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Original article

Fertility and hatchability characterization of three strains of egg type chickens

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The fertility and hatchability characteristics of three popular strains of egg type chickens in Nigeria, namely chickens (ISA BROWN), Alpha (Improved native) and the local strain (Pure native) chickens were studied. They were compared from twenty weeks of age using 15 hens and 3 cocks from each strain. The parameters recorded were egg production, egg weight, percent fertility and hatchability. The experiment was replicated three times. The data obtained showed that the improved native strain produced more eggs followed by the exotic strain and lastly, the pure native strain. ISA Brown strain and improved native strain were similar in egg weight; but performed better than pure native and the other strains. The ISA Brown recorded mean egg weight of 59.27 ± 0.02, Improved native recorded mean egg weight of 53.10 ± 002 and the pure native recorded mean egg weight of 41.00 ± 0.02. Conversely, fertility was highest in the pure native strain (86.04) followed by improved native strain 83.08) and the exotic strain recorded the least percent fertility of (68.21). Hatchability was highest in the improved native strains with percentage hatchability of 77.33, followed by the pure native of percentage hatchability of 73.55 and ISA Brown (exotic) recorded the least percentage hatchability of 61.24. From the findings, the improved native did well in all the parameters investigated and has enough room to carry out selection for improvement.

1. Introduction

It has been established that poultry production is one of the quickest sources of animal protein because of its faster growth rate and high prolificacy (Akinyemi et al., 1998). The importance of protein consumption by man cannot be over emphasized. The stock industries contribute tremendously to man's daily need. Protein of animal origin has no alternative in the growth, development, replacement and repair of body tissues, hormones and enzymes. There is still no adequate animal protein to satisfy people in Nigeria so as to reduce the problem of malnutrition.

There has been rapid increase in the number of farmers keeping chicken parent and grand parent stock leading to increase in the population of meat type chicken in Nigeria (Kathleen, 2002; Adebambo et al., 2005). Unfortunately, in Nigeria, poor fertility and hatchability rates among other factors constitute the major threat to performance of the industry (Landaner et al., 1997). This study therefore, was designed to access the fertility and hatchability characteristics of three strains of egg type chickens preponderant in Nigeria.

2. Materials and methods

The experiment was conducted at the poultry unit of Department of Animal Science, Delta State University, Asaba Campus. A total of 175 layer chickens aged 24 week and twenty nine cockerels aged 56 weeks, made up of three strains were used. A total of 15 hens and three cocks were used for each strain and replicate pens. A mating ratio of 5:1, which is 5 hens to one cock, was adopted in the replicate pens since a highly selected male can produce enough spermatozoa that can serve 5 – 10 females at a time. Following the introduction of males, egg collection commenced a week after. The eggs were cleaned with sand paper and arranged in egg trays on size basis: large, medium and small sized eggs respectively. The eggs were stored in air conditioned room or under a fan until they were incubated on the 7th day. Fertile eggs were identified through candling, and only the eggs identified as being fertile during candling were set. All eggs were promptly fumigated prior to storage and incubation. Storage and subsequent hatching were replicated in three batches.

2.1. Management of eggs in the incubator

The eggs were set horizontally and vertically in egg trays of table incubators, with broad ends up in cabinet incubator. Coloured labels were used on the trays to identify the different eggs from the three strains and to identify those eggs inserted at a particular time. Egg turning is automatic in the electric type incubator, but if it is not electric type, egg turning should start within twenty-four hours of setting the eggs. Turning should be in opposite direction and for an odd number of times, not less then three or five times.

On the eighteen day of incubation, the eggs were tested again by candling. This was aimed at identifying dead embryos (dead germs). The eggs with living embryos were then transferred from the setter to the hatchery. The chicks normally hatch on the twenty-first day, but were given extra day to fluff out or for the down feathers to dry. Only the chicks that have fully emerged from their shells were removed from the incubators according to the recommendation of Landaner (1997).

