Indian Journal of Animal Sciences **67** (5) : 422-425, May 1997

Effect of guineacorn/palm kernel-meal based diet with niacin supplementation on the performance of broilers

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Received : 28 November 1995

ABSTRACT

Commercial broiler chicks, 350 day-old, were randomly assigned to duplicate floor pens with 25 chicks each. They were fed a guineacorn-palm kernel-meal based diet supplemented with 0.0, 7.5, 15.0, 22.5, 30.0, 37.5 and 45.0 mg niacin/kg feed for 42 days. Significantly poorer live-weight gain, feed intake and apparent utilization of nitrogen metabolizable energy, calcium and phosphorus, and a higher incidence of dermatitis and leg bone deformities in broilers on niacin-unsupplemented diets showed a deficiency of niacin in the basal diet which were all reversed with addition of 30.0 mg niacin/kg feed.

Key words : Broilers, Guineacorn, Palm kernal-meal, Niacin, Supplementation

High cost and inadequate supply of groundnut-cake have led to an increased use of palm kernel-meal in poultry diet. However, in palm kernel-meal-based rations the birds developed pellagra-like symptoms attributed to a deficiency of niacin in guineacorn-based diets (Filho *et al.* 1983) besides a modification of niacin requirement in palm kernel-meal-based diets (Fisher *et al.* 1955). This paper describes the effect of supplemental niacin to guineacorn-palm kernel meal-based diets with a view to improve broiler performance.

MATERIALS AND METHODS

Commercial broiler chicks 350 day-old were randomly assigned to 7 supplemental niacin groups (0.0, 7.5, 15.0, 22.5, 30.0, 37.5 and 45.0 mg/kg feed) each level with 2 replicates consisting of 25 birds each. Practical experimental diets based on guineacorn and palm kernel-meal were formulated (Table 1), analysed for niacin content by the method of Association of Vitamin Chemists, Inc. (1966) and then supplemented with graded levels of the vitamin. Chicks were raised in 14 floor 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. Throughout the period of experimentation (1 to 42 days), the birds were offered the test diets *ad lib.*

Individual body weights, feed intake, per cent incidence of dermatitis and of leg-bone deformities (twisted legs, perosis, crippled) were recorded at weekly intervals during the 6 week test period.

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During the last 3 weeks of the experiment, a metabolic study was conducted on 4 replicate samples of experimental chicks randomly selected from each group at the beginning of the fourth week. Following the total collection procedure, excreta were collected daily from each treatment group on 14 successive days during the fifth and sixth week. Feed and excreta were analysed for nitrogen and phosphorus (AOAC 1980) and calcium (Perkin-Elmer Inc. 1973). Gross energy values were determined with a ballistic bomb calorimeter and apparent metabolizable energy values of diets were calculated. Apparent retention of nitrogen, phosphorus and calcium were calculated as the difference between the amount of the constituent in the diets and excreta samples collected.

At the end of the experiment, 4 replicate samples of birds were selected from each treatment group in the floor pens, starved for 6 hr weighed, slaughtered and dressed for evaluation of dressing percentage. The abdominal fat pad was carefully excised and weighed. Bones in the carcasses were carefully removed and the edible meat was separated. Total edible meat and total bone from each of the carcasses were weighed and the meat to bone ratio was calculated. Meat and bones were also expressed as percentage of carcass weights.

The data obtained were subjected to analysis of variance (Steel and Torrie 1960) and significantly different treatment means were compared using the multiple range test of Duncan (1955).

RESULTS

Feed utilization and health performance

Weight gain and feed intake were significantly affected by the dietary supplemental niacin but feed efficiency was not

(Table 2). Birds on up to 22.5 mg supplemental niacin/kg feed consumed significantly less feed, had poorer live-weight gain and weighed less at 42 days than those given higher supplemental niacin levels.

