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Egg quality factors of laying chickens fed different combinations of levels of energy and protein in the Northern Guinea Savannah zone of Nigeria

Yusuf[1], H. B., Yahaya[1], M. S. Goniwa[1], A. B. and Duwa[2], H.
[1]Department of Animal Science and Range Management, Modibbo Adama University of Technology, PMB 2076 Yola, Nigeria
[2]Department of Animal Science, University of Maiduguri, PMB 1076 Maiduguri, Nigeria

Abstract
This study was conducted at the Modibbo Adama University of Technology Yola. The aim was to investigate the egg quality factors of laying chickens fed different combination levels of energy and protein. The parameters considered include egg weight, shell thickness, shape index, albumen index, yolk index and haugh unit. Two hundred and forty three (243) Isa Brown pullets were randomly allocated into 9 treatments replicated three times in a RCBD involving 3×3 factorial arrangement. The layers were fed 9 treatment diets containing 3 energy levels (2500, 2700 and 2900kcal ME/kg) and 3 Crude Protein (CP) levels (16, 17 and 18%). The results of egg quality factors showed significant (P<0.05) difference for egg shell thickness, shape index and haugh unit while egg albumen index and yolk index were not significantly (P>0.05) affected by the treatments diets. Layers on 2500 kcal ME/kg recorded high haugh unit (91.73) at 17% CP but also recorded a low shell thickness (0.327mm at 18% CP) and shape index (74.24% at 17% CP). Those on 2700 kcal ME/kg recorded high haugh unit (87.03 at 18% CP) and low shape index (77.07 at 16% CP). Layers consuming 2900 kcal ME/kg diet recorded low shell thickness (0.373mm) at 16% CP. The results of this study showed that laying chickens can be feed on 2500kcalkg at 17% crude protein for better egg quality factors hence it could be recommended.

Key words: Energy, Protein, Layers and egg quality factors

Introduction
Protein is one of the major nutrient deficiency in most part of the world (Awolola and Adegbija, 1999). The concept of energy – protein ratio (EP ratio) or calorie – protein ratio (CP ratio) is very important in poultry feeding. It ensures adequate protein intake at all possible dietary metabolizable energy levels. It makes possible formulation of high energy diets for maximum growth rate and feed conversion ratio of chickens.

The quality of eggs and the preservation of this quality during storage is a function of their physical structure and chemical composition (FAO, 2004). The most important factors of concern in egg quality are egg composition, shell quality, egg yolk and egg white quality, deterioration, moisture loss and microbiological spoilage (FAO, 2004).

Several measurements of egg quality are used by poultry products technologists and breeders. Some of the more important and common ones deal with the interior quality of eggs, often referred to as IQ, and the porosity and thickness of the shell (Mountney and Parkhurst, 1995).

Also, FAO (2004) reported that commercial hybrids lay eggs of about 58g while Isa brown layers, lay eggs of about 59.2 g weight, 0.35 mm shell thickness, 0.46 yolk index, 0.12 albumen index and 89.9 Haugh unit.

Materials and Methods
Study Location
The study was conducted at the University Poultry Research Farm, Modibbo Adama University of Technology, Yola, Adamawa State, Nigeria. Yola is Located between latitude 7^0 and 11^0N and longitude11^0 and 14^0E at an altitude of 185.9m above sea

level. The area lies within the Northern Guinea Savanna Zone of Nigeria. Maximum temperature in the area can reach up to 40 ^{0}C particularly in April while minimum temperature can be as low as 18 ^{0}C between December and January. Mean monthly temperature in the area ranges from 26.7 ^{0}C in the South to 27.8 ^{0}C in the North eastern part of the state (Adebayo, 1999).

Experimental Animals and Management
Two hundred and forty three (243) pullets were used for this study. The birds were reared on deep litter concrete floor covered with wood savings as bedding material. Records of feed intake and egg production were taken daily. Mortality was recorded as they occurred. Vaccination for NDV kamorov was carried out on all the birds after every three months, as a booster dose. The layer chicken diets were fed for a period of thirty four (34) weeks during the laying period. Feed and water were given *ad libitum*.

Treatments and Experimental Design
The chickens were allocated into nine treatments, replicated three times. Each treatment contained 27 laying pullets with nine pullets per replicate. A combination of three energy and three proteins levels were used in a randomised complete block design involving 3x3 factorial arrangement to obtained nine treatment diets.

