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Effect of Oral Administration of Aqueous Leaves Extract of *Vitex doniana* on Serum Electrolyte Levels in Rats

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Abstract: Despite the fact that leaves of *Vitex doniana* has been in use for many decades in the treatment of many illnesses, little is known about its effect on serum electrolytes balance in mammals. This study sought to determined the effects of its aqueous leaves extract on serum electrolytes (sodium, potassium, chloride and bicarbonate ions) using standard laboratory methods, following 4 weeks oral administration to 30 albino rats at varied doses (100, 150 200 mg kg^{-1}) with 10 albino rats as control group. The values of serum sodium, potassium, chloride and bicarbonate ions for the control group were 170±.00, 5.3±0.16, 130±2.00, 30±2.00 mMol L^{-1}, respectively. However, significant increase ($p<0.05$) in serum chloride and bicarbonate ions was found at 100, 150 and 200 mg kg^{-1} and potassium ion at 150 and 200 mg kg^{-1}, where as sodium ion at only 150 mg kg^{-1}. It can be inferred that *Vitex doniana* leaves extract at dose of 150-200 mg kg^{-1} could be toxic. Therefore, like any other drug, it should be taken at a therapeutic dose to be determined, since it has been found to increase electrolytes level and may help in replenishing loses.

Key words: *Vitex doniana*, leaves, aqueous extract, albino rats, serum electrolytes

INTRODUCTION

Vitex doniana is the most abundant and wide spread *Vitex* in savannah regions widely recognized by its long stalked glabrous leaves with the leaflets usually rounded at the apex, though some time they may be indented or occasionally have a very short triangular top, with fruits that are edible (Keay *et al*., 1964). The tree grows up to 15 m heights and 3 m in girth, with dense rounded crown and dark green foliage (Keay *et al*., 1964). The bark is grey to pale-grown in colour, finely tissured longitudinally and fibrous, slash yellowish, darkening on exposure (Keay *et al*., 1964). Flowering usually starts from January and ends around April. The flowers are pinkish white in colour 2.5-5 cm long, crowed in compact branched maxillary about 2 cm across on a stout, central stalk 2-3 cm long (Keay *et al*., 1964). Fruiting start in June and normally ends in October (Keay *et al*., 1964). The fruits are broadly ellipsoidal, about 2.5 cm in diameter, with calyx forming a shallow saucer. They are dark-green when unripe and gradually turns to black when fully rip (Keay *et al*., 1964).

Because of the sweetness of the ripe fruits, a kind of molasses is made from them. The fruits candy is usually used along with honey to make sweet called "Alawar Dinya" (Hausa) or rather used in sweetening pap of cereals origin. A beverage can also be made from them. In eastern Sudan the roasted fruits are used as substitute for tea (Dalziel, 1937). The young leaves are used as vegetables to make soup. The young cooked leaves are taken along with ground nut cake, salt and pepper amongst other things, to make a northern delicacy known as 'Dinkin dinya' (hausa) (Dalziel, 1937).

The young leafy shoots are used as herbs. In French and guinea, an infusion of leaves is given for colds (Adjanohoun *et al*., 1991). A mixture of the pounded roots is used for stomach trouble (Adjanohoun *et al*., 1991). In northern Nigeria, out growths growing on the tree is used as remedy for leprosy (Dalziel, 1937). A decoction of the root bark is recommended for children with rickets, in Ivory Coast (Kerharo and Bouguet, 1950). The bark is used in various Ivory Coast remedies for leprosy and sterility. The bark decoction is a gargle for mouth ailments (Kerharo and Bouguet, 1950). The bark is used in western Ashanti for stomach complaints (Dalziel, 1937). The bark and leaves are sometimes given for diarrhea and dysentery (Dalziel, 1937). In Sierra Leone, they are considered good for conditions due to A and B avitaminosis, associated with sores at the corners of the mouth and eyes and sometimes in advance cases, with

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paralytic symptoms (Dalziel, 1937). The leaves are used by moshi (Ghana) on the cost to keep crocodiles from water holes (Irvine, 1961). The leaves and bark are also used in the treatment of inguinal lymphadenitis, asthma, diarrhea, hemorrhoids, insomnia and nervous disorders (Adjanohoun *et al*., 1991).

