AMM -14

Effect of Heavy Metals in Borehole Water on Broiler Chickens in Delta State

J.U. Unukevwere[1], Anthony D. Ologhobo Timothy[2], T. Kuka[3] and Oghenebrorhie Obakanurhe[1]
[1]Department of Animal Science, Delta State University Abraka; [2]Department of Animal Science, University of Ibadan;[3]Department of Animal Health and Production Technology, Fed. College of Agric. Ishiagu
Corresponding author: J.U. Unukevwere; E-mail: unukesjrom@gmail.com, 08120549077

Abstract
This study was conducted to evaluate the effect of heavy metals from the environment through ground water on chickens in some selected farms in Delta State, Nigeria. Concentration of some heavy metals Cadmium (Cd), Vanadium (V), Nickel (Ni), Iron (Fe) and Mercury (Hg) in ground water and their bioaccumulation in chicken tissues were evaluated and compared with the World Health Organization (WHO) standard for drinking water. 21 poultry farms were selected, water samples were collected analysed for Cd, Fe, Ni, V and Hg. Blood samples were also collected from broilers from these farms into sterile bottles and allowed to coagulate. The results indicated that heavy metals concentration in water samples were high compared to WHO standards for drinking water.

Key words: Drinking water, muscle tissues, Serum, heavy metals, chicken.

Introduction
Unsustainable oil exploration activities have rendered the Niger Delta region as one of the five most severely petroleum damaged ecosystems in the world (Odeyemi and Ogunseitan, 1985). Oil spillages from the oil industries located primarily in the Niger Delta region have caused massive destruction to farmlands, sources of drinking water, mangrove forest, fishing grounds and reduction of aquatic creatures which are source of income for the Niger Delta people (Tolulope, 2004).

Gas flaring in the area is a major source of Nox and particulate matter and the cumulative environmental impact of these flaring activities result in contaminant build up on land, shallow ground water, greenhouse effect and general global warming. Water is needed by all living things and the possible pollution of water with heavy metals, have a devastating negative effects on human and animals including fish. Furthermore, water pollution pose a serious threat to society today and in the future (Grossman, 2006). Crude oil heavy metals contamination of water sources is a common occurrence in the Niger Delta area of Nigeria where most of the water supply is derived from shallow and uncontained aquifers. Its deleterious effects on animals' lives and the environment know no bound as it affects growth and reproduction (Akporhuarho *et al*., 2011).

Food safety has stimulated research regarding the risk associated with consumption of foods contaminated with heavy metals (D'Mello, 2003). Some of the heavy metals that are known as potentially toxic include cadmium, mercury, lead, nickel, iron and vanadium which play a definite role in the intrinsic mechanisms regulating biological processes; toxic elements can be harmful even at low concentrations when ingested over a long period of time (Young, 2005).

The present study aimed at the determination of Cadmium, Vanadium, Nickel, Iron and Mercury in broiler chickens from representative poultry farms in Delta state.

Materials and Methods
This study was carried out in Delta state. A total of 21 farms were sampled, 3 farms in each Zone, across 7 Ethnic zones in Delta State. Water samples were collected in glass containers, and caped tightly immediately after collection. Water samples were treated with approximately 3 ml of HNO_3 and deionised water per 250ml in a 1:3 (USEPA, 2002). Water samples were analysed for heavy metals - Nickel (Ni), Mercury (Hg), Vanadium (V) Iron (Fe) and Cadmium (Cd) Alpha (1995) and Abdel Kader, (1994). Data were subjected to analysis of Variance, while means were separated by LSD.

Serum was collected and used for determination of liver enzymes such as Aspartate amino transferase (AST), Alanine amino transferase (ALT), Alkaline phosphatase (ALP). Furthermore, muscle tissues from the breast cut of broiler chickens were prepared and analysed using the Atomic absorption spectrophotometer for Cd, Fe, Ni, V and Hg concentration

Results and Discussion

Table 1 showed the mean concentration (ppb) of vanadium, cadmium, iron, nickel and mercury in water samples from different zones with crude oil exploration. The results from these studies clearly showed that there were very high levels of heavy metals in the water samples from poultry sites in different zones, particularly for Vanadium, cadmium and iron, which were above the permissible limits, when compared with the national and international organizations limits (WHO, 2008). These results were similar to those of Chaitali *et al*. (2013) who reported that well and borehole water samples contain high concentrations of cadmium, above the WHO's maximum acceptable concentration (MAC). It is obvious that the examined water samples for vanadium in zones 2 and 3 (Isoko and Itsekiri) exceeded the permissible limits, while cadmium and iron across the zones also exceeded the permissible limits indicative of water pollution (Cd=0.005, and Fe=0.3 ppm) and poor water quality standard (WHO, 2008).

