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Comparative Study on Egg Characteristics of Yoruba Ecotype Nigerian Local Chickens and Isa Brown Chickens Fed Graded Levels of *Moringa oleifera* Seed Meal

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ABSTRACT

Background: *Moringa oleifera* seed meal is a potential noble feed ingredient that could be incorporated into the diet of poultry. It is a potential cheaper alternative considering its ability to thrive under all climatic conditions in Nigeria, West Africa. The study was aimed at evaluating the effects of the dietary inclusion of *Moringa oleifera* seed meal (MOSM) on the egg characteristics, feed conversion ratio and body weight of parameters of Yoruba Ecotype Nigerian Local Chickens (YENLC) and Isa Brown chickens.

Methods: The study assessed the comparative influence of dietary MOSM on the egg characteristics of YENLC and Isa Brown chickens. Data obtained were subjected to analysis of variance using the general linear model procedure of Statistical Package for Social Sciences (SPSS) software version 22.

Result: The findings of this study were that: dietary inclusion of MOSM affected the egg characteristics of YENLC and Isa Brown chickens. Egg length, egg width, yolk weight and yolk height decreased significantly ($p<0.05$) with increasing levels of MOSM. There was significant interaction ($p<0.05$) between MOSM inclusion and genotypes of chickens. For both genotypes, egg number was significantly higher ($p<0.05$) till 5% inclusion level of MOSM while hen day production reduced with increasing levels of MOSM. It can thus be concluded that MOSM can be included for both genotypes up till 10% but YENLC would still perform better at 15% when compared with the Isa Brown hens.

Key words: Egg, Genotypes, Isa brown chickens, Yoruba ecotype Nigerian local chickens.

INTRODUCTION

Protein sources diversification and antibiotic growth promoter ban have led to the use of plants. Also, the high cost of feed ingredients in poultry production especially protein sources necessitated the need for alternative feed ingredient without compromising the quality of the feedstuffs. Also, feed accounts for about 70% of the total cost of production for poultry hence the need for sourcing cheaper and high quality alternative feed ingredients. *Moringa oleifera* seed meal (MOSM) has a very good potential since *Moringa oleifera* thrive well in almost all climatic conditions in Nigeria and the growth is fast coupled with its perennial in nature (Akintunde and Toye, 2012). Akintunde and Toye (2014) reported that MOSM had a crude protein of 21.67%, crude fat of 36.50% and crude fibre, total ash and energy of 17.88%, 3.67% and 14.39 MJ/Kg respectively. The phytochemical properties of MOSM could also be beneficial to the well-being of the chickens when fed within the safety limits (Akintunde *et al.*, 2019).

Poultry egg is one of the cheapest, most affordable and acceptable animal products. Egg possesses two characteristics that make them valuable as foodstuffs; they are highly nutritious and serve important role in many food products because of their functional properties (Scott and Silversides, 2000). Thus, they are excellent means through which the animal protein of the populace can be met (Oleforu-Okoleh *et al.,* 2016).The Nigerian local chicken has been reported to be small in size and grows slowly but possesses good potential for egg and meat production (Omeje and Nwosu 1983). However, besides genetics make-ups, growth response generally in domesticated animals to a large extent is absolutely determined by its environment (Adesola *et al.,* 2013; Olgun *et al.*, 2015; Gunn *et al.,* 2016; Saikhlai *et al.*, 2019). Oluyemi and Robert (1979) reported that egg production *i.e.* fertility and hatchability of eggs are both functions of breed and environment. It has been reported that the effect of MOSM is influenced by genotypes hence the results of one genotype of chickens could not be used to generalize (Akintunde and Toye, 2014, Akintunde *et al.*, 2019). Peters *et al.*, (2005) reported that strain had prominent effect on fertility and hatchability of eggs.

The study was aimed at determining the effect of feeding various levels of MOSM to Yoruba Ecotype Nigeria Local chickens (YENLC) and Isa Brown chickens on egg parameters.

