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Folic acid supplement for broilers fed guinea corn-palm kernel-meal based diet

R A OLOYO[1]

Federal Polytechnic, P.M.B. 50 Ilaro, Ogun State, Nigeria

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ABSTRACT

Eight duplicate groups of 20 day-old commercial broiler chicks each were raised in deep litter up to 42 days and fed on guinea corn-palm kernel-meal based diet with or without folic acid supplementation (i.e., 0.0, 0.25, 0.50, 0.75, 1.00, 1.25, 1.50 and 1.75ppm). Growth, feed utilization and nutrient retention data, haematological picture, incidence of leg abnormalities and carcass studies indicated that broilers maintained on folic acid unsupplemented basal diet suffered vitamin deficiency, and that a dietary supplement of 0.75ppm folic acid was adequate for good performance.

Key words: Broiler chicken, Folic acid, Guinea corn, Palm kernel-meal

Drastic changes in composition of poultry diets because of replacement of high-cost traditional feed protein sources with lower-cost alternatives, coupled with the wide variation in the amounts and bioavailability of folic acid in feed ingredients, and the many interactions between the vitamin and protein and lipid in the diet (Roche 1988) mean that requirement may differ depending on the type of diet fed. This consideration therefore underlines the significance of establishing the vitamin requirement for chicken using practical diet based on locally available feed ingredients. Indeed, in Nigeria, Ogunmodede (1982) estimated folic acid requirement of broilers fed a diet based on groundnut-cake (GNC; expeller), which until recently had been the most commonly used feed protein source in the country.

The recent problem of high cost and inadequate supply of GNC encouraged the use of palm kernel-meal (PKM) as an alternative which offers a significant protein cost advantage in poultry rations. However, information on the folic acid requirement of broilers fed PKM based ration is lacking.

Characteristic high fibre content of PKM in the diets of broilers, is another factor that is of concern. More especially dietary fibre that adversely affected vitamin-synthetic capacity of the gut microflora with consequent alteration of folic acid requirement of broiler chicks (Belcic and Friesecke 1979, Best 1993). This study aimed to establish folic acid supplement required for optimum performance of broilers fed guinea corn-PKM based diet.

Present address: [1]Chief Lecturer, Department of Science Laboratory Technology.

MATERIALS AND METHODS

Eight duplicate groups of 20 day-old commercial broiler chicks each was raised in deep litter up to 42 days and fed on guinea corn-PKM based diet (Table 1) and supplemented with 0.0, 0.25, 0.50, 0.75, 1.00, 1.25, 1.50 and 1.75 ppm folic acid.

Table 1. Composition of basal diet supplemented with graded levels of folic acid

Ingredients	%
Guinea corn	53.0
Palm kernel-meal	20.0
Blood-meal	8.9
Fish-meal	7.8
Wheat bran	5.0
Oyster shell	1.0
Bone-meal	2.0
Vitamin/mineral premix*	0.1
Salt (NaCl)	0.2
Palm kernel oil	2.0
	100.0
Analysis	
Crude protein (%)	21.7
Fat (%)	4.5
Gross energy (Kcal/kg)	3041.6
Folic acid (ppm)	0.25

*Vitamin/mineral premix supplied per kg of feed: Vitamin A, 1200 IU; vitamin D, 2500 IU; vitamin E, 10 IU; menadione sodium bisulphite (vitamin K), 1.5mg; vitamin B_1, 2.5mg; vitamin B_2, 5mg; choline chloride, 500mg; calcium D-pantothenate, 10mg; nicotinic acid, 35mg; vitamin B_6, 4mg; vitamin B_{12}, 0.02mg; biotin, 0.2mg; iron, 50mg; manganese, 150mg; copper, 2.5mg; zinc, 45mg; cobalt, 0.2mg; selenium, 0.08mg; iodine, 1.4mg.

Table 2. Effect of folic acid supplementation on growth, incidence of leg disorders and haematological features in experimental broilers up to 42 days

Parameter	Supplemental folic acid (ppm)								±SEM
	0.0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	
Live weight at 42 days (g)	1096.0c*	1122.0bc	1164.0b	1534.0a	1550.0a	1546.0a	1558.0a	1563.0a	102.79
Live weight gain (g/bird/day)	25.1b	25.8b	26.8b	35.6a	36.0a	35.9a	36.1a	36.3a	2.45
Feed intake (g/bird/day)	77.2b	78.3b	81.1b	110.7a	108.6a	112.6a	110.0a	112.2a	7.77
Feed efficiency (g gain/g feed)	0.33	0.33	0.33	0.32	0.33	0.32	0.33	0.32	2.42E-03
Incidence of leg disorders (%)	7.5a	2.5b	2.5b	0c	0c	0c	0c	0c	1.24
Haemoglobin (g/100cm^3)	3.20b	4.58b	8.10a	8.26a	8.00a	8.21a	7.92a	8.12a	0.93
Packed-cell volume (%)	8.2c	13.1b	28.9a	28.5a	29.4a	29.6a	28.8a	28.2a	4.00
Red blood cell (10^6/mm^3)	0.38b	0.64b	2.19a	2.17a	2.20a	2.17a	2.18a	2.19a	0.36

*Mean values in a row followed by different subscripts differ significantly at P<0.05; **SEM, standard error of the mean.