Heavy metals in drinking water samples are related with chronic diseases and health impact. These elements have no beneficial effects in humans, and there is no known homeostasis mechanism for them (Draghici *et al*., 2010; Vieira *et al*., 2011). They are generally considered the most toxic to humans and animals; the adverse human health effects associated with exposure to them, even at low concentrations, are diverse and include, but not limited to, neurotoxic and carcinogenic actions (Jomova & Valko, 2011; Tokar *et al*., 2011). Iron is an essential dietary element for humans and animals as it is an essential compo 2nent of haemoglobin. Iron facilitates the oxidation of carbohydrates, proteins, and fats to control body weight. Low iron concentration level increases suitability to gastrointestinal infections, nose bleeding, and myocardial infarctions (Hunt, 1994).

Table 1: Concentration of heavy metals in water samples (ppb) in Delta state

	ZONES								
Parameters	1	2	3	4	5	6	7	SEM	P. Limit
Vanadium	0.067^{b}	22.290^{a}	29.189^{a}	0.059^{b}	0.055^{b}	0.023^{b}	0.054^{b}	2.26	--------
Cadmium	15.682^{b}	15.819^{b}	22.317^{a}	8.752^{c}	11.800^{bc}	7.863^{c}	10.113^{bc}	0.83	0.00-0.005
Iron	2002.2^{a}	1162.0^{ab}	1334.6^{ab}	619.9^{b}	577.1^{b}	497.8^{b}	1275.1^{ab}	118.23	0.3
Nickel	0.010^{b}	0.013^{a}	0.001^{b}	0.017^{a}	0.003^{b}	0.002^{b}	-0.009^{b}	0.002	0.00-1.12
Mercury	0.001^{b}	0.009^{b}	0.030^{a}	0.001^{b}	0.003^{b}	0.002^{b}	0.025^{a}	0.002	1.00-2.68

$^{ab:}$ means in the .same rows with different superscripts are significantly (P<0.05) 0different.; Zones: 1= Urhobo, 2=Isoko, 3=Itsekiri, 4=Ijaw, 5=Ukwani, 6=Aniocha and 7=Ika. P. =Permissible

Serum biochemical parameters of broilers are presented in Table 2. Aspartate amino transferase (AST) values of birds of birds across zones showed no significant variation. Alkaline phosphatase (ALP) value of birds on zone 5 (101.51 IU/L) had the highest value and was significantly different from the values observed for birds on zones 1 and 6 (77.00 and 78.43), but showed no significant difference from the values obtained for birds on zones 2, 3, 4 and 7 (84.53, 80.25, 81.71 and 996.85 IU/L). While zones 1 and 6 (77.00 and 78.43) had the lowest values compared with other zones, but were not significantly (p<0.05) different from the values observed for birds in zones 2, 3, 4 and 7 (84.53, 80.25, 81.71 and 996.85 IU/L) respectively. The Alanine amino transferase (ALT) of birds in zones 5 (52.99) had the highest value compared with values across all other zones and was significantly (P<0.05) different from values obtained for birds in all other zones 1, 2, 3, 4, 6 and 7 (27.70, 21.62, 29.50, 28.73, 28.10 and 38.98 IU/L).

