Vitamin E Requirement of starting broiler chickens in Nigeria.

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Abstract

Five trials were conducted with a vitamin – E free basal ration to establish the requirement of broiler chickens in a humid tropical environment. Results of the first trial showed that dietary 0.1 ppm selenium prevented exudative diathesis in broiler chicks. In the second trial it was established that 12 ppm of dietary dl– &– tocopherol – acetate was as effective as 0.1 ppm selenium in preventing exudative diathesis. However a combination of dietary selenium, vitamin E and methionine with the basal ration in the third experiment showed that 12 ppm vitamin E, under the condition, was better than 0.1 ppm selenium. Palm oil replaced lard in ration formulation in the fourth study as the oil is a normal feed ingredient for poultry in Nigeria. The results showed that 12 ppm of Vitamin E was adequate. In the final trial a longer period of study was allowed and BHT was added to the ration. It was then confirmed that dietary levels of vitamin E higherj than 12 ppm did not produce better results. It was concluded that starting broiler chickens require 12 ppm of dietary dl – &– tocopherol acetate in Nigeria.

Introduction

Feeding of chickens in developing countries depended over the years on recommended nutrient requirements prescribed by the developed nations. However differences occur in the feed ingredients as well as in the nutrient requirements. Thus the National Research Council (1971) recommended 23% protein and 3200 kcal of metabolisable energy per kilogram of diet for broiler chickens in the United States of America while the Agricultural Research Council (1975) of Britain recommended 18.8% protein and 3100 kcal of metabolisable energy per kg of diet. In recent years efforts had been directed towards the establishment of nutrient requirements of poultry in Nigeria. The protein and energy requirements for starting chickens, finishing broiler chickens, chicken pullets, laying chickens and other types of poultry had been reviewed by Olomu (1978).

Requirements of the chickens in Nigeria for some vitamins had also been studied. Ogunmodede (1977) established the riboflavin requirement, the needed vitamin D3 was estimated by Ogunmodede and Oluyemi (1978) while the biotin requirement was studied by Ogunmodede (1979). The various results showed the need to evaluate the needs of chickens not only under the local environment by also with the feed ingredients available. This paper deals with the Vitamin E requirements of the starting chickens as one of the studies for evaluating nutrient requirement of poultry in Nigeria.

Materials and Methods

Duplicate groups of 10 broiler chicks at day old were fed either the basal vitamin E – free ration (Table 1) or the basal ration to which 0.04, 0.08 or 0.1 ppm selenium had been added respectively. Body weight, mortality as well as external symptoms of exudative diathesis were recorded for a period of four weeks.

In the second trial six duplicate groups of day old chicks with 15 chicks per group were allocated to the following rations; the basal ration, basal plus 0.1 ppm Se, basal plus 8, 10, 12 or 14 ppm of vitamin E (Dl – &– tocopheryl acetate). At the end of the third week the body weights were recorded. Blood samples were obtained by heart puncture with a syringe containing heparin and the haemoglobin concentration, number of red blood cells, the haematocrit and reticulocytes were estimated in four chicks from each of the groups.

The third trial was conducted with four duplicate groups of day–old chicks with 20 birds per group. One duplicate group was given the basal ration to which 0.1 ppm selenium was added. The other three groups had the basal ration plus 0.1 ppm selenium with graded levels of vitamin E at 10, 12 or 14 ppm; in addition 0.5% methionine replaced equal amount of the yeast. At the end of the third week the body weight, haemoglobin, red blood cells, and haematocrit were determined as in the second trial. The total plasma protein was determined by the kjeldahl method while the albumin and the globulins were estimated after precipitation colourimetrically as described by the National Institutes of Health (1957).

The experimental design in the fourth trial was similar to that of the third study but palm oil replaced stripped lard in the formulation of the basal ration shown in Table 1. Similar parameters as in the third experiment were used to assess the status of the birds. In the final trial the ration containing palm oil was used as the basal diet and 0.05% butylated hydroxy toluene (BHT) was added. At the end of the sixth week body weight, haemoglobin, red blood cells, haematocrit, total plasma protein and the albumin to globulin retios were used to assess the birds.

