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Effects of dietary phytase above the industry standards on the water intake pattern of broiler chicken.

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Abstract
Supplementation of poultry diets with microbial phytase has found to offer many advantages. Objective of this study was to determine the effect of dietary phytase above the industry standards on the water intake pattern of broiler chicken. Twenty-one-days old broiler chicks (n=72) in 24 cages received one of the four experimental diets ad libitum until day 38. Experimental diets contained 0, 750, 1500 or 2250 FTU of phytase/kg of diet. Daily water and feed intakes were measured from day 21-38. Water intake was corrected for evaporation losses. Water intake of the broilers given phytase free diet increased linearly (WI=149 + 11* day; R^2=86; P<0.001) from day 1-18 of the feeding trial. Water intake pattern of phytase given birds could best be described by a significant (P<0.01; R^2=44) cubic model. When computed as ml/ 100 g of live weight (LW) or as ml/g $LW^{0.75}$, WI reduced in all four treatments, as birds grew. Over the 18 days of feeding period, birds given 2250 units of dietary phytase maintained a significantly (P<0.001) higher water intake than the birds fed other phytase levels. The WI of the birds given 0, 750 and 1500 units of phytase were significantly different from each other only until day 28, but not thereafter. When WI expressed as ml/100 g LW or as ml/g $LW^{0.75}$, a similar pattern was seen until day 34. After day 34, 2250 units of dietary phytase tend to increase the WI/100 g LW (p=0.06) and WI/ g $LW^{0.75}$ (p=0.09). During first seven days, water: feed ratio of the birds given 0, 750, 1500 and 2250 units of dietary phytase were 2.2, 2.8, 3.4 and 3.6, respectively and were significantly (p<0.001) different from each other. There was no significant effect of phytase levels on water: feed after day 34. It was concluded that the supplementation of the broiler diets with microbial phytase above industry average increased the water intake.

Key words: Broiler, phytase water intake

Introduction

Much of the phosphorus (P) in plant feed ingredients used in poultry rations are in phytic form. As poultry lacks the enzyme phytase, the availability of P from those feed ingredients to the poultry is low. Phytic acid complexes with other cationes, proteins, amino acids and starch molecules and some enzymes as well making the availability of other minerals and amino acids also low. Supplementation of poultry diets with exogenous microbial phytase is now a common practice Beneficial effects of supplemental phytase on the utilization efficiency of dietary phytate phosphorus, other minerals, protein and energy, growth performance and mineral excretion have recently been revived by Selle et al. (2007). The levels of phytase used in commercial diets do not normally exceed 750-1000 FTU/kg diet. Several studies (Sherley and Edwars, 2002; Sherley and Edwards, 20003; Augspurger and Baker, 2004) have shown that higher levels of dietary phytase that exceed the normal levels used in commercial poultry diets further improved the broiler performance, bone ash and the utilization of phytate P.

Several dietary, environmental and animal factors determine the intake of water by broilers. Atapattu and Gamage (2006) and Atapattu, (2007) found that normal levels of dietary phytase increased the water intake of broiler chicken. Higher water intakes of broilers may have implication on litter qualities, litter ammonia emission, carcass qualities and birds' health and welfare. If mega doses of phytase lead to almost complete dephytination, it may release a substantial amount of minerals bound to phytates into the

intestinal lumen. This situation may affect the water intake of the birds fed high doses of dietary phytase. Objective of this study was to evaluate the effects of dietary phytase given above the industry standards on the water intake pattern of broiler chicken.

Materials and methods

Twenty days old broiler chicks were allocated into 24 cages and the cages were randomly assigned into four experimental diets. From day 21- 38 birds were fed with one of the experimental diets containing 0, 750, 1500 and 2250 FTU/kg of microbial phytase (Table 1). All diets met or exceeded the nutrient standards set out in NRC (1994). Phytazag was used as the phytase source. Each cage was supplied with a drinker and a feeder. Water intake was corrected for evaporation losses. Live weights of the birds were recorded on day 28, 34 and 38. Water and feed intakes were determined daily.

Statistical analysis was performed with the general linear model of Minitab (Version 11.12).

Table 1. Ingredient composition and the calculated nutrient composition of the diets

	Phytase level (FTU/kg)			
Ingredient (g/kg)	0	750	1500	2250
Maize meal	315.6	318.6	321.2	321.1
Rice bran	200	200	200	200
Soyabean meal	130	132	132	132
coconut oil	87.5	87	86	86
Fish meal	3.3	3.3	3.3	3.5
Sesame oil meal	173	173	173	172.6
Coconut oil meal	64.6	60	58	58
Dical Phosphate	13.9	13.9	13.9	13.9
$CaCo_3$	4.6	4.5	4.5	4.5
D Methionine	0	0	0	0
L lysine	2.5	2.4	2.5	2.5
Salt	2.5	2.5	2.5	2.5
Vit/mineral mix	2.5	2.5	2.5	2.5
Phytase	0	0.3	0.6	0.9
Calculated nutrient composition				
CP (%)	20			
Energy (Kcal/kg)	3200			
Ca		0.9		
Non phytate phosphorus	0.35			
Lysine	1			
Methionine +Cystein		0.76		

Results and Discussion

Water intake of the broilers given phytase free diet increased linearly (WI=149 + 11* day; R^2=86; P<0.001) from day 1-18 of the feeding trial. Water intake pattern of phytase given birds could best be described by a significant (P<0.01; R^2=44) cubic model (Figure 1).