Appearance of dermatitis and leg deformities in the birds were also significantly influenced by the dietary treatments. In some of the affected birds, vision was impaired because the edges of the eyelids became granular and contracted. Also, there was a production of viscous exudate in the affected birds. Skin lesions of varying degree appeared around the corners of the mouth and the nostrils. Dermal lesions also occurred on the feet and toes with pronounced haemorrhagic fissures on the bottom of the feet to the extent that birds found it difficult to stand or walk. Other leg deformities observed included bowing and or twisting of leg bone and enlargement of tibiotarsal joints. All cases of skin lesions and leg deformities recorded developed within the 4th and 16th day of the feeding trial. Results presented in Table 2 niacin/kg indicated that supplemental 15.0 mg niacin/kg feed and 22.5 mg niacin/kg feed prevented incidence of dermatitis and leg deformities respectively.

Table 1. Composition of practical diet supplemented with graded levels of niacin

Constituent	Inclusion level (g/kg)
Guineacorn	505
Palm kernel-meal	200
Blood-meal	72
Fish-meal	52
Wheat offal	128
Oyster shell	10
Bone-meal	20
Vitamin/mineral premix*	1
Salt (NaCl)	2
Palm kernel oil	10
Chemical composition (analysed)	
Niacin (mg/kg)	14.8
Gross energy (Kcal/kg)	3037.9
Crude protein (%)	21.7
Calcium (%)	1.18
Phosphorus (%)	0.80
Tryptophan, calculated (%)	0.23

*Vitamin/mineral premix supplied the following vitamins and mineral elements per kg of feed : Vit. A, 1200 IU; vit. D, 2300 IU, Vit. E, 10 IU; menadione sodium bisulphite (vit. K), 1.5 mg; vitamin B_1 2.5 mg; vit. B_2 5 mg; choline chloride, 500 mg; calcium D-pantothenate, 10mg; vit. B_6, 4mg; vit. B_{12}, 0.02 mg; biotin, 0.2 mg; iron, 50 mg; manganese, 150 mg; copper 2.5 mg; zinc, 45 mg; cobalt, 0.2 mg; selenium, 0.08 mg; iodine, 1.4 mg.

Carcass characteristics

All the parameters of carcass characteristics (Table 2) except abdominal fat were markedly influenced by dietary supplemental niacin. Supplementation of niacin at 22.5 mg/kg diet seemed to be adequate for dressing percentage, both meat and bone expressed as per cent of carcass weight and meat : bone ratio, higher level of supplementation (i.e. 30.0 mg/kg diet) appeared to be needed for carcass weight, total edible meat, total bone weight and abdominal fat expressed as per cent of carcass weight.

Nutrient utilization

All the nutrients examined were significantly affected by dietary treatments, where supplemental 22.5 mg niacin/kg feed appeared to be adequate for metabolizable energy and calcium utilization (Table 3). However, this supplemental niacin level seemed marginal for nitrogen retention, but was inadequate for phosphorus utilization.

DISCUSSION

The niacin requirement of birds and/or levels of supplementation vary widely due to the types of ingredients used in diets, niacin bioavailability in diets and tryptophan content of diets. In this study, practical ration based on guineacorn and palm kernel-meal and containing 0.23% tryptophan (Table 1) constituted the test diet that was supplemented with graded levels of niacin. Feed utilization results indicated that a minimum of 30.0 mg added niacin/kg feed was needed for satisfactory feed consumption and growth rate. Czarnecki *et al.* (1983) and Waldroup *et al.* (1985) concluded that the birds required supplementary niacin ranging from 30-100 mg/kg. Working with purified diets, with adequate tryptophan levels, Childs *et al.* (1952), Patterson (1956) and NRC (1984) reported a lower niacin requirement of 18-33 mg/kg. The marked reduction in feed intake of birds fed diets supplemented with 0-22.5 mg niacin/kg might be due to reduction in free movement of the birds due to bowing and/or twisting of the leg bone and the dermal lesions developed in the feet.

