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Effect of Feed Type on Performance of Nera Black Hens in the Humid Tropical Environment

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Authors' contributions

This work was carried out in collaboration between both authors. Author AOA designed the study, wrote the protocol in collaboration with author CEO, who wrote the first draft of the manuscript and managed literature searches. Author CEO helped in data collection and in performing the statistical analysis in collaboration with author AOA. Authors AOA and CEO managed the analyses of the study and literature searches. Both authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

A twelve-week study was conducted to determine the effect of feed type on performance of Nera black hens in the humid tropical environment. One hundred and twenty (120) Nera Black hens of 28 weeks of age were used for the study at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka between March and July, 2012. The hens were divided into five groups of 24 hens each and each group was randomly assigned to one of five experimental diets (self-compounded layers' diet 'B' and four commercial layers' diet A 'reference diet', C, D, and E, respectively). Each diet constituted a treatment and each treatment was replicated thrice with 8 birds per replicate. Each hen in a replicate received about 130g of layers' mash daily and ad libitum supply of water for the twelve weeks. Results showed that the final body weight, hen day production, average daily feed intake and feed conversion ratio, average egg weight, egg shell thickness and egg shell weight were significantly (P<0.05) influenced by treatments, while treatments had no significant (P>0.05) effect on average body weight gain, egg diameter, egg length and egg shape index. Birds that consumed homemade diet (B) had

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significantly (P<0.05) higher average egg weight than those fed the commercial diets which had similar mean egg weights. While some internal egg parameters were significantly (P<0.05) affected by treatments, others were not affected. Although dozens of eggs produced per bird and revenue from dozens of eggs produced were not significantly (P>0.05) influenced by treatments, total feed consumed, cost of feed consumed and gross profit were significantly (P<0.05) influenced by treatments. It was concluded that the use of homemade diet resulted in better performance than the use of commercial diets in the present study.

Keywords: Egg production; egg quality; feed type; nera black hens; tropical environment.

1. INTRODUCTION

Developing countries like Nigeria is facing a big problem of protein malnutrition. Animal proteins are essential in human nutrition in order to solve the problem of kwashiorkor which is a resultant effect of malnutrition [1]. Food and Agricultural Organization has recommended about 36 g daily animal protein intake for an adult of 60 kg of the populace [2]. Poultry products especially eggs and table birds are major sources of animal protein [3]. However, egg production in Nigeria is grossly inadequate because of the wide gap between demand and supply of the product. The situation whereby egg buyers had to make orders several days before such orders could be met is evidence to less egg production [4].The increase in egg production is a sure way of achieving the target of providing quality animal protein at a minimum cost to the consumers [5]. Advances in genetics selection make today's commercial layers quite different from those of years ago. Body weight is less, total number of egg has increased, egg mass is greater, and feed conversion has improved considerably [6,7]. Successful advances in genetic selection for increased production depend on the availability of feed. Therefore, the types of feed used in feeding the birds also play a significant role in the performance of laying hen. The effect of feed on the performance of the birds stands out as the most reliable method of assessing the quality of a feed [8]. Availability of balanced poultry feed is very important in poultry production. The birds can only perform economically well if it consumes on daily basis the appropriate amount of energy, protein, vitamins and minerals [5]. Thus all the essential elements (nutrients) must be present in their ration for proper growth, production and maintenance of the body. Different studies have shown that layers fed with high quality rations perform better than their counterparts reared on low quality or badly produced feed [5,9]. According to [10], the proliferation of small feed mills, run sometimes by illiterates and semi-literate individuals has compounded the problem of poor feed quality in the market. Egg and broiler meat production are still at subsistence, small or medium scale level in Nigeria, in spite of its roles in income, food and gross domestic products. This shortfall could be attributed to inadequate and high cost of feed which is not even readily available [11]. These lapses paved way for commercial poultry feed manufacturers to source for unconventional, unwholesome and stale feed ingredients in order to maximize profit, undermining the fact that qualitative feed enhances good performances of egg and broiler meat production [12]. This situation is thriving in many major cities across Nigeria because of lack of government control on feed quality standards. Farmers are therefore left at the mercy of these quacks for supply of feeds and in many cases these feeds are very poor in quality [13]. The present study was therefore conducted to investigate the effect of feed type on performance of Nera black hens in the humid tropical environment.

