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RESEARCH ARTICLE

Chemical Composition of Coconut Water

Ibe CC[1], CN Osuji[1], EU Nwabueze[1] and EO Ahaotu[2]

[1]Department of Science Laboratory Technology, Imo State Polytechnic Umuagwo, Nigeria
[2]Department of Animal Production Technology, Imo State Polytechnic Umuagwo, Nigeria

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***Corresponding Address:**
EO Ahaotu
emmaocy@ovi.com

ABSTRACT

Coconut water is one of the world's most versatile natural product with increasing scientific evidence that support the role of coconut water in health and medicinal application. The aim of this work is to assess the biochemical properties of coconut water using standard and accepted methods; inorganic ions, total proteins, albumin, pH, specific gravity, volume, and weight. Sixty (60) coconut samples (48 ripe and 12 unripe) were used for the study. The result shows that Nigeria coconut water contains various electrolytes, devoid of bicarbonates and albumins. Also result shows that both ripe and unripe coconut water contain high mean K^+ concentration (Meq/L, μ±SE) of 44.75±1.02 and 35.23±3.41 respectively with a pH of 5.4. The application of coconut water in clinical trial for the treatment of pathological conditions is advocated.

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INTRODUCTION

The coconut palm, *Cocos nucifera* is a member of the family *Arecaceae or Palmae* (palm family). It is a large palm growing up to 45m tall with pinnate leaves 4–6 m.

In its natural form, coconut water 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 benefits (Seow and Gwee 1997; Sandhya and Raja Mohan, 2008; Campbell-flack *et al.,* 2000). It is believed that coconut water could be used as 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). Some of 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 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). Recent studies shows that trans-zeatin can be a potential drugs to treat neural diseases, some research found that Trans-zeatin actually possess an inhibitory effect on Acetyl cholinesterase and it can be used to treat Alzheimer diseases or related neural dysfunction such as dementia of medicine (IOM, 2000).

Acetyl cholinesterase degrades the neural compounds that mediate neural transmission and thus by blocking its action synaptic transmission can be improved. Yet another study also found that trans-zeatin can prevent amyloid β-protein formation, which has causal role in the development and progress of Alzheimer disease. Inorganic ions are required for normal cellular function and are critical for enzyme activation, bone formation, haemoglobin function, gene expression, and the metabolism of amino acids, lipids and carbohydrates (IOM, 2000). Coconut water contains a variety of inorganic ions (Miller *et al*., 1955) 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 (Campbell-flack *et al*., 2000). The concentration of these electrolyte in coconut water generate an osmotic pressure similar to that

observed in the body (Kuberski *et al*., 1979) and it also does not affect homeostasis (plasma coagulation).

Interestingly Anurag and Rajamohan showed that coconut water has cardio protective effect in experimental myocardial infarction induced in rats and this was probably attributed to the rich mineral in coconut water especially potassium (Pumer *et al.,* 2001; Anurag and Rajamohan, 2003). 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 (Jackson *et al.,* 2004) which also help to prevent mitochondrial toxicity induced by methanol metabolites. The biochemical composition of coconut 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). Hence our motivation to study the inorganic ions, proteins, pH, Electrolytes and glucose content of Nigerian coconut.

MATERIALS AND METHODS

The study was carried out on coconut water and the laboratory work done in the department of Science Laboratory Technology, Imo State Polytechnic, Umuagwo, Nigeria.

A total of 60 coconut fruits of different species used comprising of 48 unripe and 12 ripe were harvested from the Crop Production Technology Research Farm, Imo State Polytechnic, Umuagwo. The coconut water was extracted under aseptic to avoid contamination. In situation where immediate analysis was not possible the sample were preserved at 4°C. The samples were analyzed for the following constituents: chloride, sodium and potassium, calcium, magnesium, phosphates, protein and glucose respectively.

The pH, Specific gravity, volume and weight were equally measured using spectrophometer to measure Ca^{2+}, glucose oxidase method using randox reagent to measure glucose. Na^{+}, Cl^{-}, K^{+}, and HCO_3^{2-}, Mg^{2+} and phosphate were assay using ion selective electrode. Total protein was assayed using Biuret method and Bromocrysol method for albumin.

RESULTS

Table 1 shows mean±S.D of Weight, Volume, Glucose, Total proteins, Albumin, and Inorganic ion concentration in unripe and ripe coconut palms examined.

The water weighed 0.91±0.01 0f unripe and is significantly higher (P<0.0025) than ripe (0.30±0.07). There exists a significant difference between unripe coconut and ripe coconut palms studied in terms of inorganic ions glucose and proteins (Table 1). There was no difference in chloride ion between unripe and ripe. There exist a significant difference (P<0.05) in glucose between unripe and ripe coconut and thus giving the unripe coconut a good hypoglycaemic fluid. Electrolytes are responsible for normal haemostasis of the human body. A comparison between coconut water electrolytes and body electrolytes (Table 2) shows an increase in potassium, calcium, magnesium, and phosphate ions in coconut water than body plasma.

