Liver Histopathology of Chickens Fed With Aluminium Phosphide-Treated Maize-Based Diets

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Abstract. Pesticides are used in agriculture to protect crops but residues of synthetic pesticides have adversely affected the environment, livestock and man. However, information on toxic effects of these pesticides on livestock in Nigeria is scanty. Therefore, the study was conducted to assess toxicity of insecticides on chickens. Fourteen-week old Nera black hens (n=60) were allotted into three treatments and fed Aluminium phosphide (AlP)-treated maize-based diets. T1 was the control diet. T2, T3, T4 and T5 contained maize grains fumigated with 1.04 g of AlP tablet per 25 kg of maize grains fumigated for 2 weeks, 2.08 g of AlP tablet per 25 kg of maize grains fumigated for 2 weeks, 1.04 g of AlP tablet per 25 kg of maize grains fumigated for 4 weeks, and 2.08 g of AlP tablet per 25 kg of maize grains fumigated for 4 weeks respectively. Each diet was fed for 10 weeks. The study lasted for ten weeks. The experimental design was a completely randomized design. Each treatment had three replicates with 20 birds per treatment. Slide preparation and microscopy of the tissues were carried out at the Department of Clinical Pathology, University of Ibadan, Nigeria. Liver histopathology showed mild, moderate and severe congestion of blood vessels.

Keywords: Aluminium phosphide, chickens, maize, liver histopathology, toxicity

1. INTRODUCTION

Food loss cannot be over-emphasised. Food loss could occur after planting, on the field and after harvesting. Ware and Whitcare (2004) remarked that about one-third of the world’s food crop is lost by insect pests. Maize is one of the most important cereal food crops in Nigeria. Maize is primarily used for animal feed, food, and industrial uses. One class of livestock that utilises maize predominantly as feed ingredient is poultry. Poultry is kept in most areas of the world. Poultry production is faced with fewer religious and social taboos. Poultry have short generation interval, they are good and efficient feed converter as well as being highly productive among other factors of economic importance (Smith, 2001).

George (2005) recommended that steps to be taken to ensure food security include use of improved crop varieties, expansion of crop acreages, improved methods of cultivation, as well as improved crop protection. Chemical method of pest control is extensively used over the years, and the results of researches have shown that chemical control with the use of pesticides is an efficient means of controlling, reducing and combating agricultural pests. AlP is the most commonly used maize storage insecticide in Nigeria (Adejumo et al., 2014a, b, c).

AlP is a fumigant used to disinfect grains. It is a broad spectrum and effective fumigant for grain storage and preservation. It is an extremely volatile fumigant which diffuses rapidly. Its residue may however persist in food commodities even when fumigated at the recommended application rate (Fengzu et al., 2011). Gurvinder et al. (2012) observed that almost all the vital organs are affected in cases of AlP poisoning. AlP has been reported as the most common cause of poisoning in sub-urban and rural parts of Northern India (Siwaji and Gupta, 1995; Singh et al., 1997; Christophers et al., 2002). Poisoning cases have also been reported in other countries such as France, Turkey, Germany and Iran (Anger et al., 2000; Bayazit et al., 2000; Popp et al., 2002; Mehrpour and Singh, 2010). Reduction in total blood proteins has been reported in the blood of broiler chicks exposed to sublethal doses of phostoxin (Otitoloju et al., 2010). AlP is however freely available for use in Nigeria as grain preservatives and usually handled by illiterate farmers (Adejumo et al.,
Livestock farmers ignorantly purchase these treated grains from open markets for feeding their livestock. The aim of the study therefore, was to examine the toxic effects of AlP-treated maize-based diets on liver architecture of broiler chickens.

2. MATERIALS AND METHODS

2.1. Preparation of Test Ingredients

Five batches of maize grains were used for the study. The first group was not fumigated, while the 2nd, 3rd, 4th and 5th groups were fumigated with 1.04 g of AlP per 25 kg of maize grains of AlP tablet fumigated for 2 weeks, 2.08 g of AlP tablet per 25 kg of maize grains fumigated for 2 weeks, 1.04 g of AlP tablet per 25 kg of maize grains fumigated for 4 weeks, and 2.08 g of AlP tablet per 25 kg of maize grains fumigated for 4 weeks respectively. The five groups were milled separately and used to formulate diets for the experimental birds.