Table 2: Serum biochemistry of broiler chickens from poultry farms in Delta State

	Zones						
Parameters	1	2	3	4	5	6	7
Albumin (g/dL)	4.0620^{b}	1.4030^{d}	$2.\ 8630^{c}$	2.8780^{c}	3.9093^{b}	3.5035^{bc}	4.7380^{a}
Direct bilirubin	0.66	0.34	0.53	0.42	0.58	0.60	0.84
Indirect bilirubin	0.8737^{a}	0.4537^{c}	0.5964^{bc}	0.5686^{bc}	0.7228^{ab}	0.7150^{ab}	0.8773^{a}
Total Protein (g/dL)	13.1933^{a}	13.4739^{a}	12.2474^{ab}	8.1000^{c}	12.6017^{ab}	11.3643^{b}	11.9150^{ab}
Cholesterol (mg/dL)	98.12	101.74	198.17	98.58	96.64	113.97	99.61
Uric acid (mg/dL)	3.0667^{a}	2.1778^{ab}	1.3556^{b}	2.0444^{ab}	2.6111^{a}	2.5333^{a}	2.4111^{ab}
AST (IU/L)	20.44	13.78	16.67	13.00	17.67	15.22	40.33

ALP (IU/L)	77.001^{b}	84.534^{ab}	80.252^{ab}	81.706^{ab}	101.511^{a}	78.435^{b}	96.853^{ab}
ALT (IU/L)	27.698^{bc}	21.618^{c}	29.498^{bc}	28.733^{bc}	52.989^{a}	28.095^{bc}	38.975^{b}

^{abcd}: means in the same row with different superscripts are significantly (p<0.05) different. ALT- Alanine amino transferase, AST- aspartase amino transferase, ALP- alkaline phosphatise.

The ALT value of birds on zones 7 (38.98) was significantly different (p<0.05) from the values obtained for birds on zone 2 (21.62), but was not significantly different (p<0.05) from those obtained from zones 1, 3, 4 and 6 (21.62, 29.50, 28.73, 28.10 and 38.98 IU/L). Value observed for birds in zone 2 (21.62) had the lowest compared with ALT values obtained from all other zones. Low level of ALT is an indication of no toxic effect within the liver parenchyma of the birds, while higher levels indicate liver toxicity of birds.

Table 3: presented the concentration of Vanadium, Cadmium, Iron, Nickel and Mercury in meat samples (ppb) of broilers from crude oil exploration areas. Although the results from previous studies on underground water clearly showed that there were high levels of some heavy metals present in the water samples from poultry sites in different zones, particularly for Vanadium, cadmium and iron, above the permissible limits, and Nickel and Mercury within the tolerable levels, when compared with the international organizations (WHO, 2008). Yet the concentration of these metals in the meat samples were below the permissible limits recommended by WHO, (2008). The trace amounts of heavy metals detected in the muscle tissues of broiler chickens showed the current status and against the background high levels of heavy metals particularly vanadium, cadmium and iron concentrations in underground water, available in the poultry sites. This report is in line with that of Marettova *et al*. (2003) and Cabanero *et al*. (2005), who detected low levels of mercury in chicken muscle, blood tissues and organs when fed diets.

Table 3: Concentration of heavy metals in meat samples (ppb) of broiler chickens in Delta State

	Zones							
Parameters	1	2	3	4	5	6	7	SEM
Vanadium	0.2272^{ab}	0.4750^{a}	0.1950^{ab}	0.1778^{ab}	0.0681^{b}	0.1797^{ab}	0.001^{b}	2.26
Cadmium	1.4921^{a}	0.2326^{b}	0.1658^{b}	0.1861^{b}	0.1248^{b}	-0.002^{b}	-0.002^{b}	0.83
Iron	1.6143	1.6786	1.7534	1.4252	1.4552	1.5032	1.4068	118.23
Nickel	0.003	-0.002	-0.002	-0.001	-0.001	-0.001	-0.002	0.002
Mercury	0.336^{a}	0.227^{ab}	0.168^{ab}	0.112^{ab}	0.116^{ab}	0.122^{ab}	0.004^{b}	0.002

^{ab}: means in the same row with different superscripts are significantly (p<0.05) different.

Conclusion

Water samples from poultry farms across seven zones in Delta State contained varying levels of vanadium, cadmium and Iron above permissible limits, therefore pose a dangerous threat to human health and quality of the of poultry products at prolonged exposure. It is recommended that water sources from the area should be routinely monitored to ascertain its suitability for drinking and other purposes.

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