Rations were analysed for folic acid content as per Cooperman (1967) prior to supplementation. Body weight, feed intake, feed efficiency (gain / feed intake) and incidence of leg abnormalities were recorded weekly. Feed and water were provided at all times and routine vaccinations were administered during the experimentation period.

In the last 3 weeks of experimentation metabolic studies were conducted with 4 replicate samples of birds randomly selected from each treatment group at the beginning of the fourth week. Feed and excreta samples were analyzed for nitrogen and lipid contents (AOAC 1980), and apparent retention of nitrogen and lipid were calculated as the difference between the amount of the constituent in the diets and excreta samples collected. Gross energy values were determined with a ballistic bomb calorimeter and apparent metabolizable energy values of diets were calculated.

To estimate the folic acid supplement required for optimum performance of broilers fed a guinea corn-PKM based ration, birds were given the basal diet (Table 1) supplemented with graded levels of the vitamin. The unsupplemented basal diet contained 0.25 ppm folic acid and was about a half and a quarter of the NRC (1984) and ARC (1975) recommended requirement values respectively. Total folic acid content of the ration that had the highest vitamin supplementation was 8-times the lowest. Thus a wide range of dietary supplemental folic acid level was tested.

Table 3. Apparent nitrogen and lipid retention and metabolizable energy values as affected by supplemental folic acid

Supplemental folic acid (ppm)	Nitrogen retention (%)	Lipid retention (%)	Metabolizable energy (Kcal/kg)
0.00	54.6c*	65.2b	2 746b
0.25	59.8b	66.4b	2 738b
0.50	65.9a	78.1a	2 854a
0.75	65.6a	82.3a	2 852a
1.00	67.8a	79.0a	2 846a
1.25	66.2a	81.5a	2 856a
1.50	66.7a	80.6a	2 849a
1.75	65.4a	78.9a	2 850a
±SEM**	2.10	3.16	23.70

*Mean values in a column followed by different subscripts differ significantly at P<0.05; **SEM, standard error of the mean.

At the end of the feeding trial, 2 ml of blood was collected in a heparinized container from wing veins of each of 4 replicate samples of experimental chicks randomly selected from each treatment group for measurement of haemoglobin content, packed-cell volume and red blood cells (RBC) (Lamb 1981). Selected bird samples were then fasted for 6 hr, weighed, slaughtered and dressed for carcass characteristic studies. The data were analysed as per Steel and Torrie (1960).

RESULTS AND DISCUSSION

Growth performance of experimental broilers (Table 2) indicated that whereas live weight gain and feed intake were significantly affected by the dietary supplemental folic acid, feed efficiency was not. Birds maintained on up to 0.50 ppm supplemental folic acid, consumed significantly less feed, had poorer live weight gain and weighed less at 42 days than those given 0.75 -1.75 ppm supplement of the vitamin. The depression in feed consumption of birds fed diets supplemented with 0.00-0.50 ppm folic acid might be due to locomotory problems which developed due to high incidence of abnormalities in the leg bones. This observation is in agreement with those of Cook *et al.* (1984). Leg disorders were characterized by shortened tibia, enlargement of the hock joint and slippage of the tendon at the hock joint, which resulted in the twisting of the legs. Majority of the affected chicks was less active and more inclined to sit more than the normal ones.

In addition to retarded growth and poor feed utilization, which were manifestation of folic acid deficiency in birds given 0.00-0.50 ppm supplemental vitamin, most of the affected birds had white watery diarrhoea and were anaemic. They exhibited very poor feathering appearance with greater proportion of the feathers becoming ruffled. This result confirmed the inadequacy of supplemental 0.50 ppm folic

Table 4. Carcass characteristics of broilers fed graded levels of folic acid from 1 to 42 days of age