2.2. Percent fertility

Percent fertility was computed for each strain as follows:

$$\% \text{ fertility} = \frac{\text{Number of fertile eggs}}{\text{Number of eggs set}} \times \frac{100}{1}$$

Percent hatchability was computed narrowly and in broad sense as:

$$\text{(A) \% hatch, Narrow sense} = \frac{\text{Number of chicks hatched}}{\text{Number of fertile eggs identified at candling}} \times \frac{100}{1}$$

(B) % hatch in Broad sense = $\frac{\text{Number of hatched egg}}{\text{Number of all eggs set}} \times \frac{100}{1}$

2.3. The model and design

The study was a 3 x 3 factorial experiment in randomized complete block design (RCBD) involving one factor monitored over three batches or blocks. The factor was genotype where there were three levels. The data obtained were analyzed using the following statistical model by steel and Torrie (1981).

Xijk= μ + Gi + Bj + Eijk

Xijk= Measurement of the kth individual from the jth batch,

belonging to the ith genotype.

μ= Population mean

Gi= Effect of ith genotype (i ranging from 1, 2, 3.)

Bj= Effect of the jth batch or block (j = 1, 2, 3)

Eijk= Error made while measuring the kth individual from the ith

genotype belonging to the jth batch.

All data collected were subjected to analysis of variance (ANOVA), using SAS (2000). Significant means were separated using Duncan Multiple range test techniques of the same package.

3. Results and Discussion

Table 1
Parameters measured.

Parameters measured	Exotic strain	Improved native strain	Pure native
Means egg number	3.05 ± 0.02	3.30 ± 0.02	1.83 ± 0.01
Egg weight (g)	59.21 ± 0.02	52.19 ± 0.02	41.00 ± 0.02
Body weight of parent (kg)	1.96 ± 0.03	1.95 ± 0.03	1.33 ± 0.02
Body weight of progeny (g)	198.23 ± 12.26	191.01 ± 9.97	160.31 ± 8.85
Fertility (%)	68.21 ± 12.06	83.08 ± 14.81	86.04 ± 7.22
Hatchability (Narrow)	61.24 ± 9.04	77.33 ± 12.11	73.55 ± 10.55
Hatchability (Broad)	43.01 ± 5.32	63.34 ± 9.30	62.78 ± 6.37
95% confidence intervals:			
Mean egg number	3.39	3.13	1.68
Egg weight (g)	57.73	52.19	41.02
Fertility	68.21	83.08	86.04
Hatchability (Narrowly)	68.22	83.04	85.94
Hatchability (Broadly)	61.23	77.33	71.48
Body weight of progeny	231.66	221.23	182.22

The mean egg number values in Table 2 indicates that the mean egg production for ISA Brown and Improved Native do not very significantly (P> 0.05). There were significant difference between the mean egg production of the pure native and other breeds. However, the mean batch values in egg number did not vary significantly (P>0.05) especially between batches two and three; but batch one differed significantly from batches two and three. The levels of variation between batches, breeds, and batches versus breeds shows that there were no significant differences (P> 0.05) in the interaction between batches and breeds. The batch records revealed that batch one recorded mean egg number of 3.22, batch two had 2.63 and batch three had 2.78. The strains record also showed that the exotic strain had 3.50 ± 0.02, Improved native had 3.30 ± 0.02 and pure native had 1.83 ± 0.01.

The 95% confidence interval of the mean egg number of the three genotypes showed variation in the lower and upper limits among the strains. The exotic strain varied from 3.17g lower limit to 3.62g upper limit with interval of 3.39. The improved native had lower limit of 1.52g to 1.83g upper limit with mean interval of 1.68. The mean of the pure native is tight and has a narrow base and can not complete like other strains for selection for improvement in most economic traits. Although the mean of the exotic strain was on the high plane, of 3.39g, the improved native strain has larger interval for selection for improvement.