In all the trials th mhicks were fed *ad libitum* with water being available at all times. For the first three weeks they were kept in electrically heated brooder cages. New castle disease vaccine was givebn inter ocularly at day old, fowl pox vaccine was given by wing puncture at 4 weeks and the Newcastle disease vaccine was given intramuscularly when the birds were 40 days old.

Results and Discussions

Level of Selenium

The basal ration (Table 1) was similar to that of Scott, Hill, Norris, Dobson and Nelson (1955); however the level of crude protein was higher as Olomu (1976) Babatunde and Fetuga (1976) showed that between 23 and 24% crude protein produced the best result for the broiler starters. The generally lower body weights obtained in this study compared with the studies of similar protein level reflected the quality of the proteins used. The first trial was conducted with graded levels of selenium ranging from 0 to 0.1 ppm. This was necessary to ascertain the adequacy of dietary selenium level as scott, Bieri, Briggs and Schwarz (1957) as well as Stokstad, Patterson and Milstrey (1957) showed the effectiveness of selenium and vitamin E in the prevention of exudative diathesis.

The results in Table 2 shoed that there were marked depression of growth at 3 weeks in groups of chicks given either the basal ration or the basal ration and 0.04 ppm selenium. In these two groups all the chicks died during the four weeks of study. Birds that received 0.08 or 0.10 ppm selenium did not show the subcutaneous oedema in the breast and/or abdomen which is characteristic of exudative diathesis. However at 4 weeks the mean body weight of chicks that received 0.1 ppm selenium was greater than that of birds given 0.08 ppm selenium.

Graded levels of E.

Exudative diathesis involves diffusion of blood proteins as well as erythropoiesis as shown by Goldstein and Scott (1956) hence parameters involving the blood were used in the second trial as quantitative estimations of

TABLE 1. PERCENTAGE COMPOSITION OF VITAMIN E FREE DIET.

Torula yeast	54.5
Glucose	37.4
Stripped lard	5
Glycine	0.7
L - arginine Hcl	0.5
Mineral mixture[1]	0.5
Vitamins[2]	0.5
Oyster shell	0.5
Salt	0.4
Crude protein %	24.3

1. The mixture supplied the following per kg of feed: Dicalcium phosphate 25.5g, $CaCO_3$ 9.5g, Nacl 6.0g, $FeSO_4 . 7H_2O$ 0.54g, $MnSO_4 . H_2O$ 0.36g, KI 0.03g, $CoCl_2$ 2.0 mg.

2. The following vitamins were supplied per kg of feed: Thiamine Hcl. 2mg, riboflavin 5.1 mg, calcium pantothenate 15mg, Pyridoxine Hcl. 4.5mg, biotin 0.15mg, folic acid 0.8 mg, menadione 0.8mg, B_{12} 5 micrograms, Vitamin A 1,500 I.U and D_3 100 ICU per kg of feed.

TABLE 2. MEAN BODY WEIGHT (g) AND MORTALITY OF CHICKENS FED GRADED LEVELS OF SELENIUM*

Weeks	Basal ration	Basal ration + 0.04ppm Se	Basal ration + 0.08 ppm Se	Basal ration + 0.1 ppm Se
1	53(0)	60(0)	63(0)	70(0)
2	60(3)	65(6)	88(0)	103(0)
3	55(5)+	68(4)+	120(0)	149(0)
4	-(2)	-	154(0)	200(0)

* Figures in bracket denote mortality during the week.

\+ Indicates incidence of exudative diathesis.