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MATERIALS AND METHODS

The test ingredient, *Moringa oleifera* seed, was sourced from Kaduna metropolis in Nigeria. The seeds were air dried at the room temperature after which the meal was prepared. The seeds of *Moringa oleifera* were then milled and incorporated into the chickens' diets in appropriate proportion. The experiment was carried out at the Livestock Farm Section of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan. The city has coordinates of 70 24′ 7.0632″ N and 30 55′ 2.3268″ E.

Animals, experimental design and management

Ninetysix Isa Brown pullets and ninety six local chickens were randomly allotted to the four dietary treatments containing graded levels of MOSM: 0% (diet 1), 5% (diet 2), 10% (diet 3), 15% (diet 4) (Table 1) fed independently to the Isa Brown chickens and local chickens such that each treatment comprised of three replicates of eight birds each in a 2 × 4 factorial design. YENLC were sourced from the Department of Animal Breeding and Genetics, Federal University of Agriculture, Abeokuta, Nigeria while the Isa Brown pullets were sourced from Obasanjo Farm, Oluyole, Ibadan, Nigeria.

Determination of egg characteristics parameters

Egg weight was individually determined to 0.01 g accuracy using a digital weighing scale. Egg length (along the longitudinal axis) and egg width (along the equatorial axis) were measured with a Vernier Calliper. Egg shape index was calculated as the ratio of egg width to length (%) by the method of Anderson *et al.* (2004). Shell weight (with membrane) was measured using a sensitive weighing scale and the percentage proportion of the shell in the egg was determined. The albumen weight was calculated from the difference between the egg weight and the yolk and shell weight and the percentage proportion of the albumen in the egg was determined. Albumen index (%) was determined by the method of Alkan *et al.* (2010) on the basis of the ratio of the thick albumen height (mm) measurement taken with a micrometer to the average of width (mm) and length (mm) of this albumen with 0.01mm accuracy. Haugh unit was calculated according to the procedure of Haugh (1937). Yolk weight with 0.01g accuracy was determined using a sensitive weighing scale and its percentage proportion was calculated. Yolk index (%) was measured on the basis of the ratio of the yolk height (mm) to the yolk width (mm) by the method of Funk (1948) using micrometer with 0.01 mm accuracy.

Statistical analysis

Data from this study were further subjected to a two-way analysis of variance for the effect of breed and treatment and their interactions. Means were separated by the use of Duncan new multiple range test at 95% confidence interval.

Data were analyzed using the General Linear Model procedure of the SPSS Version 22 (IBM, SPSS). The appropriate statistical model used was:

$$Y_{ijk} = \mu + G_i + M_j + (GM)_{ijk} + \varepsilon_{ijk}$$

Y_{ijk} = Observation on k^{th} population, of i^{th} genotype and j^{th} MOSM inclusion.

μ = Common mean.

G_i = Fixed effect of genotype (i=2).

M_j = Fixed effect of MOSM inclusion (j=4).

$(GM)_{ijk}$ = Interaction effect of genotype and MOSM.

ε_{ijk}= Error term associated with each record (normally, independently and identically distributed with zero mean and constant variance).

RESULTS AND DISCUSSION

For the ISA Brown pullets, egg weight, egg length, egg width, albumen weight, yolk length and yolk height reduced significantly across the group while for the YENLC, egg weight, egg length, egg width, albumen weight, yolk length,

Table 1: Composition of experimental diet.

Ingredient	A	B	C	D
Maize	48.00	48.00	48.00	48.00
Soybean meal	18.00	15.50	13.00	10.50
Groundnut cake	7.00	7.00	7.00	7.00
Moringa oleifera seed meal (MSM)	0.00	5.00	10.00	15.00
Fish meal	3.00	3.00	3.00	3.00
Wheat offal	10.00	10.00	10.00	10.00
Corn bran	10.00	7.50	5.00	2.50
Bone meal	1.00	1.00	1.00	1.00
Oyster shell	1.50	1.50	1.50	1.50
Premix	0.50	0.50	0.50	0.50
Salt	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20
Methionine	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00
%CP (Calculated)	19.99	19.89	19.79	19.69
ME supplied (Kcal/Kg)-Calculated	2,897.76	2,894.61	2,891.46	2,888.31

yolk height, shell weight, albumen height and yolk height decreased significantly (p<0.05) across the group (Table 2).

