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Effects of the Withdrawal of Vitamin Trace Mineral Mixture from Broiler Finisher Diet Supplemented With Phytase on Growth Performance, Visceral Organ Weights and Feed Cost

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Abstract: Objective of this study was to determine the effects of the withdrawal of vitamin trace mineral mixture (VTM) from a broiler finisher diet supplemented with phytase on growth performance, visceral organ weights and feed cost. Giving a completely randomize design in 2 (0 or 1000 FTU phytase /Kg) * 2 (0 or 2.5 g VTM/kg) factorial arrangement, 128 broiler chicks received one of the four experimental diets ad libitum, from day 23-43. Withdrawal of VTM reduced feed intake, live weight and weight gain while increasing the relative weight of the visceral organs. Removal of VTM reduced the tibia length but had no effect on ash content. Costs per Kg empty carcass and Kg of seleable carcass were lowest when VTM free diet was supplemented with phytase. It is concluded that, despite inferior growth performance, withdrawal of VTM is financially profitable if the diet is supplemented with phytase supplemented.

Keywords: Vitamin, trace mineral, withdrawal, performance, broiler

Introduction

Poultry ration formulations are not normally balanced for trace minerals and vitamins. Instead, a vitamin/trace mineral mixture (VTM) is added to make sure that the ration contains sufficient levels of those nutrients. However, modern commercial feed formulators adopt wide safety margin and use 3-10 times higher trace mineral and vitamin level than recommended (Skinner et al. 1992; Inal et al., 2001). Under Sri Lankan condition, even added at recommended level (2.5g/kg), VTM incurs Rs 2.50 per kg of feed. Furthermore, since a higher proportion of these trace elements are not absorbed, use of excessive levels of trace minerals is not an environmentally sound practice.

Broilers vitamin and mineral requirements reduce as they mature. Also, when birds grow at slower rate due to high temperature and/or poor management conditions which is often the case in Sri Lanka, their vitamin and trace mineral requirements may be even low. Vitamin premix of a broiler finisher diet can be removed when grown on litter which is a good source of many vitamins and minerals (Shahrasb et al. 2012). Mash form diets which have not been subjected heat processing contains a substantial level of vitamins. Therefore, even without a VTM, a typical poultry feed could meet a substantial level of trace minerals and vitamins requirements. It has also been shown that availability of minerals is increased when the diet is deficient in minerals. Above arguments have been supported by a number of studies (Khajali et al., 2006; Maiorka et al., 2002; Deyhim et al., 1993; Skinner et al., 1992) which have shown that VTM can be removed totally or partially from broiler diets, for a short period, particularly during later stages of growth without affecting performance. However, Sayadi et al. (2005) showed that removal of VTM for 21 days reduced the performance.

Supplementation of poultry diets is now a common practice. Apart from P, phytase improves the availability of Ca and a range of other trace minerals such as Zn Mg, Fe, Cu (Viveros et al., 2002). Objective of this study was to determine whether VTM of a broiler finisher diet could be removed for a longer period if the diet is supplemented with phytase.

Materials and Methods

Day old broiler chicks were brooded for 10 days and fed a commercial broiler starter diet until day 22. On day 22, 128 chicks were allocated in to 32 floor pens so that live weight variation among pens was minimum. Pens were randomly assigned into eight replicates of a completely randomized design in 2 x 2 factorial arrangement. Four broiler finisher diets with Phytaze or without phytase, each with or without vitamin/trace mineral mixture were prepared. Experimental factors were two dietary phytase (0 or 1000 FTU/Kg) and two dietary VTM levels (0 or 2.5g/Kg). Ingredient composition and the calculated nutrient composition of the control diet (phytase – VTM+) is given in Table 1. Phytazag was the phytase source and all rations had 3g of non phytate phosphorus (NPP)/kg. VTM free diet had 2.5g washed sand/kg. All diets fed *ad libitum* from day 23-43. Birds were weighed on day 33 and 43. One randomly selected bird from each pen was killed on day 43 and dissected to determine the carcass parameters. Left tibias were analyzed for fat free tibia ash. Breast meat samples were boiled for 30 minutes and subjected to organoleptic evaluation by 30 untrained panelists. Four organoleptic attributes (colour, taste, toughness and overall acceptability) were evaluated on a five point Likert scale.