Table 3 indicates that the mean egg weight of the exotic strain was 59.21 and this is in agreement with the findings of (Akanno, 2005). The mean egg weight recorded by the improved native n this study was 53.10 and the pure native recorded 41.00. It should be noted that in all the traits, the improved native had larger interval for improvement on most of the economic traits such as egg number and egg weight (size) as reported by Redddy et al (2004) that matured eggs should weigh from 53 – 58g. The pure native strain recorded the least egg weight among others, and this could be attributed to the genetic make up of the local chicken which has a narrow base and tight mean in most economic characters.

The 95% confidence intervals of the mean egg weight (g) of layer chickens revealed that variations existed between the lower limit and upper limit in all the strains. The exotic strain had 57.15g lower bound and 58.31g upper bounds, improved native had 51.63g lower bound and 52.75g upper bound. The least mean egg weight value was recorded by the pure native strain of 40.45 lower limit and 41.68 upper limit. It could be observed that the exotic strain was on the high plane with interval of 57.73g and was closely followed by improved native with interval of 52.19g and lastly, pure native with interval of 41.07g. The improved native has the ability to carry out selection for improvement unlike the pure native that has no genetic ceiling for selection for improvement. The analysis of variance on the effect of strain of chicken and age on egg weight showed significant difference among treatment means. This means that the weight of egg is dependent on the strain and the age of birds, as older birds are known to produce heavier and better eggs. (Hafez, et al., 1998., Olawunmi, et al., 2009). Table 4a revealed the mean percentage fertility values of three genotypes of chickens. The result revealed that fertility was highest in the pure native strain with mean percentage fertility of 86.04, this was closely followed by the improved native strain with mean percentage fertility of 83.10, and the exotic strain recorded the least mean percentage fertility of 68.21. The differences that existed may be attributed to genotype, ratio of male to females as Campbel et al., (2003) and Akanno et al., (2007) revealed that poor semen quality can cause infertility in layer chickens.

The 95% confidence interval of the mean percentage fertility of the three strains revealed that the exotic strain had lower limit of 42.64% and upper limit of 95.75%, the improved native had lower limit of 72.83% and 93.33% upper limit. The pure native recorded the highest mean percentage fertility of 86.04% and had lower limit of 68.82% and 98.19% upper limit. The exotic strain had a narrow base for improvement in the above trait. The improved native strain has a larger interval for selection and improvement in fertility trait. The pure native also have the ability to carry out selection for improvement in fertility trait.

The result of mean percentage hatchability of eggs revealed that the improved native (Alpha) group recorded the highest mean percentage hatchability of 77.33% narrowly and 63.34% broadly, this was followed by the pure native birds which had mean percentage hatchability of 73.35% narrowly and 62.78% broadly.

The least mean percentage hatchability was register by exotic strain of 61.24 narrowly and 43.01 broadly. The lower percentage hatchability recorded by exotic strain could be attributed to large egg size as reported by Asuquo et al (1993) that eggs with the intermediate to large size ranges hatch better than those within larger size and above range. Swan (2004) revealed that egg within very small size range do not hatch.

The mean values of hatchability as affected by genotype in this study suggests that hatchability may not entirely be a function of fertility because of some intrinsic factors associated with the eggs (Branwell, et al., 1996., Anyehie, et al., 2008). These intrinsic factors may include the external traits and internal traits of the egg. The external traits are egg weight, shape index, shell thickness, colour and cleanliness. The internal traits are haugh unit and yolk index (Ibe, 1998; Marion, 2002). Other factors that can affect hatchability of fertile eggs could be incubator management factors like mal-positioning of eggs, improper turning and irregular temperature (Benneth, 1992) on the 95% C.L.On the 95% confidence interval, the pure native had a very high mean percentage hatchability narrowly and broadly,. It recorded 68.72% lower limit and 98.16% upper limit, with mean interval of 85.94%. The improved native strain competed with the pure native and had percentage hatchability of 72.82 lower limit and 93.26 upper limit with mean interval of 83.04%.