From Table 3, it was observed that all the egg parameters of ISA Brown pullets were significantly higher than that of YENLC. For all the egg parameters, the values decreased significantly (p<0.05) across the group.

The body weights of Isa Brown pullets at weeks 8 and 24 were significantly (p<0.05) higher than that of YENLC but YENLC consumed more feeds (p<0.05) than the Isa Brown pullets. The egg number, FCR and HDP of Isa Brown were significantly higher (p<0.05) than that of YENLC (Table 4).

Table 4 further showed at week 8 that birds fed 5% and 10% MOSM had significantly (p<0.05) higher body weight when compared with the control (0% MOSM) but at week 24, birds fed 5% and 15% MOSM had significantly (p<0.05) higher body weights when compared with the control 0% MOSM) and 10% MOSM. Egg number and hen day production decreased significantly (p<0.05) with increasing levels of MOSM. Feed intake up to 10% MOSM was significantly higher (p<0.05) than 15% MOSM. FCR of birds in the control (0% MOSM) and 5% MOSM were significantly (p<0.05) better than 10% and 15% MOSM.

Table 5 further revealed that at week 24, body weights of YENLC also increased significantly with increasing levels of MOSM while in Isa Brown hens, birds fed 5% MOSM had significantly higher (p<0.05) body weights compared to the control (0% MOSM) and 10% MOSM but feeding MOSM at 15% inclusion significantly (p<0.05) depressed the growth.

However, for both genotypes, egg number and hen day production significantly (p<0.05) decreased with increasing levels of MOSM (Table 5). Table 5 also showed that feed intake also decreased significantly (p<0.05) with increasing levels of MOSM for YENLC while in Isa Brown, birds fed 10% MOSM had significantly higher (p<0.05) feed intake compared to 0% MOSM, 5% MOSM and 15% MOSM that were similar (p>0.05).

In YENLC, birds fed 5% MOSM and 10% MOSM had significantly better (p<0.05) FCR compared to the control (0% MOSM) and 15% MOSM while for the Isa Brown hens, FCR was significantly better (p<0.05) at 0% MOSM and 5% MOSM (Table 5).

The report agreed with the findings of Hrncar *et al.* (2014), who studied the effect of genotype on egg quality characteristics of Japanese quails (*Coturnix japonica),* they observed that egg weight was significantly affected by the quail type. Also, the egg shape index was significantly influenced by genotypes.

Also, in the study of Adeosun (2004) on the effects of genotype of dam on egg quality characteristics of chickens, the results showed that egg weight, length and width were highly significantly by the genotypes of the chickens but on the contrary, the internal egg parameters indicated that albumen height, albumen pH, yolk weight, egg shell, thickness and yolk colour were not significantly affected by genotype.

Table 2: Egg characteristics of YENLC and Isa brown pullets fed graded levels of MOSM.