2. MATERIALS AND METHODS

The study was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. Nsukka lies within longitude 6° 451 E and 7° E and latitude 7° 12.51 N [14] and on the altitude 447 m above sea level. The climate of the study area is typically tropical, with relative humidity ranging from 65 – 80% and mean daily temperature of 26.8°C [15]. The rainy season is between April – October and dry season between November – March with annual rainfall range of 1680 – 1700 mm [16]. The entire study lasted for 12 weeks.

2.1 Experimental Diets

Five experimental diets (A, B, C, D and E) were used as follows: Diets A, C, D and E comprised Top®, Gold medal®, Chidera® and Vital® commercial layers feeds, respectively while diet B was self-compounded (homemade) layers' mash. The percentage composition of the self - compounded diet is presented in Table 1.

2.2 Management of Animals and Experimental Design

The experiment was carried out in accordance with the provisions of the Ethical Committee on the use of animals and humans for biomedical research of the University of Nigeria, Nsukka (2006). A total of one hundred and twenty (120) 28 weeks old Nera black hens were used for the study. The hens were housed in the laying house situated at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. The house is an open – sided tropical type, fitted with two-tier battery cages with feeders and drinkers. Flat aluminum metal plates were constructed and used to partition the feeding troughs at intervals of four (4) cages.

The idea was to prevent spillover of feeds from the feeding trough or to neighboring treatments. The birds were randomly divided into five groups of 24 hens each. Each group was randomly assigned to one of five experimental diets (self-compounded layers' diet 'B' and four commercial layers' diet A 'reference diet', C, D, and E, respectively),using a completely randomized design (CRD). Diet A which has been successfully established in the feed market for a long time served as the control diet. Each diet constituted a treatment. Each treatment was replicated three (3) times with eight (8) birds per replicate. Two hens were housed in a cage measuring 49 x 35 x 42 cm (length x width x height, respectively), while the floor space of each cage was 0.17 m^2. Four (4) of such cages constituted a replicate. Each hen in a replicate received about 130 g of layers' mash daily and *ad libitum* supply of water for the twelve weeks experimental period. The droppings were cleared promptly to prevent disease buildup. Foot dip (containing disinfectant) was made available at the entrance of the poultry house, as a general flock prophylactic management strategy. Routine vaccinations were administered as and when due.

2.3 Performance Parameters Measured

The parameters measured include the following:

Initial and final body weights: These were measured at the beginning and at the end of the experiment, respectively.

Average Body Weight (kg) =

Final body weight – initial body weight.

Average Daily Feed Intake (g):

$$\frac{\textit{Feed Offered (g) – Feed Refusals (g)}}{\textit{Number of Hens}}$$

Feed Conversion Ratio =

$$\frac{Quantity\ of\ feed\,consumed}{Doz.\ of\ eggs\ produced}$$ [17].

Average Egg Weight (g) =

$$\frac{Total\ weight\ of\ eggs\ (g)\ per\ treatment}{Total\ number\ of\ birds\ in\ that\ treatment}$$

Hen day Production (%) =

$$\frac{Average\ No\ of\ eggs\ per\ day}{No\ of\ birds\ alive} \times 100\%$$

Egg Weight (g): Egg weight was taken for every egg collected for the hens and the weighing was done for all the collected eggs within one hour of collection. Electronic balance (D & G sensitive scale) was used and the measurement expressed in grammes.

Egg Quality: Sixteen (16) eggs were randomly selected weekly for egg quality analysis. The indices determined were as follows:

Egg Shell Weight (g): Each egg was carefully broken and the shell was dried, after which the dried egg shell was weighed using a weighing balance.

Egg Shell Thickness (mm): This was determined by pulling off the shell immediately the egg was broken and the shell was air-dried for a day (24 hours) after which the egg shell thickness was determined with the help of a micrometer screw gauge.

Egg Shape Index: The egg shape index was calculated as the proportion of egg length to diameter.

Albumin Height and Diameter (mm/cm): The eggs after weighing were broken into a flat bottom glass (beaker) positioned on a flat surface. The albumin height was measured using a tripod micrometer. Albumin diameter was taken as the maximum cross sectional diameter of the albumin using a pair of calipers and read on a ruler calibrated in millimeter.

