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Early Sexual Maturity Characteristics in Bovan Nera and Isa Brown Parent Stock Layer Strains as Influenced by 10th-Week Bodyweight, Feed Intake and Weight Gain

Jesuyon, O. M. A.

Department of Animal Production and Health, Federal University, P. M. B. 373, Oye - Ekiti, Ekiti State, Nigeria.
Corresponding author: dr.oluwatosinjesuyon14@gmail.com

Target Audience: Poultry Farmers, Poultry Industry Managers, Poultry Breeders, Researchers.

Abstract

The study was conducted to compare early sexual maturity characteristics in Bovan Nera and Isa Brown Parent stock chickens reared under same commercial breeding system in Ibadan, humid Tropical Nigeria. The effects of pullet weight at 10th week (PW10), feed intake from 11th week to first egg (FI11) and weight gain from 11th week to first egg (WG11) on growing-pullet weight at first egg (PWFE) and pullet age at first egg (PAFE) were investigated consecutively. Data on above traits were culled from the record books of a commercial parent stock breeding farm in the environment from 1999 to 2008. A total of 20 flocks of each strain were compared. Data were analyzed using GLM procedures of SAS® (1999) in randomized complete block (RCBD) design. Findings revealed that three body weight categories at 10th week (<700, 801-900 and >900 g) caused significant differences (P<0.05) between strains in WG11, PWFE and PAFE. The 701-800 g body weight category at 10th week produced no meaningful (P>0.05) differences between strains. At feed intake level of 2.1-3.0 kg (body weight=785-795gm) there were significant (p<0.05) differences in WG11 (712.79; 535.29 g) and PWFE (1507.74, 1321.00 g) between BN and IB; while the 3.10-4.00 kg feed consumption level (body weight=755-765gm) revealed significant (p<0.05) differences between strains in FIFE (83.50; 71.12 g), PWFE (1510.45; 1387.69 g) and PAFE (123; 115 days). PWFE was positively related with PAFE in BN (R^2=0.11) and IB (R^2=0.71). Findings revealed that BN and IB strains could attain a minimum age of 115-121 and 103-115 days and minimum body weight of 1436-1504 and 1151-1351gms respectively before laying the first egg. Strain average parameters revealed significant (p<0.05) differences between strains in all characteristics, and this led to 6-day difference in PAFE between BN and IB strains. Equations obtained on WG11 and PWFE were significant (P<0.0001, R^2=0.90.) with basal differences between strains. The variabilities elicited by strains constitute some of the causes of genetic differences between Bovan Nera and Isa Brown parent stock chicken.

Keywords: Age, body weight, first egg, phenotypic correlations, regression equations, breeding, weight-gain management.

Description of problem

The time duration to sexual maturation in modern domestic chicken has been reduced drastically. Compared to the Red Jungle fowl, domestic layer hens attain maturity approximately 20% earlier (1) today. Growers begin to exhibit rapid growth and sexual development from the 10th week while onset of lay and sexual maturity is signified by the first egg in a flock. Onset of lay varies greatly from flock to flock, and strain to strain in the tropics. Pullets have two stages of early sexual maturity (ESM) determined by growth rate and body composition (2) rather than chronological age. The first stage is characterized by appearance of comb development while the second stage by the laying of first egg, thus beginning egg production. This second stage of sexual development could be age related. At first egg, a pullet attains her mature body weight while weight gain beyond this point is small and influenced by type of feeding program employed (3). Despite the huge amount of information available, ESM characteristics have demonstrated a high level of variability in in-coming pullets leading to varying values for PWFE (4, *5*); PAFE (4, *5, 6*) and EWFE respectively for layer chickens in the hot humid environment. These traits are affected by breed, strain and genetic diversity (7, 8,6,9); management and components of the environment. Literature recommends high body weight at first egg, to enhance high weight of first egg, productivity and persistency of production (2, 10). This study was aimed at comparing ESM characteristics in Bovan Nera (BN) and Isa Brown (IB) Parent stock layer chickens and highlight salient differences between strains under same field, management and environmental conditions. The hypothesis for study was:

Ho: There are no significant differences in ESM traits between strains.

