Nigerian J. Anim. Sci. 2021, 23 (1): 46-52

Effect of levels of niacin supplementation on egg quality

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Target Audience*: Animal Scientist, students and farmers*

Abstract

The objective of this study was to investigate the effect of niacin supplementation in layers diets on the internal and external quality of table eggs. A total of 75 laying birds at 24 weeks of age were used in the trial. Four dietary treatments with niacin at 0ppm, 30ppm, 40ppm, and 50ppm were fed to the birds for a period of 20 weeks. Each treatment had 18 birds comprising of 3 replicates of six birds each.Twenty four eggs (2 per replicate) from each treatment were used for the egg quality analysis at four weeks interval for the 20 weeks of the experiment. Significant ($p<0.05$) effect of niacin was noticed in the egg shape index (ESI) and shell thickness at (0-4) and (4-8) weeks of the experiment when 50ppm of niacin was fed. The shell % was significant ($p<0.05$) at (16-20) weeks of the experiment when 30ppm of niacin was fed. No significant differences were noticed in egg weight and yolk %. Egg shape index, (ESI) was generally above 0.66 across all the treatment groups.

Key Words*: Niacin, Egg weight, Yolk weight, Egg shape index, shell thickness*

Description of Problem

Poultry egg is a rich source of high quality protein and provides a unique source of nutrient for humans (1). In Nigeria, different poultry species contribute significantly to the annual animal protein supply to the populace (2). Poultry eggs are good sources of income and are of particular significance in scientific research, such as vaccine production(3). The egg is a complex structure distinguished by having four different parts; the egg shell, shell membrane, albumen and yolk.When eggs are for human consumption, it is important that they are suitable for this purpose(4). This will be determined by both the internal and external quality of the egg(5). Egg quality is factor which contributes for better economy price of fertile and table eggs. Egg quality was defined by (6) as characteristics importantfor consumers. Economic success for a production flock is measured with total number of produced eggs (7). Egg quality is presented by it weight, percentage of eggshell, thickness and strength of eggshell. The significance of the egg as a protein source for the nourishment of humans led to the consumers demand for some qualities in these nutrients (8). Therefore monitoring and evaluation of external and internal quality of chicken eggs is important in production economy and consumers' preferences for better quality of *eggs*.(9) reported that genotype significantly affected the egg shape index, yolk and albumin quality and yolk index. (*10*) found that the external and internal egg quality traits of the breeds affect the future generations and their performance. Similarly, (11) observed significant differences between naked neck and normal feathered in most of the egg parameters except shell weight and yolk index. The economic success of a laying flock solely depends on the total number of quality eggs amount eggs are broken through the transfer of the eggs from the production to the consumer. Thus, the amount of cracked and broken eggs results in serious economical problems both for the producers, dealers and consumers (12). (13) and (14) reported that egg weight and egg index are determinant of egg resistance to cracking and are considered very important traits when eggs are packed in container. (5) reported the acceptable value for egg index as 0.75 and haugh unit at least 40% (15). So far there are very limited research findings and dearth of information on the egg quality characteristics on different feeds fed to laying hen. The present study was undertaken to evaluate egg quality traits of layers feed different levels of niacin supplementation.

Materials and Methods

This study was carried out at the Poultry Unit of Teaching and Research Farm, University of Agriculture, Abeokuta on latitude($7^0 10^0$N and longitude (32^0E) in Odeda Local Government Area Ogun State. This area has an average rainfall of 1100mm, mean ambient temperature of about 34^0C and yearly avarage relative humidity 82%. All poultry facilities were supplied by Poultry Management Technical Committee (POMTEC).

Management of Experimental Birds

A total of 72 laying birds of 24 weeks old Harco brown were obtained . The house and cage used were throughly washed and disinfected before arrival of the laying birds. Feed and clean water were supplied *ad libitum* while the other routine vaccination with necessary medication was administered to the birds accordingly.Four Experimental diets were formulated such that the niacin was added to the basal diet at 0, 30, 40, 50mg/kg of feed respectively. The laying birds were randomly allocated to the four dietary randomized design. Each treatment group were further divided into three replicates of 6 birds each. Feed and water were supplied *ad libitum*, the experiment last for 20 weeks.

Data collection

Twenty four eggs (2 per replicate) from each treatment were sampled at four weeks interval for the 20 weeks of the experiment. Assessment was done within 24hours of lay on external (egg weight, egg lenght, egg breadth, and egg shape index) and internal (albumen height, albumen weight, yolk weight, shell weight, shell thickness and haugh unit) qualities.