Table 1: Chemical composition of Nigerian coconut water (n=30)

Parameters	Unripe	Ripe	P-value
Glucose (Meq/L)	42.06±1.51	4.23±2.12	P<0.01
Total protein (g/100mL)	0.14±0.01	0.27±0.14	P<0.0005
Na^{+}(Meq/L)	25.54±0.84	28.30±5.21	P<0.005
K^{+}(Meq/L)	44.75±1.02	35.23±3.41	P<0.05
Cl^{-} (Meq/L)	21.70±0.68	23.23±0.88	NS
Ca^{2+}(Meq/L)	6.30±0.21	5.17±0.58	P<0.0025
Mg^{2+}(Meq/L)	6.12±0.40	20.72±7.51	P<0.0025
PO_4^{-}(Meq/L)	3.88±0.04		
Weight(kg)	0.91±0.01	2.64±0.19	P<0.0005
Volume(M/kg)	394.96±8.23	0.30±0.07	P<0.0025
pH	4.79±0.208	79.33±33.35	P<0.0025
S.G	1.027	5.00±0.00	

Key: Na^{+} = Sodium cations, K^{+} = Potassium cations, Cl^{-} = Chlorine ions, Ca^{2+} = Calcium cations, Mg^{2+} = Magnesium cations, PO_4^{-} = Phosphate ions, pH = Level of acidity and alkalinity, S.G = Specific Gravity.

Table 2: Comparison between Nigerian coconut water electroltyes and plasma electrolyte

Parameters	Unripe coconut H_2O	Ripe coconut H_2O	Plasma electrolyte
Na^{+}(Meq/L)	25.5	28.3	120-140
K^{+}(Meq/L)	44.4	35.2	4.5-5.8
Cl^{-}(Meq/L)	21.7	23.3	98-106
HCO_3^{-}(Meq/L)	0.0	0.0	15-35
PO_4^{-} (Meq/L)	3.4	2.6	2-4
Mg^{2+}(Meq/L)	6.1	20.7	1.8-2
Ca^{2+}(Meq/L)	5.2	6.3	5.0
Glucose (mmol/l)	0.76	0.08	10
Total protein (g/100mL)	0.14	0.27	6-8
Albumin (g/100mL)	0.0	0.0	2.5
pH	4.8	5.0	7.4
S.G	1.027	-	1.027

Table 3: Comparative study between Nigerian and ghanian coconut water specie

Parameters	Nigerian	Ghanian
Na^{+}(Meq/L)	26.3	0.7
K^{+}(Meq/L)	40.0	81.8
Cl^{-}(Meq/L)	22.5	38.6
Ca^{2+}(Meq/L)	5.8	7.2
Mg^{2+}(Meq/L)	13.4	26.8
HCO_3^{-}Meq/L)	0.0	3.4
PO_4^{-}(Meq/L)	3.0	6.4
Glucose (mmol/L)	0.4	0.3
Total protein (g/100mL)	0.2	0.005
Albumin (g/100mL)	0.0	0.0
pH	5.4	6.0
S.G	1.027	1.019

P<0.05

Therefore from this study coconut water when used intravenously can be beneficial to the body. Interestingly bicarbonates and albumin level in both ripe and unripe was nil in coconut water compared to body plasma. Ghanian coconut water contain elevated inorganic ion compared to the Nigerian species studied. (Table 3).

DISCUSSION

The composition of coconut water is acidic and is in agreement with Jean *et al*. (2009). 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 and is in agreement with work of (Msengi *et al.,* 1985). This makes coconut water 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 forth calcium is gradually reduced from the colostrums and we are advising regular intake of coconut by nursing mother to meet up the calcium nutritional requirement of the baby. Jean *et al.* (1990) has however shown that neuromuscular effect of potassium is neutralized by calcium and magnesium in the body which might be responsible for the reduction in ECF.

Coconut water when given intravenously is electrolitically harmless to a patient in circumstances where it may be dangerous to give the same amount of potassium alone. The phosphates ion is nearly same as that of body fluid. However sodium and chloride ion were lower when compared with ECF several researchers obtained similar lower values (Jean *et al.,* 2009). The glucose content is slightly lower than that of fasting blood sugar level for humans. With this coconut water could be the best drinks for diabetic's patient.

Also glucose could be a source of energy in diarrhoea patients and this can promote intestinal absorption of water and electrolyte. Coconut is deficient in bicarbonate in this study and agrees with that of Kuberski *et al.* (1976) and disagrees with that of a Ghanaian research Msengi *et al.* (1985). Comparing Nigerian coconut water to others, the difference in inorganic content is minimal.

Conclusion

The chemical composition of coconut is dependent on environmental factors, soil and the state of maturity. Nigerian and Ghanaian coconut species show remarkably differences in chemical composition. Nigerian coconut water is also a prototype of good electrolyte to the body.

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