. INTRODUCTION

Numerous works have offered mankind with dependable information on the importance of numerous diets that are found in natural foods which are able to inhibit sickle cell haemoglobin polymerization process (Nwaguikpe *et al.*, 2012). The therapeutic process to the management of sickle cell disease have been the most recent and effective method accepted in the control of sickle cell disease. Sickle cell disease is a rising world wellbeing challenge and is the commonest heritable hematologic abnormality affecting human and estimates shows that 300,000 babies are being

given birth with cell sickle anaemia every year (Frederic *et al.*, 2017).

Coconut water is known to have numerous impacts on wellbeing since it have electrolytes, inorganic ions, amino acids, lipids, organic acids, nitrogenous compounds, enzymes, flavonoids, tannins, phenols, steroids, sugars, proteins, antioxidants and dietary fibers. It is an excellent drink for diabetes as it is good in nutrients needed by diabetes to keep their glucose state in regulation (Nidhi *et al.*, 2017). Studies have displayed that Coconut water have organic substance that keep a massive development elevating capacities which is being applied as a treatment in the caring of kidney stones (Aggarwal *et al.*, 2017). It has also been reported to act as an antioxidative agents against red cell fragility. In a study on how sickle erythrocytes resisted osmotic lysis, it was found that these features of coconut water could be used to stop the main crises in sickle cell disease by removing water from the cell and this could serve as a clue toward alleviating haemolytic crisis in sickle cell patients (Ajayi and Igwilo, 2016). Furthermore, Alusio *et al.*, 2009 explained that the fractions of *Cocos nucifera* water can perform as a natural oxidant as a result of its free radical strength.

Coconut water has been widely worked since its beginning to the research community in the 1940s. In its natural form, the micronutrients and vitamins act importantly in helping the human body antioxidant system (Evans and Halliwell, 2001). It is also accepted that coconut water was applied as a vital option for oral rehydration when medical saline was unavailable and could be used for intravenous hydration of person in remote areas (Campbell-Falcketal. 2000). In this review, the therapeutic benefits of *Cocos nucifera* (Coconut) water and especially its benefit to sickle cell patients will be highlighted. It is wish that this study will function as an activator for additional work into the therapeutic benefits of coconut water in cell sickle anaemia and a search for real therapeutic process for the medical management of Sickle Cell Disease.

II. COCOS NUCIFERA: CHARACTERISTICS AND COMPOSITION

Coconut (*Cocos nucifera*) is a vital tree substance in the native tropical areas and the fruits can be created into numerous of food and teas. Coconut is described as the most important and extensively grown palm with local clean water

found in the undeveloped coconut fruit also termed as “water endosperm”. It is clear, it also have adequate quantity of amino acids, proteins, glucose, and antioxidant (Jean *et al.*, 2009). *Cocos nucifera*, the botanical name of palm coconut is a vital member of the *Arecaceae palmae* and the only kind of the genus *Cocos*.

Every part of the plant is useful as it is grouped as “Functional food” as a result it provide numerous wellbeing and economic advantage. In countries like Nigeria, coconut substance are described to be used against harmful substance and are able to remove dangerous and risky materials (Aiyeloja and Bello, 2006) while it is used as a religious symbol in Asia, especially in India (Alexia *et al.*, 2012). It is also used for decoration or horticulture in Oman and United Arab Emirates (Coconut Research Center, 2004). The trunk and leaf offer constructing substance, the root is applied as mouthwash and as medicine for diarrhea and dysentery (Corleone, 2017). The husk or coir is processed into ropes, carpets, mats, geotextile and sacks, as substance for boats and fiber for building materials (Alexia *et al.*, 2012). Also as a growth supplement in tissue culture/micro propagation (Jean *et al.*, 2009). Ceremonial gifts especially in India (Rethinam and Kumar, 2001) and can be processed into vinegar (Bourdeix *et al.*, 2003) or wine (Augustine, 2007). The massive brown shell can be assessed into very standard activated substance - charcoal. The inner portion of the fruit is grouped into two edible parts; a white kernel meat and a clear liquid called coconut water (Alexia *et al.*, 2012).

