

THE RESPONSE OF LEAD (Pb) IN LIVER AND KIDNEYS OF GROWING DUCKS GIVEN PHYTATE IN DIET AND LEAD (Pb) IN DRINKING WATER

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Abstract

The experiment concerning the response of lead (Pb) in liver and kidneys of growing ducks given phytate in diet and lead (Pb) in drinking water was conducted at the Faculty of Animal Husbandry and the Faculty of Mathematics and Natural Science, Padjadjaran University. The experiment was carried out to growing group of local duck. The experimental design of a completely randomized design with a factorial pattern 3x3 was applied. Three dietary treatments containing different levels of phytate and 3 levels of lead in drinking water with 3 replication were applied to growing ducks and each combination consisted of five. There was no interaction between the administration of Pb in drinking water and phytate content in diet. Administration of Pb in drinking water up to 90 ppm increased Pb in the liver and kidneys, while the phytate content up to 2.18% in the diet did not provide a decrease of Pb content in liver and kidneys of growing ducks.

Key words: phytate, lead, liver, kidneys and duck

INTRODUCTION

Water plays a major role and it is very important in the lives of animals especially ducks because the water function in addition to meeting the needs of daily life, water is also the place of pollution from various industrial wastes either directly or indirectly. Thereby the quality of water will eventually affect the ducks.

Liver and kidneys are vital organs in animal and used as indicators to determine the toxicity and counteract the body's ability to dispose of the waste products of metabolism. This condition is associated with the fact that many of the problems encountered in the field for the ducks that are kept extensively because it allows the ducks exposed to heavy metals such as lead (Pb) contamination. The effects of this pollution are directly affects the ducks and indirectly in the end can be fatal to consumers who eat the product of duck.

Lead is the most dangerous second heavy metal after mercury. Dangers that are apparent

in animal include metabolic disturbance that causes the decrease in body weight and mortality. At high doses of lead cause anaemia, kidney failure, high blood pressure and permanent brain damage. Lead can be absorbed by the body through foods or drinking water. Lead can also be inhaled through the air and penetrate directly through the skin.

One of the efforts made to minimize the absorption of lead is to prevent lead of ducks by phytic administration in the diet. This is done because phytate has a positive value, in addition to functioning as *anti-nutrition substance* but it also serves as a *chelating agent* for two-valence metals, especially lead. Another alternative that is by changing the pattern from extensive to intensive care in areas suspected of heavy metal contamination of lead.

Ducks have an important role in contributing to the improvement of nutrition through meeting the needs of meat and eggs for the community. Naturally, most ducks are reared extensively, but with the rise of Pb pollution in recent years, the rear of these ducks need to be re-examined to avoid contamination of lead through diet supply or drinking water.

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For solving this problem the authors tried to collect more information from fieldwork of lead pollution effects on Pb in liver and kidneys. For more information conducted laboratory studies to simulate field conditions. The physiological parameters were used as a quantitative basis in drawing a conclusion.

MATERIAL AND METHODS

Ducks used were female ducks which was a continuation of the first study, aged 29 days as many as 135 head with an average body weight of 212.5 to 306.5 grams. Ducks

were placed in the same cage as the starter and were treated for 12 weeks. At the end of sixteen weeks to be taken at random a duck from each cage unit as a sample for analysis.

The source of phytate used in diet of the experiment was phytate contained in rice bran, corn and soybean meal. Diet of experiment was made with the form of pellets and 15% protein content and metabolic energy 2800 kcal/kg (Table 1). The heavy metals were used as a source of pollutant was Pb acetate with the molecular formula $(CH_3COO)_2Pb + 3H_2O$.

Table 1 Nutrients of Experimental Diet of Growing Ducks (5-16 weeks)

Materials	R0	R1	R2
Dry matter, (%)	90,74	90,42	90,57
Protein, (%)	15,00	15,08	15,00
Fat, (%)	8,69	8,65	9,93
Fibre, (%)	7,49	6,31	5,70
Ca, (%)	0,75	0,78	0,84
P, (%)	0,67	0,72	0,77
Phytate, (%)	0,12	1,16	2,18
Metabolic energy (kcal/kg)	2816	2800	2802

Samples dried in an oven at 70°C for 24 hours. Samples of known dry ingredients have been made using a *wet ashing system*. Filtrate from each sample was filtered with filter paper and then stored in a separate vial and then performed measurements of the concentration of Pb in liver and kidneys by using AAS.

Research carried out experimentally and experimental design used a Completely Randomized Design with 3x3 factorial patterns. The first factor was the phytate in diet with 0.12% (R0); 1.16% (R1) and 2.18% (R2). 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 variance followed by Duncan test. The experiment had 3 times replication with 5 individuals per sub-test and the overall gained 135 growing ducks.

RESULTS AND DISCUSSIONS

Effect of Pb Treatment on Pb of Liver and Kidneys

There was no interaction between phytate in the diet and Pb in drinking water on Pb in liver and kidneys. The main effect of Pb in drinking water showed significant effect

($P < 0.05$) in liver and kidneys while the main effect of phytate in the diet showed was no significant effect on Pb in liver and kidneys.

a. Effect of Pb in Drinking Water on Pb in liver and kidneys

Duncan's multiple range test results on the effect of Pb in drinking water on Pb in liver and kidneys of growing ducks can be seen in Table 2.