The exotic strain had a tight mean for hatchability and recorded the least mean percentage hatchability of 42.66% lower limit and 70.01% upper limit with mean interval of 61.23%. The improved native had larger interval for selection for improvement. The mean body weight of progeny revealed that the exotic and improved native progenies did not differ significantly (P>0.05). The pure native strain had the least mean body weight among the three strains. This confirms the findings of Oluyemi et al., (2000), and Obi (2002) each reported that little or no attention was given to local chicken in the past because of its low heritability in such traits as body weight, egg weight, egg size and egg number. The exotic strain progeny showed superiority to the other strains as was in the parent stock. This confirms that genotype sets a ceiling on weight gain and other body parameters. However, the improve native progeny exhibited some similarities with the exotic strain in some weeks. The 95% confidence interval graph for mean progeny body weight showed that the improved native strain has larger interval and ability to carry out selection for improvement. The pure native has narrow base because of it's lower genetic ceiling.

Table 2
Mean Egg Number observed for the different strains of chickens.

Batch 1	Strains	Mean egg number
Batch 1:	Exotic	3.90 ± 0.13^a
	Improved Native	$3. 70 \pm 0.15^a$
	Pure Native	$2. 07 \pm 0.12^c$
	Total	$3. 22 \pm 0.02^a$
Batch 2:	Exotic strain	3.27 ± 0.16^a
	Improved Native	3.00 ± 0.15^b
	Pure Native	1.65 ± 0.10^c
	Total	2.63 ± 0.02^b
Batch 3:	Exotic strain	3.33 ± 0.14^a
	Improved Native	3.20 ± 0.17^a
	Pure Native	1.80 ± 0.10^c
	Total	2.78 ± 0.02^b
Strains mean:	Exotic strain	3.50 ± 0.02^a
	Improved Native	3.30 ± 0.02^a
	Pure Native	1.83 ± 0.01^c

Superscript a, b, c, are means that varied significantly (p<0.05).

Table 4
2b: 95% confidence interval of mean egg Number.

Strains	Number	Mean	Std. Dev.	Std error	Lower limit	Upper limit
Improved Native	116	3.13	1.29	0.12	2.89	3.36
Pure Native	116	1.68	0.85	0.08	1.52	1.83
Exotic strain	116	3.39	1.21	0.11	3.17	3.62

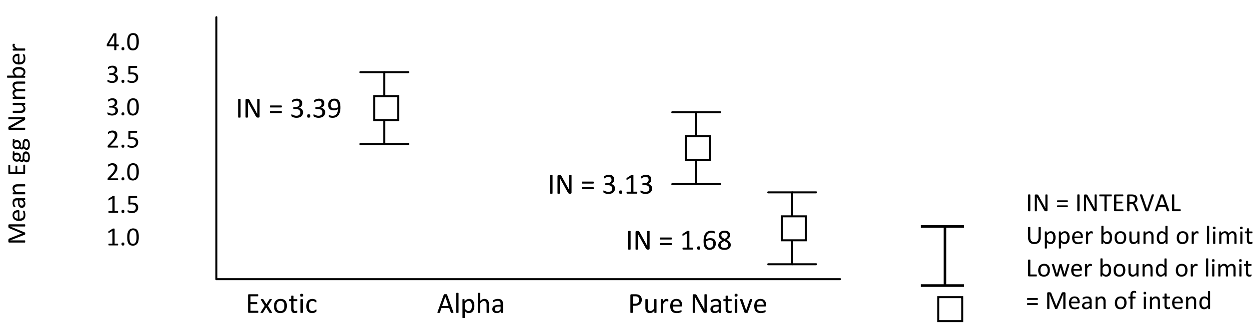


Table 3a
Effect of Breed and Age on the mean Egg weight of layer chickens.