The treatments are made up of metabolizable energy (ME) values of 2500 kcal/kg diet (low energy), 2700 kcal/kg diet (medium energy) and 2900 kcal/kg diet (high energy) in combination with 16%CP (low protein), 17% CP (medium protein) and 18% CP (high protein) respectively (Table 1).

Measurements
Egg Production was determined by collecting eggs, three times daily, from each pen between the hours of 7.00 to 9.00 am (morning), 12.00 to 3.00 pm (afternoon) and 4.00 to 6.00 pm (evening). Egg weight were determined by using an electronic digital scale (DHAUS digital scale) having a maximum load of 600g. Eggs collected from each pen (replicate), comprising of nine chickens were weighed together and mean taken to represent an average weight of that group. Egg maximum length and width were measured using the Vanier callipers. After measuring the egg maximum length and width, the eggs were broken on the egg breaking glass for measuring the length and width of the albumen and yolk using a Vanier calliper. The egg quality traits which include shape index, albumen index, and yolk index were calculated using the formulae described by Singh (1985) while the haugh unit was calculated as described by Kondaiah *et al*. (1983) as follows:

$$\text{Shape Index} = \frac{\text{Egg Maximum Width}}{\text{Egg Maximum Length}} \times 100$$

$$\text{Albumen Index} = \frac{\text{Albumen Height}}{\text{Albumen Width}} \times 100$$

$$\text{Yolk Index} = \frac{\text{Yolk Height}}{\text{Yolk Width}} \times 100$$

$$\text{Haugh Unit} = 100 \log H - \frac{G\,(30W^{0.37} - 100)}{100} + 1.9$$

Where:
H = Albumen height in millimetres
G = Gravitational Constant
W = Weight of egg in gram

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Statistical Analysis
Analysis of variance (ANOVA) was carried out on all the data collected in respect of egg quality factors from the laying chickens placed on the experimental diets. Where significant differences were found among the treatment means, Duncan Multiple Range Test (DMRT) was used to separate the means (Duncan, 1955).

Results and Discussion
Egg Characteristics
The effect of energy level on egg quality factors of laying chickens were significant ($P<0.05$) among treatments for shell thickness, shape index and Haugh unit (Table 2) while that of protein were not significantly ($P>0.05$) different for all the parameters (Table 3). The interaction effect of dietary energy and protein on egg quality factors of laying chickens showed significant effects only on shape index (Table 4).

The main effects of energy for shell thickness on low energy diets (2500kcalME/kg diet) was 0.33mm which is similar to the values of 0.32mm and 0.33mm obtained by Parmar *et al*. (2006). The mean shell thickness for medium energy (2700kcalME/kg) and high energy (2900kcalME/kg) diets (0.35mm and 0.36mm respectively) were higher than the result obtained by Parmar *et al*. (2006). This showed that feeding layers 2700kcalME/kg and 2900kcalME/diets resulted in a better shell thickness.

The results of interaction effects showed that average mean shape index values which ranged from 74.24% (LEMP) to 77.05% (MELP) were similar to the range of 73.56 – 75.66% obtained in Jhabua-1 (Parmar *et al*., 2006). The average mean shape index values which ranged from 74.24 – 75.57% recorded by low and high energy diets (2500kcalME/kg diet and 2900kcalME/kg diet) were similar to the range values of 73.56 – 75.66% obtained in Jhabua-1 (Parmar *et al*., 2006).

Chickens placed on medium energy diets (2700kcalME/kg diet) recorded higher shape index with a mean shape index value of 76.26%, irrespective of their protein levels which is contrary to the 74.22% obtained by Parmar *et al*. (2006).

The mean albumen index ranged of 11.28 – 12.98%, 11.30 – 11.70% and 11.60 – 11.88% for chickens placed on low, medium and high energy diets (2500, 2700 and 2900kcalME/kg) respectively were all higher than the result obtained by Parmar *et al*. (2006) who reported mean albumen index range of 8.04 – 8.98%. Similarly, Subramanian *et al*. (2001) reported albumen index of 7.3% in free ranging peahen in contrast to a pooled mean value of 11.77% obtained in this study. This result showed that eggs from chickens placed on LEMP are broader and rounder than those placed on medium and high energy diets.

The mean yolk index values of 42.68 – 44.20%, 42.13 – 44.32% and 43.07 – 43.73% for chickens placed on low, medium and high energy diets (2500, 2700 and 2900kcalME/kg diets) respectively were all higher than that reported by Parmar *et al*. (2006) who obtained yolk index values of 37.12 – 38.10% in Jhabua-1. He also reported a comparatively higher yolk index of 43.01 which is similar to the result obtained in this study.

