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RESEARCH PAPER

EFFECT OF AQUEOUS EXTRACT OF ALLIGATOR PEPPER (*AFRAMOMUM MALEGUETA*) ON SERUM ELECTROLYTES

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ABSTRACT

This study was carried out to determine the effect of intraperitoneally injected aqueous extract of alligator pepper (AP) on the serum levels of Sodium (Na), Potassium (K) and chloride (Cl). Twenty adult female Sprague dawley rats aged five months and weighing between 150 - 200g were randomly allocated into 5 groups: A, B, C, D and E (n=4 each). Group A served as control, while B, C, D, and E served as the experimental groups. Baseline values of the specified serum electrolytes were obtained from group A rats which were not treated with aqueous extract of (AP), while the rats in groups B, C, D and E, received 13.3 mg/kg body weight of the extract of AP. Blood samples from the experimental animals in group B, C, D and E were then collected and analyzed 24 hours, 7 days, 14 days, and 21 days post intervention respectively. The results showed that there was a reversible increase in K+ concentration 24 hours post intervention; a significant decrease in Na^+ concentration 7days post intervention; and a significant decrease in Cl^- concentration 14 days post-intervention. Our findings suggest that intraperitoneally injected aqueous extract of alligator pepper induces reversible changes in serum electrolytes.

Key words: Alligator pepper, Electrolytes, Homeostasis, Renal function

INTRODUCTION

The therapeutic uses of Alligator pepper have been well documented, (Inegbenebor *et al.,* 2009, 2009; Mojeku *et al.,* 2011; Sugita *et al*., 2013.). Available literature indicates that it is useful in managing hypertension in young and elderly hypertensive patients (Lawal et al., 2007). It has also been shown to inhibit the growth of many bacterial organisms suggesting that the plant extract has broad spectrum activity on bacteria (Doherty *et al.,* 2010). Other laboratory based studies have shown that Alligator pepper can halt multiplication of virus (Doherty *et al.,* 2010), while Inegbenebor and Ebomoyi, (2012) have suggested that fetal macrosoma (birth weight >4kg), could be prevented by the use of intraperitoneally administered aqueous extract of alligator pepper as a vaccine or food supplement). In addition, the aqueous extract of the leaves of Alligator pepper has been found to lower blood glucose in alloxan induced diabetic rats faster than the conventional anti diabetic drugs such as diabenese (Mojeku *et al.,* 2011). However, there are reports that the ingestion of large quantities of Alligator pepper poses a health risk to women in their first trimester of pregnancy (Inegbenebor *et al.,* 2009).This has a public health implication as Alligator pepper consumption is a common phenomenon in typical Nigerian populations.

Considering the role of the Kidney in homeostasis, it is therefore necessary to determine the effect of Alligator pepper on the regulatory functions of the kidney via assessment of the changes in serum levels of Sodium,

Potassium, and Chloride. These electrolytes are relevant in the regulation of blood pressure as alterations in their normal values can alter some physiological processes that are associated with hypertension, renal failure, and cardiovascular problems, amongst others (Rose and Post, 2001). Hence, this study sets out to determine the effect of intraperitoneally injected aqueous extract of alligator pepper (AP) on the serum levels of Sodium (Na), Potassium (K) and chloride (Cl).

MATERIALS AND METHODS

Experimental Animals: Twenty (N=20) adult female Sprague dawley rats aged five months old, and weighing between 150 - 200g were acclimatized for two weeks during which all rats were fed with growers marsh and water *ad libitum.* The rats were randomly allocated into 5 groups A, B, C, D and E (n=4 each). Group A served as control, while groups B, C, D, and E served as the experimental groups.

Research Design: This was a prospective Cross-sectional intervention study.

Substance Administration: Each rat in the experimental groups - B, C, D, and E, was intraperitoneally administered with 13.3mg/kg body weight of aqueous extract of alligator pepper on the first day of the experiment, while group A (control) received 13.3ml/kg body weight of distilled water only). All the rats in both control and experimental groups had food and water ad *libitum.*

Sample Collection. On the first day of the experiment, rats in the control group were anesthetized using chloroform, and a transverse incision was made in the neck region of the rat. The jugular vein was identified; venipuncture was done and 3ml of blood was obtained and transferred to lithium heparinized anticoagulant bottle, which was analyzed to determine serum electrolytes. Blood samples from the experimental animals in groups B, C, D, and E were then collected for analysis after 24 hours, 7 days, 14 days, and 21 days post intervention respectively, using same procedure stated above.