Skin lesions and leg deformities characteristic of niacin deficiency in young chickens (Summers *et al.* 1984, Gries and Scott 1972, Cook *et al.* 1984, Leeson 1988) developed distinctly in birds given lower levels of the supplemental niacin. The results indicated that while 22.5mg niacin/kg was the minimum level needed to prevent incidence of dermatitis, a higher supplemental level of 30.0 mg niacin/kg was required for normal leg bone development.

Information is lacking on the niacin requirement for carcass characteristics such as those examined in this study excepting abdominal fat pad. The nonsignificant effect of supplemental niacin on abdominal fat pad *per se* is in agreement with the observation of Waldroup *et al.* (1984). However, the result of this study indicated the ability of higher levels of supplemental niacin (30.0-45.0 mg/kg) to significantly lower abdominal fat pad which is a desirable feature from the con-

Table 2. Growth, feed efficiency, health performance and carcass characteristics of broilers fed graded levels of niacin from 1-42 days of age

Parameter	Supplemental niacin (mg/kg feed)							±SEM**
	0.0	7.5	15.0	22.5	30.0	37.5	45.0	
			Feed utilization					
Live weight at 42 days (g)	1074.0b*	1120.8b	1150.1b	1183.3b	1540.9a	1549.1a	1528.0a	101.95
Live weight gain (g/bird-day)	24.6b	25.7b	26.4b	27.2b	35.7a	35.9a	35.4a	2.43
Feed intake (g/bird-day)	82.1b	84.8b	84.2b	91.7b	110.6a	112.1a	110.4a	6.23
Feed efficiency (g gain/g feed)	0.30	0.30	0.30	0.30	0.32	0.32	0.32	4.95E-03
			Health performance					
Incidence of dermatitis (%)	8a	4b	0c	0c	0c	0c	0c	1.46
Incidence of leg deformities (%)	6a	2b	2b	0c	0c	0c	0c	1.03
			Carcass characteristics					
Carcass weight (g)	654.1c*	687.1c	694.7c	824.8b	1081.7a	1072.0a	1051.3a	90.88
Dressing percentage	60.9b	61.3b	60.4b	69.7a	70.2a	69.2a	68.8a	2.14
Abdominal fat (g)	23.8	24.9	24.09	25.2	24.6	25.0	24.8	0.24
Abdominal fat (% carcass weight)	3.6a	3.6a	3.5a	3.1a	2.3b	2.3b	2.4b	0.89
Total edible meat (g)	412.7c	442.5c	442.5c	570.8b	744.2a	739.7a	719.1a	70.12
Meat (%carcass weight)	63.1b	64.4b	63.7b	69.2a	68.8a	69.0a	68.4a	1.28
Total bone (g)	217.6b	219.7b	228.2b	228.8b	312.9a	307.3a	307.4a	21.28
Bone (% carcass weight)	33.3a	32.0a	32.8a	27.7b	28.9b	28.7b	29.2b	1.05
Meat : bone ratio	1.90b	2.01b	1.94b	2.49a	2.38a	2.41a	2.34a	0.12

*Mean values in a row followed by different subscripts are significantly different at P<0.05.

**SEM, standard error of the mean.

Table 3. Effect of supplemental niacin on apparent nitrogen, calcium and phosphorus retention and metabolizable energy values

Supplemental niacin (mg/kg feed)	Nitrogen retention (%)	Calcium retention (%)	Phosphorus retention (%)	Metabolizable energy (Kcal/kg)
0.0	54.1b*	65.2b	53.2c	2732.0b
7.5	52.6b	64.0b	52.6c	2770.6b
15.0	53.7b	66.1b	54.8c	2752.3b
22.5	60.4ab	72.6a	68.2b	2816.1a
30.0	67.6a	74.2a	73.5a	2858.7a
37.5	68.2a	73.4a	74.1a	2846.5a
45.0	68.4a	74.5a	72.7a	2849.6a
±SEM**	3.39	2.16	4.69	23.90

*Mean values in column followed by different subscripts are significantly different at P<0.05.

