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Pyridoxine Requirement of Broilers on Fed Guinea Corn-Palm Kernel Meal Based Diet

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ABSTRAK

Uji kaji telah dijalankan bagi memantapkan keperluan piridoksin makanan salai pada catuan yang praktikal. Lapan kumpulan yang sama daripada 25 anak ayam yang dikomersil, diberi makan inti sawit-jagung berasaskan pemakanan sampingan yang paras piridoksin digred (4.5, 5.0, 5.5, 6.0, 7.0, 7.5 dan 8.0 mg/ makanan) sejak hari yang pertama hingga hari yang ke-42. Data penggunaan makanan, penahanan nutrien dan ciri-ciri karkas menunjukkan bahawa 6.0 mg piridoksin/makanan adalah keperluan minimum, sedangkan 5.5 mg/kg makanan diperlukan bagi mengelak kematian dan mengekalkan kepekatan hemoglobin, isi padu sel terpadat (PVC) dan aktiviti aminotransferas aspartat di dalam serum dan hati.

ABSTRACT

A trial was conducted to establish pyridoxine requirement of broilers fed on practical ration, in which 8 duplicate groups of 25 commercial broiler chicks were fed guinea corn-palm kernel meal based diet supplemented with graded levels of pyridoxine (4.5, 5.0, 5.5, 6.0, 7.0, 7.5 and 8.0 mg/kg feed) from day-one to 42 days. Data on feed utilisation, nutrient retention and carcass characteristics showed that 6.0mg pyridoxine/kg feed is the minimum requirement whereas 5.5mg/kg feed was required for prevention of mortality and maintenance of normal haemoglobin concentration, packed cell volume (PCV) and aspartate aminotransferase activities in serum and liver.

INTRODUCTION

Dietary essentiality of pyridoxine for optimum productive performance of broilers had been established (ARC 1975). However, because of its relatively poor bioavailability and varied contents in feed ingredients, and also because of its involvement in amino acid metabolism and protein utilisation, estimated requirement figures varied widely depending on the type of test diet and the dietary protein content and method of processing of feed ingredients such as soybean, cottonseed and safflower used in the test diets (Whitehead 1982). It seemed therefore that to ensure adequate pyridoxine supplement for broilers under a practical feeding regime in a particular region, it is necessary to establish the bird's requirement using rations formulated with locally available feed ingredients. Indeed, in Nigeria, Ogunmodede (1981) had established pyridoxine requirement of broilers feed ration based on groundnut cake (GNC), which hitherto was the most commonly used feed protein source in the country. In recent times, poultry diets in the country had undergone drastic changes in composition due to replacement of high-cost traditional feed protein sources with lower-cost alternatives. In this regard, the use of palm kernel meal (PKM) in lieu of GNC is gaining popularity as an alternative, which offers a significant protein cost advantage in broiler rations. However, information on the pyridoxine demand of broilers fed PKM based ration is lacking.

The objective of this study was to establish pyridoxine supplement required for optimum performance of broilers, fed guinea corn-PKM based diet. Guinea corn was included in the ration because it is a major feed energy source in broiler rations in Nigeria.

MATERIALS AND METHODS

Duplicate groups of day-old commercial broiler with 25 chicks per group were given a basal practical diet based on guinea corn-PKM (Table 1). On the whole, 400 day-old chicks were used in this study. The diet was supplemented with pyridoxine to achieve graded levels of 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5 and 8.0 mg pyridoxine/kg feed. Pyridoxine content of basel diet was estimated (Association of Vitamin Chemists Inc. 1966) prior to vitamin supplementation. The chicks were housed in deep litter pens, each of 5.5m^2 floor area and containing dry wood shavings litter, two 4-litre plastic drinkers, a through feeder and a 200-W tungsten filament lamp. Birds were maintained on the respective dietary treatments for a period of 42 days during which they had free access to feed and water and routine vaccinations were administered. Feed intake, body weight gain and feed efficiency were recorded on a weekly basis. Birds were observed regularly for clinical signs of anaemia and symptoms of pyridoxine deficiency in the chickens (Gries and Scott 1972). All birds that died were sent to the Veterinary Clinic of the State's Ministry of Agriculture and Natural Resources for post mortem examination. Mortality due to pyridoxine deficiency was recorded.

