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EFFECT OF Pb-ACETATE IN DRINKING WATER AND PHYTATE IN DIET ON CALCIUM, ZINC AND IRON IN BLOOD OF GROWING DUCK

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Abstract

The research was conducted at the Laboratory of Physiology and Biochemistry, Faculty of Animal Husbandry and the Laboratory of Chemistry Material and Environment, Faculty of Mathematics and Natural Science, Padjadjaran University. Treatment of Pb-acetate in drinking water was given during 16 weeks. The purpose of this study was to determine the effect of Pb-acetate in drinking water and phytate in diet on concentrations of calcium, zinc and iron in blood of growing duck. The experimental design used a completely randomized design (CRD) with a factorial pattern 3x3. Three levels of Pb-acetate in drinking water (0, 45 and 90 ppm) and dietary treatments containing different levels of phytate (0,12; 1,16 and 2,18%) with 3 replications were implemented. The results showed that there was no interaction between lead in drinking water and phytate in diet on calcium, zinc and iron of blood. The main effect of lead treatment up to 90 ppm increased calcium, zinc and iron in blood, but the main effect of phytate up to 2,18% in diet did not give significant difference.

Keywords*: phytate, lead, calcium, zinc, iron, duck*

INTRODUCTION

Duck's life cannot be separated from the water, both as a place to swim or as a source of drinking water. In fact water cannot be separated from pollution as a result of a wide variety of household and industrial waste (PPSDAL, 2004). Thereby, both the poor quality of water either directly or indirectly affect the growth of ducks, especially blood minerals. Many problems encountered in the field because ducks reared extensively that allows ducks exposed to contamination, especially lead (Pb). This pollution will ultimately lead to consumers who consume the products of duck.

Many studies reveal that the lead is a heavy metal that is most dangerous after mercury (Saeni, 1989; Darmono, 2001). The apparent effect on livestock, for example disruption of metabolism, is causing a decrease in body weight and high mortality. Basically, the lead enters the body through food or drink, the air and the skin. One of the efforts to minimize lead enters the body by way of phytate in the diet (Noor, 1992). How this is done because phytate has the ability to bind lead. Although phytate serves as anti nutrition substance, but it also serves as *chelating agent* for divalent metals, especially lead. Another way that is by changing the pattern of extensive maintenance becomes intensive in areas suspected of heavy metal contaminated lead.

In daily life, ducks also play a role in contributing to society through improved nutrition fulfilment of meat and eggs. On the farm, most of the ducks were reared extensively but lately with the increasing environmental pollution, especially lead, then the system needs to be improved so that maintenance of duck lead contamination either through food or drinking water.

The author tried to collect a variety of information field research the extent to which the effects of lead pollution on blood indicator minerals such as calcium, zinc and iron in blood. This laboratory study was conducted by simulating field conditions so that the physiological parameter that was used to provide a foundation in drawing a conclusion.

MATERIALS AND METHODS

In this experiment, 135 ducks aged 29 days with body weight between 212.5-306.55 grams. Due to they were as a continuation of the first experiment, thereby they had been treated lead-acetate since that time.

Ducks were kept in the same cage as in the first experiment and were treated for the next 12 weeks. At the end of the week sixteen, blood samples of ducks were taken randomly from each unit of the cage as a sample for analysis.

Phytic treatment used in this experiment were bounded in the bran, corn and soybean meal. Based on the analysis and calculations, phytic content of the experimental diets as follows: R0 = 0:12%, R1=1:16% and R2=2:18%.

Contaminant material was lead-acetate with molecular formula $(CH_3COO)+3H_2O_2$. Pb is given to duck through drinking water in *ad libitum*. Treatment concentrations of lead (lead-acetate) given in drinking water was made in the following manner: Pb0=0 ppm, Pb1=45 ppm and Pb2=90 ppm.

The experimental diet was a mash-shaped and made with 15% protein content and metabolizable energy 2800 kcal/kg.

The measured variables of this study were calcium, zinc and iron of blood, and the experimental design of this research was a completely randomized design with a 3x3 factorial pattern. The first factor was the phytate in the diet with 0.12% (R0); 1.16% (R1) and 2.18% (R2), while the second factor was the lead in drinking water with levels of 0 ppm (Pb0): 45 ppm (Pb1) and 90 ppm (Pb2). Data were analyzed with ANOVA followed by Duncan's test. The experiments were repeated three times with five individuals per sub-test.

RESULTS AND DISCUSSIONS

Effect of Lead and Phytate on Calcium, Zinc and Iron Blood

No interaction between phytic content of the ration and Pb in drinking water on calcium, zinc and iron of blood. Effect of Pb in drinking water showed significant effect ($P<0.05$), whereas phytate in the diet showed no significant effect on calcium, zinc and iron of blood.

