Electrolyte Concentrations in Apparently Healthy Individuals after Consumption of Aqueous Extract of *Jatropha tanjorensis*

Ibiene Sarah Kalio[1*] and Okorie Akuegbo Ezinne[1]

[1]School of Medical Laboratory Science, Rivers State College of Health Science and Technology, Rumueme, PMB 5039, Port Harcourt, Rivers State, Nigeria.

Original Research Article

ABSTRACT

Jatropha tanjorensis is a herbaceous plant used locally for the treatment of diabetes, inflammation, and stomach ache in Nigeria. Longtime effect of *Jatropha tanjorensis* on electrolyte concentrations in the body is yet to be determined. This study was conducted to determine electrolyte concentrations in healthy individuals after consumption of aqueous extract of *Jatropha tanjorensis*. Seven (7) healthy individuals aged between 23-26 years, weighing 44-75 kg were recruited for the study. Blood samples were collected before the commencement of the study as control samples while test samples were collected on the 7^{th} and 14^{th} day of consumption of 7.8g/175 ml of *Jatropha tanjorensis* daily for 14 days. The electrolyte was estimated using an ion selective electrode. The result showed that sodium ($p<0.05$), potassium ($p<0.05$), chloride ($p<0.05$), bicarbonate ($p<0.05$) and Anion gap ($p<0.05$) were significantly lower after 7 days of consumption of aqueous extract of *Jatropha tanjorensis* when compared to results before consumption of the extract. However, after 14 days of consumption of *Jatropha tanjorensis* aqueous extract, sodium and bicarbonate were lower ($p<0.05$) when compared to the values before consumption. The results suggest that *Jatropha tanjorensis* aqueous extract predispose consumers to electrolyte imbalance and metabolic acidosis.

**Corresponding author: E-mail: ibienekalio@gmail.com;*

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1. INTRODUCTION

Medicinal plants in the form of herbs have been used in different parts of the world as traditional herbal remedies [1]. *Jatropha tanjorensis* is one of such medicinal plants which belongs to Euphorbiaceae family and commonly called "hospital too far" among the local users [2]. Phytochemical screening *of Jatropha tanjorensis* leaves revealed that it contains bioactive substances such as alkaloids, flavonoids, tannins, cardiac glycosides, anthraquinones and saponins [3]. Reports showed that the administration of *Jatropha tanjorensis* leaves to humans resulted in the improvement of their haematological indices, which revealed an enhancement of bone marrow functions [4], while some researchers claim that the plant is toxic to different organs in the human body [3]. Nutritionally, the leaves of *Jatropha tanjorensis* are locally consumed as vegetables [4]. The leaves also serve for medicinal purposes, as they are used for the treatment of fevers, itches, sores on the tongues of babies, stomach ache, eczema, cabuncles and venereal diseases [5]. The leaves of *Jatropha tanjorensis* has been used as a vegetable and also for the treatment of diabetics in southern parts of Nigeria [6]. The leaf extract has also been used as an anticoagulant for biochemical and haematological analysis [5].

Electrolytes are a substance that becomes ion in solution and acquire the capacity to conduct electricity. All life form requires a complex balance of electrolyte inside and outside the body structure. In humans, this balance is regulated by hormones and the disruption of this balance leads to health problem [7]. The primary ions of electrolytes are sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), chloride (Cl^-) and the bicarbonate (HCO_3^-) [7].

The maintenance of precise osmotic gradient of the electrolyte is important since electrolyte gradient effect and regulates the hydration of the body, blood pH and is critical for nerve and muscle functions [7]. Muscles and neurons are activated by electrolyte activity between the extracellular fluid and intracellular fluid. Electrolytes may enter or leave the cell membrane through specialised protein structures embedded in plasma membrane called ion channel [7].

Electrolyte balance may be maintained by oral or intravenous intake of electrolyte containing substances, and it is regulated by hormones such as antidiuretic hormones, aldosterone and parathyroid hormone. Serious electrolyte disturbance such as dehydration and overhydration may lead to cardiac and neurological complications and medical emergency. Electrolyte disturbance can also cause muscle weakness or severe muscle contractions [7].

This study sought to determine electrolyte concentrations in healthy individuals after consumption of a known concentration of aqueous extract of *Jatropha tanjorensis* leaves for a period of seven (7) and fourteen (14) days.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Rivers State College of Health Science and Technology, Port Harcourt metropolis, Rivers State Nigeria.

2.2 Study Population

A total of seven (7) healthy individuals aged between 23-26 years and weighing 44-75 kg were recruited for the study. The 7 individuals used for the study were volunteers who gave informed consent to participate in the study. Each participant was duly informed about the research before obtaining formal consent.

Each participant's anthropometric data which included weight, age, and sex were documented.

