QUALITY OF EGGS FROM LAYING HENS FED SUPPLEMENTAL SELENIUM AND A-TOCOPHEROL

[1]Jemiseye, F. O., [1]Ogunwole, O. A., [2]Mosuro, A. O., [1]Adedeji, B. S. and [3]Alonge, O. O.
[1]Agricultural Biochemistry & Nutrition Unit, Department of Animal Science, University of Ibadan, Ibadan, Nigeria
[2]Department of Human Nutrition, Lead City University, Ibadan
[3]Animal Science Department, Ahmadu Bello University, Zaria.
Correspondence email-jemiseyefo@gmail.com, Phone number-08037064917

ABSTRACT
Effects of dietary supplement of selenium and α–tocopherol on quality of eggs from laying hens was assessed in a 20-week trial. *ISA brown pullets (n=192, age =20 weeks) were randomly assigned to six experimental diets in a completely randomised design:* Basal diet (T1) without any supplemental selenium or α–tocopherol, T2: Basal + 0.5 mg/kg selenium, T3: Basal diet + 1.0 mg/kg selenium, T4: Basal diet + 1.5 mg/kg selenium, T5: Basal diet + 20 mg/kg α–tocopherol, T6: Basal diet + 40 mg/kg α–tocopherol. *Each treatment was replicated four times and a replicate comprised eight pullets.* At week 36 freshly laid eggs (3 eggs per replicate) were collected randomly for measurement of internal and external egg quality parameters using an electronic top loading scale and Vernier caliper following appropriate procedures. *External egg characteristics* parameters were not significantly affected (P>0.05) by supplemental selenium and α–tocopherol. Albumen length (69.62), yolk weight (12.74) and albumen weight (0.35) were significantly (P<.05) reduced in hens on supplemental 40mg/kg α-tocopherol diet but yolk diameter increased in the control and 40mg/kg α-tocopherol supplemented groups. In conclusion, supplemental selenium and α–tocopherol did not influence the external egg characteristics though supplementation of α–tocopherol up to 40 mg/kg reduced most of the internal egg quality characteristics.
Keywords: Isa Brown layers, selenium, α–tocopherol, egg quality, supplement

INTRODUCTION
Egg quality is a serious concern in egg producing industries and marketing. Quality of a particular food is defined as the properties which impact its approval or refusal by the consumer (Kramer, 1951). Egg quality refers to the attributes of an egg which influence consumer's tolerability, therefore, it is of great importance to pay attention to the difficulties of safeguarding and promotion of eggs to preserve the quality characteristics (Adeogun, and Amole, 2004).
A change in egg quality can be caused by several factors. Proper management and dietary modification strategies however could alleviate the problems associated with egg quality. Selenium and α-tocopherol are antioxidants of proven capabilities of cell protection in domestic animals (Finch and Turner, 1996). Some of the established applications of these antioxidants are in the improvement of egg production, shelf life and quality, inhibition of cholesterol and lipid oxidation during cooking, storage and importantly antioxidant-fortified eggs. Alpha tocopherol prevents formation of lipid hydroperoxides from unsaturated phospholipids existing in subcellular membrane (McDowell, 1989) thus prevent lipid peroxidation in egg yolk. While the sparing effects of selenium on vitamin E has been established. However, there have been conflicting reports of dietary supplementation of selenium and α-tocopherol on egg quality parameters of laying hens. *Therefore,* this research was designed to investigate the influence of selenium and α-tocopherol supplementation in the diets of laying hen on egg quality.

MATERIALS AND METHODS
The experiment was carried out at the Poultry Section of the Teaching and Research Farm, University of Ibadan, Ibadan. The geographical location is longitude 7°.27.05 North and latitude 3°53.74 of Greenwich Meridian East at an altitude above 200 m sea level. Average temperature and relative humidity of the location is about 23-55°C and 60%, respectively. Open sided pen housing system of 29 by 13.9 m^2

constructed with wire mesh fitted to concrete wall of 8.4 m above ground was used in this trial. A conventional 3-tier battery cage system and the dimension of each unit of the cage was 40 x 41 x 32 cm^3 accommodating four hens each. The cages were arranged in rows placed on leg supports so the floors of the cages were about 61.00 to 91.44 cm above ground with a rectangular hollow in the middle to collect the droppings.