Effect of Pb in Drinking Water on Calcium, Zinc and Iron of Blood

Duncan's multiple range test results regarding the effect of Pb in drinking water to calcium, zinc and iron duck blood grower phases can be seen in Table 1.

Table 1. Results of Duncan's Multiple Range Test Effects of Pb in Drinking Water on Blood Mineral of Growing Duck

Treatments	Ca (ppm)	Zn (ppm)	Fe (ppm)
Pb0	62.74^{a}	23.46^{a}	408.84^{a}
Pb1	63.63^{bc}	36.75^{b}	544.12^{b}
Pb2	76.78^{c}	38.18^{b}	547.69^{b}

Description: the same letter in the same column showed no significant difference

Table 1 illustrates that the blood calcium in the treatment of growing duck of Pb1 and Pb2 did not show significant differences, but the blood calcium in both the treatment significantly ($P<0.05$) higher than that of calcium in the treatment Pb0.

The high concentration of calcium in the blood of growing duck with increasing intake of Pb, most likely due to have occurred mobilization of calcium from bone into the blood. This is as a result of Pb deposition in the bone to encourage the release of calcium from the bone matrix due to parathyroid hormone action.

According to Klassen (1986), parathyroid hormone can mobilize bone mineral and its role in the synthesis of 1,25-dihidxyvitamin D. The action of this hormone resulted in the collection of citrate in bone. The citrate solution causes of woven bone mineral mobilization and move into the extracellular body fluids, subsequently resulting in bone mineral dissolution and transport of calcium citrate pass into the blood plasma. The citrate will undergo metabolism in plasma or excreted in the urine while the calcium remains in the blood plasma.

The pattern of the same relative increased calcium either in starting ducks of the experiment 1 or growing ducks (Kamil et al., 2011). This suggested that the starting duck was more sensitive than the growing duck to administration of Pb in drinking water. Therefore, a long time giving ducks Pb and age likely plays a role in maintaining the consistency of calcium to some extent Pb poisoning.

Table 1 illustrates that blood zinc in Pb1 and Pb2 treatment showed no significant difference but blood zinc in both the treatment was significantly higher than in the blood zinc treatment Pb0. It is interesting from an increase in blood zinc duck grower turned out to have the same pattern as it did of starting ducks (Kamil et al., 2011).

Increased blood zinc phenomenon was due to the strong influence of Pb given through drinking water that could encourage greater uptake of zinc. This was due to that the growing number of incoming Pb, most likely will change the pH of the small intestine is the major site for absorption. According Wahyu (1997), the pH of the small intestine has a pH in the range 5-6. Increased intake of Pb given through drinking water, most likely more acidic small intestine and result in an increased absorption of zinc so zinc in the blood increased.

Table 2 shows that the levels of iron in the treatment of growing ducks of Pb2 and Pb1 showed no significant difference, but the iron in the blood of the two treatments was significantly higher ($P<0.05$) compared with an average iron content on Pb0 treatment. These results had the same pattern as the increase in blood iron levels in starting ducks (experiment I).

Increased iron in the blood of both the growing and the starting ducks (experiment 1) treated with Pb through drinking water, it can be explained that the more incoming Pb, most likely will change the pH of the small intestine was the major site for absorption which increases the absorption of iron, thereby, the iron in the blood increased.

Another possibility is that the micromineral content must be enough in the food, so that iron remains high in the plasma. This was in line with the opinion of Kasperczyk et al. (2012).

Effect of phytate in the diet on calcium, zinc and iron of blood

Duncan's multiple range test results regarding the effect of phytate in the diet on calcium, zinc and iron of duck grower can be seen in Table 2.

Table 2. Results of Duncan's Multiple Range Test Effects of Phytate in Diet on Blood Mineral of Growing Ducks

Treatments	Ca (ppm)	Zn (ppm)	Fe (ppm)
R0	66.31[a]	30.26[a]	537.32[a]
R1	67.26[a]	38.12[a]	515.73[a]
R2	69.58[a]	30.05[a]	447.60[a]

Description: the same letter in the same column showed no significant difference

Table 2 shows that calcium, zinc and iron in the blood of growing ducks of R0, R1 and R2 did not show significant differences. This was due most likely to decompose phytate late, therefore the effect of phytate did not show significant differences on calcium, zinc and iron in blood. This was due to the effect of phytate on Pb which has a larger molecule showed that it was significant effect. Most likely others that needed higher phytate and purely to affect blood calcium, as seen from the content of phytate in the diet to 2.18% seen no significant effect on growing ducks though the molecular weight of Pb greater than calcium.

In addition, because the nutrient content in the form of micromineral is enough in food, then absorption will also be parallel as reported Kasperczyk et al. (2012).

CONCLUSIONS

The results showed that there was no interaction between lead in drinking water and phytate in diet on calcium, zinc and iron of blood. The main effect of lead up to 90 ppm increased calcium, zinc and iron in blood, but the main effect of phytate up to 2.16% in diet did not give significant difference.

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