

Biochemical Indices on Coconut Water for Packaging as Infusion Fluid and its Effect on Kidney Function of Fasted Wistar Rats

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Abstract

Background/Aim: Coconut water (*Cocos nucifera* L.) is an ancient tropical beverage whose popularity on the international market has been continuously increasing in recent years. This research was aimed to evaluate the potential effect of Coconut water of wistar albino rats exposed to stress.

Materials and Methods: Qualitative analysis was carried out on the coconut water to test for glucose, sucrose, fructose using Benedict's test, hydrolysis test and Seliwanoff's test respectively. Mineral elements analysis for sodium, potassium, calcium and magnesium were conducted using Varian AA240 Atomic Absorption Spectrophotometer. Quantitative analysis of ascorbic acid and chloride were determined using titration method. A total of twenty (20) male wistar albino rats with mean weight of 150g was used for this studies. They were divided into four groups with five rats in each. Group A, B and C are the normal control, positive control and negative control respectively. Group D was the treated group. The animals were stressed (water starved) for 48 hours before the commencement of the treatment. The coconut water was administered to Albino rats orally for 7 days to observe its effect on the rats. These rats were starved for 48 hours as a means of inducing stress then given coconut water as well as feed.

Results: The results showed the presence of glucose, fructose, sucrose, sodium ppm 3.102, calcium ppm 19.090, potassium ppm 1.344 and magnesium ppm 18.968. It also showed the presence of ascorbic acid in the quantity 4.403 mg and the absence of chloride which can be gotten by the addition of iodized salt. There was observed weight increase as well as a significant decrease in serum level of Urea and significant decrease in serum level of creatinine ($p < 0.05$) using the control group as reference.

Conclusion: Coconut water is a good and healthy supplement for infusion fluids because of the sugars and nutrients it contains since an infusion fluid can only provide the body with sugars and fluid. It should be taken into consideration that the nutrient present in coconut water can differ depending on region, cultivation practices as well as condition of soil. The Young Tender Coconut market could be a solution for regional markets but research on the preservation of the fruits will need future efforts, especially in the coating and packaging fields.

Keywords: Coconut Water; Mineral Elements; Infusion; Nutrients; Kidney

Introduction

Physiological and behavioral changes are induced by stressful situations in an organism to maintain the homeostasis, and among the most common human experiences is the exposure to stressful situations. A series of immunological, behavioral and neuro chemical changes occur that ought to serve in an adaptive capacity in response to stressors [1].

Coconut, an important member of monocotyledons belongs to the family of *Arecaceae*. It is botanically known as *Cocos nucifera* [2]. Coconut fruit products have been used in popular medicine around the world for the treatment of various diseases, such as arthritis and diarrhea [3]. The antiproliferative activity against lymphocytes on a study carried out with the coconut husk fibre was reported by Kirszberg, *et al.* [4] and also its analgesic and antioxidant activities was determined as stated by Alviano, *et al* [5]. Coconut is known as 'Aku-beke' in Ibo, 'Mosara' in Hausa, 'Agbon' in Yoruba, in Nigeria native parlance.

Campbell-Falck, *et al.* [6] reported that Coconut water, an isotonic beverage, was regularly used to give emergency plasma transfusion to wounded soldiers in the pacific war because it has the same level of electrolyte balance as that of human blood. It has less sodium (25 mg) than energy drinks (200 mg) and sport drinks (41 mg), it is very high in chloride at 118 mg compare to 38 mg of sport drinks [7]. According to Bruce [8], coconut water contains 95.3% water, 0.25% Potassium, 0.56% Phosphoric acid, 0.005% nitrogen, 0.69% Calcium Oxide, 0.59% Magnesium Oxide, 0.5% Iron, 0.8% reducing sugar and a total sugar of 2.08%. Coconut water contains less fat and no cholesterol, thus, makes it more nutritious than whole milk, contains much lower calories making it healthier than orange juice and better than processed baby milk as it contain lauric acid which is present in human mother's milk [7]. Ranti, *et al.* [9] reported the use of Coconut water as therapeutic means of fighting against viruses, it also lowers cholesterol, replenishes the body's fluid after exercise, re-hydrates the body and can carry nutrients and oxygen to cells [6].

