IOSR Journal of Applied Chemistry (IOSR-JAC)
e-ISSN: 2278-5736.Volume 8, Issue 1 Ver. II. (Jan. 2015), PP 57-59
www.iosrjournals.org

Effect of Different Levels of Cadmium, Lead and Arsenic on the Growth Performance of Broiler and Layer Chickens

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Abstract: *A total number of sixteen (16), one day old of commercial broiler and layer chicks, eight per each chicken type were used to study the effect of cadmium, lead and arsenic on their growth performance from one day to 56 days. The chicks were raised in a cage made up of eight partitions and fed with feeds mixed with specific concentrations of Pb, As and Cd which are 0ppm, 10ppm, 20ppm and 30ppm respectively in the specific partitions. The 16 chickens were analyzed for heavy metal accumulation in their internal organs using flame atomic absorption spectrometer and the result showed that the metals increased as follows; Cd > Pb > As. The result of the body weight of the chickens from 0 – 56day period showed a remarkable decrease as the concentration of the metals were increased in the respective partitions from 0 to 30ppm. There were also a remarkable decrease in feed intake as the concentration of the metals increased from 0 to 30ppm. For the partition fed with 0ppm of the heavy metals, the range of the body weights of the chickens after 56 days were 1800 – 2350g, 10ppm; 1210 – 1600g ; 20ppm; 1020 – 134g and 30ppm; 820 – 1100g.*

Keywords: *Cd/Pb/As metals, Broiler, Layer chickens, growth performance*.

I. Introduction

Metals are redistributed naturally in the environment by both geologic and biological cycles (Ng et al; 1981). Environmental pollution with heavy metals is considered a very serious concern because these metals cannot be degraded and stay permanently in the environment (Baykov et al; 1996).

The metals of particular concern in relation to harmful effects on health are mercury, lead, cadmium, tin and arsenic. The toxicity of these metals has two main aspects, the fact they have no known metabolic function but when present in the body disrupt normal cellular processes leading to toxicity and the potential of these heavy metals to accumulate in biological tissues, a process known as bio accumulation (Mariam et al., 2004). This occurs because the metals, once taken up into the body is stored in particular organs, for example the liver and the kidney (Demerezen et al., 2006).

(Hassan et al., 1998) conducted experiment with multiple heavy metals including cadmium, lead and mercury added to water at high and low concentrations for 7 weeks. They reported subtle adverse effects on the immune system of the chicks.

Also, they reported clinical sings which include retarded growth, weight loss, salivation and low feed intake during the 7 week period. (Miklos, 2004) observed that birds fed with more than 30ppm of lead in their diets experienced poorer growth and low egg production.

To provide further information concerning the toxicities of lead, cadmium and arsenic at different concentration on the growth performance of the chickens, this study was undertaken.

II. Materials And Methods

Sample Collection: The sixteen chick's one day old were purchased in Awka main market, Awka South Local Government Area, Anambra State.

Sample Preparation

The chicks were raised two each in an eight partition cage constructed by the researchers and were fed with feeds contaminated with specific prepared concentrations of lead, arsenic and cadmium which were at 0ppm, 10ppm, 20ppm and 30ppm in the respective partitions.

A weighing balance was used to monitor the body weight of the chickens within the eight weeks period. The chickens were butchered after wards and the heavy metals (Pb, Cd and As) were analyzed in their internal organs (muscle, gizzard, liver and kidney) using flame atomic absorption spectrometer after acid digestion with a mixture of perchloric and nitric acids in the ratio of 2:3.

Appropriate quality assurance procedure and precautions were carried out to ensure reliability of the results. In all metal determinations, analytical blanks were prepared in similar manner. All glass wares were carefully cleaned with a solution of 10% nitric acid followed by rinsing with deionized water.

III. Results And Discussions

Table 1: Mean concentration of lead in the internal organs of broiler and layer chickens after two months administration of varying concentrations in the feeds (mg/g).