Materials and Methods

Parent stock data on Bovan Nera (BN) and ISA Brown (IB) chickens were obtained from the record books of CHI Limited in Ibadan, Nigeria. Information required were culled from 24 batches of each strain from1999–2008. Data collected were pullet weight at 10th Week (PW10, g), Feed-intake at 10th week (FI10, g), Feed-intake from 11th week to first-egg (FI11, kg), Feed-intake at first-egg (FIFE, g), Pullet weight gain from 11th week to first-egg (WG11, g), Pullet weight at first-egg (PWFE, g) and Pullet age at first-egg (PAFE, days). Experimental design employed was randomized complete block design, RCBD, using strain as Fixed effect; and pullet weight, weight gain and Feed-intake as Treatment. Data were then subjected to ANOVA, Least squares means (LSM) analysis, Duncan's multiple range test (DMRT) and Tukey's tests ($p<0.05$) using SAS (11). The analysis compared ESM characteristics between strains within category. The average population of hens in each flock of strain was 3800 at 10 weeks. Statistical Model employed was:

$$Y_{ij} = \mu + G_i + \varepsilon_{ij}$$

Y_{ij} = Response due to ith strain in jth replicate.

μ = General and unknown mean.
G_i = Fixed effect due to ith strain (i=1, 2) within Treatment category.
ε_{ij} = Random error due to ith strain in jth flock nid (0, δ^2).

Results and Discussion

Table 1 shows result of least-squares estimates for Bovan Nera and Isa Brown pullet-growers as influenced by the 10th week body weight. There were significant differences ($p<0.05$) between strains in WG11, PWFE and PAFE at <700, 801-900 and >900 g weight categories at 10th week. Body weight category 801-900 gin both strains gave figures of FIFE, PWFE and PAFE closest to strain means of BN and IB respectively. Thus, these values were not significantly ($P>0.05$) different from strain means respectively. FIFE showed that strains could be fed with adequate nutrition that meets their physiological requirement at 78 and 70 g/day at First egg. Result trend revealed that the higher the body weight at 10th week, the lower the chronological PAFE, that is, shorter days to onset of lay {885 - 645g, 117- 124 days (BN) and 916 – 674g, 105 – 115 days (IB)}within strains. Also, Pullets with >900g body weight at 10th week consumed less feed (BN:2.83; IB:1.9, kg) and gained less weight (BN:551.3; IB:233.2 g) to First egg in shorter time intervals of 117 and 105 days respectively. For early First egg (117, 105 days) and higher profitability, managers could target higher than 900 g body weight for growers at 10th week, and offer about 3.0 and 2.0 kg feed gift to BN and IB respectively from 11th week to first egg. The701-800 g body weight category at 10th week produced no meaningful ($P>0.05$) differences between strains; while average body weight (1504.20 and 1351.40g) at first egg in both strains were higher than 1369 and 1405g for black dominant strain, BDS and Fulani ecotype chicken, FEC (4). The average age (121±8 and 115±9 days) at first egg in both strains were lower than 162.33±1.22 days reported for Nigerian south-eastern local chicken which was (6), 155 days for BDS and 169 days for FEC (4). PWFE was positively related with PAFE in BN (R^2=0.11) and IB (R^2=0.71). This result differed from that of (12) who reported a negative relationship between body weight and age at sexual maturity (first egg) in dwarf White leghorn chicken. Variability among body-weight groups as influenced by the 10th week body weight in BN and IB were 240.17 and 242.44 g, 9.01 and 9.85g, 0.92 and 1.1kg, 16.72 and 7.29g, 346.27 and 451.34g, 106.10 and 278.22g, and; 9and 13 days for PW10, FI10, FI11, FIFE, WG11, PWFE and PAFE. These values were indications of the importance of the10th week body weight for subsequent growth, development, breeding and management of chicken to first egg.