Aim of the Study

This present study was aimed at evaluating the potential effect of coconut water on kidney function of male Wistar rats exposed to stress.

Materials and Methods

Sample procurement and preparation

Fresh coconut samples were collected from a local farm in Otuocha town in Anambra State. It was identified and authenticated by a Taxonomist from Department of Botany, Nnamdi Azikiwe University, Awka, with herbarium specimen number NAU179b. 10 of the samples collected were taken to the laboratory for phytochemical analysis. The coconut samples were stored in a laboratory cupboard and broken to extract the coconut water from each of them only immediately before carrying out the various analyses so as to keep them fresh and prevent microorganisms from interfering with its chemical components.

Qualitative tests

Qualitative tests for Glucose, Fructose and Sucrose were conducted using Benedict's test, Seliwanoff's test and hydrolysis test respectively. Chloride and Ascorbic acid concentrations were estimated using titration method.

pH of coconut water

The pH of the samples were recorded using a universal pH indicator paper.

Mineral elements analysis

Mineral elements analysis were conducted using Varian AA240 Atomic Absorption Spectrophotometer according to the method of APHA 1995 (American Public Health Association).

Preparation of animal for study

Male wistar albino rats were purchased from Animal farm, Department of Applied Biochemistry, Nnamdi Azikiwe University, Awka, then allowed to acclimatize for seven days with feed and water. They were kept in cages, separated into four groups; Normal control, Positive control (Stressed + standard (Std) drug), Negative control (Stressed + No treatment) and Test group (Stressed + Treatment with Otuocha coconut).

Stress induction of animal

The test animals were stressed by fasting. They were fasted for a duration of 48 hours.

Kidney function test

Kidney function parameters creatinine and urea were measured using Randox routine diagnostic kit. The procedures were according to the manufacturer’s instructions.

Statistical analysis

Data obtained from the experiments were analyzed using the Statistical Package for Social Sciences (SPSS) software for windows version 21 (SPSS Inc., Chicago, Illinois, USA). All the data were expressed as Mean ± SD. Statistical analysis of the results obtained were performed by using ANOVA and POS-HOC Tests to determine if significant difference exists between the mean of the test and control groups. The limit of significance was set at $p < 0.05$.

Results and Discussion

Result for pH of coconut water: The pH for the coconut water was 7 indicating a neutral pH.

Result for qualitative test for sugars, chloride and ascorbic acid: Table 1 reveals the qualitative test for sugars, chloride and ascorbic acid in Coconut water. The results shows the presence of glucose, fructose, sucrose and chloride while ascorbic acid was absent.

Sample	Glucose	Fructose	Sucrose	Chloride	Ascorbic Acid
Coconut Water	+	+	+	+	-

*Table 1: Test result for the presence of glucose in the coconut water samples.
+ = Positive, - = Negative.*

Result for quantitative test for mineral content of coconut water: Table 2 reveals the quantitative test for mineral contents of Coconut water. Magnesium was found to be 18.968, Calcium 19.090, Sodium 3.102 and Potassium 1.344 respectively.

Sample	Mineral contents (PPM)			
	Magnesium	Calcium	Sodium	Potassium
Coconut Water	18.968	19.090	3.102	1.344

Table 2: Shows the mineral contents of coconut water.

Kidney function test

20 wistar rats divided into Normal control, Positive control (Stressed + standard (Std) drug), Negative control (Stressed + No treatment) and Test group (Stressed + Treatment with Coconut water). Positive Control, Negative Control and Test Group were stressed by fasting for 48 hours. The Creatinine and Urea concentration levels were evaluated for kidney function.

Effect of coconut water on creatinine concentration: Table 3 shows the effect of coconut water on Creatinine concentration (g/dl) of the male wistar rats. From the table, there is significant difference in the mean creatinine concentration between Normal control, Positive control, Negative control and Test group (F = 480.65, P = 0.00001).