The results for Haugh unit showed that LEMP and LELP have higher Haugh unit of 65.2 and 60.0 which were considered as good quality eggs using the US standard classification which classified good quality eggs as those eggs having haugh units of 60 and above (Choice-Test, 2004) while MEHP recorded the lowest haugh unit of 55.8 which is considered as medium quality eggs, equally classified as “weak and watery”

(Choice-Test, 2004). The results of Parmar *et al*. (2006) recorded an overall mean haugh unit of 73.77 while working on indigenous kadaknath breed of poultry which was far above the present results of 65.2 and 60.0 obtained in the diets with LEMP and LELP respectively.

Conclusion

The results for main effect for dietary energy interaction between energy and protein in this study for egg quality factors for layers showed significant difference for egg shell thickness, shape index and Haugh unit while those of albumen index, and yolk index did not show any significant differences. Based on the results obtained in this study for the main effects of dietary energy and protein on egg quality factors, I therefore recommend metabolizable energy of 2500kcal/kg diet at 17% crude protein levels having a better Haugh unit of 89.44 and 89.12, respectively, for laying chickens in the Northern guinea savannah zone of Nigeria.

References

Adebayo, A. A. (1999). Climate I: Sunshine, Temperature, Evaporation and Relative Humidity. In: A. A. Adebayo and Tukur, A. L. (Eds.). *Adamawa State in Maps*. Paraclete Publishers. pp 20-22.

Awolola, M.D. and Adegbija, M.V. (1999). Factors Associated with the Adoption of Recommended Practices for Poultry Keeping in Kwara State. Book of Proceedings of 26th Annual conference. Nigeria Society for Animal Production (NSAP). 21 – 25 March, Ilorin. pp. 453- -456.

Choice-Test (2004). Eggs (archived).htm. Retrieved on 13/01/2008.

Duncan, D.B. (1955). Multiple Range and Multiple F-Test *Biometrics II*.

F.A.O. (2004). Small-scale Poultry Production technical guide. http://www.fao.org/docrep/008/y5169e/y5169e00.htm

Kondaiah, N., Ponda, B. And Singh, R.A. (1983). Internal Egg Quality Measure for Quail Eggs. *Indian Journal of Animal Science. 53*: 1261-1264.

Parmar, S.N.S., Thakur, M.S., Tomar, S.S. and Pillai, P.V.A. (2006). Evaluation of Egg Quality Traits in Indigenous Kadaknath Breed of Poultry. *Livestock Research for Rural Development*. 19 (9).

Singh, R.A. (1985). *Poultry Production*, 2nd edition. Kalyani Publishers, Daryaganj. New Delhi (India)-110002.

Subramanian, K.S., Rajavelu, D. And Narahari, D. (2001). Study on the Nesting Behaviour and Egg Characteristics of Free Ranging Peahen (*Pavo cristatus*). *Indian Journal of Poultry Science*. *43*: 284-286.

Table 1: Composition of experimental laying chickens diets

Ingredients (%)	Metabolizable Energy (kcal/kg Diet) 2500			2700			2900		
	16%CP (LELP)	17%CP (LEMP)	18%CP (LEHP)	16%CP (MELP)	17%CP (MEMP)	18%CP (MEHP)	16%CP (HELP)	17%CP HEMP)	18%CP (HEHP)
Maize	28.15	28.00	28.00	50.00	50.00	49.00	56.35	56.00	55.50
Maize Offal	41.00	38.20	35.00	18.45	15.45	13.65	8.00	5.45	3.00
Groundnut Cake	19.30	22.25	25.45	20.00	23.00	25.80	21.10	24.00	26.95
Palm Oil	--	--	--	--	--	--	3.00	3.00	3.00
Bone Meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	6.83	6.83	6.83	6.83	6.83	6.83	6.83	6.83	6.83
Lysine	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Methionine	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Salt	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Calculated Analysis									
Energy (kcal/kg diet)	2501.19	2503.92	2508.40	2706.25	2710.45	2705.03	2903.30	2904.09	2903.55
Crude Protein (%)	16.02	17.01	18.10	16.03	17.05	18.01	16.02	17.00	18.01
Energy-Protein Ratio	156.13	147.20	138.59	168.82	158.97	150.20	181.23	170.83	161.22