Table 1. Percentage (%) and calculated compositions of experimental diets

Ingredients	Diets				
	A	B	C	D	E
Maize	-	48	-	-	-
Wheat offal	-	10	-	-	-
Palm kernel cake	-	14	-	-	-
Groundnut cake	-	10	-	-	-
Fish meal	-	2	-	-	-
Soy bean meal	-	6	-	-	-
Bone meal	-	3	-	-	-
Lime stone		6			
Salt	-	0.25	-	-	-
Lysine	-	0.25	-	-	-
Methionine	-	0.25	-	-	-
Layers' premix*	-	0.25	-	-	-
Total		100			
Calculated composition:					
Crude protein (%)	16.50	17.00	16.50	16.50	16.50
Crude fibre (%)	6.00	5.49	6.50	6.00	6.50
Ether extract (%)	5.00	4.97	4.50	4.56	4.00
Lysine (%)	0.80	1.24	1.00	0.90	1.00
Methionine (%)	0.34	0.92	0.50	0.45	0.55
Calcium (%)	3.80	3.73	3.50	3.55	3.60
Energy (Mcal/kg ME)	2500	2700	2550	2600	2650

Yolk Height and Diameter (mm/cm): The eggs after weighing were broken into a flat bottom glass (beaker) positioned on a flat surface. The Yolk height was measured using a tripod micrometer. Yolk diameter was taken as the maximum cross sectional diameter of the yolk using a pair of calipers and read on a ruler calibrated in millimeter.

Albumin Index: The albumin index was calculated as the proportion of yolk height to diameter.

Yolk Index: The yolk index was calculated as the proportion of yolk height to diameter.

Haugh Unit: This was calculated from the values obtained from the albumin height and egg weight by using the formula: Haugh's unit = 100log $(H+7.57-1.7W^{0.37})$ as described by [18].

2.4 Determination of Cost Implication Indices

Data generated were used to determine the cost implication of feeding self-compounded layers' diet and some commercial layers' diets to the experimental hens. The economic parameters determined included the following:

Dozens of Egg Produced per bird (dozen) =

$$\frac{Total\ egg\ number\ per\ bird}{12}$$

Price per Crate of Egg (₦): A crate of egg was sold at ₦650 as at the time of the research work.

Cost of 1 kg of Feed (₦) =

$$\frac{Amount\ per\ bag\ of\ feed\ (N)}{25kg\ feed\ (1\ bag\ of\ feed)}$$

Total Feed Consumed (kg) =

$$\frac{Total\ feed\ consumed\ (g)}{1000}$$

Cost of Feed Consumed (₦) = Total feed Consumed (₦) × Cost of kg of feed (₦)

Price of a Dozen of Eggs (₦) = 1 dozen of eggs was sold at ₦260.40 as at the time of the research work.

Revenue from Dozens of Eggs Produced (₦) = Total dozens of eggs produced x Price of one dozen of eggs.

Gross Profit (₦) = Revenue from dozens of eggs produced (₦) - Cost of feed Consumed (₦) (all other things been equal).

2.5 Proximate and Statistical Analyses

Samples of the five experimental diets were analyzed for their proximate compositions according to [19] methods. Data collected were subjected to analysis of variance (ANOVA) in a completely randomized design as outlined by [20] using Statistical Package for the Social Sciences [21], windows version 8.0. Significantly different means were separated using Duncan's New Multiple Range Test [22] option in [21].

3. RESULTS AND DISCUSSION

3.1 Effect of Feed Type on Laying Performance of Nera Black (NB) Hens

The proximate composition of the experimental diets is presented in Table 2 while Table 3 shows the performance of Nera Black hens fed self-compounded layers' diet (B) and four different commercial layers' diets.