Parameter	Supplemental folic acid (ppm)								±SEM**
	0.0	0.25	0.50	0.75	1.00	1.25	1.50	1.75	
Carcass weight (g)	670.8b*	712.5b	802.0b	1061.5a	1057.1a	1066.7a	1071.9a	1069.1a	83.26
Dressing percentage	61.2b	63.5b	68.9a	69.2a	68.2a	69.0a	68.8a	68.4a	1.42
Total edible meat (g)	430.0c	446.0c	542.2b	723.9a	723.1a	726.4a	720.3a	727.0a	62.73
Meat (% carcass weight)	64.1b	62.6b	67.6a	68.2a	68.4a	68.1a	67.2a	68.0a	1.02
Total bone (g)	240.8b	266.5b	259.8b	337.6a	334.0a	340.3a	351.6a	342.1a	21.07
Bone (% carcass weight)	35.9a	37.4a	32.4b	31.8b	31.6b	31.9b	32.8b	32.0b	1.02
Meat : bone ratio	1.79b	1.67b	2.09a	2.14a	2.16a	2.13a	2.05a	2.13a	0.09

*Mean values in a row followed by different subscripts differ significantly at $P<0.05$; **SEM, standard error of the mean.

acid for efficient feed utilization and prevention of leg deformities in the chicks.

Folic acid is required for normal maturation of RBC in the bone marrow and hence prevents the development of macrocytic anaemic condition in animals. Its deficiency has resulted in reduction in number and increase in average size of RBC and reduction in haemoglobin concentration in birds (Ogunmodede 1982). Haematological data (Table 2) show marked decreases in haemoglobin concentration, packed-cell volume and RBC counts in birds given 0.0-0.25 ppm supplemental folic acid, and all of which indicated occurrence of macrocytic anaemia in the chicks. It appeared therefore that a supplement of 0.50 ppm folic acid is required for maintenance of normal haematological characteristic of the blood.

In broiler chicks requirement for folic acid is influenced by the dietary protein and lipid contents and hence the conclusion that the vitamin is important in the metabolism and utilization of the nutrients (Creek and Vassitis 1963). The significant effect of dietary treatment on the apparent retention of the nutrients (Table 3) therefore confirmed reports of earlier studies. The trend of results of apparent nitrogen and lipid retention and metabolizable energy values was similar to those of haematological characteristics where birds given 0.00-0.25 ppm supplemental folic acid had poorer nutrient utilization than those fed on higher (0.5.-1.75 ppm) supplemental vitamin.

Information is lacking on the effect of folic acid on the carcass characteristics such as those studied in this trial. However, the significant dietary treatment effect on the carcass quality parameters (Table 4) indicated the need for folic acid in the production of good carcass quality. Supplementation of folic acid at 0.75 ppm seemed to be adequate for carcass weight, total edible meat and total bone weight, whereas a lower supplement (0.50ppm) appeared to be needed for dressing percentage, both meat and bone expressed as per cent of carcass weight and meat: bone ratio.

From the foregoing therefore, it may be concluded that folic acid unsupplemented guinea corn -PKM basal diet induced in the chicks symptoms characteristic of folic acid deficiency, and that a dietary supplement of 0.75 ppm was adequate for the promotion of optimum growth performance and better nutrient retention, prevention of leg bone disorders and anaemic condition and production of good carcass characteristics.

REFERENCES

AOAC. 1980. *Official Methods of Analysis*. 13th edn. Association of Official Analytical chemists. Washington DC.

ARC. 1975. Agricultural Research Council. *The Nutrient Requirement of Farm Livestock*.No.1. Poultry, London.

Belcic I and Friesecke H. 1979. *Folacin in Animal Nutrition*. ROCHE Publication.

Best P. 1993. Ingredients for broiler diets: Choose wheat by its fibre fraction? *Feed International*. December 1993. A Watt Publication.

Cook M E, Springer W R, Kerr K M and Herbert J A. 1984. Severity of tenosynovitis on reovirus-infected chickens fed various dietary levels of choline, folic acid anganese, biotin or niacin. *Avian Diseases* **28** 562-73.

Cooperman J M. 1967. Microbiological assay of serum and whole blood folic acid activity. *American Journal of Clinical Nutrition* **20**. 1015-24.

Creek R D and Vassitis V. 1963. The effect of excess dietary protein on the need for folic acid by the chick. *Poultry Science* **42**. 1136-41.

Lamb G M. 1981 *Manual of Veterinary Laboratory Techniques*. Kenya, CIBA-Geigy.

National Research Council. 1984. *Nutrient Requirement of Poultry*. 8th edn. NAS-NRC.Washington, D C.

Ogunmodede B K. 1982. Folic acid requirement of broiler chicks in a humid tropical environment. *Nigerian Journal of Nutritional Science* **5**: 31-9.

ROCHE. 1988. *Folic Acid for Poultry*. ROCHE Publication.

Steel R G D and Torrie J H. 1960. *Principles and Procedures of Statistics*. McGraw-Hill Book Co., New York.