*Premix manufactured by Bio-Mix, supplying the following per 2.5kg: vitamin A,15,500,000.00IU; Vitamin D3,2,750,000.00IU; Vitamin E, 25,000.00mg; Vitamin K3,2,000.00mg; Vitamin B1, 2,625.00mg; Vitamin B2, 10,500.00mg; Niacin, 32,500.00mg; Pantothenic Acid, 10,500.00mg; Vitamin B6, 11,250.00mg, Vitamin B12, 85.00 mg; Folic Acid, 1,025.00mg; Biotin, 525.00mg; BHT/Endox, 250,000.00mg; Choline Chloride, 375,000.00mg; Cobalt, 200.00mg; Copper,15,000.00mg, Iodine,1,500.00mg; Iron,125,000.00mg; Manganese,150,000.00mg; Selenium,250.00mg; Zinc,125,000.00mg; Antioxidant,2,500.00mg.

LELP = Low Energy-Low Protein, LEMP = Low Energy-Medium Protein, LEHP = Low Energy-High Protein

MELP = Medium Energy-Low Protein, MEMP = Medium Energy-Medium Protein, MEHP = Medium Energy-High Protein

HELP = High Energy-Low Protein, HEMP = High Energy-Medium Protein, HEHP = High Energy-High Protein

Table 2: Main Effect of Dietary Energy on Egg Quality Factors of Laying Chickens

	Metabolizable Energy (kcal/kg Diet)			
Parameters	2500	2700	2900	SEM
Egg Weight (g)	52.26[b]	52.10[b]	54.10[a]	0.70*
Shell Thickness(mm)	0.33[b]	0.35[a]	0.36[a]	0.01*
Shape Index (%)	74.82[b]	76.26[a]	75.18[b]	0.49**
Albumen Index (%)	12.05	11.51	11.76	0.40[NS]
Yolk Index (%)	43.45	42.86	43.44	0.43[NS]
Haugh Unit	89.44[a]	87.58[a]	88.25[a]	0.98*

Means in the same row with different superscripts are significantly different (P<0.05)
SEM: Standard Error of Mean
Not: Not Significant

Table 3: Main Effect of Dietary Protein on Egg Quality Factors of Laying Chickens

	Crude Protein Levels (%)			
Parameters	16	17	18	SEM
Egg Weight (g)	52.85	53.20	52.41	0.70[NS]
Shell Thickness(mm)	0.36	0.34	0.34	0.01[NS]
Shape Index (%)	75.74	75.33	75.20	0.49[NS]
Albumen Index (%)	11.82	12.03	11.46	0.40[NS]
Yolk Index (%)	43.24	43.13	43.37	0.43[NS]
Haugh Unit	88.51	89.12	87.66	0.98[NS]

SEM: Standard Error of Means
NS: Not Significant

Table 4: Interaction Effect of Dietary Energy and Protein on Egg Quality Factors of Laying Chickens

	Metebolizable Energy (kcal/kg Diet)									
	2500			2700			2900			
Protein (%)	16 (LELP)	17 (LEMP)	18 (LEHP)	16 (MELP)	17 (MEMP)	18 (MEHP)	16 (HELP)	17 (HEMP)	18%CP (HEHP)	
Parameters										SEM
Egg Weight (g)	52.38	52.42	51.97	51.90	52.60	51.81	54.27	54.59	53.43	0.70^{NS}
Shell Thickness (mm)	0.342	0.332	0.327	0.354	0.353	0.348	0.373	0.353	0.346	0.01^{NS}
Shape Index (%)	75.22^{bc}	74.24^{c}	75.01^{bc}	77.05^{a}	76.18^{ab}	75.56^{abc}	74.95^{bc}	75.57^{abc}	75.03^{bc}	0.49*
Albumin Index (%)	11.87	12.98	11.28	11.70	11.52	11.30	11.88	11.60	11.82	0.40^{NS}
Yolk index (%)	42.68	44.20	43.47	43.32	42.13	43.13	47.73	43.07	43.52	0.43^{NS}
Haugh Unit	88.92	91.73	87.67	88.14	87.59	87.03	88.46	88.03	88.27	0.98^{NS}

Means in the same row with different superscripts are significantly different ($P<0.05$)
SEM: Standard Error of Means
NS: Not Significant ($P>0.05$)
LELP = Low Energy-Low Protein, LEMP = Low Energy-Medium Protein, LEHP = Low Energy-High Protein
MELP = Medium Energy-Low Protein, MEMP = Medium Energy-Medium Protein, MEHP = Medium Energy-High Protein
HELP = High Energy-Low Protein, HEMP = High Energy-Medium Protein, HEHP = High Energy-High Protein