	Exotic strain	Improve Native	Pure Native
Week 1	54.87 ± 0.49^{a}	51.10 ± 0.52^{b}	40.08 ± 0.60^{c}
Week 2	58.56 ± 0.50^{a}	51.86 ± 0.33^{b}	40.33 ± 0.64^{c}
Week 3	58.18 ± 0.52^{a}	51.76 ± 0.52^{b}	44.52 ± 0.74^{c}
Week 4	64.59 ± 0.55^{a}	55.60 ± 0.56^{b}	43.00 ± 0.60^{c}
Week 5	56.83 ± 0.50^{a}	52.51 ± 0.53^{b}	39.25 ± 0.47^{c}
Week 6	55.83 ± 0.51^{a}	51.74 ± 0.57^{b}	39.30 ± 0.68^{c}
Week 7	59.40 ± 0.60^{a}	52.21 ± 0.60^{b}	41.00 ± 0.66^{c}
Week 8	62.73 ± 0.61^{a}	55.46 ± 0.63^{b}	42.61 ± 0.63^{c}
Means	59.21 ± 0.02^{a}	53.10 ± 0.02^{b}	41.00 ± 0.02^{c}

Means with similar superscripts do not vary significantly (P>0.05).

Table 3b
95% confidence interval for mean egg weight.

Strains	Number	Mean	Std.D	Std. error	Lower limit	Upper limit
Improved Native	80	52.18993	2.529544	0.282812	51.627	52.752
Exotic	140	57.72631	3.47006	0.293274	57.146	58.306
Pure native	55	41.06662	2.280987	0.307568	40.450	41.683
Total	275	52.78379	7.008715	0.422641	51.952	53.616

Table 3c

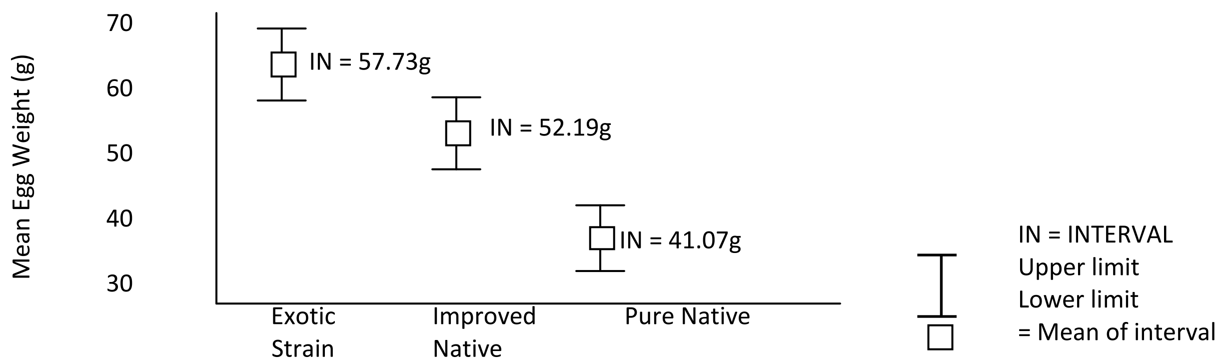


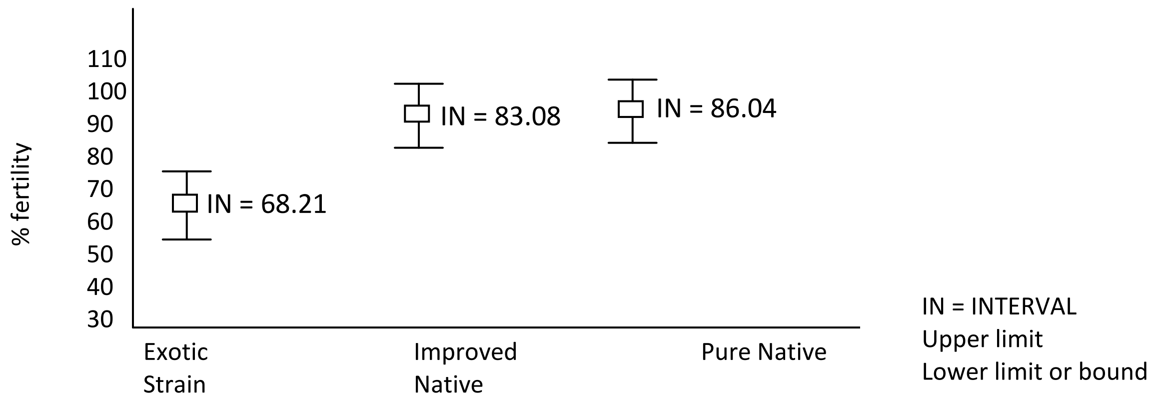
Table 4a
The mean percentage fertility and Hatchability values of three genotypes of chickens.