TABLE 3. BODY WEIGHT AND BLOOD PARAMETERS IN CHICKS FED GRADED LEVELS OF VITAMIN E.*

	Body wt. 3 weeks (g)	Haemoglobin (gm/100ml)	Red blood Cells millions/mm^3	Haematocrit	Reticulocytes
Basal + 0.1 ppm Se	219c	7.5bc	1.9b	20bc	80bc
Basal + 8 ppm E	166a	6.2a	1.74a	17a	65a
Basal + 10 ppm E	195b	7.0b	1.84b	19b	75b
Basal + 12 ppm E	228cd	7.9c	2.13c	22c	86cd
Basal + 14 ppm E	232d	8.2c	2.24c	25d	90d
S. E. of means	30	0.7	0.1	1.9	6.3

* Means in the same column not marked by the same suffix are significantly differently from each other ($P < 0.05$).

the efficacy of graded levels of dietary vitamin E compared with 0.1 ppm Se. The results prevented in Table 3 showed that 8 and 10 ppm dietary dl – &– tocopheryl acetate did not support as much growth as 0.1 ppm selenium added to be basal diet but 12 ppm vitamin E was as good as the level of selenium while 14 ppm of the vitamin produced better body weight than 0.1 ppm selenium.

Haemoglobin concentration as well as the haematocrit showed that 0.1 ppm Se was as effective as 10 or 12 ppm vitamin E although 12 ppm of the vitamin was better than 10 ppm. Measurement of the red blood cells also suggested that 10 ppm of the vitamin had the same efficiency as the level of selenium fed while results for the reticulocytes were similar to those obtained for haemoglobin and haematocrit. These results tend to suggest that at least 10 ppm of dietary vitamin E would be effective as 0.1 ppm selenium in the prevention of exudative diathesis but that levels of the vitamin above 10 ppm support better body weight.

Combinations of Se, E and methionine.

Both selenium and vitamin E are normally added to practical rations as suggested by studies of Nesheim and Scott (1958). Also Shimazu and Tappel (1964) observed that sulphur amino acids especially in the presence of selenium protect cellular components affected by lack of vitamin E. Since methionine is added to practical rations for poultry at about 0.5%, this level was used along with 0.1 ppm Se and graded levels of vitamin ranging from 10 ppm to 14 ppm in the third trial. The mean body weight of chicks fed the basal ration and 0.1 ppm selenium (Table 4) was lower than for those that had additional methionine. The groups that had 12 ppm of E was not significantly different in weight from these that had 14 ppm when 0.5% methionine was used to replace equivalent weight of yeast in the ration formulation.

The haemoglobin concentrations and the red blood cells were not significantly different for the groups that had methionine although the groups fed the basal ration and selenium had lower values. The results for haematocrit, total plasma protein (%) and the albumin to globulin ratio were of similar trends to those obtained for the body weight. The values for total plasma protein and the albumin to globulin ratio reflected the lowering of total plasma proteins as a result of capillary permeability characteristic of vitamin E deficiency. Thus more albumin escaped into the tissues and this was reflected particularly in the values for chicks that had no dietary vitamin E and methionine. The overall results in this trial confirmed those of the second trial that 10 ppm of vitamin did not support optimum performance. In addition the results showed no advantage in feeding 14 ppm of vitamin E as 12 ppm was equally effective. In this trial as well as in trials 4 and 5, ration 1 containing adequate selenium was used as the control.

Feeding palm oil in place of lard

The fourth trial was undertaken to test the required level of vitamin E when

TABLE 4. EVALUATION OF CHICKS GIVEN SELENIUM AND METHIONINE WITH GRADED LEVELS OF VITAMIN E *

	Body wt. 3 weeks (g)	Haemoglobin gm/100ml	Red blood cells millions/mm^3	Haematocrit	Total plasma protein %	Albumi / Globumin
Basal + 0.1 ppm Se	205a	7.2a	1.85a	19a	23a	0.3a
Basal + 0.1 ppm Se + 100ppm E + methionine	222b	9.9b	2.25b	25ab	3.0b	0.6b
Basal + 0.1 ppm Se + 12ppm E + methionine	240c	10.4b	2.28b	27b	3.4c	0.75c
Basal + 0.1 ppm Se + 14ppm E + methionine	245c	10.6b	2.3b	27b	3.6c	0.8c
S. E. of means	19	0.7	0.17	7.0	0.2	0.05

* Means in the same column not marked by the same suffix are significantly differently from each other ($P < 0.05$).