TABLE 1
Composition of the basal diet

Constituent	g/kg
Guinea corn	500
Palm kernel meal	200
Blood meal	67
Fish meal	45
Brewer's grain	125
Palm kernel oil	20
Vitamin/mineral premix*	1
Oyster shell	10
Bone meal	20
L-Lysine	5
DL-Methionine	5
NaCl	2
TOTAL	1000
Chemical analysis	
Crude protein (%)	21.2
Crude fat (%)	4.2
Gross energy (Kcal/kg)	3068.6
Pyridoxine (mg/kg)	4.02

* vitamin/mineral premix supplied the following vitamin and minerals per kg of feed: 1200 IU Vit. A; 2500 IU Vit D; 10 IU Vit E; 1.5 mg Menadione sodium bisulphite; 2.5 mg Vit. B1; 5 mg Vit. 52; 500 mg Choline chloride; 10 mg Calcium d-panthothenate; 35 mg Nicotinic acid; 0.02 mg Vit. B12; 0.16 mg Biotin; 1 mg Folic asid; 50 mg iron; 150 mg Manganese; 2.5 mg cooper; 45 mg zinc; 0.2 mg Cobalt; 0.08 mg Selenium; 1.4 mg Iodine.

In the last three weeks of experimentation, metabolic studies were conducted with four replicate samples of birds randomly selected from the respective treatment groups at the beginning of the fourth week. The birds were housed in single-bird cages, 400 x 300 mm, with wire floors allowing for separate collection of excreta. The cages had individual feed and water troughs. In accordance with the total collection procedure, excreta samples were collected daily from each treatment group on 14 successive days during the fifth and sixth week for nutrient analysis. Feed and excreta were analysed for nitrogen and lipid (AOAC 1980). Gross energy values were determined using the Ballistic bomb calorimeter and apparent metabolizable energy values of the diets were calculated. Apparent retention of nitrogen and lipid were calculated as the difference between the amount of the constituent in the diet and excreta samples collected (Oloyo 1997).

At the end of the feeding trial, four replicate samples of birds were selected randomly from the respective treatment groups in the floor pens for blood collection and subsequent slaughtering. Blood samples were taken from the wing veins of each bird and kept for measurement of haemoglobin content and packed cell volume, PCV (Lamb 1981) and aspartate aminotransferase (L-aspartate: 2-oxoglutarate aminotro-ansferase [EC 2.6.1]) activity (Reitman and Frankel 1957). Selected birds were killed by cervical dislocation, the livers were removed for the measurement of asparate aminotransferase activity (Tonhazy *et al.* 1950) and were dressed for carcass characteristics evaluation (Oloyo and Ogunmodede 1990).

Results obtained in the trial were subjected to analysis of variance (Steel and Torrie 1960), and differences between treatment means were tested using the multiple range test of Duncan (1955).

RESULTS AND DISCUSSION

Results of feed utilisation (Table 2) indicated that groups of birds that received from 4.5 to 5.5 pyridoxine/kg feed consumed less feed, gained less body weight and had poorer efficiency of feed conversion than those given 6.0 – 8.0 mg of the vitamin per kg of feed. Poorer feed consumption observed in birds given 4.5 – 5.5 mg pyridoxine/kg feed might be due to inability of the birds to move freely because anaemic conditions set in making them sluggish and easily fatigued. Results from this study tend to show that 6.0mg pyridoxine /kg was the lowest dietary level required for optimum feed intake and growth rate.

Starvation, a consequence of depressed appetite was believed to be the cause of death in pyridoxine-deficient chickens (Gries and Scott 1972). Indeed, mortality due to pyridoxine (ARC 1975) recorded in the present study was noted among groups of birds fed 4.5 – 5.0 mg pyridoxine/kg (Table 2). In addition these groups consumed significantly less feed. Trembling fits and convulsions preceded death in most cases. Postmortem examination indicated gizzard erosion and haemorrhagic patches around the follicles of the wing feathers.