Final body weight (FBW), hen day production (HDP), average daily feed intake (ADFI) and feed conversion ratio (FCR) were significantly ($P<0.05$) influenced by treatments. Treatments had no significant ($P>0.05$) effect on average body weight gain. Birds fed self-compounded diet (B) and commercial (control) diet (A) had significantly ($P<0.05$) higher hen day production (87.67% and 86.00% for diets B and A, respectively) than birds that were fed other commercial feed types (C, D and E) which had similar HDP values (79.33±6.77, 80.67±1.76 and 77.33±2.40, respectively). The final body weight of birds fed self-compounded feed was significantly ($P<0.05$) higher than the FBW of birds fed commercial diet E. Birds fed commercial diets A, C and D and those fed homemade diet had similar FBW values while those fed all the commercial diets also had similar FBW values. The average daily feed intakes values of birds fed self-compounded diet (B) and those fed commercial diet E were similar and lower ($P<0.05$) than the ADFI value of birds fed commercial diet C. Birds fed commercial diets C, A and D had similar ADFI values, while those fed homemade diet and those fed commercial diets A, D and E also had similar ADFI values. The FCR value of hens fed diet B (self-compounded) was significantly ($P<0.05$) lower than the FCR value of hens fed commercial diet C. Birds fed commercial diets A, D and E and those fed self-compounded diet had similar FCR values while those fed all the commercial diets also had similar FCR values. Hens fed self-compounded diet 'B' had higher performance than those fed commercial diets C, D and E in terms of hen day production percentage. This could be due to differences in ingredient combinations which are major determinants of feed quality. Perhaps diet B (self-compounded) had better quality as regards ingredient combination than diets C, D and E. [23] reported that feeds with better ingredient combinations were utilized more efficiently when fed to birds. According to [24-28], the most important factor influencing the performance of poultry birds, all other factors being constant is the quality of feed offered to the birds. It was observed that birds which consumed the self-compounded diet and commercial diet E had lower feed intake than those fed commercial diet C (Table 3). The variation in feed intake values could be related to the energy content of the diets as birds are known to eat to satisfy their energy requirements [29]. Feed intake of birds reduced as the energy increased. Interestingly, the feed intake values obtained in this study were not similar to the values (121.07 g/day and 122.62 g/day- 122.14 g/day) for self-compounded diet and commercial diets, respectively reported by [13]. The disparity could be attributed to differences in feed quality and strains of egg-type chickens used.

Table 2. Proximate compositions of the experimental diets

Determined compositions	Diets				
	A	B	C	D	E
Dry matter (%)	88.55	88.65	88.70	89.09	88.70
Crude protein (%)	17.30	17.80	17.00	17.20	16.96
Crude fibre (%)	4.60	3.00	4.45	4.15	5.00
Ether extract (%)	5.33	5.77	5.17	5.56	5.64
Ash (%)	10.70	11.40	10.40	13.30	13.10
Nitrogen-free extract (%)	49.38	50.68	51.68	51.12	48.00

Table 3. Effect of diet type on laying performance of Nera Black (NB) hens

Parameters	Commercial diet A (control)	Self-compounded diet B	Commercial diet C	Commercial diet D	Commercial diet E	Sig.
Initial weight (kg)	1.33±0.05	1.39±0.02	1.32±0.05	1.43±0.03	1.28±0.05	NS
Final weight (kg)	1.40±0.05^{ab}	1.52±0.03^{a}	1.37±0.02^{ab}	1.48±0.04^{ab}	1.34±0.07^{b}	*
Av body wt gain (kg)	0.07±0.03	0.13±0.01	0.05±0.03	0.05±0.01	0.06±0.04	NS
Hen day production (%)	86.00±2.52^{a}	87.67±5.21^{a}	79.33±6.77^{b}	80.67±1.76^{b}	77.33±2.40^{b}	*
Av daily feed intake (g)	93.10±4.91^{ab}	79.17±2.32^{b}	99.25±5.26^{a}	89.58±1.67^{ab}	79.17±6.31^{b}	*
Feed conversion ratio	1.37±0.03^{ab}	1.09±0.07^{b}	1.52±0.06^{a}	1.35±0.04^{ab}	1.25±0.06^{ab}	*

*^{a,b,c} Mean values in a row with different superscripts are significantly (P<0.05) different. *= (P<0.05); NS= Not Significant*