palm oil used normally in many poultry ration formulations was present ir place of lard. The results in Table 5 showed that the trends were similar to what obtained in Table 4 when stripped lard was present in the ration. However, the birds given 12 and 14 ppm of vitamin E when palm oil was present in the ration (Table 5) were heavier than birds given corresponding dietary E but lard (Table 4). This improvement in body weight was probably due to a combination of activities of additional vitamin E and the carotenoids that were present in the palm oil. Blood parameters used gave similar results as those obtained when lard was fed. Thus it became clear that in the presence of 0.1 ppm selenium and 0.5% methionine dietary level of 12 ppm vitamin E was adequate for good performance of broiler chicks in the tropical environment.

Antioxidant and vitamin E requirement

Antioxidants prevent oxidative rancidity of dietary oils added to rations; hence several antioxidants such as ethoxyquin and butylated hydroxy anisole (BHA) are added to rations. Butylated hydroxytoluene (BHT) was added as antioxidant to the basal ration containing palm oil in place of lard and graded levels of vitamin E were fed when adequate amounts of selenium and methionine were present. The results (Table 6) for body weight showed that 12 ppm E was better than dietary 10 ppm E. The study was conducted for 6 weeks as antioxidant was present in the diet that could be kept for such a period. In addition a period longer than those used for the first four trials was needed in order to eliminate the possible effect of short time study on the 12 and 14 ppm E. Despite the longer period of study, neither the body weight nor the blood parameters used showed statistically significant results between 12 and 14 ppm E. Hence 12 ppm of dietary vitamin was established as the minimum requirement for broiler starting chickens. This value was about 20% higher than the suggested amount by Scott and Nesheim (1969) for the temperate region. The 10 ppm suggested for the temperature zone did not produce optimum body weight; the increased amount required in the tropics is probably a reflection of the environmental effects. Oxidative activities including lipid peroxidation tend to increase at elevated temperatures and the amount of vitamin E needed under such conditions would increase.

TABLE 5. BODY WEIGHT AND BLOOD PARAMETERS OF CHICKS FED PALM OIL IN PLACE OF LARD IN THE BASAL RATION.*

	Body wt. at 3 weeks (g)	Haemoglobin	Red blood cells	Haematocrit	Total plasma protein	Albumin / Globulin
Basal + 0.1 ppm Se	190a	7.0a	1.73a	20a	2.4a	0.40a
Basal + 0.1 ppm Se + 10 ppm E + methionine	229b	9.6b	2.11b	26b	3.1b	0.66b
Basal + 0.1 ppm Se + 12ppm E + methionine	269c	11.0c	2.32b	29c	3.6c	0.85c
Basal + 0.1 ppm Se + 14 ppm E + methionine	273c	10.8c	2.28b	29c	3.5c	0.83c
S. E. of means	17.6	0.8	0.22	1.9	0.21	0.05

*Means in the same column not marked by the same suffix are significantly different from each other ($P < 0.05$).

TABLE 6. PERFORMANCE OF BIRDS GIVEN DIETARY ANTIOXIDANT IN ADDITION TO SELENIUM METHIONINE AND GRADED LEVELS OF VITAMIN E FOR 6 WEEKS.*

	Body wt. at 6 weeks (g)	Haemoglobin	Red blood cells	Haematocrit	Total plasma protein	Albumin Globulin
Basal + BHT + 0.1 ppm Se	280a	9.0a	1.8a	25a	2.7a	0.5a
Basal + BHT + 0.1 ppm Se + 10ppm E + methionine	322b	10.5b	2.2b	27a	3.3b	0.7b
Basal + BHT + 0.1ppm Se + 12ppm E + methionine	367c	11.6c	2.4b	31b	3.8c	0.9c
Basal + BHT + 0.1ppm Se + 14ppm E + methionine	364c	11.6c	2.5b	31b	3.9c	0.9c
S. E. of means	30	0.94	0.3	2.2	0.3	0.08

Means in the same column not marked by the same suffix are significantly different from each other ($P < 0.05$).

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