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Effect of Ethanol Leaf Extract of *Anthocleista vogelii* on the Kidney Parameters of Albino Rats Exposed to Cadmium Oxide

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ABSTRACT

This work evaluates the ameliorating effect of ethanol extract of *Anthocleista vogelii* leaves on serum electrolytes and kidney parameters of albino rats exposed to cadmium oxide. The electrolyte parameters; Sodium (Na^+), potassium (k^+), chloride (Cl^-) and Bicarbonate (HCo_3^-), with some kidney parameters, creatinine, and urea were assayed.The extract was administered to the rats by oral intubation at a dose of (5mg/kg body weight) daily for 21 days after which electrolytes and kidney function indicators were measured in the serum using a standard method. The result showed that there was significant increase in the serum electrolytes and kidney levels in rats exposed to cadmium oxide. Treatment with (400 or 600 mg/kg body weight) extract showed a significant ($P < 0.05$) reversal effect that mitigated the deleterious effect of cadmium oxide. Thus, indicating that *Anthocleista vogelii*leaves extract maybe useful in the management of both electrolytes' imbalance and kidney alterations in albino rats exposed to cadmium oxide toxicity.
Keywords: *Anthocleista vogelii,* Kidney, Cadmium oxide and Electrolytes.

INTRODUCTION

Naturally, metals are found in the earth's crust with varying compositions among different localities, resulting in spatial environmental concentrations. The metal distribution in the atmosphere is monitored by the properties of the given metal and by various environmental factors [1, 2, 3]. The most commonly found heavy metals in waste water include arsenic, cadmium, chromium, copper, lead, nickel, and zinc, all of which cause risks for human health and the environment [4, 5, 6]. The main objective of this review is to provide insight into the harmful effects of heavy metals on the environment and living organisms.

Cadmium (Cd) is a silvery-white, soft, ductile chemical metal belonging to the group 12 element in d block of the periodic table 5. It is a heavy metal with the atomic number 48. The oxidation of cadmium vapour in air results in the formation of cadmium oxide (CdO) [7]. Cadmium is known as one of the most toxic environmental and industrial pollutant. Its application to industries was developed due to its unique and chemical properties [8, 9]. It has been found that cadmium is one of the most harmful heavy metals capable of inducing serious injury to mammalian organs [10, 11]. Cadmium is the seventh most toxic heavy metal as per ATSDR ranking. It is a by-product of zinc production which humans or animals may get exposed to at work or in the environment. Cadmium oxide as a common by-product of zinc refining, is found in association with zinc ores [12, 13, 14], and also can be found as a colorless amorphous powder, brown or red crystals [15].

Human exposures to cadmium especially people who live or work near waste sites that are harmful or factories that release cadmium into the air have been discovered to suffer from health issues such as damaged lungs, infertility, central nervous system imbalance, Psychological disorder, nephropathy and possibly DNA damage [16]. Cadmium can modulate the cellular level of some electrolytes such as; Sodium (Na^+), potassium (k^+), chloride (Cl^-) and Bicarbonate (HCo_3^-). In higher cadmium exposure, a decrease in serum electrolytes levels may induce the release of calcium, Bicarbonate, sodium and potassium from bone tissues [17]. Cadmium nephropathy is an important determinant of mortality in cadmium workers.Toxic effects on the kidney is dose-related [18]. For workers, the risk of clinical nephropathy increases significantly with total airborne exposures greater than 300 mg/m^3 [19]. Cadmium have been implicated in the depletion of glutathione and protein-bound sulfhydry groups, which leads to enhanced production of reactive oxygen species (ROS) [20]. Damaging consequences of cadmium oxide toxicity can be prevented by employing medicinal plants and spices containing natural antioxidants that can inhibit the generation of free radicals and prevent nephropathy, thereby conferring protection to the kidney [21].

As a result of their therapeutic potential, medicinal plants have been used by man for ages in the treatment of various diseases. Several researches on medicinal plants have led to the discovery of potential drugs for treatment of different ailments [3]. Findings of World Health Organization (WHO) in 2008, showed that more than 80% of the world's population depend on traditional medicine for treatment of various diseases [5].