Despite the fact that *Vitex doniana* leaves has been in use for many decades in the treatment of many illnesses and as food, little or nothing was done to find out whether the its consumption brings about changes in electrolytes balance and buffering system in mammals, with a view to suggesting its safety or otherwise.

MATERIALS AND METHODS

Plant materials: The leaves of the *Vitex doniana* were collected from within Kano metropolis, Kano. It was identified and authenticated at the specie level at the Herbarium unit of Biological Sciences Department, Faculty of Science, Bayero University, Kano. The specimen was deposted in herbarium with voucher number 73 and plant number 224. The leaves were thoroughly washed and air dried for 2 weeks to a constant weight. The dried leaves were pounded to fine powder with mortar and pestle and then stored in dried containers until needed.

Experimental animals: The protocol employed met the guidelines of Good Laboratory Practice (GLP) regulations of World Health Organisation and also the guidelines governing handling of laboratory animals as stipulated by Bayero University animal research ethics committee as well as the principles of laboratory animal care. Apparently healthy Albino rats of both sexes weighing between 190-270 g were used for the research and were obtained from the department of biological sciences, Bayero University Kano Nigeria. The Albino rats were kept in well ventilated laboratory cages with 12 h day/night cycles. They were maintained on a ration containing commercial poultry feed (Vital Feeds®, Jos, Nigeria) made up of 54% carbohydrate, 20% protein, 2% minerals, 10% fibre, 1% vitamin and 13% fat. Water was also supplied *ad libitum*.

Preparation of extract for animals' treatment: The extracts of the leaves of the plant were prepared by suspending 50 g of the bark powder separately in 100 cm^3 of distilled water and shaken intermittently with mechanical shaker for 6 h. The preparation was allowed to stand for 24 h and then filtered through a Whatmann's no 1 (11 Cm) filter paper. The filtrate was concentrated to dryness at 40°C under reduced pressure on a rotary evaporator and stored in a refrigerator at -4°C until required.

Determination of serum electrolytes: Forty white albino rats were divided into four groups of 10 rats each. Groups 2, 3 and 4 were orally given daily doses of 100, 150, 200 mg kg^{-1} b.wt., respectively of the aqueous leaves extract by gastric tube for 4 weeks after which they were sacrificed and blood samples collected. Group 1 was not administered with any extract. The rats were sacrificed humanely by jugular decapitation 24 h after the last administration of the extract and blood samples collected. The samples were allowed to clot and centrifuged at 3500 rpm for 10 min and serum collected for analysis.

Methods: Serum collected from the blood samples at the end of the treatment was used to assay for serum bicarbonate ion (HCO_3) as described by Vanslyke and Neill (1924), serum chloride ion (Cl^-) as described by Schales and Schales (1941) whereas, sodium and potassium ions were determined by flame emission photometric method of Margoshes and Valle (1956).

Statistical analysis: Statistical analysis was carried out using Students' T-test to compare the measured parameters with those obtained in the control group the differences were accepted when $p<0.05$. The analysis was carried out using in STAT. 3 for windows 2003.

RESULTS

Table 1 shows the results of the physical examination of the albino rats following 4 weeks oral administration of *Vitex doniana* leaves extracts. There is corresponding decline in agility and increase in sluggishness and emaciation, as the dose increases. At the dose of 200 mg kg^{-1}, the rats were completely sluggish and emaciated.