5, Like very much 4, Like somewhat 3. Neither like no Dislike 2, Somewhat dislike 1, Don't like at all

Growth performance and carcass data were analyzed as a completely randomize design in 2 x 2 factorial arrangement. Significant main effects were compared using DMRT procedure. Organoleptic data were analyzed using kruskal Wollis procedure.

Table 1:
Ingredient composition and calculated nutrient composition

Ingredient	g/Kg	
Maize meal	507	
Rice bran	150	
Soya bean meal	249	
coconut oil	31	
Fish meal	35	
Dicalcium phosphate	8	
CaCo3	14.5	
D Methionine	0.5	
Salt	2.5	
Vit/min mix	2.5	0
Washed sand	0	2.5
Phytase	+/-	
Calculated nutrient composition		
CP	200	
ME (Kcal/kg)	3050	
Ca	10	
Non phyteen phosporus	3	
Lysine	10.7	
Methionine+Cystine	7.3	
Methionine	3.6	
Crude fibre	45.9	

Results and Discussion

Suggesting that withdrawal of VTM from day 23-43 had no severe negative effects on health of the birds, no mortalities was reported during the experiment. Apart from the improved FCR of young birds from day 23-33, phytase had no significant effect on any of the growth performance parameters (Table 2). Effects of supplemental phytase are more obvious when diet is deficient in NPP. The absence of positive effects of phytase on performance may be due to the use of marginally deficient (3g/kg) NPP level. Phytase*VTM withdrawal interaction had no significant effect on any of the growth performance or carcass parameters (Table 3). In contrast, withdrawal of VTM reduced feed intake, live weight and weight gain significantly. However, withdrawal of the VTM had no effect on FCR. In line with our results, a number of other studies (Siahpour *et al*., 2006; Sayadi *et al*., 2005 and Wang *et al*., 2008) have also shown that removal of VTM for 21 days decreased daily weight gain, feed intake and feed efficiency. However, 7-14 days of VTM withdrawal at later stages of the growth had no influence on weight gain, feed intake and feed efficiency (Siahpour *et al*., 2006; Maiorka *et al*., 2002). It seems that the effect of the withdrawal of VTM is

influenced by the time of withdrawal and the length of the withdrawal. Results of this experiment suggest that 21 days of VTM withdrawal from 23-43 impairs the performance, even with supplemental phytase.

As reviewed by Woyengo and Nyachoti, (2011), Phytase supplementation increased the tibia ash content. Meanwhile phytase reduced the relative weight of the liver and heart. Similarly, Viveros *et al.* (2002) have also reported that supplemental phytase reduced the relative weight of liver of broiler chicken. Interestingly, removal of VTM reduced the length of the tibia but had no effect on tibia ash content. Wang *et al.* (2008) have also shown that withdrawal of VTM had no effect on tibia ash content. The diets contained adequate level of Ca and 0.3% NPP. Since bones are mainly made up of Ca and P, a negligible effect on bone ash could be expected. It seems that trace minerals and vitamins have stronger effect on the elongation of the long bones than on the bone ash content.

Siahpour *et al.* (2006) found no effect of VTM withdrawal on carcass parameters. However, in the present experiment, withdrawal of VTM increased the relative weight of the visceral organs such as liver, heart, gizzard and proventriculus and the relative length of the small intestine. In partitioning the available nutrient within the body, supply organs such as digestive tract get priority. Several restricted feeding strategies (Rosenbrough *et al,*. 1988; Palo *et al.*, 1995; Atapattu and Lal, 2009) have shown that relative weights of digestive organs and heart increased when general growth is retarded. Therefore, increased relative weight of the visceral organs of the birds given VTM free diet may be due to the continued growth of those organs despite the general reduction of growth.

Interestingly, taste of the meat of the broilers fed diet supplemental phytase and VTM was significantly higher than the counterparts fed other three diets. Other organoleptic properties were not significantly different among the treatments.