Egg weight was individually determined to 0.01g accuracy using a laboratory scale Owa Labor (VEB Wägetechnik Rapido, Germany). Egg length (along the longitudinal axis) and egg width (along the equatorial axis) were measured with a micrometer. shell index calculated as the ratio of egg width to egg length (%) by method of (16). Shell ration was calculated as ratio of shell weight and egg weight according to (17). After the eggs are broken, egg shells were washed with water and dried in order to clean the remaining albumen. Following Anderson's procedure, shell weight (with membrane) was measured using a laboratory scale Owa Labor (VEB Wägetechnik Rapido, Germany) and the percentage proportion of the shell in the egg determined. Shell thickness (with membrane) was measured at the sharp poles, blunt poles and equatorial parts of each egg. Shell thickness is obtained from the average values of these three parts. The albumen weight was calculated from the difference between the egg weight, and the yolk and shell weight. The percentage proportion of the albumen in the egg was also determined. Albumen index (%) was determined according to (18) on the basis of the ratio of the albumen height (mm) measurement taken with a micrometer to the average of width (mm) and length (mm) of this albumen with 0.01mm accuracy × 100. Individual Haugh Unit score (19) was calculated using the egg weight and albumen height. The Haugh Unit values are calculated for individual egg using the Haugh equation (7):

$HU = 100 \log (H - 1.7w0.37 + 7.6)$

where:

HU – Haugh Unit

H – observed height of albumen in mm

w – weight of egg in g

Yolk weight with 0.01 g accuracy was determined using a laboratory scale Owa Labor (VEB Wägetechnik Rapido, Germany) and its percentage proportion was calculated. Yolk index (%) on the basis of the ratio of the yolk height (mm) to the yolk width (mm) was measured according to (20) using micrometer with 0.01 mm accuracy.

Statistical Analysis

Data obtained for internal and external traits were subjected to general linear model in analysis of variance (21). Significant means were separated using Duncan's Multiple Range Test (22).

The analysis was based on this model

$X_{ij} = \mu + T_i + E_{ij}$

Where Xij = observation in the ith treatment

μ = Population mean

Ti = Effect of niacin level

Eij = random error

Results

Effect of niacin supplementation on egg quality (0-4 weeks).

Table 1 shows the effect of niacin supplementation on the egg internal and external characteristics of laying hens at 0-4 weeks of feeding the experiment diets. The results showed that egg shape index(ESI) and the shell thickness were significantly ($P < 0.05$) affected by the experimental diet while the egg weight, yolk %, shell %, albumen % and haugh unit were not significantly ($P > 0.05$) affected by the diet. Birds fed 30ppm and 50ppm niacin based diet had significantly highest value and statistically similar to 40ppm for the shell thickness and was significantly different from the control.

The effects of niacin supplementation at 4-8weeks as shown Table 2 revealed a significant ($P < 0.05$) different on the shell % and shell thickness. The egg weight, yolk %, albumen % ESI and haugh unit were not significantly ($P>0.05$) influenced by the experimental diets. Birds fed 50ppm niacin had the highest ($P < 0.05$) values for shell % and was significantly different from the control. Shell thickness had the highest significant value of 0.29% at 30ppm and was significantly ($P < 0.05$) different from the birds fed the control diets. The trend with egg weight was that the weight increased as the level of niacin increases though not significant.

Table 1: Effect of niacin supplementation on egg internal and external characteristics (0-4 weeks.)

Parameters	0ppm	30ppm	40ppm	50ppm	SEM
Egg weight (g)	67.38	66.92	59.65	67.54	1.95
Yolk (%)	25.07	23.83	25.68	24.61	0.49
Shell (%)	9.58	9.49	8.89	8.86	0.21
Albumen (%)	65.35	66.68	64.44	66.53	0.47
Egg shape index	0.68^a	0.62^b	0.68^a	0.66^a	0.01
Shell thickness (mm)	0.22^b	0.32^a	0.25^{ab}	0.32^a	0.02
Haugh unit (%)	87.39	90.88	85.88	98.11	2.34

^{abc} means on the same row having different superscripts are significantly different ($P <0.05$).

Table 2: Effect of niacin supplementation on egg internal and external characteristics (4-8weeks.)

Parameters	0ppm	30ppm	40ppm	50ppm	SEM
Egg weight(g)	61.70	62.40	65.29	58.07	1.77
Yolk (%)	24.40	23.23	23.45	23.76	0.65
Shell (%)	9.82^{ab}	9.75^{ab}	8.71^{b}	10.28^{a}	0.23
Albumen (%)	65.78	67.02	67.85	066.08	0.63
Egg shape index	0.78	0.68	0.82	0.68	0.03
Shell thickness (mm)	0.23^{b}	0.29^{a}	0.28^{a}	0.22^{b}	0.01
Haugh unit (%)	90.95	98.28	98.38	89.88	0.66

^{abc} means the same row having different superscripts are significantly different (P < 0.05)

Effect of niacin supplementation on egg quality (8-12 weeks).

Table 3 shows the effects of niacin supplementation on egg qualityfrom 8-12 weeks of the experiment. The results showed that shell % was significantly (P <0.05) influenced. It was observed that 30ppm and 40ppm of niacin supplementation had the highest significant values for the shell % which was statistically different from the control diet. The egg weight, yolk %, ESI, Shell thickness and haugh unit were not significantly (P > 0.05) influenced by the level of niacin supplementation. It was also observed that the yolk %, ESI, shell thickness and haugh unit had increased values as the level of niacin supplementation increases, although no significant difference were recorded.