Table 1: Comparative least -squares estimates for Bovan Nera and Isa Brown pullet growers as influenced by the10th week body weight

Pullet weight@ 10th week	Strain	FI10 (g) Mean±SD	FI11 (kg) Mean±SD	FIFE (g) Mean±SD	WG11 (g) Mean±SD	PWFE (g) Mean±SD	PAFE (days) Mean±SD
< 700 g	BN	61.46±6.07[a]	3.62±0.82	85.31±14.97[a]	897.57±70.08[a]	1542.40±81.01[a]	124±11[a]
	IB	50.05±6.68[b]	2.77±0.85	68.02±3.26[b]	567.04±92.03[b]	1241.50±91.26[b]	115±14[b]
701-800 g	BN	57.51±2.17	2.70±0.27	68.59±2.50	770.38±152.19	1529.58±172.34	115±4
	IB	54.16±7.05	3.00±0.70	74.19±5.43	684.54±145.35	1428.89±125.28	118±8
801-900 g	BN	60.02±7.24	3.23±0.53	78.08±11.79[a]	667.87±97.24[a]	1492.65±100.80[a]	122±7[a]
	IB	55.47±2.87	2.71±0.67	67.91±3.79[b]	542.63±136.55[b]	1381.17±117.74[b]	114±8[b]
> 900 g	BN	52.45±10.01	2.83±2.41	72.96±6.68	551.30±38.49[a]	1436.30±22.58[a]	117±4[a]
	IB	59.90±13.5	1.90±0.92	66.90±7.82	233.20±21.40[b]	1150.67±31.42[b]	105±6[b]
DIF	BN	9.01	0.92	16.72	346.27	346.27	9
	IB	9.85	1.10	7.29	451.34	278.22	13
SEM	SEM	1.04	0.14	1.54	25.32	21.39	1.36
Strain	BN	59.02±6.94[a]	3.41±1.05[a]	77.67±12.10[a]	727.81±148.13[a]	1504.20±104.56[a]	121±8[a]
Average	IB	53.88±5.87[b]	2.79±0.71[b]	70.08±5.07[b]	582.93±158.90[b]	1351.40±137.62[b]	115±9[b]

Notes: Value within same group with different superscripts are significantly different from each other at 0.05% level.
FI10= Pullet feed -intake at 10th week, FI11= Pullet feed -intake from 11th week to first egg, FIFE=Pullet feed -intake at first egg, WG11=Pullet weight -gain from 11th week to first egg, PWFE=Pullet weight at first egg, PAFE=Pullet age at first egg. DIF= Difference between lowest and highest body weight classes. SEM= Standard error of difference between any two means = SD/SQR(N).

Table 2 shows the effect of feed consumption from 11th week to first egg on early maturity traits within feed intake categories. Feed intake between 2.1-3.0 kg level caused significant ($p<0.05$) differences in WG11 (712.79; 535.29 g) and PWFE (1507.74, 1321.00 g) between BN and IB; but the higher consumption level between 3.10-4.00 kg showed significant ($p<0.05$) differences between strains in FIFE (83.50; 71.12 g), PWFE (1510.45; 1387.69 g) and PAFE (123; 115 days). These values were higher than 1499.60 and 1422.30g and lower than 140 and 145 days reported for PWFE and PAFE in BN and IB reared under experimental farm conditions (9). Results indicated that pullets that consumed more feed (5.4, 4.1 kg) from the 11th week to first egg spent more days (126, 119) to first egg due to low body weight (766.8, 725 g) at 10th week while those that recorded less feed intake (2.6, 2.4 kg) from 11th week spent less days (116, 110 days) to first egg because they posted higher body weights (795, 786 g) at 10th week of life. With a high body weight target (≥800 g) at10th week, pullets could be fed at pre-determined level of feed gift (FI11: 3.5-3.3 kg) to First egg, thus regulating daily feed consumption during this period to attain strain or targeted PWFE and PAFE. Strain averages showed that BN significantly ($p<0.05$) consumed more feed (3.4 kg) than IB (2.8 kg) from 11th week to first egg, while values of ESM traits obtained from 3.1-4.0 kg body feed intake level for strains were close to the strain averages, and were significantly ($P<0.05$) different from each other except for PW10. Feed consumption variation between strains from 11th week to first egg were 2.75 and 2.33kg, 12.38 and 13.37g for FI11 and FIFE respectively. Since body weight is a major factor influencing pullet weight development at first egg (13), this character could be managed through regulated feed gift, and body weight monitoring and control of pullets from the 10th week of life to First egg.