Phytase supplemental incurred 0.40 Rs of an addition cost per kg of diet whereas withdrawal of VTM saved 2.50 Rs per Kg of feed. Feed cost per Kg of empty carcass or per Kg of seleable carcass were not significantly altered due to dietary manipulation studied (Table 4). However, costs per Kg empty carcass and Kg of seleable carcass was highest when there was

Table 2.
Effects of the withdrawal of vitamin trace mineral mixture from broiler finisher diet supplemented with phytase on growth performance

Treatment factors				Live weight (g)			Feed intake (g)			Weight gain (g)			FCR		
				23 d	33 d	43 d	23-33 d	34-43 d	23-43 d	23-33 d	34-43 d	23-43 d	23-33 d	34-43 d	23-43 d
Ph	+	VTM	+	918	1620	918	1201	1572	2774	701	682	1384	1.70	2.35	2.01
			–	890	1535	2302	1123	1337	2451	645	574	1219	1.74	2.42	2.01
	–		+	911	1590	2237	1204	1423	2627	679	646	1325	1.78	2.24	1.98
			–	903	1493	2052	1195	1298	2493	589	559	1149	2.03	2.37	2.18
SEM				23.6	53.9	96.4	111	114	174	50.5	80.3	92.1	0.14	0.31	0.11
Probability		Ph		NS	NS	NS	NS	NS	NS	NS	NS	NS	*	NS	NS
		VTM		NS	**	***	NS	**	*	**	*	***	NS	NS	NS
		Interaction		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Main effects		Ph	+	904	1311	2206	1162	1360	2560	673	628	1301	1.72[b]	2.38	2.01
			–	907	1298	2144	1200	1450	2612	634	602	1237	1.90[a]	2.30	2.08
		VTM	+	915	1605[a]	2269[a]	1202	1497[a]	2700[a]	690[a]	664	1354[a]	1.74	2.29	1.99

reatment factors | Parameter1 | Organoleptic properties

no supplemental phytase and VTM. On the other hand respective cost items were lowest when VTM free diet was supplemented with phytase. Contrast to our findings, Sayadi *et al.* (2005) showed that removal of VTM increased the feed cost per unit of product. Results of this experiment clearly show that despite the retarded growth performance, withdrawal of VTM is financially profitable if the diet is supplemented with phytase supplemented.

Table 3:
Effects of the withdrawal of vitamin trace mineral mixture from broiler finisher diet supplemented with phytase on visceral organ weight and meat organoleptic properties

				Gizzard	Liver	Heart	Proventriculus	S.Intestine (L)	Tibia length	Tibia ash (%)	Color	Taste	Toughness	Overall Acceptability
Ph	+	VTM	+	2.17	2.71	0.52	0.96	9.75	6.95	44.7	4.1	4.3[a]	3.9	4.1
			–	2.28	3.43	0.67	1.27	10.8	6.77	45.7	4.0	3.6[b]	3.6	3.7
	–		+	2.37	3.16	0.66	1.03	10.4	6.97	41.5	3.7	3.6[b]	3.5	3.7
			–	2.58	3.24	0.82	1.09	11.8	6.67	43.7	3.8	3.6[b]	3.5	3.7
SEM				0.37	0.38	0.12	0.12	1.05	0.22	2.28				
Probability		Ph		NS	*	*	NS	NS	NS	*				
		VM		NS	*	*	**	*	*	NS				
		Interaction		NS	NS	NS	NS	NS	NS	NS				
Main effects		Ph	+	2.23	3.07[b]	0.66[b]	1.11	10.30	6.86	45.2[b]				
			–	2.48	3.20[a]	0.74[a]	1.06	11.12	6.82	42.6[a]				
		VTM	+	2.27	2.94[b]	0.59[b]	1.00[b]	10.10[b]	6.96a	43.1				
			–	2.43	3.34[a]	0.74[a]	1.18[a]	11.32[a]	6.72b	44.7				

1. As a % of empty carcass

Means with different superscripts within a column are significantly different at $p<0.05$

Table 4:
Effects of the withdrawal of vitamin trace mineral mixture from broiler finisher diet supplemented with phytase on feed cost 1

Diet	Cost of formulation (Rs)	Feed cost/Kg empty carcass	Feed cost/Kg Saleable carcass
Ph+VTM+	75	150.9	127.2
Ph–VTM+(control)	74.6	148.3	126.5
Ph+VTM–	72.5	146.5	119.5
Ph–VTM–	72.1	157.5	132.5

1. As of Oct 2012

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