Breeds	Fertility (%)	Hatchability (%) (Narrow sense)	Hatchability (Broad sense)
Exotics strain	68.2^{1}	61.24^{b}	43.01^{b}
Improved Native	83.10	77.33^{a}	63.34^{a}
Pure native	86.04	73.35^{ab}	62.78^{a}

Within each column, means with the same superscripts are not significantly different (P>0.05).

Table 4b
95% confidence interval analysis for mean % fertility.

Strains	Mean ± S.E	Lower bound	Upper bound
Exotics strain	68.21 ± 12.06	42.64	95.78
Improved Native	83.08 ± 14.81	72.83	93.33
Pure native	86.04 ± 7.22	68.82	98.25



95% confidence interval of the percentage fertility of the strains

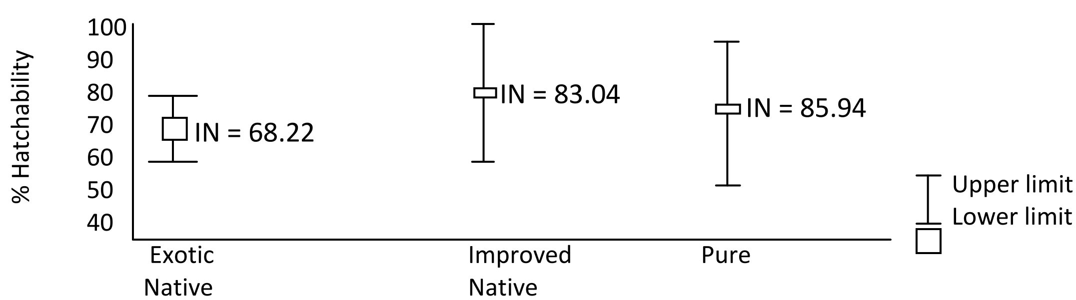
Table 4c
95% confidence interval analysis for mean percentage Hatchability (Narrow sense).

Strains	Number	Mean	Std. Deviation	Std. Error	Lower limit	Upper limit
Exotics strain	3	68.22	10.29	5.94	42.66	93.78
Improved Native	3	83.04	4.11	2.38	72.82	93.26
Pure native	3	85.94	6.93	4.00	68.72	98.16

Table 4d
The 95% confidence interval Analysis for mean percentage Hatchability (Broad sense).

Strains	Number	Mean	Std. Deviation	Std. Error	Lower limit	Upper limit
Exotics strain	3	61.33	3.53	2.04	52.46	70.01
Improved Native	3	77.33	7.09	4.10	59.71	94.95
Pure native	3	73.48	7.76	4.48	54.20	92.75

95% confidence interval Analysis for mean percentage hatchability in Narrow sense