	YENLC				ISA brown			
	(0% MOSM)	(5% MOSM)	(10% MOSM)	(15% MOSM)	(0% MOSM)	(5% MOSM)	(10% MOSM)	(15% MOSM)
Egg weight (g)	32.85±0.42^{b}	29.35±2.69^{a}	30.61±0.49^{ab}	25.73±0.30^{a}	50.39±0.29^{d}	49.65±0.90^{cd}	42.02±0.44^{c}	42.84±0.23^{c}
Egg length (cm)	2.74±0.02^{b}	2.55±0.24^{b}	2.33±0.04^{b}	1.87±0.08^{a}	4.15±0.02^{d}	3.96±0.06^{d}	3.32±0.05^{c}	2.92±0.05^{b}
Egg width (mm)	1.95±0.01^{b}	1.76±0.16^{ab}	1.61±0.02^{ab}	1.46±0.03^{a}	3.24±0.02^{d}	3.05±0.03^{d}	2.74±0.03^{cd}	2.47±0.03^{c}
Albume weight (g)	19.82±0.20^{bc}	17.4±1.60^{b}	17.23±0.20^{b}	14.88±0.22^{a}	26.62±0.25^{d}	23.49±0.34^{c}	21.83±0.27^{c}	17.38±0.36^{b}
Yolk weight (g)	9.84±0.17^{b}	8.89±0.83^{b}	8.32±0.26^{b}	6.84±0.12^{a}	12.47±0.22^{d}	10.98±0.19^{c}	10.04±0.30^{b}	9.09±0.09^{b}
Shell weight (g)	2.55±0.02^{b}	2.12±0.20^{b}	1.85±0.04^{a}	1.61±0.03^{a}	5.89±0.17^{cd}	6.12±0.24^{de}	6.30±0.18^{e}	5.77±0.14^{c}
Albumen height (cm)	2.86±0.01^{b}	2.56±0.23^{a}	2.42±0.02^{a}	2.30±0.03^{a}	5.66±0.12^{de}	5.72±0.08^{e}	5.29±0.17^{cd}	4.92±0.20^{c}
Yolk height (cm)	14.87±0.09^{c}	13.07±1.20^{b}	13.87±0.19^{bc}	12.87±0.23^{b}	13.22±0.31^{b}	9.73±0.35^{a}	9.25±0.38^{a}	9.02±0.28^{a}
Haugh unit	62.71±0.33^{a}	64.79±2.11^{a}	59.8±0.36^{a}	62.47±0.50^{a}	77.57±0.92^{b}	78.39±0.54^{b}	78.22±1.26^{b}	74.96±1.61^{b}
Egg index (%)	71.11±0.53^{a}	63.53±5.84^{a}	69.36±0.92^{a}	80.58±4.88^{a}	78.13±0.47^{ab}	77.21±1.19^{a}	82.56±1.07^{b}	84.98±2.01^{b}
Albume index (%)	14.42±0.15^{b}	13.51±1.24^{a}	14.08±0.25^{b}	15.48±0.24^{a}	21.27±0.46^{d}	24.42±0.53^{e}	24.28±0.84^{e}	28.66±1.68^{e}
Yolk index (%)	66.23±1.20^{b}	62.38±5.83^{b}	60.06±1.96^{b}	53.27±1.15^{a}	94.72±2.11^{c}	114.01±3.53^{e}	110.86±6.47^{de}	101.76±3.30^{d}

a, b, c means with different superscript are significantly different.

Group mean, standard error and number count of samples (x±sem(n)) shown.

*(p<0.05), NS- Non-significance, G- Genotype, MOSM- *Moringa oleifera* seed meal.

SXD- Interaction between genotype and diet.

In a related study, Olugbemi *et al.* (2010) found that *Moringa oleifera* leaf (MOL) can be safely included in layer diets up to 10% without negatively affecting productivity. Ebenebe *et al.* (2013) concluded from their study on the effect of various levels of MOL in the diet that inclusion of MOL at lower levels improved egg production and egg quality but higher levels of inclusion resulted in lower productivity and poorer egg quality indices of Isa Brown Breed of layers.

This finding is in agreement with the findings of Bhatnagar *et al.* (1996) who reported that eggs characteristics of commercial layer ISA Brown were not significantly affected by the incorporation of *Leuceana leucocephala* leaf in the diet. The present result is also in close agreement with the finding of Kakengi *et al.* (2007) who recorded heavier egg with 5% of MOL in the diet as compared to 10% inclusion. Generally, many authors (Olugbemi *et al.,* 2010, Abou-Elezz *et al.*, 2011 and Kakengi *et al.*, 2007) agreed that the use of MOL up to 10% had no negative effect on the productive performance of laying hens, but levels above that (>10%) may produce adverse effects.