2.2. Experimental Diets

Five experimental diets were formulated (Table 1). Feed ingredients (except maize) were purchased from feed mill in Ilorin, Kwara State, Nigeria. T1 which was the control diet contained maize grains which were not fumigated with AlP tablet, while T2, T3, T4 and T5 contained maize grains fumigated with 1.04 g of AlP tablet per 25 kg of maize grains fumigated for 2 weeks, 2.08 g of AlP tablet per 25 kg of maize grains fumigated for 2 weeks, 1.04 g of AlP tablet per 25 kg of maize grains fumigated for 4 weeks, and 2.08 g of AlP tablet per 25 kg of maize grains fumigated for 4 weeks respectively. Each diet was fed for 10 weeks.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Proportion (%)</th>
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<tbody>
<tr>
<td>Maize (%)</td>
<td>45.50</td>
</tr>
<tr>
<td>Soya bean (%)</td>
<td>19.00</td>
</tr>
<tr>
<td>Fish meal 72% CP (%)</td>
<td>2.00</td>
</tr>
<tr>
<td>Wheat offal (%)</td>
<td>23.80</td>
</tr>
<tr>
<td>Bone meal (%)</td>
<td>6.00</td>
</tr>
<tr>
<td>Oyster shell (%)</td>
<td>3.00</td>
</tr>
<tr>
<td>Salt (%)</td>
<td>0.20</td>
</tr>
<tr>
<td>Methionine (%)</td>
<td>0.25</td>
</tr>
<tr>
<td>Premix (%)</td>
<td>0.25</td>
</tr>
</tbody>
</table>

**Table 1:** Gross composition of experimental diet

ME= metabolisable energy, T1= control, T2 contained maize grains fumigated with 1.04 g of AlP tablet per 25 kg of maize grains fumigated for 2 weeks, T3 contained 2.08 g of AlP tablet per 25 kg of maize grains fumigated for 2 weeks, T4 contained 1.04 g of AlP tablet per 25 kg of maize grains fumigated for 4 weeks, and T5 contained 2.08 g of AlP tablet per 25 kg of maize grains fumigated for 4 weeks respectively.

2.3. Management of Experimental Birds

Sixty 14 week-old laying hens (Nera Black strain) were used for the study. The chicks were procured from Dayntee Farm, Amberi, Kwara State, Nigeria. There were three dietary treatments, and each treatment had three replicates. Each treatment had 12 birds. The study lasted for 10 weeks. The experimental birds were reared on a deep litter system. Fresh feed and cool, drinking water were supplied *ad-libitum* throughout the period of the study.
2.4. Chemical Analysis

Proximate analysis of experimental diets was analyzed according to the procedure of A.O.A.C (2002).

2.5. Histopathology of liver

Liver from one bird from each replicate were preserved in small white plastics with formalin (10%). Slide preparation and microscopy of the tissues were done at the Department of Clinical Pathology, Faculty of Veterinary Medicine, University of Ibadan, Nigeria.

3. RESULTS AND DISCUSSIONS

Photomicrographs of liver histopathology of laying hens fed with AIP-treated maize-based diets are shown in Figures 1 to 5. Liver histopathology of birds fed with diet 2 (T2) showed moderate congestion of blood vessels. Those fed with diet 3 (T3) indicated mild to moderate vacuolar change of hepatocytes; presence of few peri-portal foci of moderate mononuclear cellular aggregates as well as severe congestion of blood vessels and sinusoids. Those on diet 4 (T4) revealed presence of few peri-portal foci of moderate mononuclear cellular aggregates as well as moderate congestion of blood vessels, while those fed with diet 5 (T5) showed presence of few peri-portal foci of moderate mononuclear cellular aggregates; moderate dissociation of hepatic cords and slight individualization of hepatocytes as well as mild vacuolar change of hepatocytes. The lesions observed in the livers of birds fed with AIP-treated maize grains include moderate congestion of blood vessels, mild to moderate vacuolar change of hepatocytes; presence of few peri-portal foci of moderate mononuclear cellular aggregates, severe...
congestion of blood vessels and sinusoids, moderate
dissociation of hepatic cords and slight
individualization of hepatocytes as well as mild
vacuolar change of hepatocytes. AIP resulted in liver
degeneration in the experimental birds. AIP poisoning
had been observed to result in histopathological
changes such as central venous congestion,
degeneration of hepatocytes, and mononuclear
infiltration usually seen in the livers of the poisoned
organisms (Mehrpour et al., 2012). Krishnamoorthy et
al. (2007) earlier reported that livers of broiler birds
fed with chlorpyrifos and T-2 toxin showed periportal
fibrosis, ononuclear cell infiltration, necrosis of
hepatocytes and bile duct hyperplasia. Also, similar
lesions were observed in broilers fed with 30, 60 and
120 ppm chlorpyrifos at 2-8 weeks of age (Malik et
al., 2002) as well as 35, 70 and 140 ppm chlorpyrifos
at 2 to 8 weeks of age (Yadav et al., 2003).

4. CONCLUSION

Effect of AIP-treated maize-based diets was
pronounced on liver degeneration of laying chickens
fed with experimental diets. It is opined that higher
doses of AIP at longer period of study will have more
deleterious effects on the systems of the experimental
animals. Hence, caution should be made when
handling restricted AIP in grain preservation. Better
still, alternative bio-safe grain preservatives should be
sought to reduce potential hazards non-target
organisms could be exposed to.

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