Effects of dietary supplements of selenium and α-tocopherol on egg quality attributes was evaluated in a 20-weeks trial. *ISA brown pullets (n=192) at 20 weeks of age were assigned to six experimental diets in a* completely randomised design *(Table 1).* Basal diet (T1) was without supplementation while diets T2, T3 and T4, contained 0.5, 1.0 and 1.5 mg/kg supplemental selenium, respectively. Diets T5 and T6 were supplemented with 20 and 40 mg/kg vitamin E, respectively. *Each treatment comprised four replicates with eight birds per replicate.*

Weight (g) of the eggs and its shell were determined using an electronic top loading scale (JS-B LCD® Display Scale). Length with diameter of the eggs were measured with electronic digital Vernier caliper. The shell thickness (mm) with the membranes was also measured with the electronic digital vernier caliper and the average was determined after measurement at the sharp, broad and the middle part of the egg (Monira *et al.*, 2003). Shell ratio was measured using the formulae: Shell ratio (%) = (Shell weight / Egg Weight) x 100 (Scott and Silverside, 2000).

At week 36 of life freshly laid eggs (3 eggs per replicate) were collected randomly for measurement of internal and external egg quality parameters. Measurements of the egg internal contents were achieved after measuring the external features of the eggs. An opening was created close to the sharp portion of the egg and allows albumen and egg yolk passage into a flat plate. The yolk was carefully removed from the albumen with a spoon, thereafter the albumen and yolk were placed in separate petri dish for measurement using an electronic top loading scale. Yolk and albumen lengths and diameters were measured using a Vernier caliper.

Table 1: Gross composition of experimental basal diet fed to laying hens

Ingredients	**Level of inclusion (%)**
Corn	50.00
Wheat offal	11.00
Soya bean meal	22.00
Palm kernel cake	11.25
Di calcium phosphate	1.30
Salt (Sodium Chloride)	0.30
DL-Methionine	0.15
L-Lysine	0.15
Vitamin/mineral premix	0.30
Oyster shell	3.00
Total	**100.00**
Nutrient Composition	Calculated
ME (Kcal/Kg)	2736.01
Protein (%)	17.23
Calcium (%)	4.18
α-tocopherol	17.05
Selenium	0.18
Available Phosphorus (%)	0.17
Methionine (%)	0.51
Lysine (%)	0.87

*Vitamin-mineral premix - Vitamin A–10,000IU, Vitamin D_3–1800IU, Vitamin E–40mg, Vitamin K–1.43 mg, Vitamin B1–0.7mg, Vitamin B2–4mg, Vitamin B6–2.5mg, Vitamin B12–0.2mg, Niacin–10mg, Panthothenic–10,000mg, Folic acid –0.25mg, Biotin–100mg, Choline Chloride–300mg, Manganese–80mg, Zinc–60mg, Iron–40mg, Copper– 80mg, Iodine–0.8mg, Selenium–0.2mg, Cobalt–0.3mg, Antioxidant–100mg

Albumen and yolk height was measured by putting the pointed tip of the Vernier caliper in the middle of the albumen and yolk, height of the fluid on the tip was marked and read on the digital screen of the vernier caliper. Yolk colour was accessed with DSM Yolk Colour Fan which has colour scale from one to fifteen (Monira *et al.,* 2003). Relationship between height of the albumen and weight of the egg was used to determine the Haugh unit as described (Haugh, 1937); Haugh unit = 100 $\log_{10}$ (h - $1.7W^{0.37}$ + 7.6) (Where: h= Albumen height (mm); W= Egg weight (g)), Yolk ratio was calculated. Data were subjected to analyses of variance (SAS, 2003) and means were separated at $\alpha_{0.05}$ using New Duncan's multiple range test option of the same software.