3.2 Effect of Feed Type on External Egg Parameters of Nera Black Hens

Table 4 shows the external egg characteristics of Nera Black hens fed self-compounded layers' diet B and four different commercial diets A, C, D and E. Average egg weight, egg shell thickness and egg shell weight were significantly (P<0.05) affected by treatments while egg diameter, egg length and egg shape index were not significantly (P>0.05) influenced by treatments. Birds that consumed self-compounded diet (B) had significantly (P<0.05) higher average egg weight than those fed the commercial diets which had similar mean egg weight. Hens fed self-compounded diet and those fed commercial diets C and D had similar egg shell thickness values and these were significantly higher (P<0.05) than the egg shell thickness values of hens that consumed commercial diets A and E which had similar egg shell thickness values. The egg shell weight value of hens that consumed self-compounded diet was significantly (P<0.05) higher than the shell weight value recorded for hens that were fed commercial diets A, C and E. Hens that were fed commercial diet D had significantly (P<0.05) higher egg shell weight value than those that were fed commercial diet C. Hens that were fed diets A, C and E had similar egg shell weight values, while those that were fed commercial diet D had similar egg shell weight value with those that were fed self-compounded diet (B).

As revealed in the present study, birds fed self-compounded diet (B) had the highest egg weight. It was also observed that hens fed the self-compounded diet had higher hen day production than those fed commercial diets C, D and E (Table 3). However, the present observation contradicts earlier report by [13] who observed that birds which produced fewer eggs tended to have bigger eggs than birds that produced many eggs. Earlier report by [30] had also shown that egg number is negatively correlated with egg size. Differences were found to exist among treatments in egg shell thickness (Table 4). The variations in egg shell thickness may be attributed to difference in the amount (quantity) of minerals in the experimental diets since all the experimental diets might not have contained the same amount of sources of mineral such as bone meal, lime stone and/or oyster shell [27,28].

As shown in Table 4, birds fed self-compounded diets (B) had the highest egg shell weight of 8.62g followed by D (8.35 g). Diets A, E and C had egg shell weights of 7.97 g, 7.95 g and 7.88 g, respectively. It tends to suggest that the quality (external) of eggs produced by hens that consumed the self-compounded diet was superior to quality (external) of eggs produced by hens that consumed most of the commercial diets. The egg weight values (63.11 g – 69.55 g) and egg shell weight values (7.88 g-8.62 g) recorded in this study were higher than the egg weight values (58.2 g – 56.17 g) and the egg shell weight values (5.28 g – 5.33 g) reported by [13] who studied the effect of self-compounded diets and two commercial diets on performance of laying hens.

3.3 Effect of Feed Type on Internal Egg Parameters of Nera Black Hens

Table 5 shows the internal egg characteristics of Nera Black Hens fed self-compounded diet B and four different commercial diets A, C, D and E. Haugh unit score, yolk height, yolk diameter, yolk index, albumin height and albumin diameter were significantly (P<0.05) affected by treatments, while yolk weight, albumin weight, albumin length and albumin index were not significantly (P>0.05) influenced by treatments. Hens fed self-compounded diet(B) had the highest Haugh unit score of 92.33%, while birds fed all the commercial diets had similar Haugh unit score values of 83.33%, 86.33%, 86.00% and 82.67% for A, C, D and E, respectively. According to the United States of America, Department of Agriculture (USDA), a haugh unit score of 72 and above (score AA) is an acceptable indication of freshness in egg [31] as cited by [32]. The haugh unit values obtained from all the groups in the present study tends to indicate that eggs produced by hens fed both self-compounded and commercial diets were fresh and of standard quality. As shown by [33], cited by [34] Haugh units of inferior quality have values less than 40%. However, the significant effect of dietary treatments on Haugh unit scores is not in line with earlier reports [35,13] which showed that feed type had no significant (P>0.05) on Haugh unit score.