III. COCONUT (COCOS NUCIFERA) WATER AS MEDICINE

Coconut water is an ancient tropical beverage that is highly valued due to its nutritional and medicinal (therapeutic) properties. It is a power house of natural electrolytes, vitamins, antioxidant, minerals, trace element, amino acids, enzymes and phytonutrients and is low in sugar but pleasantly sweet (Unagul *et al.*, 2007). Coconut water is consisted of numerous bioactive enzymes which are phosphatase, catalase, dehydrogenase, RNA polymerase, diastase, and peroxidase. These substances are vital for generating energy, breaking down harmful growth, and aiding cell development, conversely these substances aid in digestion and metabolism (Fonseca *et al.*, 2009).

The natural and sterile liquid carries a good amount of electrolytes; potassium, sodium, magnesium and phosphorus. These electrolytes aid restore electrolytes lack in the system as a result to dehydration, vomiting, loose stool and diarrhea (Umesh, 2009). Its liquid is also an excellent source of vitamins - biotin, niacin, folic acid, vitamin C and B –which are folate, thiamin, riboflavin and pyridoxine. These substances are vital in that the human system need them for enzymatic and cellular functions (Depeint *et al.*, 2006).

Because Coconut water is isotonic, sterile and very similar to blood plasma with Osmolarity of 300mOsm-l which is slightly lower in Sodium ions than that of WHO stated ORS substance, it has been used as intravenous fluid under certain emergency situations (Campbell- Falck *et al.*, 2000). New work on the application of coconut water as an intravenous fluids has shown it to compare favorably with commercial intravenous solutions. Coconut water has no harm effect on the red blood cells, is non allergenic, and is readily accepted by the human system and it has been displayed to be adequate as commercial electrolytes substance in prolonging survival times in sick patients (Bruce and Vermen, 2015.).

Because its electrolytes is likely to human plasma, it has been recognized internationally as a natural sport drink for oral rehydration (Probhakar and Mohana, 2014). As an intravenous solution. Anzaldo *et al.*, 1985 inject (500-700) ml of coconut water into nine volunteers' individuals and did not observed any important alteration either in the electrolytes constituents of the blood or in blood pressure, pulse level or breathing. However, Campbell- Falck, (2000) stated that coconut water is not an ideal solution for prolonged resuscitation but may function as a quick option in emergency. This rich isotonic solution is given to ill person with loose stool in tropical remote areas to replace loss of fluids from the GIT tracts and to decrease the need for hospitalization. The presence of another functional composition like amino acids, fatty acids, minerals may account the high in osmolarity.

One of the benefits related with coconut water that is of importance is its ability to reduce cholesterol levels as well as reduced blood pressure. However, a 3 weeks study on the intake of coconut water in rats resulted in the animal having reduce blood pressure and also decreased total cholesterol and free fatty acids (Bhagya *et al.* 2010). Coconut water has also been reported to have high antioxidant features that can aid protect the body from numerous abnormal growth (Manna *et al.*, 2014).

IV. ANTI- HYPERGLYCEMIC ACTIVITY

Coconut water improves the function of insulin and regulates blood sugar. Studies have shown that coconut water are directly connected with insulin receptor function and can significantly lower the chances of diabetic episode. Coconut water is seen to help remove signs and decrease wellbeing danger related with increased glucose by elevating insulin release and application of blood glucose. In a study of diabetic rats treated with coconut water, it shows that coconut water controlled adequate blood glucose state compared to other animals not treated with coconut water and it also helps to balance blood glucose and insulin levels (Pinto *et al.*, 2015). A similar work showed that the animals had reduced state of haemoglobin, an assessment of prolonged situation of blood glucose regulation (Pinto *et al.*, 2015).

In another study of diabetic animals being treated with ethanolic extract of coconut water, the results showed that the pretreated diabetic rat maintained better blood sugar level than diabetic rats not treated with coconut water (Nidhi *et al.*, 2017). Another study have shown coconut water to be able to reduced blood glucose state and elevate other wellbeing signs in diabetic animal (Preetha *et al.*, 2015). In furtherance, it is an absolute source of magnesium which has been displayed to elevate insulin activity and reduce blood glucose state in individual with type 2 diabetes and prediabetes (Rodriquez and Guerrero, 2003).

V. KIDNEY STONES TREATMENT

“Coconut water is good at clearing Urinary path” says Ayurvedic medicine of India. It is stated to remove bladder contamination, clear hepatic stone and elevate kidney function. Clinical work has displayed intake of coconut water to be very adequate in dissolving kidney stone (Bruce *et al.*, 2008). The use of coconut water on regular basis said Dr Eugenio Macalalag, head of Urology department at the Chinese hospital in the Philippines, has shown coconut water to be effective in ill person experiencing hepatic and kidney stone problem (Macalalag, 1987).