2.3 Plant Material / Plant preparation

The plant used for the study was collected from Igwuruta in Rivers State, Port Harcourt Nigeria. The plant material was identified by the pharmacist in the Pharmacy Laboratory in the Rivers State College of Health Science and Technology, Port Harcourt. The leaves of *Jatropha tanjorensis* was used for the study. The leaves was carefully plucked off or detached from the branches and washed to remove dirt on the surface of the leave. The leaves were weighted (LW) and ground to tiny bits and were squeezed to obtain the juice. The part left after removal of the juice was weighted and labelled as SW. Weight of *Jatropha tanjorensis* in the juice was calculated as follows:

Weight of *Jatropha tanjorensis* in extract (g) = LW -SW

7.8 g/175 ml of *Jatropha tanjorensis* extract was given daily to each participant for fourteen (14) days. Blood samples were collected before the commencement of the study as control samples.

2.4 Experimental Design / Sample Collection

A total of seven (7) healthy individuals were used for the study. Blood samples were collected from these individuals before the commencement of the study into a lithium heparinised test tube which served as the control samples. The blood samples were taken to the laboratory for the analysis of sodium, potassium, chloride, bicarbonate and anionic gap. On the 7^{th} and 14^{th} day of commencement of the study, blood samples were collected by vein puncture from the antecubital vein. The skin was cleaned with 70% alcohol and allowed to air dry. A tourniquet was tightened on the hand above the site of puncture, and disposable needle and syringe were used to collect 2 ml of blood which was immediately dispensed into lithium heparin anticoagulated bottle that was labelled with the patient's name, sex and age. Each sample was centrifuged at 1500 rpm for 5 minutes and analysed immediately using ion electrode analyser.

2.5 Determination of Electrolyte

The Electrolyte concentration was determined using the Ion Selective Electrode (ISE) machine, model ISE 4000, serial no 04020329, Paris France. The results were obtained in each case of the triplicate measurements and were validated by comparing the results with known values obtained from the standard sample provided.

2.6 Principle of Electrolyte

An ideal ISE consists of a thin membrane which is only intended to transport ions. The transport of ion from a high concentration to a low one through a selective binding with some sites within the membrane creates a potential difference.

2.7 Procedure

The **On** button at the back of the ion selective electrode analyser was pressed, the analyser was allowed to boot after which the rest **mode button** was pressed. The sample test number (GCT PAT) was entered, the "**Yes**" button was pressed. The plasma was taken to the probe after which the RUN button was pressed. The screen displayed test in progress until the result was ready and displayed on the screen and were all printed out. The sample was removed after the "sample off" "beep", and the result was entered in the result book. The probe was flushed with distilled water after each run.

2.8 Statistical Analysis

Data obtained were analysed using Excel and Graph pad prism version 6.0. A p value <0.05 were considered statistically significant. Results are presented in mean ± standard deviation.

3. RESULTS

The study was conducted to determine electrolyte concentrations in healthy individuals aged between 23-26 years, weighing 44-75 kg after consumption of 7.8g/175 ml of aqueous extract of *Jatropha tanjorensis*.

The results are summarised in Table 1-3 and Fig. 1.

3.1 Electrolyte Concentrations in Control Group and Test Subject after Consumption of *Jatropha tanjorensis* Aqueous Extract after Seven (7) days

Table 1 shows that sodium, potassium, chloride, bicarbonate and anion gap were significantly lower ($p<0.05$) in test subjects that consumed 7.8 g/175 ml of *Jatropha tanjorensis* daily for seven (7) days than in control (before consumption of 7.8 g/175 ml of *Jatropha tanjorensis).*

3.2 Electrolyte Concentrations in Control Group and Test Subject after Consumption of *Jatropha tanjorensis* Aqueous Extract after Fourteen (14) Days

After 14 days of consumption of *Jatropha tanjorensis*, result in Table 2 showed that sodium and bicarbonate were significantly lower ($P<0.05$) in test subjects that consumed 7.8g/175 ml of *Jatropha tanjorensis* daily for 14days when compared to concentrations in control (before consumption of 7.8g/175ml of *Jatropha tanjorensis).* While potassium, chloride, bicarbonate

and anion gap did not show any significant difference before and after consumption of the extract.

3.3 Electrolyte Concentrations in Test Subject after Consumption of *Jatropha tanjorensis* Aqueous Extract after 7 and 14 Days

Table 3 shows the Comparison between test subjects after 7 days and 14 days of daily consumption of 7.8 g/175 ml of *Jatropha tanjorensis*. Results showed that potassium, sodium, chloride and anionic gap were significantly increased (P<0.05) after 14 days of consumption while bicarbonate did not show any significant difference (p>0.05) after 7 and 14 days of consumption.