Table 2 The Results of Duncan's Multiple Range Test of the Effect of Pb in Drinking Water on Pb of Liver and Kidneys of Growing Ducks (5-16 Weeks)

Pb (ppm)	Pb of Liver (ppm)	Pb of Kidneys (ppm)
Pb0 (0)	4,95 ± 3,45 ^a	7,99 ± 3,21 ^a
Pb1 (45)	7,22 ± 6,36 ^{ab}	36,17 ± 10,84 ^b
Pb2 (90)	12,38 ± 4,10 ^b	38,37 ± 10,26 ^b

Note: The same letters in the same column indicates no significant differences

Table 2 shows that the average Pb in the liver of grower in Pb2 treatment was significantly higher than the group of Pb0, but Pb of liver on a group of Pb1 and Pb2 was not difference. Similarly, Pb of liver in Pb1 and Pb0 was not difference. There was differences in the concentration of Pb in the

liver in each Pb treatment caused the liver is the main organ that is sensitive to changes in Pb administration in the grower. Response pattern of Pb in liver was very interesting because Pb of liver were relatively stable compared to the starter (study I) even though treatment was given Pb in drinking water during for 4 months compared with starter for a month treatment [7].

Liver proved to have exceptional ability in the grower because there was not an excessive accumulation of Pb compared with the period of starter. Liver on grower group believed to still be able to cope with a given Pb through drinking water up to 90 ppm compared to the starter. This was due to considering the liver was the largest tissue in the body and has a unique role in circulation system because the liver received the largest part of the venous return of blood supply [12].

In its action, the liver acts as the primary filter for the blood that comes from the bottom of the body such as heart, spleen and gastrointestinal tract before the blood is pumped through the lungs to re-oxidize. Liver released all the elements of metabolized substances that transported the blood. If releasing and done fast and extensive metabolism by the liver, blood will come out clean and then go to other organs [8, 12]. One thing to keep in mind that the heart has a limitation that if the heavy metal Pb in this case to be given continuously in turn will lead to the accumulation of Pb in the liver. This is why the administration of high doses of Pb resulted in the accumulation of Pb and that condition caused why the liver was the main indicator of Pb contamination.

In Table 2 is also shown that the average Pb in kidneys of grower in the treatment of Pb2 and Pb1 was significantly higher ($P < 0.05$) than Pb of Pb0. Pb of Pb1 and Pb2 was not significant difference. The interesting thing in both Pb either starter (Research I) and grower had a relatively equal. This means that the kidneys were more sensitive to starter despite treatment with Pb through the administration of drinking water was only a month but the concentration of Pb in the kidney was immediately increased sharply [7]. For grower although Pb administration through drinking water during

4 months but it did not accumulate excessive Pb and this could be seen from the concentration of Pb in the kidney was relatively stable with starter. Similarly, the pattern of increased Pb in Pb1 and Pb2 had the same pattern. Another possibility that kidneys own ability to accommodate Pb where Pb was given even higher, the kidneys will be set by releasing Pb in urine which then mixes with excreta.

The discovery of Pb in the kidneys at grower was as a result of Pb treatment given. This was due to kidneys function were very sensitive to the foreign elements that were toxic. Both kidneys had the primary function as an organ of releasing the rest of blood in the urine. The presence of Pb that exceeds the capacity of the kidneys would result in damage to the neurotoxin that is a damage of proximal tubule in the nephron. Re-absorption of glucose, phosphate and amino acids is suppressed in the proximal tubule. Administration of Pb in a long time caused *irreversible dysfunction* and *morphological changes* which are manifested by a strong interstitial fibrosis which is accompanied by atrophy and dilatation of the tubule, which in turn result in kidneys failure and death [8, 12].

Effect of Phytate in Diets on Pb in Liver and kidneys

Duncan's multiple range test results regarding the administration of phytate in the diet of Pb in liver and kidneys in the grower can be seen in Table 3.

Table 3 The Results of Duncan's Multiple Range Test of the Effect of Phytate in Diet on Pb of Liver and Kidneys (5-16 Weeks)

Phytate (%)	Pb of Liver (ppm)	Pb of Kidneys (ppm)
R0 (0,12)	5,03 ± 2,52 ^a	22,59 ± 8,28 ^a
R1 (1,16)	11,02 ± 6,90 ^a	31,66 ± 10,67 ^a
R2 (2,18)	8,50 ± 4,49 ^a	28,29 ± 5,36 ^a

Note: The same letters in the same column indicates no significant differences

Table 3 shows that the Pb in the liver of grower of R0, R1 and R2 showed were not significant differences. It was strongly suspected that the phytate in the diet did not influence the strong bond of Pb given through drinking water. It was predicted that phytate

was stronger on of zinc, calcium and iron compared to Pb [15]. This was also supported by the opinion Rustiawan, et al. (1993) who reported that the intestinal capacity to absorb Pb was relatively small at only 8-12%.

Table 3 shows that Pb of kidney of R0, R1 and R2 showed significant differences. It was strongly suspected of phytate present in the diet did not influence strong bond on Pb which was given through drinking water. This was most likely due to phytate in the form of bonds that break down slowly, which in turn is bound Pb slightly. Alternatively, a high phytate needed in the diet to bind Pb in the digestive tract and as a comparison in this study were up to 2.18% phytate in the diet showed was not significant effect. Basically, the opportunity of phytate to bind Pb only occurs in the digestive tract caused by phytate is not absorbed by the body. Therefore, the binding of Pb by phytat would be minimum. Effect of phytate in the diet on Pb showed was no significant difference was due to the influence of phytate in the diet on Pb of blood was no difference. This was due to the kidneys received blood supply.

CONCLUSIONS

There was no interaction between the administration of Pb in drinking water and phytate content in diet. Administration of Pb in drinking water up to 90 ppm increased Pb in the liver and kidneys, while the phytate content up to 2,18% in the diet did not provide a decrease of Pb content in liver and kidneys of growing ducks.

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