Table 2: Comparative least-squares estimates for Bovan Nera and Isa Brown as influenced by feed intake from 11th week to first egg

Feed Intake 11th week to first egg	Strain	PW10 (g) Mean±SD	FI11 (kg) Mean±SD	FIFE (g) Mean±SD	WG11 (g) Mean±SD	PWFE (g) Mean±SD	PAFE (days) Mean±SD
<2.0 kg	BN	-	-	-	-	-	-
	IB	783.4±162.09	1.77±0.23	65.63±1.46	485.77±219.66	1269.17±169.02	107±3
2.1-3.0 kg	BN	794.96±69.26	2.62±0.26	71.12±4.54	712.79±120.59[a]	1507.74±113.45[a]	116±7
	IB	785.71±70.30	2.37±0.30	69.39±4.79	535.29±200.87[b]	1321.00±169.16[b]	110±10
3.1-4.0 kg	BN	764.86±105.91	3.51±0.27	83.50±14.45[a]	745.62±173.29	1510.48±111.28[a]	123±7[a]
	IB	754.90±63.72	3.31±0.26	71.12±4.92[b]	632.79±73.74	1387.69±96.70[b]	115±7[b]
> 4.0 kg	BN	766.80±101.29	5.40±1.76	79.01±5.85	701.63±158.37	1468.43±61.44	126±7
	IB	725.00±54.36	4.10±1.36	79.00±4.31	759.20±144.42	1484.20±56.11	119±5
SEM	SEM	18.18	0.14	1.54	25.32	21.39	1.36
Strain	BN	776.39±90.23	3.41±1.05[a]	77.67±12.10[a]	727.81±148.13[a]	1504.20±104.50[a]	121±8[a]
Average	IB	768.46±79.80	2.79±0.71[b]	70.08±5.07[b]	582.93±158.90[b]	1351.40±137.60[b]	115±9[b]

Notes: Value within same group with different superscripts are significantly different from each other at 0.05% level. PW10=Pullet weight at 10th week, FI10= Pullet feed-intake at 10th Week, FI11= Pullet feed-intake from 11th Week to first egg, FIFE=Pullet feed-intake at first egg, WG11=Pullet weight gain from 11th week to first egg, PWFE=Pullet weight at first egg, PAFE= Pullet age at first egg. SEM=SD/SQR(N).

Table 3 shows the effect of weight gain from 11th week to first egg on early maturity traits in both strains. At 501-600 g weight gain, there were significant (P<0.05) differences between strains in WG11(544.70 and 529.47 g) and PWFE (1390.27 and 1287.90 g). The 601-700 g weight gain caused significant (P<0.05) differences between strains in FIFE (83.5 and 71.12 g), and PWFE (1510.48 and 1387.69 g) respectively. Results showed no definite pattern in relationship between PAFE and body weight gain of pullet growers within and between strains. Result further revealed that pullets with higher body weights at 10th week of life gained smaller body weights (WG11: 544.7, 529.5 g) and recorded shorter days to first egg (117, 116 days); while those with lower body weights at 10th week gained higher weights (WG11: 846.1, 816.0 g) from 11th week to first egg and spent longer days to first egg (PAFE:122, 123 days) within strains respectively. Strain averages revealed significant (p<0.05) differences between strains in all characteristics, leading to a 6-daydifference in PAFE between BN and IB. A strict feeding programme relative to 10th week body weight at this transition period could be employed to delay or accelerate onset of lay (PAFE), increase or reduce egg weight at first egg and profitability in both strains. To obtain a 10% higher body weight (10) in the tropics than recommended standards of primary breeders, generous and higher feeding regime should be adopted from 11th week to first egg without jeopardizing flock health. This would result to accumulation of high level of body fat at onset of lay and elimination of high mortality during subsequent laying period as also reported by (14).

Table 3: Comparative least-squares estimates for Bovan Nera and Isa Brown Pullet growers as influenced by weight-gain from 11th week to first egg.