3.4 Electrolyte Concentrations on the 7th day and 14th Day of Consumption of *Jatropha tanjorensis* Aqueous Extract

Fig. 1 shows the different electrolyte concentrations on the 7th and 14th day after daily consumption of 7.8 g/175 ml of *Jatropha tanjorensis.*

Table 1. Electrolyte concentrations in control group and in test subject after consumption of *Jatropha tanjorensis* aqueous extract after seven (7) days (n=7)

Parameter	Control(before consumption) n=7 Mean ±SD	Test subject after 7days n=7 Mean ±SD	T.value	P.value
Sodium (mmol/l)	142.0±3.51	126.85±2.79	8.9829	0.0001
Potassium (mmol/l)	4.24±0.13	3.60±0.19	7.3203	0.0001
Chloride (mmol/l)	104.8±0.83	96.00±3.10	7.2732	0.0001
Bicarbonate(mmol/l)	23.85±2.84	16.14±2.00	5.8588	0.0001
Anion gap(mmol/l)	11.85±1.55	10.42±0.72	2.2137	0.0470

P<0.05 is considered significant

Table 2. Electrolyte concentrations in control group and test subject after consumption of *Jatropha tanjorensis* aqueous extract after fourteen (14) days (n=7)

Parameter	Control (before consumption) n=7 Mean ±SD	Test subject after 14days n=7 Mean ±SD	T.value	P.value
Sodium (mmol/l)	142.0±3.51	137.28±4.60	2.1582	0.0519
Potassium (mmol/l)	4.24±0.13	4.32±0.32	0.5738	0.5767
Chloride (mmol/l)	104.8±0.83	104.00±1.24	1.4185	0.1815
Bicarbonate(mmol/l)	23.85±2.84	19.14±2.40	3.3514	0.0058
Anion gap	11.85±1.55	12.28±1.20	0.5876	0.5677

P<0.05 is considered significant

Table 3. Electrolyte concentrations in Test subject after consumption of *Jatropha tanjorensis* aqueous extract after 7 and 14 days (n=7)

Parameter	Test subject after 7 days n=7 Mean ±SD	Test subject after 14 days n=7 Mean ±SD	T.value	P.value
Sodium (mmol/l)	126.85±2.79	137.28±4.60	5.1292	0.0002
Potassium(mmol/l)	3.60±0.19	4.32±0.32	5.1638	0.0002
Chloride (mmol/l)	96.00±3.10	104.00±1.24	6.3394	0.0001
Bicarbonate (mmol/l)	16.14±2.00	19.14±2.40	2.5407	0.0259
Anion gap	10.42±0.72	12.28±1.16	3.6045	0.0036

P<0.05 is considered significant

4. DISCUSSION

The result of this study showed that the consumption of *Jatropha tanjorensis* extract by healthy individuals for 14 days caused a significant increase in the blood concentration of electrolytes such as sodium, potassium and chloride when compared to concentrations before consumption. This is similar to the work of some researchers [8] who worked on the effect of *Jatropha tanjorensis* on electrolyte in Albino Wistar rats. They inferred that the increase in potassium concentration in the blood of the rat have resulted from the high potassium content in the extract of *Jatropha tanjorensis* [9]. The high percentage of potassium in the extract administered to the individuals increased the plasma concentration of potassium, and this may have stimulated the release of aldosterone by the adrenal cortex. Aldosterone acts mainly on the principal cells of the renal tubule to cause an increase in the reabsorption of sodium. This process is actively carried out by the kidneys. All these processes may also be responsible for the increase in the bicarbonate concentration. A high level of potassium led to inappropriate cellular metabolism (acidemia), insulin deficiency and decreased renal excretion [10] as a result of potassium redistribution.

Table 1 shows that anionic gap in this study after 14 days of consumption was significantly increased. This indicated that *Jatropha tanjorensis* may affect metabolic acidosis and electrical charge of the body.

Chloride concentration in the study significantly increased. This may be attributed to the fact that *Jatropha tanjorensis* helped to maintain the normal balance of fluid in the body. Chloride plays a role in helping the body to maintain a normal fluid *balance*. Chloride gives a differential diagnosis of acid-base disturbances and acid-base homeostasis. High Chloride can be caused by increased production or diminished excretion of organic acids [11].