Table 5 also shows that the effect of treatments on yolk weight was not significant (P>0.05). This is in line with the report of [36] as cited by [37] which showed that yolk weight appeared to be very constant for any given hen. Hens fed commercial diet E had significantly (P<0.05) higher yolk height and yolk diameter values than hens fed self-compounded diet and commercial diets A, C and D. Hens fed self-compounded diet B had similar (P<0.05) yolk index value with those fed commercial diets C and D and higher (P<0.05) yolk index value than those fed commercial diets A and E. Hens fed self-compounded diet (B) had higher (P<0.05) albumin height value than those fed the commercial diets. Hens fed commercial diet A (reference diet) had significantly (P<0.05) higher albumin diameter than those fed self-compounded diet B. Hens fed commercial diets C, D and E had similar albumin diameter values with those fed commercial diet A and the self-compounded diet. It does appear from the result obtained that yolk height and yolk diameter had direct relationship. Thus birds that had high yolk height had less yolk diameter. The yolk height and albumin height values (17.52 mm – 18.32 mm and 6.77 mm and 8.73 mm, respectively) obtained in this study are higher than the values (14.6 mm – 15.6 mm for yolk height and 5.9 mm – 6.67 mm for albumin height) reported by [38], and higher than 16.4 mm – 17.6 mm for yolk height and 6.21 mm – 6.68 mm for albumin height reported by [34]. Albumin and yolk heights are all indications of the freshness and quality of an egg [38]. Considering the values obtained in this study for these parameters, the use of both the self-compounded and commercial diets did not have any negative effect on the quality of the eggs produced by the treated hens. The values of yolk index obtained in this study were higher than the values reported by [39] and [34]. As shown in Table 5, the yolk index and Haugh unit score of hens fed self-compounded diet B were significantly higher than the values recorded for the commercial diets. The higher haugh unit score and yolk index recorded for the self-compounded diet is a good indication that birds which consumed the diet produced eggs that had superior and more desirable internal quality as corroborated by earlier reports [40-44].

3.4 Cost Implication of Feeding Self-compounded and Commercial Layers' Diets to Nera Black Hens

Table 6 shows the economic implication of feeding self-compounded layers' diet and four commercial diets to Nera Black hens. Although dozens of eggs produced per bird and revenue from dozens of eggs produced were not significantly (p>0.05) influenced by feed type, total feed consumed, cost of feed consumed and gross profit were significantly (p<0.05) influenced by treatments. The total feed intake values of birds fed self-compounded diet B and those fed commercial diet E were similar and lower (p<0.05) than the total feed intake values of birds fed commercial diet C. Birds fed commercial diets C, A and D had similar total feed intake values, while those fed self-compounded diet and those fed commercial diets A, D and E also had similar total feed intake values. Birds fed commercial diet C had the highest record of total feed consumed while hens on self-compounded diet B and commercial diet E consumed the least amount of feed. The costs of feeds consumed by hens fed control (commercial) diet A and commercial diet C were observed to be the highest, while hens fed self-compounded diet b had the least cost of feed consumed. The gross profit from self-compounded diet B was significantly (p<0.05) higher than those from all the commercial diets which were similar. The least cost of feed consumed recorded for self-compounded diet B may be attributed to the least cost of kg of feed recorded for this diet.

According to [8] the high cost of poultry feed results in general increase in the cost of production. Interestingly, the self-compounded diet produced the highest gross profit as compared to all the commercial diets used in this study. The present observation is in line with the findings of [13] who reported that the income from birds fed self-compounded diet was higher than the incomes from birds fed commercial diets that were used in their study. The increase in the cost of feed and low gross profit recorded for commercial diets a, c, d and e used in this study might not be unconnected with the high cost involved in milling commercial feeds which are passed on to the end users [13]. The high profit margin obtained from the use of self-compounded diet b in the present study indicates that formulating and mixing feed at the farm level can lower the cost of production. According to [45-47], the need to lower feed cost in order to produce affordable poultry meat and egg for the populace cannot be over emphasized in the face of dwindling standard of living. Earlier reports [45,48,49] had pointed out that the solution to inadequate protein intake of the populace can easily be achieved if the cost of producing poultry meat and egg (especially feed cost) can be drastically reduced.

Table 4. Effect of feed type on external egg parameters of Nera Black hens

Parameters	Commercial diet A (control)	Homemade diet B	Commercial diet C	Commercial diet D	Commercial diet E	Sig.
Av egg wt (g)	64.50±0.28^{b}	69.55±1.00^{a}	63.11±0.52^{b}	64.50±1.00^{b}	64.84±1.37^{b}	*
Egg shell thickness (mm)	0.20±0.01^{b}	0.23±0.02^{a}	0.23±0.02^{a}	0.23±0.01^{a}	0.20±0.01^{b}	*
Egg shell weight (g)	7.97±0.10^{bc}	8.62±0.21^{a}	7.88±0.19^{c}	8.35±0.15^{ab}	7.95±0.07^{bc}	*
Egg diameter (cm)	3.29±0.02	3.31±0.09	3.25±0.01	3.28±0.02	3.29±0.04	NS
Egg length (cm)	4.74±0.03	4.74±0.01	4.71±0.01	4.79±0.02	4.72±0.05	NS
Egg shape index	1.44±0.02	1.43±0.02	1.45±0.01	1.46±0.01	1.44±0.01	NS

