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Adapting Poultry Production in Nigeria to Climate Change: Economics of Micronutrient Supplementation on Egg Production of Laying Birds

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ABSTRACT

A total of two hundred and forty 24 weeks old Golden Nestlink point of lay birds were used in a 52 weeks study to investigate the economics of supplementing layers ration with dietary levels of vitamins C and E as a means of adapting the birds to heat stress resulting from changing climatic variables. The birds were randomly assigned to any of the sixteen treatments emerging from a combination of four doses of vitamin C [0, 200, 400 and 600mg/kg] and four doses of vitamin E [0, 125, 200 and 375 mg/kg] in a 16% Crude Protein ration for layers. The experimental design was a 4 X 4 factorial with sixteen treatment combination in a completely randomized design. Results showed that there was a significant improvement in all the economic indices in the supplemented groups. Economic indices of birds on 400mg vitamin C + 125mg vitamin E were significantly {P<0.05} higher. The un-supplemented group recorded the least value of all economic indices. It is concluded that a combination of 400mg vitamin C + 125 mg vitamin E per kg of layers ration will help heat stressed layers in Nigeria perform economically better in the face of emerging climatic changes.

KEYWORDS: Poultry, Climate, Micronutrient, Birds

Introduction

Nigeria, the most populous, black nation in the world has a poultry population that almost equates that of the inhabitants. Over 14 million people are directly or indirectly engaged in the commercial poultry sector alone, while the rural family poultry with cumulative value of N320 billion are managed by 85 million people. Nigeria is currently rated as number one egg producing nation in Africa and the fourth in broiler meat production (Onallo, 2013). Changing climatic variables have resulted in worsening environmental factors that impinges on the performance of poultry species in the country. High ambient temperature and relative humidity are the most important metrological stressors adversely affecting poultry in general and laying hens in particular (Nombor, 2012). The duo of these meteorological factors has moved the ambient temperature outside the zone of the moneutrality of birds under which production will be optional. Consequently, there is drastic reduction in feed intake of birds, low body weight for age, drop in egg production, small size eggs, reduced shell quality and threatened survivability of the birds (Sobayo *et al*., 2008; Biswas *et al*., 2010 and Oguz *et al*, 2010).

If this negative scenario is not properly addressed, poultry farmers may sooner or latter be forced out of business. There is a plethora of literature evidence that the use of vitamins C and E is beneficial to heat stressed birds. Smith (2010) reported that vitamin C supplementation has significantly improved egg production, shell quality and egg weight. There was improved heat resistance and enhanced performance of ascorbic acid fed laying hens (Nombor, 2012). According to Ciftci *et al*., (2007) vitamin supplementation can improve the performance of hens exposed to heat stress. Nombor (2012) showed that vitamin E supplementation had an ameliorative effect on the egg production of heat stressed birds. Considering the fact that addition of these micronutrients (vitamins C and E) to ration implies extra costs, what economic benefits do a farmer stands to gain incorporating them in a feeding protocol for heat stressed birds? This forms the major research drive for the present study.

Materials and Methods

Experimental Animal and Management

Two hundred and forty Golden Nestlink hybrid layers aged twenty four weeks were randomly selected from the Departmental flocks and used for the study. The birds were randomly assigned each to a cage measuring 49 x 35 x 4cm, five of such cages constituted a replicate and three of such replicates made up a treatment. General flock prophylactic management strategy, routine vaccinations were regularly administered when due. Each bird received 125g of feed/day of a 16.5% crude protein layers' diet whereas water was provided *ad libitum*.

Experimental Design

A 4 x 4 factorial arrangement with sixteen treatment combination in a completely randomized design was used for the study. Four doses of dietary L – ascorbic acid (vitamin C) 0, 200, 400 and 600mg/kg were combined with four doses of dL-α-tocopherly acetate (vitamin E) 0, 125, 250 and 375mg per kg of the basal diet to get a 16 treatments combination of vitamin C and E (see Table 1).

Table 1: Dietary combinations of vitamin C and E in the treatments (A – P)

Treatment	Vitamin Levels (mg/kg diet)	
	C	E
A	0	0
B	0	125
C	0	250
D	0	375
E	200	0
F	200	125
G	200	250
H	200	375
I	400	0
J	400	125
K	400	250
L	400	375
M	600	0
N	600	125
O	600	250
P	600	375

Parameters Measured/Calculated

Record was kept of the feed intake and egg production of each bird on daily basis. From these, egg revenue and net income from sale of eggs were determined.

Analysis of Data

Data collected were analyzed using the POSTHOC mixed models procedure for a one way ANOVA using SPSS software version 17.0.