Also coconut water is seen to convert excess cholesterol to bile acids in rats and those bile acids are then freely excreted. In a study of coconut water in rats with kidney stones, it was found that it prevented the formation of calcium, oxalate crystals with other compounds from attaching to the kidneys and other urinary tract. This shows that Coconut water helps in reducing the quantity of crystals found in urine (Gandhi *et al.*; 2013). The researchers also believed that it aided decrease radicals development that occur due to oxalate level in urine (Elaine and Fredric, 2010). More works have displayed that coconut water have organic compounds that shows massive elevating abilities which is being applied in the therapy of renal stone (Aggarwal *et al.*, 2017).

Coconut water being a natural diuretic, stimulates urination (rises urine removal) and decreases the toxicity of the body. This aids to dilute the urine so that stones formed are small and easily flush out and also aid in preventing bladder contamination. Coconut water is known for its rich potassium constituent and potassium citrate prevent calcium in the urine from sticking to the urinary tracts and thus prevent kidney stones. (Spencer, 2007).

VI. ANTI- OXIDANT PROPERTIES

Coconut water is abundant in antioxidant which are effective in removing dangerous free radicals and separate system from toxins which are the main causes of advanced and deteriorating disease and even abnormal growth like cancer. Coconut water has been shown to scavenge numerous kinds of free radicals substances and protecting haemoglobin in the blood from nitrite activation. Free radicals are random

substance that are developed in tissue and their development rises in respond to damage. When there are excess free radicals, the system is said to be in an oxidative stress of damaging the cells and increase danger for other diseases (Gargi *et al.*, 2006).

One research observed that rats with liver injury showed improvement in oxidative stress when they were treated with water coconut (Manna *et al.*, 2014). In other work, rats with high intake of fructose diet and then treated with coconut water, showed decrease in free radicals process, blood pressure and insulin level (Bhagya, 2010).

Furthermore, concerning the vitamin antioxidant component of coconut water, Mantena *et al.*, 2003 performed an in vitro assessment of *Cocos nucifera* water, they found the existence of ascorbic acid in fresh coconut water and they related these properties with antioxidant properties which help the body from free radicals molecules that are main reasons behind deteriorating disease such as abnormal growth and sickle cell.

VII. SUPPORTS IMMUNE FUNCTION

Coconut water is also very effective in improving immunity. It protect body because of its antimicrobial lipids, lauric acids, capric acids and caprylic acids, which have antifungal, antimicrobial and antiviral properties (Ricardo *et al.*, 2004). Coconut water aids the immune system in battling infection while aiding to remove intestinal worms and candida. It helps strengthen the immune system by converting lauric acids into monolaurin, which study has suggested as an adequate method to eradicate viruses and bacteria that causes disease likes herpes, influenza, cytomegalovirus and even HIV. Coconut water helps in fighting harmful bacteria like *Listeria monocytogenes* and *Helicobacter pylori*, and harmful protozoans such as *Giardia lamblia* (Matsui *et al.*, 2008).

VIII. BOOSTS FERTILITY

Coconut water has numerous beneficial effects on health and on serum sex hormones such as Testosterone, Follicle Stimulating Hormones (FSH), Luteinizing Hormone (LH) and Prolactin. A study shows the level of Testosterone, FSH and LH to be significantly increased when coconut was administered to fertile rats. This implies that the intake of coconut water could boosts reproductive function and is likely to increases fertility. It also stated that coconut water possesses sex hormone-like activity that can help boost fertility because of its effect on menstrual cycle (Sade, 2016). The amino acids L-arginine is proven to be effective in increasing sperm count and motility (Sinclair, 2000), while Vitamin B9, also known as folic acid is shown to increase sperm count, motility and morphology (Safarinejad *et al.*, 2011).

IX. PROMOTE HEALTHY HEART

Coconut water has been found to have blood pressure benefits and potentially decrease the risk of blood clots forming in the arteries as it contains high levels of mineral ions especially potassium that has been found to help prevent heart attacks (Anurag *et al.*, 2003). In the West Indian Medical Journals, coconut water is seen to be effective in treating hypertension. The research involved participation of 28 individuals who are tested for 14 days without treatment, followed by another 14 days with treatment. The study showed remarkable finding as the group who drank coconut water showed a decrease in both systolic and diastolic pressure (Alleyne *et al.*, 2005).