Anthocleista vogelii is a medicinal plant that is used in treatment of diseases and swelling in the body [19]. It belongs to the family Gentiamuceae an erect, cylindrical tube of about 20m tall [21]. Traditionally, the leaves and stem-bark are known for treating swellings in the body (anti-inflammatory) [20], while the root-bark and leaves are used in local medicine [15].

Phytochemical studies of the leaves of *Anthocleista vogelii* revealed that it consists of flavonoid, saponins, alkaloid, sterols, phenols, and terpenes [11]. The presence of these secondary metabolites in them have been evaluated in different medicinal plants for treatment of ailments locally, thus making the plant species a subject of interest.

[11], reported that the presence of different phytochemicals constituents is an indication of presence of bioactive compounds useful in treatment of diseases like inflammation. Hence, the reason for the choice of *Anthocleista vogelii leaves* as an ameliorating agent foralbino rats exposed to Cadmium oxide toxicity.

MATERIALS AND METHODS

Plant Collection

The fresh leaves of *Anthocleista vogelii* was collected in a nearby bush beside Presco campus, Ebonyi state University, Abakaliki. The leaves were identified by a botanist, Prof.E.Onyekweru of Applied biology Department, Ebonyi State University Abakaliki.

Sample Processing

The sample was allowed to air-dry and turn crispy. The dried leaf sample was ground into power using mechanical grinder and sieved to remove chaff. The fine powders were packed into an

airtight container ready for analytical use.

Preparation of Extract

Exactly, 250g of the powdered sample was weighed into 500ml of absolute ethanol in a plastic container. This was allowed to stand for 72hours with intermittent shaking. The mixturewas filtered with Whatman No. 1 filter paper under reduced pressure. The resulting filtrate was evaporated using rotary evaporator packed in airtight container and stored in refrigerator at 4˚c pending further studies.

Preparation of Vitamin C

Vitamin C was obtained from Octovia Pharmarcy, Water Works Road Abakaliki Ebonyi State University. Exactly, 2g (5 tablets) of Vitamin C tablet was dissolved in 100ml of distilled water to obtain stock solution of 0.02g/ml.

Preparation of Cadmium oxide

Exactly 2g of cadmium oxide powder was dissolved in 100ml of distilled water to obtain a stock solution of 0.02g/ml.

Collection of animals

Adult albino rats were sourced from the animal farm of University of Nigeria Nsukka (UNN), weighing 200g-250g.They were kept in well ventilated and hygienic in the animal house of Biochemistry Department, Ebonyi State University, Abakaliki, Nigeria. During acclimatization, the animals had free access to animal grower feed and clean water.

Experimental Design

Thirty-six adult albino rats were obtained from the Animal house of the Department of Biochemistry, Faculty of Science, University of Nigeria Nsukka (UNN), weighing between 200 g and 250 g. The animals were allowed access to feed and water for a period of fourteen days, for their acclimatization prior to the commencement of the experiment in the animal house of Biochemistry Department. The animals were kept in well ventilated cages at room temperature (28˚ – 30 ºC), and under control lights. The rats were randomly distributed into six groups of six animals each. Group 1: served as the normal control and consisted of animals fed with rat pellet and water only. Group 2: consisted of animals fed with rat pellet and cadmium oxide only (positive control). Group 3: consisted of animals fed with rat pellet, cadmium oxide and Vitamin C (Standard control). Group 4: consisted of animals fed with rat pellet, cadmium and *A. Vogelii* extract (200 mg/kg). Group 5: consisted of animals fed with rat pellet, cadmium oxide and *A. Vogelii* extract (400 mg/kg), whileGroup 6: consisted of animals fed with rat pellet, cadmium oxide and *A. Vogelii* extract (600 mg/kg). *A. Vogelli* extracts (200, 400 and 600 mg/kg bw) was given orally by intubation for 21 days. Cadmium was administered daily (200 mg/L Cd as CdO) in the animals for 21 days to induce toxicity [2].

Collection of blood sample

After twenty-one (21) days, the rats were sacrificed and blood sample collected through venous puncture into a sterile bottle for analysis.