Weight-gain 11th week to first egg	Strain	PW10 (g) Mean±SD	FI11 (kg) Mean±SD	FIFE (g) Mean±SD	WG11 (g) Mean±SD	PWFE (g) Mean±SD	PAFE (days) Mean±SD
200-500 g	BN	-	-	-	-	-	-
	IB	836.28±95.17	2.13±0.17	66.73±	343.73±77.43	1183.00±66.00	103±4
501-600 g	BN	745.57±69.10	3.15±0.32	74.15±5.65	544.70±25.26[a]	1390.27±62.93[a]	117±6
	IB	758.43±63.90	2.99±0.63	70.38±7.47	529.47±73.44[b]	1287.90±59.84[b]	116±9
601-700 g	BN	812.70±12.32[a]	4.34±1.77	83.50±16.59[a]	639.96±33.60	1510.48±111.28[a]	123±5
	IB	754.25±79.38[b]	3.03±0.70	71.12±4.63[b]	652.18±75.61	1387.69±96.70[b]	118±8
> 800 g	BN	730.49±91.32	3.17±0.74	77.25±12.54	846.12±79.21	1576.60±75.60	122±10
	IB	724.00±8.49	2.50±0.42	75.20±3.11	816.00±54.02	1540.00±62.51	123±4
SEM	SEM	12.08	0.14	1.54	25.32	21.39	1.36
Strain	BN	776.39±90.23	3.41±1.05[a]	77.67±12.09[a]	727.81±148.13[a]	1504.20±104.50[a]	121±8[a]
Average	IB	768.47±79.80	2.79±0.71[b]	70.08±5.07[b]	582.93±158.90[b]	1351.40±137.62[b]	115±9[b]

Notes: Value within same group with different superscripts are significantly different from each other at 0.05% level. PW10=Pullet weight at 10th week, FI10=Pullet feed-intake at 10th week, FI11=Pullet feed-intake from 11th week to first egg, FIFE=Pullet feed-intake at first egg, WG11=Pullet weight gain from 11th week to first egg, PWFE=Pullet weight at first egg, PAFE=Pullet age at first egg. SEM=SD/SQR(N).

Table 4 shows the matrix table for r and R^2between pairs of early sexual maturity characteristics in both strains. In BN, PW10 was significantly associated with WG11 (R^2=-0.514) while WG11 was associated with PWFE (R^2=0.634). In IB, WG11 was significantly associated with PWFE (R^2=0.748) while PAFE was associated with FI11 (R^2=0.476). All other correlation and R^2 values in both strains were low ranging from 0.0074 to -0.295. These results implied that weight gain from 11th week to first egg in BN grower pullets was closely associated with the body weight at 10th week of age while pullet weight at first egg was associated with the weight gain at the period. This indicated that the same set of genes influencing PW10 might have influenced WG11 and PWFE. R^2 values in IB meant that FI11was moderately associated PAFE, while PWFE was highly influenced with WG11. Thus, with a high 10th week body weight, and a high feed gift offered to pullets from 11th week to first egg would lead to high PWFE and lower PAFE. The phenotypic correlation (r) between PWFE and average egg weight was 0.24 for whole population and this value was found consistent for 3 generations of study while0.60 and 0.49 was obtained for selected and control populations in an egg production traits' improvement study (15). Highly and negative value (r=-0.52) was found between age at sexual maturity and egg number during the first 90 days after sexual maturity. Phenotypic correlations of age at sexual maturity with average egg weight was 0.37, which indicated that early maturing birds produce smaller egg weight (16) and this finding was also in agreement with (17). Limited information on phenotypic correlations between PW10:WG11, WG11:PWFE, WG11:PAFE, FI11:FIFE, FI11:PAFE and PWFE:PAFE were obtained from literature.

Table 4: Pearson's and multiple correlation coefficient matrix for early sexual ma turity traits in Bovan Nera and Isa Brown strains reared in Ibadan, South-west Nigeria

			Bovan Nera					
			PW10	FI10	FI11	FIFE	WG11	PWFE	PAFE
	PW10	r,		-0.146 ^{NS}	-0.066 ^{NS}	-0.252 ^{NS}	-0.717****	-0.153 ^{NS}	-0.086 ^{NS}
		R^2		0.021	0.0044	0.064	**0.514**	0.023	0.0074
	FI10	r	0.390 ^{NS}		-0.308 ^{NS}	-0.379 ^{NS}	0.160 ^{NS}	0.100 ^{NS}	0.036 ^{NS}
		R^2	0.152		0.095	0.144	0.026	0.010	0.0013
	FI11	r,	-0.187 ^{NS}	0.109 ^{NS}		0.147 ^{NS}	-0.058 ^{NS}	-0.140 ^{NS}	0.309 ^{NS}
Isa Brown		R^2	0.035	0.012		0.022	0.0034	0.020	0.095
	FIFE	r,	-0.295 ^{NS}	0.058 ^{NS}	0.602 ^{NS}		0.255 ^{NS}	0.145 ^{NS}	0.510**
		R^2	0.087	0.0034	0.362		0.065	0.021	0.260
	WG11	r,	-0.500*	-0.365 ^{NS}	0.487*	0.575*		0.798****	0.372 ^{NS}
		R^2	0.25	0.133	0.237	0.331		**0.634**	0.138
	PWFE	r,	0.0026 ^{NS}	-0.195 ^{NS}	0.454*	0.492*	0.865****		0.453**
		R^2	$6.76X10^{-6}$	0.038	0.206	0.242	**0.748**		0.205
	PAFE	r,	-0.254 ^{NS}	-0.131 ^{NS}	0.690****	0.548**	0.625***	0.573***	
		R^2	0.065	0.017	**0.476**	0.300	0.391	0.328	

