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Assessment of Kidney Function Status in Chickens (*Gallus gallusdomestica*) in Rural (Elele) and Urban (Nnewi) Areas

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Abstract
Control of accumulation of toxic substances in eco-systems is of great value in the context of global atmospheric pollution. This study investigated the kidney function status of the factory chickens in Nnewi, Anambra State, Nigeria. A total of twenty-nine (29) chicks aged between four (4) and five (5) months were grown to adult birds (chickens) for the study. They were allowed to feed from the surrounding homeland until they were due for the experiment. The chickens were sacrificed to obtain the blood for analyses. Approximately, 5ml of blood sample was collected from the heart into lithium- heparin containers for estimation of biochemical parameters (Na^+, K^+, Cl^-, $HCO3^-$, Urea, and Creatinine). Biochemical parameters were assayed using standard laboratory methods. Thereafter, the data obtained were subjected to statistical analysis by Students t-test using Statistical package for social sciences (SPSS) (Version 16) software and Statistical significance was tested at $P<0.05$. The result revealed a significant decrease in the mean plasma concentration of $HCO3^-$ion in factory chickens than in control ($p<0.05$). Furthermore, the result showed that no significant mean differences were observed between all other kidney parameters of the control and factory chickens ($p>0.05$) respectively, however, while the Na^+, K^+, and Cl^- ions as well as creatinine levels were reduced in the factory chickens, the urea level and urea/creatinine (U/C) ratio was elevated in the factory chickens as against the control. Therefore, this study revealed no deleterious effect on the kidney functions which may be attributed to the short duration of exposure of the factory chickens to the factory sites.
Keywords: *Industrialization, kidney functions, factory chickens, Nnewi.*

Introduction

Industrialization of the modern world has been found to generate compounds which are deleterious to life especially to those who work in such industries. One of the major effluents of some of these industries is‘heavy metals’. Heavy metals refer to any metallic chemical element that has a relatively high density and are toxic or poisonous at low concentrations (PSR, 2013). Also, chemicals such agrochemicals, herbicides, pesticides, halogenated polycyclic hydrocarbons as well as food additives form part of the hazardous chemicals which are constantly introduced into the environment. In Nigeria, the growing rate of industrialization is gradually leading to contamination and deterioration of the environment (Ibeto and Okoye, 2010).

Control or accumulation of toxic substances in eco-systems is of great value in the context of global atmospheric pollution (Lebedeva, 1997). Entire life organisms may often be analyzed more easily than abiotic samples. Also, the fluctuation of toxicants in the environment related to decreases in toxic emissions are possible, however, the toxicants accumulated in organisms, as well as different indirect factors related to pollution, may significantly influence the biota even if the discharges have been stopped for a period of time. Birds are traditional objects of biological monitoring in polluted ecosystems, especially in territories adjacent to stationary sources of pollution. Extensive studies on heavy metal concentration in birds have been conducted in most polluted areas of the world (Okpogba *et al*., 2018). It was demonstrated, with reference to pigeons and sparrows (Kendall and Scanlon, 1981), that the lead concentrations in urban populations of birds were 6-8 times higher than in birds living in agricultural habitats. Meat and meat products are important for human diet because they provide a great part of nutrients, including the necessary trace elements. Heavy metal from man-made pollution sources are continuously released into aquatic and terrestrial ecosystems and therefore, the concern about the effect of anthropogenic pollution on the ecosystems is growing. These metals are accumulated along the food chain of which chickens are an integral part (Demirezen and Urue, 2006). These pollutions often have direct physiological toxic effects because they are stored or incorporated into tissues, sometimes permanently (Mariam *et al.*, 2004).

The kidney is the first target organ of heavy metal toxicity because of its ability to reabsorb and accumulate divalent metals. The extent of renal damage by heavy metals depends on the nature, the dose, route and duration of exposure (Barbier *et al*., 2005). Many of the effluents of such industries have been known to compromise liver and kidney functions in artisans occupationally exposed to them (Dioka *et al.*, 2004; Wu *et al.*, 2012). Chronic (long-term exposure) effects of Cu can damage the liver and kidneys (Niebeor *et al.*, 2007).It has been reported that some of these metals are nephrotoxic, for example, chronic exposure of lead acetate or acute intravenous injection of it in rats and mice cause marked stimulation of mitosis in the proximal renal tubular cells (Choice and Richer, 1974a).Pb induces renal tumors, reduces cognitive development and increased blood pressure and cardiovascular disease risks in adults (Ikem and Egiebor, 2005). Lead poisoning is a potent factor in brain damage, mental impairment with severe behavioral problems, as well as anaemia, kidney insufficiency, neuromuscular weakness and coma (Donald *et al.*, 2006).

In Nigeria, chicken meat, gizzard and turkey meat are a major source of protein to the population and are widely consumed (Akan *et al.*, 2010; Abdullahi *et al.*, 2013). It has been severally reported that some heavy metals accumulate in the tissues of animal species that live around sources of environmental pollutants and when consumed may pose a threat to human health. Therefore, this study investigated the kidney function status of the factory Chickens in Nnewi, Anambra State, Nigeria.