EXPERIMENTAL PROCEDURES

Determination of Urea: Urea level was determined using Urease Berthelot according to Fawcett (1960) as described in Randox commercial kit.

Determination of Creatinine: Creatinine level was determined using Direct Endpoint according to Henry *et al.,* (1974) as described in Randox commercial kit.

Determination of Serum Sodium and Potassium Ion Concentrations: Serum sodium and potassium ion (K^+) concentrations were estimated using colorimetric method based on modified Maruna and Trinders method as described by Trinder (1951).

Determination of Serum Chloride and Bicarbonate Ion Concentrations: Theconcentration of serum Chloride ion (Cl^-) and bicarbonate ($BCO_{3)}$ ion were determined using the turbidometric

method as described by Henry *et al.* (1974).

RESULTS

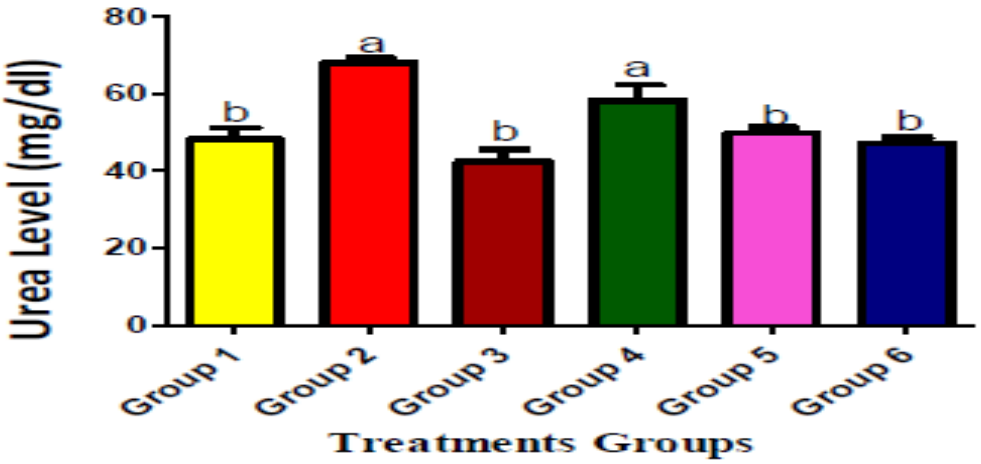

Figure 1. Plot of Urea level in different groups (**Group 1:** Control (Nothing given, only feed), **Group 2:** Heavy metal given, **Group 3:** Heavy metal + Vitamin C, **Group 4:** 200mg + Heavy metal, **Group 5:** 400mg+ Heavy metal, **Group 6:** 600mg + Heavy metal).

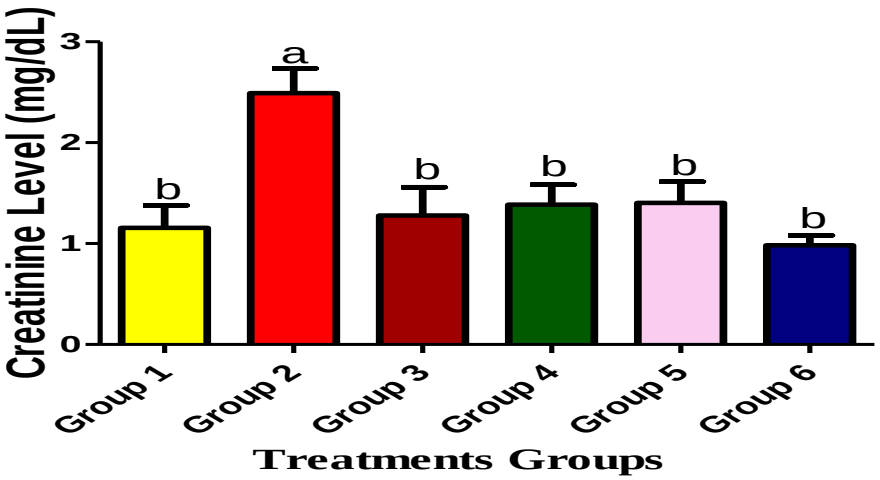

Figure 2. Plot of Creatininelevel in different groups (**Group 1:** Control (Nothing given, only feed), **Group 2:** Heavy metal given, **Group 3:** Heavy metal + Vitamin C, **Group 4**: 200mg + Heavy metal, **Group 5:** 400mg+ Heavy metal, **Group 6:** 600 + Heavy metal).