RESULTS AND DISCUSSION

Internal quality characteristics of eggs from laying hens fed supplemental selenium and α-tocopherol is shown in Table 2. Albumen weight and haugh unit were not significantly affected (p>0.05) by the dietary supplements of selenium and α-tocopherol. *Egg albumen length (69.62), yolk weight (12.74) and yolk to albumin ratio (0.35) were significantly lower in hens on* 40mg/kg α-tocopherol supplementation. *Egg y*olk diameter of hens on 20 mg/kg α-tocopherol (41.63) was similar to the control (44.64), 0.5 mg/kg (43.34), 1.0 mg/kg (41.83) and 1.5 mg/kg (43.14) selenium supplementation, though, yolk diameter in the control treatment and hens fed diet supplements of 40 mg/kg α-tocopherol (40.16) were different (p<0.05) significantly. *Y*olk weight to albumen weight was increased with selenium supplementation at 0.5 (0.40), 1.0 (0.40) and 1.5 (0.41) mg/kg. *Ratio of* egg yolk weight to albumen weight was increased with selenium supplementation at 0.5, 1.0 and 1.5 mg/kg. As observed from Table 2, there was reduction in albumen length, weight of the yolk, yolk diameter, yolk ratio as well as yolk/albumen weight at supplemental α-tocopherol of 40 mg/kg. This probably suggests that supplementation at this level may not support these parameters. These results negated the discoveries of Puthpongsiriporn *et al*. (2001) and Bollenger-Lee *et al.* (1999) that incorporation of α-tocopherol in laying hens diet improved internal egg quality attributes in laying chickens raised under heat stress. Vitamin supplementation as high as 25% above the 1994 National Research Council recommendations has resulted in this higher profitability (Ward, 1993). *Although,* **S**elenium and α-tocopherol supplementation in laying hens diets had no significant effect on egg Haugh unit *values recorded in this trial were within the A and AA egg classification by USDA (2000).* Haugh unit as well as the quality of egg yolk is significant characteristics in egg quality measurement (Saki *et al.,* 2012). Hens on supplemental selenium and α-tocopherol had increased albumen height which invariably resulted in improved Haugh unit in eggs obtained from supplemented hens. Yolk weight, yolk diameter and yolk ratio were relatively improved across the supplemented treatments suggesting positive influence of these supplements in egg quality.

Table 2: Internal quality of eggs from laying hens fed supplemental selenium and α-tocopherol

		Selenium (mg/kg)			α-tocopherol (mg/kg)		
Parameters	Control	0.5	1.0	1.5	20	40	SEM
AW (g)	37.33	36.00	37.70	33.73	36.66	36.46	0.70
AL (cm)	98.81^{a}	94.89^{a}	96.93^{a}	96.20^{a}	96.31^{a}	69.62^{b}	3.43
YW (g)	14.48^{a}	14.56^{a}	15.10^{a}	13.86^{ab}	13.36^{ab}	12.74^{b}	0.26
YD (cm)	44.64^{a}	43.34^{ab}	41.83^{ab}	43.14^{ab}	41.63^{ab}	40.16^{b}	0.55
YW:AW	0.39^{ab}	0.40^{a}	0.40^{a}	0.41^{a}	0.36^{ab}	0.35^{b}	0.01
HU	75.32	70.38	81.21	73.08	77.05	81.41	1.65

$^{a, b}$Means in the same row with different superscript are significantly different (P<0.05), SEM- Standard error of mean,

AW-Albumin weight, AL-Albumin length, YD-yolk diameter, YW-yolk weight, AW-Albumin weight, HU-Haugh unit

External quality characteristics of eggs from laying hens fed supplemental selenium and α-tocopherol is shown in Table 3. Dietary supplementation of selenium and α-tocopherol had no significant effect

(p>0.05) on external egg quality parameters. Barroeta *et al*. (2003) outlines optimum vitamin nutrition (OVN) as the "level of vitamin beyond minimum requirements which will optimize genetic potential, improve laying hens immune status, and result to an improvement in performance, production and egg quality". Usually, the optimum level of supplementation among all is the level of nutrients concentration that attains the best feed utilization, growth rate, good health, lower mortality and provides adequate body reserves.