Materials and Methods

Experimental design

A total of twenty-nine (29) chicks were grown to adult birds (chickens) for the study. The chicks in the exposed group were obtained from the surrounding households, about 250m, to these factories under study(lead acid battery manufacturing factory, cable manufacturing factory, metal fabricating factory and metal forging factory) while the chicks to serve as control were obtained in Elele. They were aged between four (4) and five (5) months. They were allowed to feed from the surrounding homeland until they were due for the experiment. Control chickens of the same age group were obtained from environments outside Nnewi. The chickens were sacrificed to obtain the blood for analyses.

Collection of blood from the chickens

At the end of the study period that lasted eighteen (18) weeks, the (birds) chickens were each anaesthetized with ether soaked in absorbent cotton wool and kept in a dessicator with the lid firmly put in place to prevent evaporation. Approximately, 5ml of blood sample was collected from the heart into lithium- heparin containers for estimation of biochemical parameters (Na^+, K^+, Cl^-, $HCO3^-$, Urea, and Creatinine). Determination of plasma electrolytes (Na^+, K^+, and Cl^-, $HCO3^-$)was done using Ion Selective Electrode (ISE) method, Serum urea was assayed by Berthlot method as described by Taussky, (1956), while creatinine was estimated using Jaffe-Slot alkaline picric acid method as described by Ochei and Kolhatkar, (2007).

Ethical Consideration

Ethical approval for the research was obtained from Ethical Committee, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria (NAUTH/CS/66/Vol.2/149).

Statistical Analysis

The data were presented as mean±SEM and the mean values of the control and test group were compared by Students t-test using Statistical package for social sciences (SPSS) (Version 16) software. Statistical significance was tested at $P<0.05$.

Results

The result revealed a significant decrease in the mean plasma concentration of $HCO3^-$ ion in factory chickens than in control ($p<0.05$). There was no significant mean differences observed between all other kidney parameters of the control and factory chickens ($p>0.05$), however, while the Na^+, K^+, Cl^- ions and creatinine levels were reduced in the factory chickens, the urea level and urea/creatinine ratio was elevated in the factory chickens as against the control, (See table 1).

Table 1: Kidney function status of factory chickens (250m away from the factory)

Chickens	Na^+ (mmol/L)	K^+ (mmol/L)	Cl^- (mmol/L)	$HCO3^-$ (mmol/L)	Urea (mmol/L)	Creatinine (µmol/L)	Urea/Creatinine ratio
Control (n=13)	155.38±5.78^a	4.83±0.96^a	125.15±6.71^a	22.77±3.22^b	1.09±0.29^a	45.31±6.40^a	25.00±8.58^a
Factory (n=16)	149.62±10.80^a	4.66±1.32^a	124.38±5.96^a	19.50±2.63^a	1.31±0.43^a	43.63±16.74^a	34.44±17.35^a

Values in mean (±SD); within column, mean with different superscripts are statistically significant ($p<0.05$).

Discussion

The kidney plays a central role in regulating the concentration and volume of body fluids while ensuring the removal or elimination of waste products or toxic substances from the body. This study evaluated the kidney function status of *Gallus gallusdomestica* (chickens) reared around factory sites (lead acid battery factory, cable manufacturing factory, metal fabricating factory and metal forging factory) in Nnewi, Anambra State, Nigeria.

In this study, the mean plasma bicarbonate concentration was significantly decreased in the factory chickens (Urban chickens) when compared with the control (19.50±2.63 Vs 22.77±3.22; $p<0.05$). This may be suggestive of metabolic acidosis; a condition which occurs as a result of an increased production of hydrogen ions by the body or due to the inability of the body to form bicarbonate in the kidney. Metabolic acidosis may result from diabetic ketoacidosis, lactic acidosis, kidney disease, or ingestion of toxins such as methanol, ethanol, ethylene glycol etc (Sembulingam and Sembulingam, 2010). This is in contrast with the report of Dioka *et al*., (2004).

Also, the result showed a decrease in the mean plasma levels of sodium, potassium, chloride and creatinine concentration in the factory chickens than in the control group, although not statistically significant ($p>0.05$), whereas, the mean plasma urea concentration was elevated, though non-statistically significant ($p>0.05$). Elevated urea concentration is an indication of renal dysfunction (Narayanan and Appleton, 1980). Our findings are in consonance with the report of Dioka *et al*. on the liver and renal function tests in artisans occupationally exposed to lead (Pb) in mechanic village in Nnewi, Nigeria (Dioka *et al*.,2004). They found no statistical significant differences in the mean plasma levels of sodium, potassium and chloride ions, as well as in urea and creatinine concentrations which they attributed to the kidney's considerable reserve capacity, stating that kidney impairment does not become evident until more than 50% of the functional nephrons have been destroyed (Goodman, 1985). Additionally, our findings may be as a result of the short duration of exposure of the factory chickens to the factory sites.

Conclusion

In conclusion, this study revealed a significant decrease in the mean plasma bicarbonate concentration in the factory chickens when compared with the control. However, all other renal parameters studied were similar in both groups. Therefore, this study revealed no deleterious effect on the kidney functions which may be attributed to the short duration of exposure of the factory chickens to the factory sites.

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