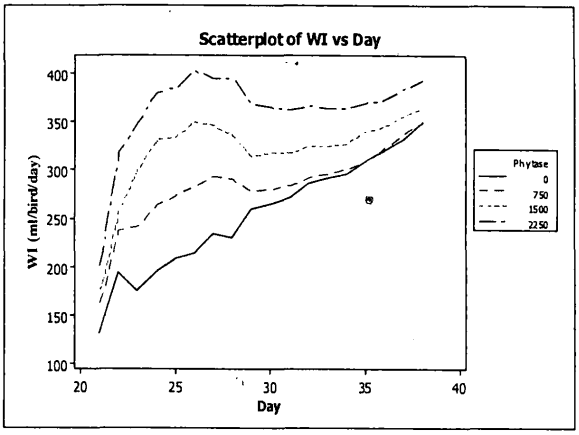

Figure 1. Effect of four dietary phytase levels on water intake from day 1-18

When WI computed as ml/ 100 g of live weight (LW) or as ml/g $LW^{0.75}$, WI reduced in all four treatments, as birds grew (Table 1). Over the 18 days of feeding period, birds given 2250 units of dietary phytase maintained a significantly (0.001) higher water intake than other phytase levels.

The water intakes of birds given 0, 750 and 1500 units of phytase were significantly different from each other only during the first seven days (until day 28) but not thereafter. After day 28, WI was not different between the birds given 0, 750 and 1500 units of phytase. When WI expressed as ml/100 g LW or as ml/g $LW^{0.75}$, a similar pattern was seen until day 34. After day 34, 2250 units of dietary phytase tend to increase the WI/100 g LW (p=0.06) and WI/ g $LW^{0.75}$ (p=0.09) (Table 1). During first seven days, water: feed ratio of the birds given 0, 750, 1500 and 2250 units of dietary phytase were 2.2, 2.8, 3.4 and 3.6, respectively and were significantly (p<0.001) different from each other (Table 1). There was no significant effect of phytase levels on water: feed after day 34. In general, birds consume approximately twice as much water as the amount of feed consumed on weight basis (NRC 1994). The water:feed ratio of the birds given phytase free diet was well within the typical value reported in NRC (1994). It is interesting to note that, tough not statistically significant, birds given phytase supplemented diets had higher water:feed ratio.

Normally, phytase is used at 750 FTU/kg. At that standard level of phytase, phytase increased water intake only during the first seven days of the feeding. However, the use of excessive amounts of phytase (2250 FTU/kg) maintained a higher water intake throughout the feeding period. Two hypotheses are proposed to explain as to why water intake increased when diets were supplemented with phytase The function of phytase is to hydrolyze phytate molecules present in plant feed ingredients. The hydrolysis of phytate releases not only phosphorus but a range of cations such Ca^{++}, Mg^{++}, Fe^{++}, Zn^{++}, Mn^{++} and Cu^{++} (Kornegay 2001). Therefore, hydrolysis of phytate might have released a high amount of dietary minerals into the intestinal lumen causing water to diffuse into the intestinal lumen. Alternatively, increased water diffusion into the ileum out of the plasma might have increased the metabolic requirement of water and thus the intake. Further researches are needed to test the above hypotheses.

Higher water intake may have implications of digesta, faecal and litter moisture contents as well as litter quality parameters such as moisture and ammonia emission rates. These aspects may warrant further studies. Furthermore, the finding that even standard levels of phytase causes a temporary increase in water intake in broiler chicken may have practical implications in broiler management.

Table 2 Efficacy of Microbial Phytase on Broiler performances

	Dietary Phytase level (FTU/kg)				ANOVA
	0	750	1500	2250	
Mean water intake (ml/bird/day)					
day 28	235 ± 14^{d}	293 ± 20^{c}	345 ± 10^{b}	394 ± 37^{a}	0.001
day 34	$296\pm^{b}$	$300\pm^{b}$	$326\pm^{b}$	$364\pm^{a}$	0.001
day 38	$349\pm^{b}$	$348\pm^{b}$	$362\pm^{ba}$	$393\pm^{a}$	0.04
Mean water intake (ml/100g of body weight)					
day 28	17.6 ± 1.6^{d}	22.1 ± 1.8^{c}	26.5 ± 2.4^{b}	29.6 ± 2.5^{a}	0.0001
day 34	16.8 ± 1.6^{b}	17.2 ± 1.7^{b}	18.7 ± 1.1^{b}	20.6 ± 1.3^{a}	0.001
day 38	16.0±1.7	15.4±2	16.4±1.3	18.0±1.1	0.06
Mean cumulative water intake (ml/$LW^{0.75}$)					
day 28	1.47 ± 0.09^{d}	1.86 ± 0.1^{c}	2.1 ± 0.07^{b}	2.4 ± 0.2^{a}	0.001
day 34	1.34 ± 0.14^{c}	1.36 ± 0.14^{cb}	1.5 ± 0.12^{b}	1.65 ± 0.07^{a}	0.001
day 38	1.2±0.1	1.3±0.1	1.3±0.09	1.4±0.09	0.09
Water:feed					
day 28	2.2 ± 0.17^{c}	2.8 ± 0.3^{b}	3.4 ± 0.6^{a}	3.6 ± 0.3^{a}	0.001
day 34	2.5 ± 0.2^{b}	2.5 ± 0.2^{b}	2.8 ± 0.2^{ba}	3.1 ± 0.1^{a}	0.002
day 38	2.7 ± 0.2^{b}	2.7 ± 0.3^{b}	2.9 ± 0.2^{ba}	3.1 ± 0.1^{a}	0.09

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