Table 4shows the effect of niacin supplementation on the internal and external characteristics of egg (12-16 weeks) of the experiment. The results showed that the shell % and ESI were significantly (P<0.05) influenced by the level of niacin supplementation,the highest value for shell % was at 50ppm and ESI was at 40ppm level of inclusion respectively and were significantly different from that of the control. Diets with the inclusion level of 30ppm-50ppmlevel were statistically similar. The egg weight, yolk %, albumen %, shell thickness and haugh unit were not significantly (P>0.05) influenced by the experimental diets.

Table3:Effect of niacin supplementation on egg quality (8-12 weeks.)

Parameters	0ppm	30ppm	40ppm	50ppm	SEM
Egg weight (g)	68.54	64.06	64.91	65.81	1.270
Yolk (%)	24.34	24.46	26.14	26.65	0.598
Shell (%)	7.39^{b}	9.40^{a}	9.94^{a}	8.91^{ab}	0.378
Albumen (%)	68.27	65.80	64.58	67.17	1.090
Egg shape index	0.76	0.67	0.72	0.74	0.019
Shell thickness (mm)	0.30	0.29	0.28	0.29	0.003
Haugh unit (%)	90.43	90.25	93.59	93.61	1.620

^{abc} means on the same row having different superscripts are significantly different (P < 0.05).

Table 4: Effect of niacin supplementation on egg internal and external characteristics (12-16 weeks.)

Parameters	0ppm	30ppm	40ppm	50ppm	SEM
Egg weight (g)	61.08	64.98	63.93	58.84	1.63
Yolk (%)	29.10	25.25	25.55	25.25	0.73
Shell (%)	8.00^{b}	9.58^{ab}	9.03^{ab}	10.20^{a}	0.33
Albumen (%)	64.24	65.16	65.43	64.53	0.80
Egg shape index	0.67^{b}	0.71^{ab}	0.73^{a}	0.69^{ab}	0.01
Shell thickness (mm)	0.29	0.26	0.30	0.28	0.01
Haugh unit (%)	83.3	88.63	85.06	84.45	1.22

^{abc} means on the same row having different superscripts are significantly different ($p<0.05$)

Effect of niacin supplementation on egg internal and external characteristics(16-20 weeks).

Table 5 shows effects of niacin supplementation on egg internal and external characteristic at 16-20 weeks of the experiment. The results revealed that the yolk % and haugh unit were significantly ($P < 0.05$) influenced by the level of niacin supplemented diets. The egg weight, shell %, albumen%, ESI, and shell thickness were not significantly ($P > 0.05$) affected. The highest significant value for the yolk% was 27.76% with the control diet and was significantly different from the value obtained from other treatments. The birds fed the control diet and 40ppm level ofniacin had the highest values for haugh unit which were significantly different from that of 30ppm and 50ppm level of inclusion.

Table 5:Effect of niacin supplementation on egg internal and external characteristics (16-20 weeks.)

Parameters	0ppm	30ppm	40ppm	50ppm	SEM
Egg weight (g)	56.89	60.13	65.85	55.17	2.12
Yolk (%)	27.76^{a}	22.92^{b}	22.51^{b}	22.95^{b}	0.73
Shell (%)	8.83	8.71	9.54	10.37	0.31
Albumen (%)	66.37	67.25	67.95	66.68	0.83
Egg shape index	0.70	0.67	0.67	0.66	0.83
Shell thickness (mm)	0.27	0.29	0.30	0.28	0.02
Haugh unit (%)	93.84^{a}	86.09^{b}	94.34^{a}	87.55^{b}	1.30

^{abc} means on the same row having different superscripts are significantly different ($P < 0.05$)

Discussion

Egg quality traits such as egg weight, yolk %, shell %, albumen % and haugh unit were not significantly influence by different levels of niacin inclusion in the diet of layers' feed. The egg shape index, and shell thickness were significantly influenced though, birds fed control diet and 40ppm had the same significant $P < 0.05$ values at 0-4 weeks of the experiment. There was a significant effect on shell% and shell thickness at 4-8 weeks of the experiment with a linear increase in the value of shell as the level of niacin increased. This implies that feeding of niacin based diet do not impair but enhance calcification of the egg shell. This enhancement could be linked with the fact that niacin interaction with calcium and ascorbic acid metabolism. The egg weight, yolk %, Albumen %, ESI and haugh unit were not influenced with the niacin based diet, though an increased values was observed for egg weight and haugh unit at 4-8 week of the experiment.

At 8-12 weeks of the experiment, no significant effect was observed for egg weight, yolk %, Albumen %, ESI, shell thickness and haugh unit, but the significant effect observed by shell % and the increased trend in value of yolks %, ESI, and haugh unit are indication of the improvement in egg quality traits of birds fed niacin supplemented diets. The trend observed at 16-20 weeks of the experiment showed an increase in the value of egg weight, shell %, Albumen % as the level of niacin increases which is also an indication of improving egg quality traits. The narrow range (0.72-0.76) and lack of significant difference in the egg shape index (ESI) values indicated that misshapen eggs were not produced as a result of feeding niacin based diets. Lack of significant differences may also mean that feeding niacin encouraged production of uniformly shaped eggs. Similar observations were made by (23) and (24).Better egg weight, shell thickness, yolk % were achieved with supplementation of niacin.

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