Specimens	Groups			
	Normal Control	Positive Control	Negative Control	Test Group
A	0.297	0.294	0.197	0.151
B	0.314	0.282	0.206	0.163
C	0.305	0.279	0.213	0.149
D	0.312	0.296	0.217	0.153
E	0.298	0.287	0.212	0.156
Mean ± SD	1.526 ± 0.0078	1.438 ± 0.0074	1.045 ± 0.0078	0.772 ± 0.0055
Common Mean	1.195			
p-value	0.00001			
f. ratio value	480.65			

Table 3: Shows the result on creatinine level (g/dl).
The result is significant at p < 0.05.

Effect of coconut water on urea concentration: Table 4 reveals the effect of coconut water on Urea concentration (g/dl) of the male wistar rats. From the table, there is significant difference in the mean urea concentration between Normal control, Positive control, Negative control and Test group (F = 1693.47, P = 0.00001).

Specimens	Groups			
	Normal Control	Positive Control	Negative Control	Test Group
A	8.72	6.27	6.23	6.24
B	8.59	6.35	6.32	6.17
C	8.67	6.38	6.28	6.28
D	8.69	6.41	6.34	6.31
E	8.65	6.19	6.31	6.34
Mean ± SD	43.32 ± 0.048	31.60 ± 0.089	31.48 ± 0.043	31.34 ± 0.066
Common Mean	34.435			
p-value	0.00001			
f. ratio value	1693.470			

Table 4: Shows the result on urea level (g/dl).

Discussion

This research was carried out to determine the presence and quality of the biochemical components in coconut water gotten from Otuocha in Anambra state as a supplement for infusion fluid. The biochemical components present as shown by the results include glucose, sucrose, fructose, ascorbic acid, magnesium ppm 18.968, potassium 1.344, sodium ppm 3.102 and calcium ppm 19.090 (Table 1 and 2). The result shows the absence of chloride in the coconut water samples which can be gotten by the addition of table salt and presence of ascorbic acid present in the amount 4.403 mg (Table 1).

A rising international demand for this product could be a highly positive issue for thousands of Asian small farmers [10]. The mineral composition and reasonable total sugar content make coconut water a natural isotonic liquid. The features of coconut water make it a perfect rehydrating and refreshing drink after physical exercise [1].

Antioxidant activities of polyphenolics derived from plants have asserted beneficial health functions for preventing cancer, retarding ageing and cardiovascular diseases [12]. Moreover, the ascorbic acid present in the natural coconut water was correlated with antioxidant properties [13].

While intravenous fluids supply only fluids, electrolytes and calories, coconut water supply the body with fluids, electrolytes, calories, minerals, vitamins and phytochemicals which are all essential to the proper functioning of the body. Although coconut water lack chloride and contains very low amounts of sodium, this can easily be replaced by the addition of table salt is suggested to compensate for sodium and chloride deficiency for oral rehydration [14].

The administration of coconut water shows significant decrease in serum level of Urea and significant decrease in serum level of creatinine ($p < 0.05$) as observed in table 3 and 4 as the two markers for kidney failure. Normal control: Creatinine (mg/dl) 1.526 ± 0.173 Urea (mg/dl) 43.32 ± 6.351 Stressed-No treatment: Creatinine 1.438 ± 0.075 Urea (mg/dl) 31.60 ± 5.517 Stressed+Std Drug: Creatinine 1.045 ± 0.162 Urea (mg/dl) 31.48 ± 2.570 Stressed+Otuocha water: Creatinine (mg/dl) 0.772 ± 0.196 Urea (mg/dl) 31.34 ± 3.207 . This adds to the promising future in coconut water consumption commercial due to its numerous benefits. To name a few; oral rehydration medium, cures malnourishment, cardioprotection because of the presence of L-Arginine [15], antithrombotic activity due to the presence of Kinetin [16] and a real potential power to reduce certain types of mammalian tumors [17].

Conclusion

Coconut water is a good and healthy supplement for infusion fluids because of the sugars and nutrients it contains since an infusion fluid can only provide the body with sugars and fluid, signifying a good potential in improving the physiological functions of body exposed to stress. Thus, coconut water can be used as infusion fluid to improve human health.

Conflict of Interest

The authors declare that no commercial or financial conflict of interest exist in the conduct of the research.

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