Table 3: External quality of eggs from laying hens fed supplemental selenium and α- tocopherol

		Selenium (mg/kg)			α-tocopherol (mg/kg)		
Parameters	Control	0.5	1.0	1.5	20	40	SEM
Egg Weight (g)	55.13	53.63	55.20	52.93	53.70	53.43	0.67
Egg Length (mm)	54.98	54.65	54.55	55.95	54.41	53.28	0.42
Egg Diameter (mm)	42.79	42.83	43.14	42.22	52.91	42.80	1.49
Shell Thickness (mm)	0.37	0.36	0. 36	0.35	0.36	0.37	0.01
Shell Weight (g)	4.70	4.70	4.93	4.20	4.50	4.63	0.11
Shell Ratio (%)	8.62	8.80	8.96	7.93	8.38	8.88	0.25

SEM-Standard error of mean

CONCLUSION

The present study revealed that dietary supplements of selenium and α-tocopherol had no effect on external egg quality parameters but imparted all internal egg characteristics monitored this study except albumen weight and Haugh unit.

REFERENCES

Adeogun, I. O. and Amole, F. O. 2004. Some quality parameters of exotic chicken eggs under different storage conditions. *Bulletin of Animal Health and Production in Africa* (52): 43-47.

Barroeta, A., M. D. Baucells, and A. Castro, (2003). Nutrición Vitamínica Óptima en Ponedoras. In: Óptima Nutrición Vitamínica Óptima de los Animales para la Producción de Alimentos de Calidad. Pulso Ediciones 2002, *Barcelona, Spain*. pp. 133-169.

Bollengier-Lee, S., Williams, P. E. V. and Whitehead, C. C. 1999. Determination of optimal concentration of dietary vitamin E to alleviate the effect of heat stress on egg production in laying hens. *British Poultry Science*, 40, 102-107.

Finch, J. M. and Turner, R. J. (1996). Effects of selenium and vitamin E non immune responses of domestic animals. *Research in Veterinary Science*, 60, 97-106.

Haugh, R. R. (1937). The Haugh unit for measuring egg quality: US Egg Poultry Magazine. 43:552-555 and 572-573.

Kramer, A. 1951. What is quality and how can it be measured: From a food technology point of view. Market Demand and Product Quality. Mktg. Res: Workshop Rept., Michigan State College.

McDowell, L. R. (1989). Vitamins in Animal Nutrition Comparative Aspects to Human Nutrition. In: Mc Dowell L. R. (ed.): Vitamin A and E. Academic Press, London. 10(52), 93–131.

Monira, K. N., Salahuddin, M. and Miah, G. (2003). "Effect of Breed and Holding Period on Egg Quality Characteristics of Chicken" (PDF), *International journal of Poultry Science* 2 (4): 261–263.

Puthpongsiriporn, U. Scheideler, S. E., Shell, J. L. and Beck, M. M. 2001. Effect of Vitamin E and C Supplementation on Performance, In Vitro Lymphocyte Proliferation, And Antioxidant Status of Laying Hens During Heat Stress. *Poultry Science*. 80: 1190-1200.

Saki, A. A., Harcini, R. N., Rahmetnejad, E. and Salary, J. (2012). Herbal additives and organic acids as antibiotic alternatives in broiler chickens diet for organic production. *African Journal of Biotechnology*. Vol 11 (8), 2139-2145.

SAS, (2003). SAS/STAT User's guide Version 8 for windows SAS Institute Inc. cary NC.

Scott, T. A., and Silversides, F. G. (2000). The effects of storage and strain of hen on egg quality. *Poultry Science*, 79:1725-1729.

United State Department of Agriculture (2000). Egg Shell Quality ARS Pub. 6612-41420. Poultry laboratory. Agricultural research service. Albany, CA: US Department of Agriculture.