Table 2 above shows the weight of rats before and after the administration of the leaves extracts of the

Table 1: Physical examination of the albino rats after oral administration of *Vitex doniana* leaves extracts

Dose of extract	Physical examination
Group 1 (Control)	No physical change
Group 2 (100 mg kg^{-1})	No physical change
Group 3 (150 mg kg^{-1})	Slightly emaciated
Group 4 (200 mg kg^{-1})	Sluggish and emaciated

Table 2: Weights of albino rats after administration of *Vitex doniana* leaves extract

	Weights (kg)	
Dose of extract	Before	After
Group 1 (control)	0.36±0.10	0.37±0.10
Group 2 (100 mg kg^{-1})	0.35±0.06	0.33±0.06
Group 3 (150 mg kg^{-1})	0.35±0.06	0.35±0.05
Group 4 (200 mg kg^{-1})	0.35±0.60	0.33±0.15*

Sample size n = 10, Result presented as Mean±SD, *Value is significantly different at $p<0.05$ from weight before treatment

Table 3: Effect of *Vitex doniana* administration on serum sodium, chloride, potassium and bicarbonate ions in albino rats

Dose of extract	Serum sodium ion (Na^+) (mMol L^{-1})	Serum potassium ion (K^+) (mMol L^{-1})	Serum chloride ion (Cl^-) (mMol L^{-1})	Serum bicarbonate ion (HCO^-_3) (mMol L^{-1})
Group 1 (Control)	170±5.00	5.3±0.16	130±2.00	30±2.00
Group 2 (100 mg kg^{-1})	188±12.48	5.7±0.64	153±3.5*	44±0.21*
Group 3 (150 mg kg^{-1})	183±2.78*	6.2±0.24*	160±10.00*	44±1.00*
Group 4 (200 mg kg^{-1})	183±2.31	6.2±0.23*	160±9.80*	46±1.70*

Sample size, n = 10, Result presented as Mean±SD, *Value is significantly different at $p<0.05$ from weight before treatment

Vitex doniana. This shows the corresponding decrease in weight of the rats after administration, with those administered with 200 mg kg^{-1} having significant loss of weight.

Table 3 above presents the results of the effects of administration of *Vitex doniana* leaves extracts on serum electrolytes. There is significant ($p<0.05$) increase in serum chlorides and bicarbonates ions in all the groups administered with leaves extract of *Vitex doniana*. The increase in potassium ion was only significant ($p<0.05$) in those administered with 150 and 200 mg kg^{-1} of the leaves extract. Moreover, serum sodium ions showed significant ($p<0.05$) increase only in those administered with 150 mg kg^{-1} of the leaves extract.

DISCUSSION

The albino rats in the control group and those administered with 100 mg kg^{-1} of the *Vitex doniana* leaves extract showed normal response or no physical change with the control group being more active while those administered with 150 mg kg^{-1} of the leaves extract were slightly emaciated, those administered with 200 kg kg^{-1} of the extract were sluggish and emaciated (Table 1).

However, there is observed corresponding decrease in weight of the rats after administration, with those administered with 200 mg kg^{-1} having significant loss of weight (Table 2). The lost of weight in the groups administered with aqueous leaves extract (Table 2), may be due to the fact that sodium combines with bicarbonate ions for neutralization of acids, thereby maintaining the PH level of the body (Guyton, 1991). Moreover, the loss of weight as observed in those administered with 150 and 200 mg kg^{-1} of the aqueous leaves extract (Table 2) can be accounted for by the fact that, the increase in concentration of electrolytes (sodium, potassium, chloride, bicarbonate ions) as depicted in Table 3, may result in the lag in water adjustment, which may contribute to the loss of weight and weakness in those groups. The hypernatremia observed, reflect hyper-osmolality and consequent cellular dehydration and chloride increases along with sodium because of the electrical potentials. This may be due to the inability of the kidney to excrete these ions (Ganong, 1999). The cellular dehydration could be the key reason for the loss of weight observed in all the groups administered with the extracts.

For serum electrolytes, the serum sodium ion concentration of the control group ranges between 165 to 175 mMol L^{-1} (Table 3). Significant increase ($p<0.05$) in the serum sodium ion concentration was observed in the group administered with 150 mg kg^{-1} b.wt. of the extract, compared to control group, but the increase observed was not dose dependent, since the serum sodium ion concentration of the group administered with lowest dose (100 mg kg^{-1} b.wt.) were found to be higher than those of other groups (Table 3). Serum potassium ion concentration of the control group is between the range of 5.14 and 5.46 mMol L^{-1} (Table 3). Significant increase in serum potassium ion was observed in the albino rats placed on 150 and 200 mk kg^{-1} b.wt. of *Vitex doniana* leaves extract, compared to control group (Table 3). No significant increase was observed in the group treated with 100 mg kg^{-1} b.wt. of the leaves extract compared to control group. The effect was found to be dose dependent, as the serum potassium ion concentration increased with an increase in the administered dose of the aqueous extract of *Vitex doniana* leaves (Table 3).