Results and Discussion

Results showed that cost of vitamin supplementation per kg diet increased as dietary levels of vitamin C and E inclusion increased (see Table 2). At 600mg/kg vitamin C and 375mg/kg vitamin E (treatment

P), it cost N16.82 to supplement these vitamins. Ordinarily as the level of supplementation increased, the cost of supplementation increased. The economics of these vitamins supplementation will thus lie at the combination that will yield the highest revenue to the farmer. Vitamin supplemented birds had significantly (P<0.05) higher feed intake than the control birds. Highest feed intake of 11.88kg/week was observed for birds on treatment J (400mg/kg vitamin C and 125mg/kg vitamin E) against the value of 5.50kg recorded for the control birds. Laying Leghorn birds had their feed intake dropped as temperature of the laying house increased from 20-37^{0}C (Davis *et al*., 1973).The significantly lower feed intake of the control birds in the present study agrees with this earlier view of Davis *et al*. (1973). At high ambient temperatures birds stay off feed as a way to combat heat stress. The supplementation of vitamin C and E in the diet counteracts the effect of heat stress and this explains the significantly higher feed intake of the birds on the vitamin supplementation, The same birds on treatment J laid significantly (P<0.05) higher number of eggs thus yielded the highest egg revenue of N1750.85. The least egg revenue of N696.60 resulted from birds on the control diet. Net income from egg sales was N1627.11 for birds on treatment J as against N560.50 recorded for the control birds (treatment A). The significant improvement in the economic indices examined justifies the supplementation of layers diets with vitamin C and E. This finding is in harmony with earlier report of Whitehead and Mitchell (2010) who reported that supplementing layers diet under heat stress with vitamins C and E gave superior economic returns. Every poultry producer aims to maximize profit. Giving the poor performance of poultry with the emerging increase in temperature and relative humidity in Nigeria, the supplementation of vitamin C and E in the diets of layers will be a feeding protocol that farmers can adapt to make more profit.

Conclusion

It is concluded that the supplementation of layers ration with vitamins C and E results in significant improvement in economics of laying hen production.

Table 2: Cost of vitamin treatment/kg diet (N)

		Mean ± SE Vitamin E				
Vitamin level (mg/kg diet)		0	125	250	375	Overall Mean
Vitamin C	0	0.00	1.50	3.00	4.50	2.25
	200	4.12	5.62	7.12	8.62	6.37
	400	8.24	9.74	11.24	12.74	10.49
	600	12.36	13.86	15.36	16.82	14.60
Overall Mean		6.18	7.68	9.18	10.67	8.43

Table 3: Effect of vitamin supplementation on feed intake of birds (kg/week/treatment)

		Mean ± SE Vitamin E				
Vitamin level (mg/kg diet)		0	125	250	375	Overall Mean
Vitamin C	0	5.50±0.15^{cd}	7.01±0.12^{bd}	8.65±0.17^{ab}	7.05±0.20^{b}	7.05±0.11**
	200	6.92±0.15^{c}	7.67±0.14b^{c}	9.25±0.18^{a}	7.28±0.18^{abc}	7.78±0.10**
	400	8.48±0.16^{ab}	11.88±0.05^{a}	8.87±0.18^{ab}	7.07±0.13^{bc}	9.08±0.14**
	600	7.51±0.13^{bc}	10.23±0.14^{ab}	8.34±0.15b^{c}	7.72±0.14^{ac}	8.45±0.10**
Overall Mean		7.10±0.08**	9.20±0.08**	8.78±0.08**	7.28±0.08*	8.09±0.04

^{abcd}Row means with different superscripts are statistically significant at P<0.01.

Table 4: Egg revenue at ₦240/dozen eggs (₦)

		Mean ± SE Vitamin E				
Vitamin level (mg/kg diet)		0	125	250	375	Overall Mean
Vitamin C	0	696.60±27.98^{d}	1041.45±28.04^{bd}	1291.65±26.11^{ab}	1055.85±27.53^{bc}	1021.39±20.51**
	200	1045.65±36.20^{c}	1165.30±28.26^{bc}	1310.45±24.60^{ab}	1104.50±29.89^{bc}	1156.48±16.52**
	400	1334.35±32.87^{ab}	1750.85±26.67^{a}	1347.10±31.03^{ab}	1200.75±30.67^{ac}	1408.26±21.20**
	600	1148.80±32.58^{bc}	1542.95±31.08^{ab}	1250.35±31.26^{b}	1146.85±29.55^{abc}	1272.24±19.38**
Overall Mean		1056.35±14.89**	1375.14±14.89**	1299.89±14.89^{NS}	1126.99±14.89**	1214.24±11.01

^{abcd}Row means with different superscripts are statistically significant at P<0.01.

Table 5: Net income/dozen eggs (₦)

		Mean ± SE Vitamin E				
Vitamin level (mg/kg diet)		0	125	250	375	Overall Mean
Vitamin C	0	560.50±32.12c	921.77±30.66bd	1166.09±29.34ab	923.60±30.64b	892.99±21.83**
	200	930.64±39.12bc	045.73±31.21bc	1176.40±27.41ab	971.21±33.11bc	1030.99±17.71**
	400	1221.48±36.86ab	1627.11±28.68a	1218.76±34.00ab	1079.85±33.27ac	1286.80±22.20**
	600	1029.23±37.15bc	1418.48±33.54ab	1117.84±34.16b	1004.52±34.03abc	1142.56±20.96**
Overall Mean		935.46±16.49**	1253.32±16.49**	1169.77±16.49^{NS}	994.80±16.49**	1088.34±11.60

^{abcd}Row means with different superscripts are statistically significant at P<0.01.

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