95% confidence interval analysis for percentage hatchability in broad sense

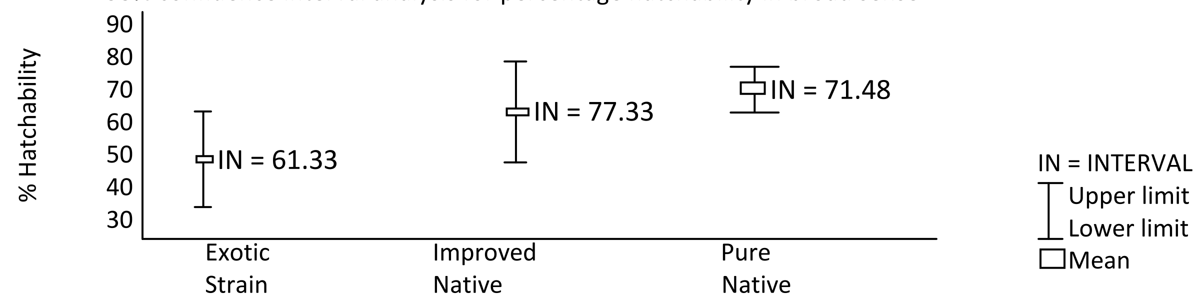


Table 5a
Effect of Breed x Age on Parental Body Weight (kg) of layer chickens.

Weeks	Pure Native	Exotic	Improved Native
Week 1	1.29 ± 0.05^c	1.99 ± 0.13^a	1.87 ± 0.04^a
Week 2	1.31 ± 0.06^c	1.91 ± 0.1^a	1.82 ± 0.04^a
Week 3	1.25 ± 0.06^c	1.86 ± 0.08^a	1.78 ± 0.04^b
Week 4	1.27 ± 0.06^c	1.89 ± 0.09^a	1.81 ± 0.05^a
Week 5	1.28 ± 0.06^c	1.90 ± 0.08^a	1.81 ± 0.04^a
Week 6	1.29 ± 0.06^c	1.87 ± 0.07^a	1.75 ± 0.05^b
Week 7	1.38 ± 0.05^c	1.84 ± 0.08^a	1.77 ± 0.06^b
Week 8	1.28 ± 0.07^c	1.83 ± 0.07^a	1.74 ± 0.03^b
Week 9	1.23 ± 0.05^c	1.84 ± 0.06^a	1.73 ± 0.03^b
Week 10	1.27 ± 0.05^c	1.80 ± 0.06^a	1.70 ± 0.04^b
Week 11	1.23 ± 0.05^c	1.78 ± 0.06^b	1.62 ± 0.04^b
Week 12	1.25 ± 0.05^c	1.75 ± 0.07^b	1.68 ± 0.06^b
Week 13	1.22 ± 0.05^c	1.73 ± 0.07^b	1.71 ± 0.10^b

Superscripts a, b, c, are means of same significant at (P>0.05) .

Table 5b
95% confidence interval of mean Body weight of layer chickens (parent stocks).

Strains	Number	Mean	Lower limit	Upper limit
Pure native	121	1.33 ± 0.02b	164.06	200.38
Improved Native	144	1.95 ± 0.03a	198.50	244.07
Exotic	144	1.96 ± 0.03a	204.40	258.92

95% confidence interval of mean body weight of layer chickens (Parent)

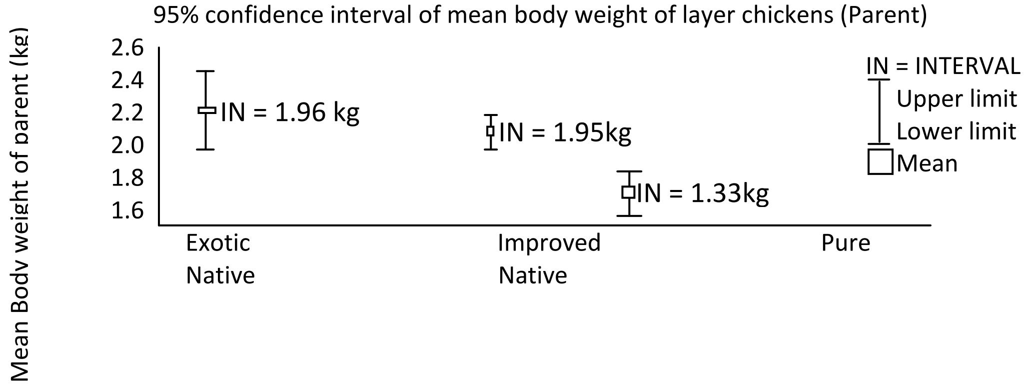


Table 6a
Weekly mean Body Weight of the progenies (g).