X. AIDS IN HIV-AIDS TREATMENT

It is believed that coconut water aids in the quick absorption of drugs and makes their peak concentration in the blood easier by its electrolytes effect and plays an instrumental role in reducing the susceptibility of HIV patients. Preliminary research shows an indication of this effect of coconut component in reducing the viral load of HIV patients (Li *et al.*, 2009). The HIV-AIDS organization has documented that in most HIV-AIDS patients, the viral load fell to undetectable levels, when they took coconut component or when they added coconut water to their anti-HIV medication (antiretroviral); the medication that had previously not been active became effective (Matsui *et al.*, 2008).

XI. NUTRACEUTICAL PROPERTIES

Also concerning Nutraceutical effect, coconut water was found to reduce histopathological changes in the brain induced by hormonal imbalance in menopausal women (Redenahmad *et al.*, 2009). It is also known to contain the neurotransmitter GABA which has anti- anxiety, anti- convulsive and relaxing effect to the body.

XII. COCONUT (COCOS NUCIFERA) WATER AND SICKLE CELL DISEASE

According to a 2016 study on the therapeutic efficacy of coconut water in sickle cell patients, the extract is said to correct anaemic condition by stimulating haemoglobin synthesis, production and early release of immature red blood cells to the blood stream as a result of the presence of reducing compounds. This research shows that coconut water contains mucilage and reducing compounds which is a good therapeutic efficacy and may be considered as remedy to anaemia (Tchongu *et al.*, 2016). Similarly, another 2016 study published in the Journal of African Association of Physiological Sciences showed how sickled erythrocytes resisted osmotic lysis and how the resistivity at different potential tonicities were observed as fresh *Cocos nucifera* water was used as test and physiological salt as control ((Ajayi and Igwilo, 2016). It was discovered that with fresh or tender *Cocos nucifera* water, there was a remarkably resistance

significant to the osmotic pressure on the red cell membrane thereby reducing the rate of osmotic destruction of the cell during hypotonic stress and it was concluded that this may be a clue towards alleviating haemolytic crisis in sickle cell patients.

Meanwhile, previous study had demonstrated on the relativity of different haemoglobin genotypes on high potassium ion obtained from *Cocos nucifera* water and how it could possibly inhibit Na^+/k^+ -ATPase enzyme activities within the membrane of sickled haemoglobin, thereby allowing for higher potassium efflux and influx of sodium, chloride and water to account for the rehydration/sickling – reversal process (Ajayi and Arishe, 2015). Expert had suggested that coconut water is a rich source of potassium and chloride ions and Ajayi *et al.*, 2010 proposed a membrane counter transport for potassium and chloride ions by demonstrating a significant rehydration channel for sickle cell erythrocytes with different high potassium- isotonic solution. It was concluded that the composition of *Cocos nucifera* water could be employed to block the major pathway in which sickle cells could easily be dehydrated before sickling process.

In a 2016 study published in the Physiological Association Journals, it indicated there was a high resistance to the osmotic lysis of sickled erythrocytes induced by coconut water and has shown that this resistance may be a physiological advantage towards viability and reduction in haemolytic anaemia (Ajayi *et al.*, 2016).

In another study, it was found that coconut water which is rich in vitamins, minerals and trace element (including Zinc, Selenium, Iodine, Sulfur and Magnesium) could be a potent inhibitors of sickle cell haemoglobin polymerization and could equally improve the oxidant status of sickle cell erythrocytes (Nwaoguikpe and Braide, 2012). Further research on the antisickling effects of coconut water by Ajayi and Ogbee demonstrated a significant rehydration of sickled erythrocytes with high potassium- isotonic solutions and a possible remarkable reversal of the sickled shaped erythrocytes.

A study on the therapeutic efficacy in anaemia was performed and the results of the constituent analysis revealed the presence of tannins, flavonoids, leucothocyanes, quinone derivatives, reducing compound and mucilage. The extract was shown to correct anaemia completely before two weeks by stimulating haemoglobin synthesis, production and early release of immature red blood cells in the blood stream. The study shows that coconut water have a good therapeutic efficacy and may be considered for treatment of anaemia (Tchongu and Senou, 2016).