Sample Analysis: Samples were analyzed using standard laboratory procedures. The serum was extracted from the whole blood. A serum separator tube (SST, tiger top tube) was used. The blood in the glass container was allowed to clot at room temperature before spinning and separating. The serum was then centrifuged at 4000 revolution/minute for 5 minutes (to sediment erythrocytes as described by Tsaley and Zaprianov (1983).

Data Analysis: Serum levels of Na^+, K^+ and Cl^- at 24hours, 7days and 14 days post intervention, were cross tabulated and subjected to one-way analysis of variance (ANOVA) at 5% level of significance.

RESULTS:

There was an increase in Sodium ion concentration of 8.5 Meq/l, 24hours post intervention (p=0.329), and a significant decrease in Sodium ion concentration of 9.3Meq/l, 7 days post intervention (p=0.0279). Recovery occurred from 14days post intervention (See Table 1). Sodium ion concentration in control rats ranged from 115-103Meq/l, while Sodium ion concentration in humans ranges from 135-145Meq/l.

Table 1: Time effect of aqueous extract of Alligator pepper on Serum Sodium ion concentration (Meq /l) in Sprague Dawley rats.

Group	Duration pre or post intervention	Mean values of Na+ concentration Meq/l	Net Na+ loss /gain in Meq/l	P-value
A control n=4	24 hrs. pre intervention	110±5.4	Nil	
B n=4	24 hrs. post intervention	118.5±23.17	+8.5	0.329
C n=4	7 days post intervention	100.7±3.7	-9.3*	0.0279
D n=4	14 days post intervention	109.8±6.6	-0.2	0.972
E n=4	21 days post intervention	112.5±8.1	+2.5	0.777

*= Statistically significant ($p < 0.05$) (+) =gain, (-) = loss

There was a significant increase in potassium ion concentration of 0.9 Meq/l 24hours post intervention (p=0.002), Recovery occurred from 7days post intervention (See Table 2). Potassium ion concentration in control rats ranged from 4.1 - 4.7 (Meq/l), while Potassium ion concentration in humans ranges from 3.5 - 4.5 (Meq/l).

Table 2: Time effect of aqueous extract of Alligator pepper on Serum Potassium ion concentration (Meq/l) in Sprague Dawley rats.

Group (n=4)	Duration pre (p1) or post intervention	Mean values of K+ Concentration Meq/l	Net k+ loss /gain in Meq/l	P-value
A	24 hrs (p1)	4.4±0.27	Nil	
B	24 hrs (p2)	5.3±0.34	+0.9*	0.002
C	7 days (p2)	4.5±0.45	+0.1	0.695
D	14 days (p2)	4.5±0.38	+0.1	0.922
E	21 days (p2)	4.2±0.27	-0.2	0.334

*= Statistically significant ($p < 0.05$) (+) =gain, (-) = loss

There was a decrease in Chloride ion concentration of 6.4Meq/l, 24hours post intervention (p=0.061), and a significant decrease in Chloride ion concentration of 13.3Meq/l, 14days post intervention (p=0.01) (See Table 3).

Table 3: Time Effect of Aqueous Extract of Alligator Pepper on Serum Chloride ion Concentration (Meq/l) in Sprague Dailey rats.