Weeks	Pure Native	Improved Native	Exotic	Weekly mean
Week 1	29.75± 1.23^{C}	3508±1.2^{C}	39.65±0.88^{C}	35.07±0.83
Week 2	41.05 ± 1.15^{C}	51.85±1.2^{C}	57.95±1.54^{C}	47.01±1.23
Week 3	73.25± 2.91^{C}	86.04 ± 3.60^{C}	93.75±5.52^{C}	84.47±0.12
Week 4	110.02± 4.19^{C}	154.06±6.95^{b}	154.75±157^{b}	146.65±6.80
Week 5	167.55± 6.8^{b}	208.03±6.85^{b}	217.05±19.7^{b}	197.63±7.73
Week 6	231.01± 6.64^{b}	270.15±9.70^{a}	286±24.13^{a}	262.42±9.29
Week 7	301.75± 8.69^{a}	314.01±13.71^{a}	355.25±23.97^{a}	323.07
Week 8	327.35± 9.30^{a}	370.95±24.12^{a}	408.95±30.64^{a}	369.08±1.83
Week 9	357.05± 11.0^{a}	463.34±4.66^{a}	497.06±43.74^{a}	439.32±20.19

Superscript a, b, c are mean of various significant at (p>0.05).

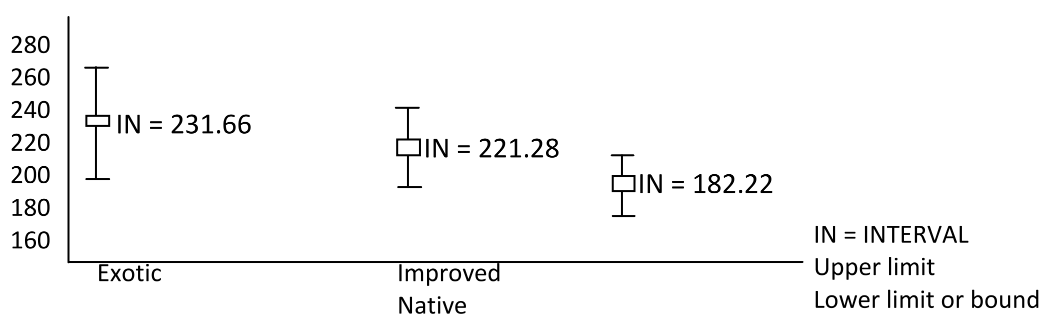
Table 5c
Effect of Breed of Birds on Body weight of the progeny.

Generation	Genotype/Breed	No of chicks	Mean ± S.E	Coeff. of variation (C.V) %
Progeny	Exotic	160	198.23 ± 12.26^{a}	78.24
	Improved Native	160	191.01 ± 9.97^{a}	66.02
	Pure Native	160	160.31 ± 8.85^{b}	69.81

A, b mean values with similar superscripts within the same column do not vary significantly (P>0.05).

Table 5d
95% confidence interval for mean Body weight of progeny (g).

Strains	Number	Mean	Std.D	Std. error	Lower limit	Upper limit
Pure Native	20	182.22	18.454	4.126	173.58	190.85
Improved Native	20	221.28	44.431	9.935	200.50	242.08
Exotic	20	231.66	75.088	16.967	196.15	267.17



Recommendations

Based on the findings from this study, the following recommendations are made:

Fertility and hatchability traits should be among the growth and production parameters to be considered in any breeding programme aimed at the genetic improvement of the indigenous fowl in Nigeria.

The local chicken's superior traits in both fertility and hatchability should be of big interest to breeders. The egg size of the local chicken (Pure Native) should be improved by cross breeding the exotic strain and the pure native strain to improve the egg size.

The exotic strain should be used by farmers because of its large egg size and body weight.

The improved native strain should be used by farmers because of its mean interval and ability to carry out selection in virtually all the economic characters.

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