*a,b,c; Mean values in a row with different letter superscripts are significantly (p<0.05) different. *=(P<0.05); NS= Not Significant*

Table 5. Effect of feed type on internal egg parameters of Nera Black hens

Parameters	Commercial diet A (control)	Self-compounded diet B	Commercial diet C	Commercial diet D	Commercial diet E	Sig.
Haugh unit score (%)	83.33±1.86^{b}	92.33±2.33^{a}	86.33±0.33^{b}	86.00±1.15^{b}	82.67±2.33^{b}	*
Yolk wt (g)	16.44±0.14	16.01±0.24	15.72±0.12	16.25±0.13	16.02±0.79	NS
Yolk height(mm)	18.32±0.05^{a}	18.96±0.22^{a}	18.73±0.20^{a}	18.40±0.16^{a}	17.52±0.39^{b}	*
Yolk diameter(cm)	3.05±0.01^{b}	2.99±0.04^{b}	2.99±0.06^{b}	3.03±0.05^{b}	3.21±0.05^{a}	*
Yolk index	0.60±0.01^{b}	0.64±0.01^{a}	0.63±0.01^{ab}	0.61±0.01^{ab}	0.56±0.01^{c}	*
Albumin wt (g)	38.23±0.74	39.18±0.93	36.88±1.02	38.98±0.67	38.10±1.03	NS
Albumin height (mm)	7.16±0.30^{bc}	8.73±0.38^{a}	7.61±0.02^{b}	7.63±0.21^{b}	6.77±0.19^{c}	*
Albumin diameter(cm)	6.31±0.14^{a}	5.74±0.20^{b}	5.96±0.17^{ab}	6.00±0.06^{ab}	6.21±0.09^{ab}	*
Albumin length (cm)	7.93±0.35	7.54±0.35	7.87±0.45	7.96±0.17	8.14±0.12	NS
Albumin index	1.26±0.05	1.31±0.03	1.32±0.04	1.32±0.01	1.31±0.02	NS

*a,b,c; Mean values in a row with different letter superscripts are significantly (p<0.05) different. *=(P<0.05); NS= Not Significant*

Table 6. Cost implication of feeding homemade and commercial layers' diets to Nera Black (NB) hens

Parameters	Commercial diet A (control)	Self-compounded diet B	Commercial diet C	Commercial diet D	Commercial diet E	Sig.
Dozens of eggs produced per bird (dozen)	6.32±0.46	6.73±0.40	6.08±0.52	6.18±0.13	5.91±0.17	NS
Price per crate of egg (₦)	650.00	650.00	650.00	650.00	650.00	NS
Cost of kg of feed (₦)	74.00	60.00	72.00	72.00	70.00	NS
Total feed consumed (kg)	8.66±0.78^{ab}	7.36±0.24^{b}	9.23±0.51^{a}	8.33±0.16^{ab}	7.36±0.58^{b}	*
Cost of feed consumed(₦)	640.84±2.46^{a}	441.60±5.95^{c}	664.56±4.66^{a}	599.76±3.05^{ab}	515.20±3.28^{bc}	*
Price of a dozen of egg (₦)	260.40	260.40	260.40	260.40	260.40	NS
Revenue from dozens of egg produced(₦)	1650.94±1.21	1752.49±1.02	1583.23±1.34	1609.27±3.46	1538.96±4.52	NS
Gross profit (₦)	1010.10±6.75^{b}	1310.89±1.15^{a}	918.67±2.99^{b}	1009.51±3.49^{b}	1023.76±5.62^{b}	*

*a,b,c; Mean values in a row with different letter superscripts are significantly (p<0.05) different. *=(P<0.05); NS= Not Significant*

4. CONCLUSION

Results obtained in the present study show that the use of self-compounded diet resulted in better performance and reduced feed cost than the use of commercial diets, considering the

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COMPETING INTERESTS

Authors hereby declare that there are no competing interests.

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