Parts / Conc.(ppm)	0	10	20	30
Muscle BR	0.073 ± 0.002	0.421 ± 0.001	0.744 ± 0.013	1.003 ± 0.004
Muscle LA	0.059 ± 0.001	0.303 ± 0.001	0.523 ± 0.001	0.831 ± 0.002
Gizzard BR	0.087 ± 0.007	0.846 ± 0.021	1.331 ± 0.001	1.846 ± 0.001
Gizzard LA	0.069 ± 0.001	0.617 ± 0.001	1.027 ± 0.001	1.507 ± 0.004
Liver BR	0.133 ± 0.001	1.280 ± 0.001	1.910 ± 0.001	2.956 ± 0.002
Liver LA	0.115 ± 0.001	1.246 ± 0.002	1.759 ± 0.001	1.759 ± 0.001
Kidney BR	0.105 ± 0.001	1.313 ± 0.001	1.709 ± 0.001	2.284 ± 0.001
Kidney LA	0.099 ± 0.001	1.153 ± 0.001	1.572 ± 0.003	1.981 ± 0.001

Table 2: Mean concentration of cadmium in the internal organs of broiler and layer chickens after two months administration of varying concentrations in the feeds (mg/g).

Parts / Conc.(ppm)	0	10	20	30
Muscle BR	0.082 ± 0.002	0.581 ± 0.001	0.809 ± 0.011	1.011 ± 0.007
Muscle LA	0.071 ± 0.001	0.319 ± 0.001	0.576 ± 0.001	0.876 ± 0.001
Gizzard BR	0.138 ± 0.014	0.926 ± 0.000	1.403 ± 0.002	1.858 ± 0.001
Gizzard LA	0.108 ± 0.001	0.701 ± 0.001	1.014 ± 0.001	1.550 ± 0.003
Liver BR	0.142 ± 0.002	1.327 ± 0.001	1.973 ± 0.001	2.888 ± 0.001
Liver LA	0.122 ± 0.001	1.302 ± 0.002	1.874 ± 0.001	2.606 ± 0.001
Kidney BR	0.116 ± 0.001	1.510 ± 0.002	1.844 ± 0.002	2.434 ± 0.001
Kidney LA	0.106 ± 0.001	1.272 ± 0.004	1.711 ± 0.001	2.014 ± 0.001

Table 3: Mean concentration of arsenic in the internal organs of broiler and layer chickens after two months administration of varying concentrations in the feeds (mg/g).

Parts / Conc.(ppm)	0	10	20	30
Muscle BR	0.099 ± 0.001	0.704 ± 0.001	0.830 ± 0.024	1.102 ± 0.002
Muscle LA	0.068 ± 0.001	0.590 ± 0.001	0.771 ± 0.001	0.922 ± 0.001
Gizzard BR	0.106 ± 0.005	0.759 ± 0.001	1.030 ± 0.001	1.340 ± 0.001
Gizzard LA	0.218 ± 0.001	0.668 ± 0.001	0.865 ± 0.001	1.208 ± 0.004
Liver BR	0.113 ± 0.002	0.973 ± 0.002	1.241 ± 0.001	1.911 ± 0.001
Liver LA	0.094 ± 0.001	0.831 ± 0.001	1.051 ± 0.001	1.778 ± 0.005
Kidney BR	0.098 ± 0.002	0.823 ± 0.001	1.041 ± 0.001	1.511 ± 0.003
Kidney LA	0.089 ± 0.002	0.775 ± 0.001	0.950 ± 0.001	1.450 ± 0.004

Table 4: Layer's body weight response to feeds contaminated with different concentration of heavy metals (Pb, As and Cd) fed for a period of two months

Weekly Weights / Heavy Metals conc.	Initial Weight	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week
0ppm	100g	220g	355g	510g	825g	1015g	1385g	1510g	1810g
10ppm	90g	190g	285g	410g	615g	755g	840g	1090g	1215g
20ppm	100g	200g	265g	340g	465g	640g	795g	920g	1030g
30ppm	90g	175g	235g	270g	375g	615g	620g	740g	830g

Table 5: Broiler's body weight response to feeds contaminated with different concentration of heavy metals (Pb, As and Cd) fed for a period of two months.