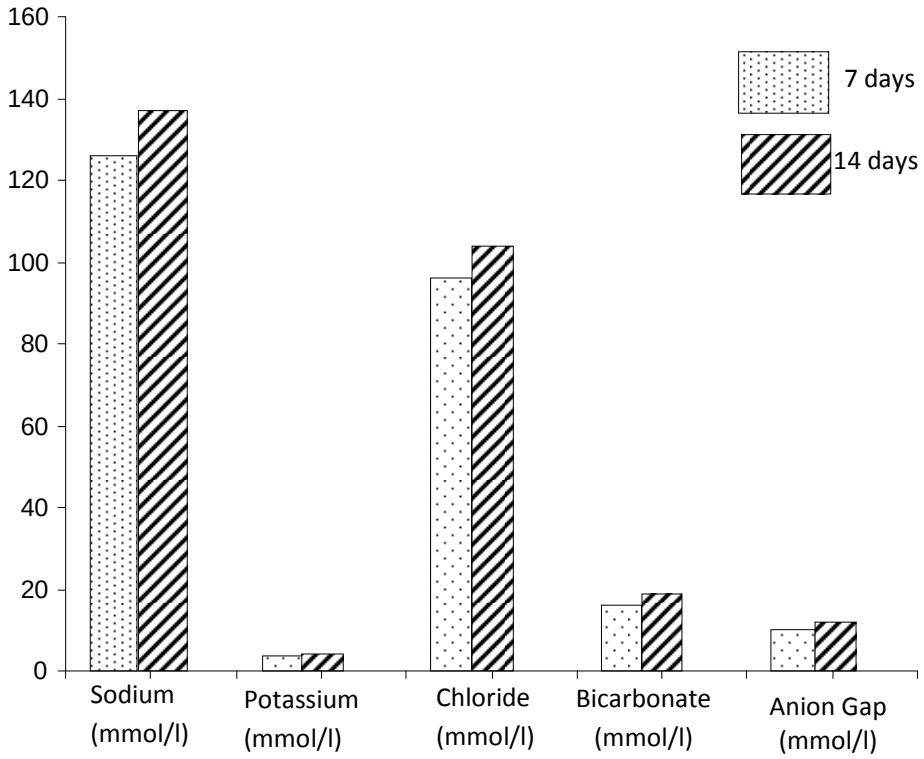

Fig. 1. Electrolyte concentrations on the 7th day and 14th day of consumption of *Jatropha tanjorensis* aqueous extract

Bicarbonate concentrations of individuals administered with *Jatropha tanjorensis* leaves were within the range. Bicarbonate ion acts as a buffer to maintain the normal level of acidity (pH) in the blood and other fluids of the body system. It is measured to monitor the acidity of the body fluid. The significant change in bicarbonate may be attributed to the presence of an antioxidant in *Jatropha tanjorensis* which contributes to anti-inflammatory functions and stimulates digestive enzyme [12].

Table 1-3 shows that sodium was significantly increased after consumption of *Jatropha tanjorensis*, Sodium is a major cation of extracellular fluid that takes care of osmotic strength of plasma, functions in the water distribution and aids the extra osmotic pressure in the extracellular fluid compartments of the body [13].

This study also showed that electrolytes (sodium, potassium, chloride, and bicarbonate and anion gap) are significantly affected by the consumption of *Jatropha tanjorensis* leaves. *Jatropha tanjorensis* has been known to have antimicrobial, antioxidant and anti-inflammatory properties [12]. However, the significant differences in serum electrolyte in healthy human administered with *Jatropha tanjorensis* leaf extract may indicate that osmotic gradient is affected by this. Electrolytes leave and enter the cell membrane through ion channel and are important for muscle concentration. The significant difference in sodium, potassium, chloride and anion gap may be attributed to the presence of mineral element present in *Jatropha tanjorensis* leaves which helps in maintenance of electrolyte balance in human.

The general increase in the electrolytes levels in the blood of the consumers resulted probably from such factors as overproduction [14], injury to organs or tissues which may have caused leakage [15] or the inability of the blood to redistribute the electrolytes to the action sites [16].

Fluctuations in ions concentrations meddle with the communication of electrical signs across the cells thus resulting in cell failure impair the co-ordination of cell instincts and relay of messages [15]. Furthermore, this situation particularly enhances the probability of experiencing unbalanced heartbeats (arrhythmias). Increase in sodium and potassium ion within the 7^{th} and 14^{th} day period can be ascribed to kidney injury or dysfunction since kidney is the usual pathway for ions [17] or from the effect of an overdose of the plant extract on vital human organs or tissues [18].

5. CONCLUSION

Conclusively, this study showed that electrolyte concentrations are affected by *Jatropha tanjoresis* consumption, as the aqueous extract significantly reduced sodium, potassium, and chloride and bicarbonate concentrations on the 7^{th} day after consumption while causing an increase on the 14^{th} day of consumption.

6. RECOMMENDATION

It is recommended that *Jatropha tanjorensis* consumption which is used for the treatment of diabetes mellitus, fever and treatment of venereal diseases should be used with caution as it could lead to derangement in electrolyte concentrations in the body. Further study on its effect on body organs such as kidney is recommended.

CONSENT

The seven (7) individuals used for the study were volunteers who gave informed consent to participate in the study. Each participant was duly informed about the research before obtaining formal consent.

ETHICAL APPROVAL

Well written approval was obtained and kept by the Authors (CHST/RJC/001/18)

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