The study was also in agreement with the report of Raphael *et al.* (2015) who studied the effects of substituting soybean with *Moringa oleifera* meal in diets on laying and eggs quality characteristics of KABIR chickens, they reported that egg weight, egg width, yolk weight and yolk diameter significantly decreased with increasing levels of MOL in the diets while egg length, yolk length, yolk index and shell weight and thickness were not significantly affected by MOL in the rations. The result of this study contradicted with the report of Wei *et al.* (2016) who reported higher albumen heights in laying hens fed 10% *Moringa oleifera* leaf.

Egg weight is among the most important parameters not only for consumers but for egg producers (Genchev, 2012). The result was in agreement with the report of Hrncar *et al.*(2014), they observed that genotype significantly affected yolk weight and yolk index for quail. However, genotype did not significantly affect Haugh unit. The higher the Haugh unit and yolk index, the more desirable is the interior quality of egg (Adeogun and Amole, 2004).

Table 3: Egg characteristics of chickens fed graded levels of MOSM and effects of genotypes.

	YENLC	ISA BROWN	0% MOSM	5% MOSM	10% MOSM	15% MOSM	GXD
Egg weight (g)	29.63±0.77	46.23±0.61*	41.62 ±1.85^{b}	39.5±2.53^{ab}	36.31±1.23^{a}	34.29±1.79^{a}	*
Egg length (cm)	2.37±0.08	3.59±0.08*	3.44 ±0.15^{b}	3.26±0.19^{b}	2.82±0.11^{ab}	2.39±0.12^{a}	*
Egg width (mm)	1.70±0.05	2.88±0.05*	2.59 ±0.14^{c}	2.41±0.16^{bc}	2.18±0.12^{ab}	1.97±0.11^{a}	*
Albumen weight (g)	17.33±0.47	22.33±0.51*	23.22 ±0.73^{b}	20.45±1.02^{a}	19.53±0.51^{a}	16.13±0.33^{a}	*
Yolk weight (g)	8.47±0.27	10.64±0.21*	11.16 ±0.31^{c}	9.93±0.47^{b}	9.18±0.26^{b}	7.96±0.25^{a}	*
Shell weight (g)	2.03±0.07	6.02±0.09*	4.22 ±0.36^{c}	4.12±0.44^{bc}	4.07±0.47^{ab}	3.69±0.44^{a}	*
Albumen height (cm)	2.53±0.06	5.40±0.09*	4.26 ±0.30^{b}	4.14±0.35^{b}	3.86±0.31^{a}	3.61±0.29^{a}	*
Yolk height (cm)	13.67±0.32	10.31±0.30*	14.04 ±0.23^{b}	11.40±0.70^{a}	11.56±0.52^{a}	10.94±0.44^{a}	*
Haugh unit	62.44±0.60	77.28±0.59*	70.14 ±1.62^{b}	71.59±1.77^{bc}	69.01±2.03^{ab}	68.72±1.54^{a}	*
Egg index (%)	71.14±2.06	80.72±0.78*	74.62±0.81^{b}	70.37±3.25^{a}	75.96±1.54^{b}	82.78±2.62^{c}	*
Albumen index (%)	14.38±0.33	24.66±0.62*	17.85±0.75^{a}	18.97±1.31^{b}	19.18±1.15^{b}	22.07±1.60^{c}	*
Yolk index (%)	60.48±1.69	105.34±2.30*	80.48±3.20^{b}	88.20±6.33^{c}	85.46±6.24^{c}	77.52±5.34^{a}	

a, b, c means with different superscript within genotype are significantly different.

Group mean, standard error and number count of samples [x±sem(n)] shown.

*(p<0.05), NS- Non-significance, G- Genotype, MOSM- *Moringa oleifera* seed meal.

GXD- Interaction between genotype and diet.

Table 4: Effect of genotype and MOSM on body weight, feed intake and egg production.