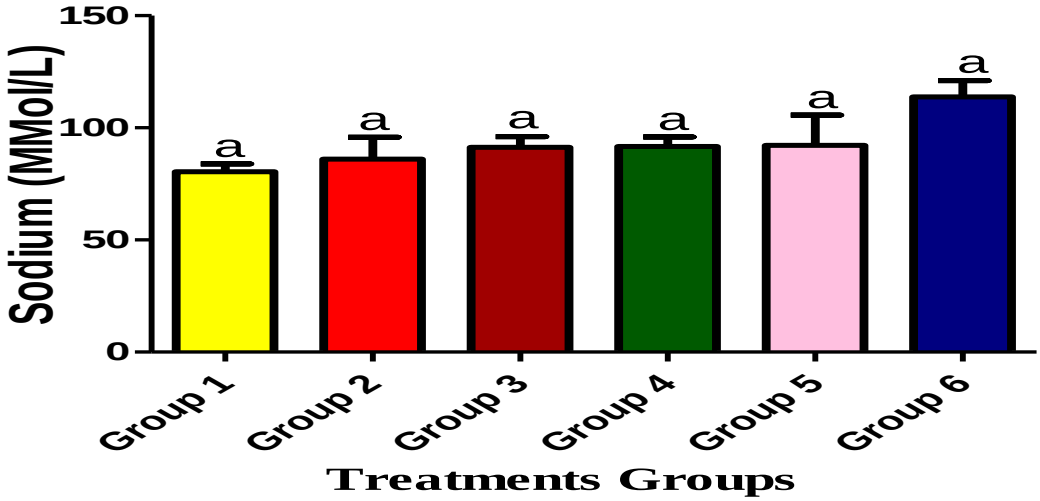

Figure 3. Plot of Sodiumlevel in different groups (**Group 1:** Control (Nothing given, only feed), **Group 2:** Heavy metal given, **Group 3:** Heavy metal + VitaminC, **Group 4:** 200mg + Heavy metal, **Group 5:** 400mg+ Heavy metal, **Group 6:** 600 + Heavy metal).