Previously, studies has shown the presence of L-arginine (300mgL⁻¹) in coconut water which is said to have a cardio protective effect through its production of nitric oxide, which favors vaso relaxation (Girish *et al.*, 2010). Another study also investigated the production of nitric oxide from its precursor-

arginine which is abundant in coconut water to be able to relax the blood vessels (Sagar *et al.*, 2011) and according to researchers at the Duke University and Howard Hughes Medical Institute who attributed the pains associated with sickle cell anaemia to decrease in production of nitric oxide from the sickle cell membrane. They also stated that sickled or distorted membrane has no ability to produce nitric oxide and so circulation of blood cells are restricted and oxygen starvation occurs causing the painful episode and ischemia seen in sickle cell patients (National Academy of Science, 2005).

Previous study revealed the treatment of sickle cell disease to include medications to reduce pains and prevent dehydration, arginine, magnesium supplementation, blockage of K⁺ loss from the erythrocytes to prevent the increase in sickled haemoglobin concentration and reduced sickling hemolysis. Sickled erythrocytes are fragile and dehydrated and they require a delicate balance for minerals and antioxidant to maintain erythrocytes hydration and membrane integrity (Malik, 1999). Studies shows that magnesium (Mg) is effective in reducing not only the painful episode in sickle cell disease but affect the hydration of Red blood cells. Nitric oxide which is derived from arginine has been shown to reduce painful symptoms and also relieve anaemia by causing expansion of the blood vessels to enable easy passage of the blood and this causes less sickling because fewer red cells would be lost to hemolysis (National Academy of Science, 2005).

Previous studies on the benefits associated with coconut water that is of greatest interest for the sickle cell patients is its potential to reduce sickling process by inhibiting the enzyme activities within the membrane of HbS, thereby allowing for significant higher potassium ion by preventing loss of potassium through dehydration. Dehydration causes reduction in the extracellular fluids and a reduction in blood volume and a possible efflux of potassium ion and influx of sodium and chloride ion (Bhagya *et al.*, 2010).

According to another study which demonstrated a decreasing osmotic lysis and an induced increase resistance in erythrocytes from different haemoglobin genotypes (AA, AS, and SS) pre-treated with coconut (*Cocos nucifera*) water, the increase in extracellular concentration of potassium coupled with that of calcium to the intracellular concentration may have reversed the osmotic pressure on the red cell membrane (Brungnara *et al.*, 1993). In the high potassium medium provided by *cocos nucifera* water, it seems probable that hypotonic stress process is slowed and this may indirectly reduce the rate of osmotic destruction of the erythrocytes (Ajayi *et al.*, 2016).

Maintaining the membrane integrity is the bottom line in the control of anaemia in sickle cell disease. Disruption of the membrane integrity arises from fragility, dehydration as well as increased production of reactive oxygen species. Protection

of the red cell membranes from free radical-mediated oxidative stress is crucial to the successful management of sickle cell crises. Certain minerals, copper, iron, magnesium, selenium as well as some antioxidant and vitamins have been found to effectively relieve the oxidative stress that prevails in sickle cell disease. Some minerals and vitamins have been found to be beneficial in the control of anaemia under this condition, these include iron (Fe), copper (Cu), zinc (Zn) and folate (Prasad, 2002). Iron is very important in the synthesis of haemoglobin, copper and zinc plays very important roles in Fe metabolism (Prasad, 2002). There has been evidence of low circulating levels of antioxidant vitamins e.g. vitamin E and C in the plasma of HbS patients. Many researchers have reported on the administration of vitamin C to human sickle cells which inhibited the formation of dense cells (Adewoye *et al.*, 2008). Other report proposed that vitamin C prevent Heinz body formation (Jaja *et al.*, 2008). These vitamins and trace element include vitamins C, E, B12, B9, iron (Fe), copper (Cu), Zinc (Zn) are abundant in coconut water (Jean *et al.*, 2005).

XIII. CONCLUSION

This review shows the use of coconut (*Cocos nucifera*) water to be very effective in the management of various diseases especially sickle cell anaemia. The therapeutic benefits is seen in its ability to alleviate the symptoms and painful crises associated with the disorder. Further studies should be done to actualize the mechanism in alleviating sickle cell crises and also possible ways of harnessing these properties to formulate a pharmaceutical agent that can be beneficial to sickle cell patients.

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