	YENLC ALL	Isa Brown-ALL	0% MOSM	5% MOSM	10% MOSM	15% MOSM	GXD
Initial liveweight (g)	23.10±0.22	28.60±0.65*	24.33±0.45	27.13±1.12	27.67±1.11	24.29±0.39	*
Liveweight at week 8 (g)	365.02±7.51	678.31±22.89*	482.25±34.80^{b}	534.17±45.34^{b}	586.08±53.45^{b}	484.17±14.12^{a}	*
Liveweight at week 24 (g)	1124.12±33.65	1783.26±29.03*	1347.38±79.49^{a}	1504.61±107.63^{b}	1387.21±83.18^{a}	1566.52±22.77^{b}	*
Egg number	4.75±0.29	60.21±1.56*	37.83±6.61^{b}	34.50±6.22^{b}	28.58±5.35^{a}	29.00±5.53^{a}	*
Feed intake(g)	114.25±3.07	113.54±2.55*	119.71±5.79^{b}	111.42±1.99^{b}	119.63±4.01^{b}	104.83±2.20^{a}	*
FCR	3.79±0.10	2.49±0.07*	3.07±0.25^{b}	2.85±0.15^{a}	3.34±0.10^{b}	3.25±0.18^{b}	*
HDP	5.95	71.43	45.24	41.67	34.52	34.52	

a, b, c means with different superscript within genotype are significantly different.

Group mean, standard error and number count of samples [x±sem(n)] shown.

*(p<0.05), NS- Non-significance, G- Genotype, MOSM- *Moringa oleifera* seed meal, FCR- Feed conversion ratio, HDP- Hen day production.

Table 5: Effect of MOSM on body weight, feed intake and egg production of YENLC and Isa brown hens.

	YENLC (0% MOSM)	YENLC (5% MOSM)	YENLC (10% MOSM)	YENLC (15% MOSM)	Isa Brown (0% MOSM)	Isa Brown (5% MOSM)	Isa Brown (10% MOSM)	Isa Brown (15% MOSM)
Initial liveweight (g)	23.25±0.59	23.08±0.36	23.33±0.50	22.75±0.33	25.42±0.53	31.17±1.45	32.00±1.23	25.83±0.32
Liveweight at week 8 (g)	322.58±5.88^{a}	337.17±1.06^{a}	363.00±12.36^{a}	437.33±8.00^{b}	641.92±19.85^{c}	731.17±39.25^{d}	809.17±52.38^{d}	531.00±19.25^{bc}
Liveweight at week 24 (g)	968.50±4.50^{a}	1002.97±16.28^{a}	1045.83±56.71^{a}	1479.17±17.39^{b}	1726.25±17.37^{d}	2006.25±49.24^{e}	1728.58±67.29^{d}	1661.82±16.78^{c}
Egg number	6.58±0.48^{b}	5.00±0.63^{b}	3.92±0.43^{a}	3.50±0.38^{a}	69.08±2.17^{d}	64.00±1.77^{d}	53.25±2.95^{c}	54.50±3.05^{c}
Feed intake (g)	129.67±10.47^{c}	113.42±1.94^{b}	110.17±2.25^{b}	103.75±3.09^{a}	109.75±3.55^{ab}	109.42±3.48^{ab}	129.08±6.77^{c}	105.92±3.23^{a}
FCR	3.96±0.33^{bc}	3.55±0.08^{b}	3.60±0.07^{b}	4.04±0.12^{c}	2.18±0.07^{a}	2.22±0.09^{a}	3.08±0.17^{b}	2.47±0.07^{a}
HDP	8.33	5.32	4.76	4.76	82.14	76.19	63.10	65.48

a, b, c means with different superscript within genotype are significantly different.
Group mean, standard error and number count of samples [x±sem(n)] shown.
*(p<0.05), NS- Non-significance, G- Genotype, MOSM- *Moringa oleifera* seed meal, FCR- Feed Conversion Ratio, HDP- Hen day production.

CONCLUSION

It can be concluded from this study that Feeding MOSM up to 10% improved the egg parameters for both genotypes of chickens however, Isa Brown had significantly better (p<0.05) egg qualities than the YENLC.

Conflict of interest: None.

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