Group	**Duration pre or post intervention**	**Mean values of CL concentration Meq/l**	**Net CL loss /gain in Meq/l**	**P-value**
A control n=4	24 hrs pre intervention	104.5±1.7	Nil	
B experiment n=4	24 hrs post intervention	98.1±3.2	-6.4	0.061
C experiment n=4	7 days post intervention	98.7±1.0	-5.8	0.88
D experiment n=4	14 days post intervention	91.25±7.4	-13.3*	0.01
E experiment n=4	21 days post intervention	100.5±5.5	-4	0.227

*= Statistically significant at ($p < 0.05$) * (+) =increase, (-) = decrease

DISCUSSION:

Toxic effects of drugs are commonly renal or hepatic. The kidney excretes or retains sodium via the action of aldosterone, antidiuretic hormone (ADH, or vasopressin), atrial natriuretic peptide (ANP), and other hormones (Schwartz et.al., 1957). Abnormal ranges of the fractional excretion of sodium can imply acute tubular necrosis or glomerular dysfunction. Derangement in these values could suggest renal impairment (Alejandro *et al.,* 2003).Serious electrolyte disturbances, such as dehydration and over hydration, may lead to cardiac and neurological complications (Oh *et al.,* 1995).

In this study, 13.3mg/Kg body weight of aqueous extract of alligator pepper was intraperitoneally administered to the test animals. Previous studies have shown the diuretic effect of Caryophyllene which is a major constituent of the aqueous extract of alligator pepper (Ajaiyeoba and Ekundayo, 1999). Elevated or decreased levels of these electrolytes may potentiate kidney damage and altered renal regulatory activities (Alejandro *et al.,* 2003). Excessive intake of sodium is associated with hypertension and swelling in the tissues (Appel *et al.,* 2001). The result of this study did show that there was a significant decrease in serum sodium ion concentration at 7 days post intervention. The osmolarity of the body fluid is greatly determined by the serum concentration of sodium ion which has a regulatory effect on the blood volume; hence low levels of sodium ion could suggest low blood volume and reduced blood pressure.

Similarly, the observed significant decrease in serum sodium ion is an indication of increased renal excretion of sodium ion. Also, the recovery of sodium concentration by the 14days post intervention, suggests that the changes observed are reversible when further consumption of the substance is stopped. Of interest, is the fact that Sodium

plays a special role in the control of heartbeat (Theodore *et al.*, 2001). Alligator pepper extract may therefore prevent hypertension or serve as a hypotensive agent at certain dosage.

Also, the observed statistically significant increase in potassium ion concentration at 24 hours post intervention, with recovery at the 7th day post intervention, draws attention to the assertion by Rastegar *et al.* (2001) that alterations in the excretion of Potassium ion indicates a decreased function of the kidney, which could result in an hyperkalemic or hypokalemic state. Hyperkalemia is usually caused by acute or chronic renal disease, low cardiac output, acidosis, sodium depletion or massive muscle injury (Mandal, 1997). Therefore, the observed increase in potassium ion concentration could be traced to the corresponding decrease observed in sodium ion concentration; though elevated potassium levels occur more rarely. Typically, this happens in people who have protein-breakdown diseases, severe infections, and reduced kidney function.

Furthermore, Alligator pepper extract caused a decrease in Chloride ion concentration at 24 hours post intervention, and a significant decrease in Chloride ion concentration at 14days post intervention ($p=0.01$). Although deficiency of chloride is rare, when it does occur, it results in a life threatening condition known as hypochloremic alkalosis, in which the blood becomes overly alkaline (Rose and Post, 2001). Thus, the observed significant decrease in Chloride ion concentration suggests hypochloremic alkalosis. Obviously, the combined decrease in sodium and chloride ion, leads to further decrease in the osmolarity of body fluid and subsequently, the decrease in blood volume, blood pressure and cardiovascular activities.

In conclusion**,** intraperitoneally injected aqueous extract of alligator pepper, induces reversible changes in major serum electrolytes in Sprague Dawley rats.This study has demonstrated that the administration or use of aqueous extract of alligator pepper, has a significant and reversible effect on the function of the kidney as shown by the significant and reversible increase in $Na^{+,}$ and decrease in levels of K^+, and Cl- concentration. Alligator pepper extract may therefore prevent hypertension or serve as an hypotensive agent at certain doses. The mode of action of Alligator pepper on serum electrolyte may be related to a reversible effect on Na^+ K^+ ATPase. We suggest that extensive histological studies be done to determine the toxic effects of Alligator pepper on the kidney.

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AUTHOR'S CONTRIBUTIONS

The authors participated adequately in all aspects this study. No conflict of interest is declared.