Pyridoxine-deficient chicken became anaemic due to a failure in the normal mechanism of haemoglobin synthesis (Scott *et al.* 1982) and showed marked reduction in plasma proteins and in aspartate aminotransferase activities in serum and liver (Kirchgessner and Maier 1968; Ogunmodede 1981) and Cheney *et al.* (1965) concluded that serum transaminase activity is a sensitive indicator of pyridoxine status. In support of earlier reports, the results of the present study indicated that birds fed 4.5-5.0 pyrodoxine/kg feed developed anaemic condition as indicated by having lower haemoglobin concentration and PCV than those given higher dietary pyridoxine levels (Table 2). In the case of enzyme activities in birds (Table 3), there was marked reduction in aspartate aminotransferase activity in serum and livers of groups of birds given 4.5 – 5.0 mg pyridoxine/kg feed than those fed higher dietary levels of the vitamin. The results of mortality, haemoglobin concentration, PCV and transaminase activities in serum and livers appeared to suggest that guinea corn-PKM diet should be supplemented with pyridoxine up to 5.5 mg per kg of feed for promotion of good health in broiler chicken.

Apparent nutrient retention in experimental broilers was signficantly affected by the dietary treatments where higher dietary levels of pyridoxine in the diet resulted in remarkable utilisation of nitrogen, lipid and metabolizable energy (Table 2). This result is in agreement with the findings of earlier reports that deficiency of pyridoxine led to an impairment of the utilisation of protein (Fuller 1964) and lipid (Ogunmodede 1981). The results of the present study indicated that supplementation of the diet with vitamins up to 6.0 mg/kg seemed adequate for optimum utilisation of the nutrients.

The importance of producing carcass of desirable quality in the economics of broiler production underline the need for the assessment of carcass characteristics of experimental chickens. Information is however lacking on the pyridoxine requirement for broiler carcass characteristics evaluated in this study. The results in Table 4 indicate that good carcass characteristics require pyridoxine as evident from the significant dietary treatment effect on the parameters. It appears that while supplementation of the practical guinea corn-PKM diet with pyridoxine up to 5.5 mg/kg seemed inadequate for carcass weight, total edible meat weight, total bone weight and meat: bone ratio, it was marginal for dressing percentage and meat and bone expressed as proportions of carcass weight.

Variations in the amounts of pyridoxine required by experimental broiler chicken for productive performance (i.e., feed utilisation, nutrient retention and carcass quality), health (mortality, haemoglobin concentration and PCV) and enzyme activities (aspartate transaminase

TABLE 3
Effect of dietary pyridoxine on aspartate aminotransferase activities in serum and livers of experimental broiler chickens

Pyridoxine (mg/kg feed)	Aspartate aminotransferase activity in	
	Serum (units/cm^3)	liver (units/mg dry tissue)
4.5	118c*	243
5.0	121bc	239b
5.5	172a	396a
6.0	174a	314a
6.5	182a	311a
7.0	177a	309a
7.5	176a	316a
8.0	178a	312a
±SEM**	12.42	16.10

* Values in a column bearing different superscripts are significantly (P<0.05) different.
** SEM, Standard error of the mean

TABLE 2

Feed utilisation, health performance and nutrient retention of broilers fed guinea corn-PKM based diet with supplementation of pyridoxine at 42 days

Parameter	Pyridoxine (mg/kg feed)								
	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	SEM**
Feed utilisation:									
Live weigh at 42 days (g)	914.4^{c*}	976.4^{bc}	1053.0^{bc}	1313.4^{a}	1300.8^{a}	1316.6^{a}	1351.2^{a}	1330.2^{a}	84.66
Daily weight gain (g/bird)	20.7^{b}	22.2^{b}	24.0^{b}	30.2^{a}	29.9^{a}	30.3^{a}	31.1^{a}	30.6^{a}	2.01
Daily feed intake (g/bird)	81.8^{b}	83.5^{b}	87.8^{b}	98.6^{a}	100.6^{a}	101.8^{a}	103.5^{a}	101.2^{a}	4.18
Feed efficiency (g gain/g feed)	0.25^{b}	0.27^{b}	0.27^{b}	0.31^{a}	0.30^{a}	0.30^{a}	0.30^{a}	0.30^{a}	9.92E-03
Health performance									
Mortality (%)	5.00^{a}	2.50^{b}	0^{c}	0^{c}	0^{c}	0^{c}	0^{c}	0^{c}	1.23
Haemoglobin (g/100cm^{3})	2.90^{c}	4.76^{b}	7.89^{a}	8.20^{a}	8.24^{a}	8.15^{a}	8.10^{a}	8.32^{a}	0.97
PCV (%)	7.2^{c}	12.8^{b}	27.4^{a}	28.1^{a}	28.0^{a}	27.6^{a}	27.8^{a}	28.2^{a}	3.93
Nutrient retention									
Nitrogen retention (%)	54.6^{b}	55.2^{b}	56.5^{b}	62.9^{a}	62.08^{a}	63.2^{a}	64.1^{a}	63.7a	1.94
Lipid retention (%)	69.2^{c}	74.1^{b}	80.8^{ab}	83.1^{a}	82.9^{a}	83.7^{a}	83.4^{a}	83.8^{a}	2.56
Metabolizable energy (Kcal/kg)	2750.2^{b}	2755.0^{b}	2784.4^{b}	2849.1^{a}	2843.5^{a}	2836.2^{a}	2843.6^{a}	2832.8^{a}	20.89