For serum chloride, values between 128 and 132 mMol L^{-1} were obtained for control group (Table 3). There were significant increase in the serum chloride ion concentration in the all groups administered with 100, 150, 200 mg kg^{-1} b.wt. of *Vitex doniana* leaves, compared to control group (Table 3). These increases were found to be dose dependent, as the serum chloride concentration increases with increase in the dose of the aqueous extract of *Vitex doniana* leaves administered (Table 3). For serum bicarbonate ion, values between 28 and 32 mMol L^{-1} were obtained for control group (Table 3). Significant ($p<0.05$) increase in the serum bicarbonate ion concentration were obtained in all the groups administered with 100, 150 and 200 mg kg^{-1} b.wt. of the *Vitex doniana* leaves extract, compared to control group. These increases in serum bicarbonate were found to be dose dependent as the serum bicarbonate ion concentration increased with increase in the dose of *Vitex doniana* leaves extract (Table 3).

Clinically electrolyte such as sodium, potassium, chloride and bicarbonate ions are among the parameters that are useful in the determination of kidney function

(Burton, 1997). The elevation or depletion of the level of any of them may be an indicator for a kidney problem in response to which medical checkup for kidney function is required. But in a situation of diseases like diarrhea, these electrolytes are lost in the fluids and in the case of excessive intake of these electrolytes or dehydration these ions concentration increase and balance in them may be destabilized (Odutola, 1992).

Therefore the observed increase in the serum sodium, potassium, chloride and bicarbonate ions in all the albino rats administered with *Vitex doniana* leaves extract (Table 3) could be due to intake of these electrolytes in the aqueous extract. The observed increase in the electrolytes of groups administered with extracts of *Vitex doniana* leaves (Table 3) qualifies the usage of the leaves in the treatment of diarrhea, stomach complainant and dysentery as reported by Dalziel (1937) and Adjanohoun *et al*. (1991). This could be due to the facts that excess chloride combines with hydrogen ions in the gastric mucosal gland to form HCl (Carolla *et al*., 1990), which may help to kill micro organisms that caused diarrhea and dysentery. The other way by which *Vitex doniana* may be useful in diarrhea and dysentery subjects is the replenishing of loss of electrolytes as observed in those administered with the leaves.

The treatment of nervous disorder with leaves and bark of *Vitex doniana* as reported by Adjanohoun *et al*. (1991) may be attributed to the observed increase in sodium and potassium ions in the albino rats administered with leaves extract (Table 3). The potassium and sodium ions are required in the stimulation of the conduction of nerve impulse and maintenance of neuro-muscular irritability (Carolla *et al*., 1990). The level of aldosterone is very sensitive to the levels of sodium and potassium ions (Murray *et al*., 2000). Therefore, the usage of *Vitex doniana* in the treatment of asthma may be attributed to the increased in the sodium and potassium ions, since asthma could be due to hypersensitivity in host defense mechanism.

CONCLUSION AND RECOMMENDATION

From the result of physical examination of the experimental albino rats in all the groups administered with the leaves extracts of *Vitex doniana* and levels of electrolytes i.e potassium, sodium, chloride and bicarbonate ions obtained, it can be inferred that *Vitex doniana* leaves extract at dose of 150-200 mg kg^{-1} could significantly increase serum electrolytes levels and may help in replenishing losses, but like any other drug, it should be taken at a therapeutic dose to be determined. Further studies are however recommended to determine the effect of *Vitex doniana* consumption on other parameters such as creatinine and urea which may further picture the kidney status, as well as to determine the liver enzymes on consumption.

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