Weekly Weights / Heavy Metals conc.	Initial Weight	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week
0ppm	100g	240g	390g	630g	865g	1450g	1860g	2090g	2320g
10ppm	90g	210g	305g	460g	610g	815g	1130g	1325g	1580g
20ppm	105g	200g	265g	340g	540g	675g	835g	1000g	1250g
30ppm	105g	180g	240g	295g	420g	520g	765g	940g	1070g

Tables 1 – 3, showed the accumulation of the studied heavy metals in the internal organs of the chickens after two months administration.

As the concentration of the heavy metals administered to the chickens in their feeds increased from 0 to 30ppm, so did the accumulation in the internal organs increased from the muscle to the liver. The heavy metals

accumulated highest in the kidney's and liver's which was a confirmation of research findings by (Musa et al., 2013).

The chickens fed with 30ppm of the heavy metals in their feeds gave the highest range of mean concentrations of the metals in their internal organs which were from 0.831 to 2.958 mg/g; 20ppm, 0.523 to 1.973 mg/g; 10ppm, 0.303 to 1.510 mg/g and the lowest 0ppm, 0.059 to 0.142 mg/g.

Tables 4 and 5, showed that the chickens fed with 0ppm of the heavy metals in their feeds gave the highest body weights of 2320g and 1810g for the broiler and layer chickens respectively at the end of the eight weeks period.

Their was a comparative decrease in body weights of the chickens over the eight weeks period as the heavy metals concentration increased from 0 to 30ppm.

At the end of the eight weeks period the lowest body weights of 1070 and 830g were recorded for the broiler and layer chickens respectively fed with 30ppm of the heavy metals in their feeds.

(Neisham et al., 1979) stated that a well fed broiler and layer chickens should have body weight above 1700g respectively after eight weeks of feeding. The above statement is in agreement with the observation in this study of the body weights of the layer and broiler chickens fed with 0ppm of the heavy metals in their feeds over the eight weeks period.

The decline in body weights of the chickens fed 10ppm, 20ppm and 30ppm of the heavy metals respectively through their feeds was an indication of toxicity to the chickens. By the beginning of the 3rd week, the researchers observed earlier signs of low feed intake, low digestibility and loss of body weight which resulted to gizzard, liver and kidney shrinkage and discolouration when the chickens were slaughtered at the end of the monitoring.

These toxicity signs manifested by the chickens became prominent as the concentration of the heavy metals increased in the feeds and analysis of the internal organs of the chickens after slaughter indicated high accumulations of the heavy metals in the liver and kidney.

(Miklos, 2004) reported that high concentrations of heavy metals in the feed fed to poultry birds results to chronic toxicity. He enumerated the toxic effects to include retarded growth, weight loss, low feed intake and glomerilo neglrithis. (Musa et al.,2013) reported that increased Cd intake depressed body weight gain probably because of decreased feed intake and feed conversion ratio. They concluded that the oxidative stress induced by cadmium and lead plays a role in decreasing the performance of chickens.(Mariam et al ., 2004) reported generalized signs of acute toxicities of arsenic and lead include decreased feed intake, loss of weight, decreased egg weight and production, suppressed immune response, retarded growth rate , loss of appetite and in some cases death.

IV. Conclusion

The study was conducted to evaluate effects of exposure of poultry chickens to heavy metals (Pb, As and Cd) on their growth performance. The study observed that increase in heavy metal concentrations in the feeds fed to chickens could retard their growth rate and body weights.

The study noted that signs of increased heavy metal toxicity to the chickens include feed refusal, loss of appetite, weight loss and organ malfunction which ultimately affected their growth rate and performance.

The research showed that poultry birds when exposed to heavy metals consistently at high concentrations either through their feeds or drinking water could adversely affect the growth rate and body weight of the birds.

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