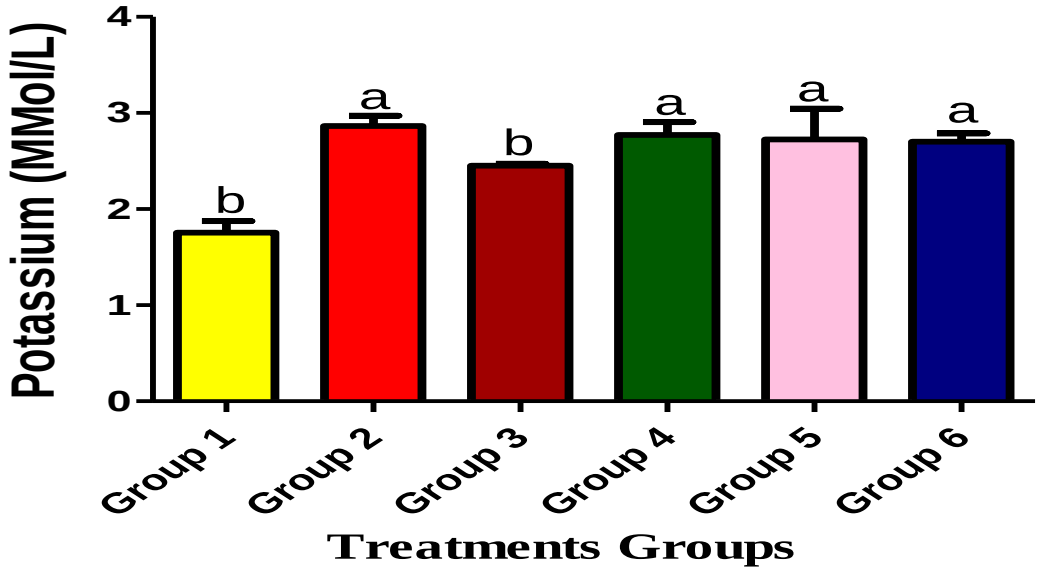

Figure 4. Plot of Potassiumlevel in different groups (**Group 1:** Control (Nothing given, only feed), **Group 2:** Heavy metal given, **Group 3:** Heavy metal + Vitamin C, **Group 4:** 200mg + Heavy metal, **Group 5:** 400mg+ Heavy metal, **Group 6:** 600 + Heavy metal).

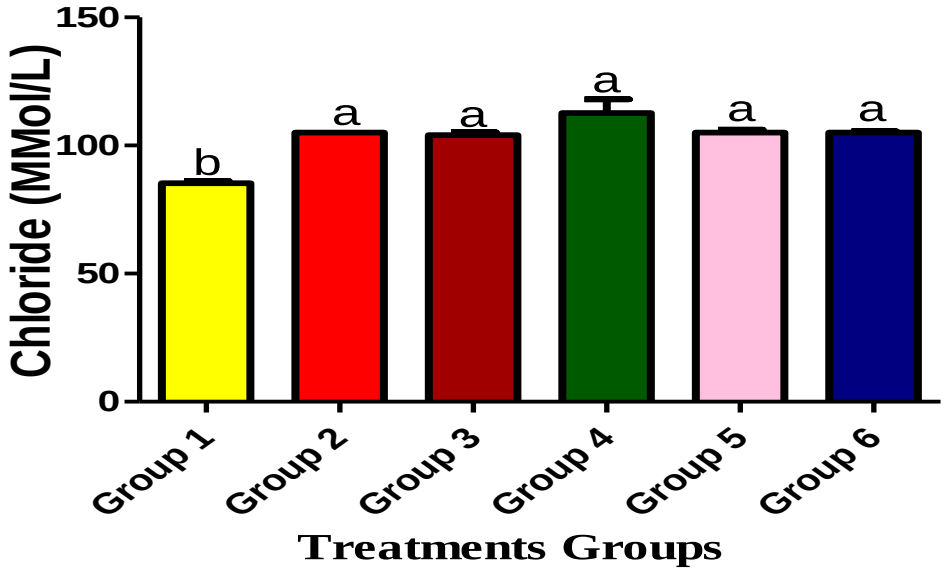

Figure 5. Plot of Chloride level in different groups (**Group 1:** Control (Nothing given, only feed), **Group 2:** Heavy metal given, **Group 3:** Heavy metal + Vitamin C, **Group 4:** 200mg + Heavy metal, **Group 5:** 400mg+ Heavy metal, **Group 6:** 600 + Heavy metal).