* Values in a row bearing different superscripts are significantly (P,0.05) different

** SEM, Standard error of the mean

TABLE 4

Carcass characteristics of broilers fed guinea corn-PKM diet and graded levels of pyridoxine at 42 days

Parameter	Pyridoxine (mg/kg feed)								
	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	SEM**
Carcass weight (g)	567.84^{b*}	603.42^{b}	688.66^{b}	895.74^{a}	898.85^{a}	916.35^{a}	929.63^{a}	911.19^{a}	72.15
Dressing percentage	62.1^{b}	61.8^{b}	65.4^{a}	68.2^{a}	69.1^{a}	69.6^{a}	68.8^{a}	68.5^{a}	1.49
Total edible meat (g)	359.44^{b}	378.95^{b}	442.12^{b}	595.67^{a}	599.53^{a}	617.62^{a}	615.42^{a}	611.41^{a}	53.13
Meat (% carcass weight)	63.3^{b}	62.8^{b}	62.4^{ab}	66.5^{a}	66.7^{a}	67.4^{a}	66.2^{a}	67.1^{a}	0.85
Total bone (g)	208.40^{b}	224.47^{b}	246.54^{b}	300.07^{a}	299.32^{a}	298.73^{a}	314.21^{a}	299.78^{a}	19.14
Bone (% carcass weight)	36.7^{a}	37.2^{a}	35.8^{ab}	33.5^{b}	33.3^{b}	32.6^{b}	33.8^{b}	32.9^{b}	0.85
Meat: bone ratio	1.72^{b}	1.69^{b}	1.79^{b}	1.99^{a}	2.00^{a}	2.07^{a}	1.96^{a}	2.04^{a}	0.07

* Values in a row bearing different superscripts are significantly (P<0.05)

** SEM, Standard error of the mean

activities in serum and livers) might be due to differences in the sensitivities of the parameters to the pyridoxine status of the birds. Indeed, Whitehead (1982) reported that the first effect of vitamin deficiency is a retardation of performance; lesions and death only occur when the deficiency is more severe or prolonged. Thus health is generally less sensitive than productive performance as an indicator of requirement. It was also noted that enzyme activity as criterion of establishing vitamin requirement is not clear cut because some enzyme activities may not be optimal with vitamin intake adequate for productive purposes. Nutrient retention, on the other hand, was considered highly valid since it is linked with ultimate objective of feeding the chicken.

From the foregoing, it may be concluded that for optimum performance, broilers require at least 6.0 mg pyridoxine per kg of guinea corn PKM based diet. The achieved requirement estimate of the vitamin for broilers in the present study falls within the range or requirement values recommended earlier i.e. 1.2 – 7.3 mg/kg (Ogunmodede 1981, Whitehead 1982; NRC 1994). Variations in the earlier reported requirement estimates have been attributed to the involvement of pyridoxine in protein metabolism and the sources of dietary protein. Soybean, cottonseed, safflower and groundnut were the main protein sources in the various test diets in earlier studies on which requirement estimates were based. All the protein sources except soybean differ in their amino acid profiles from PKM, the plant protein source in the present study. Futhermore, higher dietary fibre content of PKM suppressed hydrolysis of its protein and consequently caused reduction in the bioavailability of its amino acids (Babatunde *et al.* 1975; Nwokolo *et al.* 1977). In addition, Best (1993) noted that dietary fibre affected the functioning of the gut microflora with consequent alteration of micronutrient requirement of birds. Dietary protein contributed by guinea corn, the major energy source in the diet, is also characterised by poor digestibility and reduced bioavailability of its amino acids (Nelson *et al.* 1975) which might have influenced the estimated pyridoxine requirement of broilers in this study.

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