**SEM, Standard error of the mean.

sumers' and processors' points of view. Based on all considerations, it appeared that a minimum of 30.0 mg niacin/kg supplemented to feed was needed for good carcass characteristics.

The physiological function of niacin in chickens not only affects energy metabolism but also utilization of other nutrients as well (Lockhart *et al.* 1966). Poor utilization of calcium and phosphorus, which are required for normal bone formation and egg production was recorded in chicken deficient in niacin (LONZA 1984). In support of earlier reports, marked improvement in apparent utilization of nitrogen, metabolizable energy, calcium and phosphorus was observed in experimental birds at higher levels of supplemental niacin. The results also tended to suggest that a supplement of 30.0 mg niacin/kg was needed for optimum utilization of the nutrients.

REFERENCES

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

Association of Vitamin Chemists Inc. 1966. *Methods of Vitamin Assay.* 3rd edn. Interscience Publishers, New York.

Childs G R, Carric C W and Hauge S M. 1952. The niacin requirement of young chickens. *Poultry Science* **31** : 551-58.

Cook M E, Springer W T and Hebert J A. 1984. Enhanced incidence of leg abnormalities in reovirus WVU 2937 - infected chickens fed various dietary levels of selected vitamins. *Avian Diseases* **28** : 548-61.

Czarnecki G L, Halpin K M and Baker D H. 1983. Precursor (amino acid) : product (vitamin) interrrelationship for growing chicks as illustrated by typtophan-niacin and methionine-choline. *Poultry Science* **62** : 371-74.

Duncan D B. 1955. Multiple range and multiple F test. *Biometrics* **11** : 1-42.

Filho E C, Gondim F A L and Moraes-Santos T. 1983. Sorghum and pellagra-like disease. 2. Pyridine nucleotides in liver and erythrocyte of chicks. *Nutrition Report International* **27** : 1092-38.

Filho E C and Santos T. 1978. Sorghum and pellagra like disease. 1. Nutritional effect on ducks. *Nutrition Report International* **17** : 653-61.

Fisher H, Scott H M and Connor - Johnson B. 1955. Quantitative aspects of the nicotinic acid and tryptophan interrelationship in the chick. *British Journal of Nutrition* **9** : 340-49.

Gries C L and Scott L M. 1972. The pathology of thiamin, riboflavin, pantothenic acid and niacin deficiencies in the chick. *Journal* of Nutrition **102** : 1269-85.

Leeson S. 1988. Niacin in poultry nutrition. LONZA Publication.

Lockhart W C, Bryant R L and Bolin D W. 1966. The effects of B-vitamin deficiencies on the efficiency of metabolizable energy and protein utilization. *Poultry Science* **45** : 939-45.

LONZA. 1984. Niacin in animal nutrition. LONZA Publication.

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

Patterson E B, Hunt J R, Vohra P, Blaylock L G and McGinnis J. 1956. The niacin and tryptophan requirements of chicks. *Poultry Science* **35** : 499-504.

Perkin-Elmer Inc. 1973. Analytical methods for atomic absorption spectrophotometry. Perkin-elmer, Norwalk, CT.

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

Summers J D, Shen H, Leeson S and Julian R J. 1984. Influence of vitamin deficiency and level of dietary protein on the incidence of leg problems in broiler chicks. *Poultry Science* **63** : 1115-21.

Waldroup P W, Hellwig H M, Goodwin T L and Johnson Z B. 1984. The influence of dietary niacin levels on growth and abdominal fat content of broiler chicken. *Poultry Science* **63** : 44.

Waldroup P W, Hellwig H M, Spenser G K, Smith N K, Fancher B I, Jackson M E, Johnson Z B and Goodwin T L. 1985. The effects of increased levels of niacin supplementation on growth rate and carcass composition of broiler chickens. *Poultry Science* **64** : 1777-84.