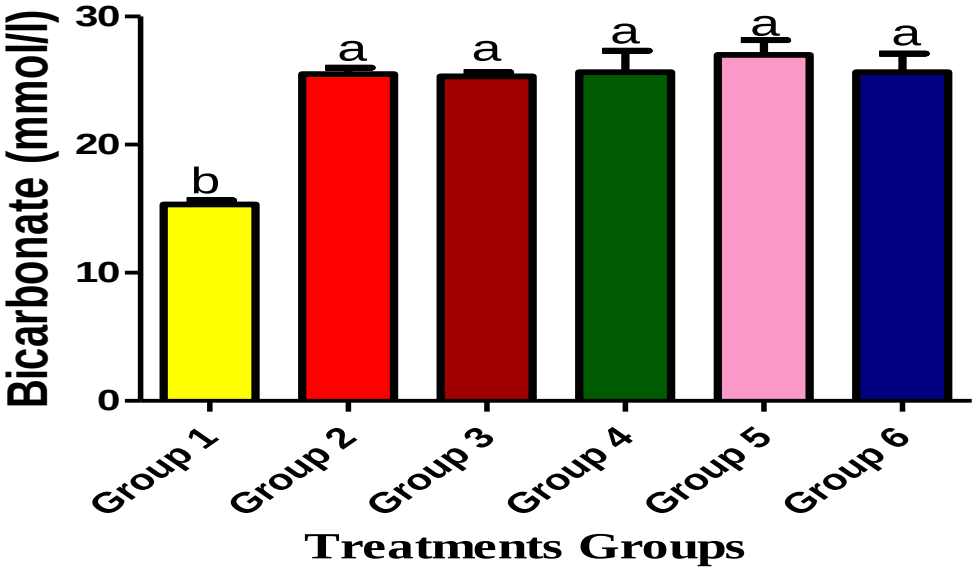

Figure 6. Plot of Bicarbonate level on different groups (**Group 1:** Control (Nothing given, only feed), **Group 2:** Heavy metal given, **Group 3:** Heavy metal + Vitamin C, **Group 4:** 200mg + Heavy metal, **Group 5:** 400mg+ Heavy metal, **Group 6:** 600 + Heavy metal).

DISCUSSION

In this study, the ameliorating effect of the ethanol extract of *Anthocleista vogelii* leaves was used as a potential repair agent against cadmium oxide

induced toxicity in kidney and electrolyte imbalance. *Anthocleista vogelli* was selected based on factors such as availability, common use as a medicinal plant for treatment of diseases and reported antioxidant potential [19]. The results in this present work revealed elevated values of kidney parameters exposed to cadmium oxide toxicity. According to Chaudhary *et al*, 2015, elevated urea levels indicate an impaired kidney function in mammals.

Urea clearance is the amount of blood, which contains the urea excreted in a minute by kidneys.In figure 1, urea level exposed to cadmium oxide only (group2) increased significantly ($p \leq 0.05$) when compared to normal control (group 1- Feed only) The standard drug and the extract, at all doses, were able to reduce the urea, at 200 mg/kg, 400mg/kg and 600 mg/kg dose levels.

Creatinine is a break-down product of creatine phosphate in muscle, which is fairly produced at a constant rate by the body and filtered out of the blood by the kidneys. When the kidney is unable to filter creatinine, creatinine blood levels rise [4]. Hence, the measurement of serum creatinine levels can be useful to indicate renal function and impact caused by exposure to cadmium oxide. A rise in blood creatinine level is observed only with marked damage to functioning nephrons [6].

Creatinine estimation is necessary in jaundice investigation because creatinine measurement is negatively interfered by bilirubin [6]. Creatinine is found in the blood when there is impairment in the kidney. In this study, significant increase ($p \leq 0.05$) was noticed in creatinine level when group 2 was compared with group 1. *Anthocleista vogelii* was able to restore the level of creatinine to normal when the extract was administered at various doses with a noticed significant change especially at 600mg/kg. A significant decrease in the creatinine level was also observed when the standard drug was given. High levels of electrolytes [Sodium (Na_+), potassium (K^+), bicarbonate (HCO_3^-), and Chloride (Cl^-)] in the body are pointers to kidney dysfunction. In this work, all the electrolytes were elevated when group 2 was compared with group 1. The use of the standard drug (Vitamin C) caused significant changes ($p \leq 0.05$) in sodium, potassium, bicarbonate and chloride levels when group 3 was compared to group 2. The extract had no significant effect on the levels of potassium, sodium, chloride and bicarbonate when all the doses of the extract were compared with group 2. This was observed in the previous work of Olatunji and Ogunka-Nnoka, 2019, who reported similar findings in their work, therapeutic effect of ethanol extract of *Anthocleista vogelii* stem bark in the treatment of jaundice in paracetamol-induced hepatotoxicity in adult Wistar rat.

CONCLUSION

The outcome of this study clearly indicates that the ethanol extract of *Anthocleista vogelii* leaves ameliorated the altered kidney function parameters and electrolyte imbalance triggered by cadmium oxide-induced toxicity in the biochemical parameters. The plant therefore could serve as a potent herbal drug for the correction of kidney malfunction and electrolyte imbalance.

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