NOTE: ****=0.0001; ***=0.001; **=0.01; *=0.05; NS= Not significant; PW10=Pullet weight at 10-Weeks; FI10=Feed intake at 10-weeks, FI11= Feed Intake from 11-week to First egg; FIFE= Feed Intake at First egg; WG11= Pullet weight gain from 11-week to First egg, PWFE=Pullet weight at First egg, PAFE=Pullet age at First egg;

Table 5 shows the multiple step-wise linear regression equations for predicting FI11, FIFE, WG11, PWFE and PAFE in BN and IB. The equations predicting FI11 (R^2=0.00-0.40) revealed minimum intake of 3.41 kg needed to rear Bovan Nera from 11 weeks to First egg, while intake required by Isa Brown depended on PAFE. This meant that based on experience, a farmer could target the minimum number of days desired from 11 weeks to First egg; and this may involve increasing PAFE and offering a pre-fixed feed quantity (3.3 kg) for IB chickens. The equations were weak and inadequate to predict FI11 in both strains. Equations in both strains predicting FIFE were significant (*P*= 0.0056, 0.0050) but posted very low R^2 (0.332, 0.327) for BN and IB respectively, indicating that equations were very weak and could not capture all variability for predicting FIFE. This means that they are unreliable for prediction purposes. The equations for prediction of WG11 for BN and IB were highly significant (0.0001) and reliable (R^2=0.900) for prediction of weight gain. The basal weight posted by IB was twice (4.4) that of BN (2.1) strain, while final weight gain from 11th week to first egg in both strains were highly dependent on PW10 and PWFE. Equations predicting PWFE revealed little basal weight difference between BN (1.9) and IB (2.0) strains. In both strains, both PW10 and WG11 contributed to the variability responsible for predicting PWFE. Thus, PWFE in both strains would depend on respective strain ability for growth before and after 10th week of life: PW10 and WG11. These two traits are genetic in origin. IB recorded lower PWFE between strains at first egg. Both equations were highly significant (*P*=0.0001) and posted high R^2 (0.900), implying that trait could be predicted to high level of accuracy in both strains.

Equations predicting PAFE revealed basal physiological ages of 94 and 83 days for BN and IB strains respectively. These figures confirmed that BN inherently possessed longer PAFE than IB. The difference between strains were partly due to FIFE and PWFE (BN), and, FI11 and WG11 (IB). Only the equation for IB would be reliable (*P*=0.0006; R^2=0.54) for predicting purpose because FI11 could be manipulated to a high level as desired in Isa brown during the transition period to desired PAFE. In BN, PAFE did not highly sensitive to FI11 but FIFE and PWFE. Thus, FI11 could not be used effectively to promote accretion of fat in BN for rapid weight gain to manipulate PAFE during the transition period. The better management practice would be to encourage high body weight to the 10th week of life to reduce PAFE in BN strain. The results obtained in the present research indicated that except the intercept term fitted in the model, all the independent variables (linear, quadratic and interaction terms) had no statistical significant (p>0.05) effects on ASM variation suggesting that other possible environmental factors could affect sexual maturity age of the indigenous chicken studied in this research. However, the predicted value of the minimum ASM was found to be approximately 161 days (close to the simple average of ASM in the data set) as the chicken weight at W8 and W12 were 504and 997 g respectively (18). Body weight and growth rate were closely related to the attainment of sexual maturity, while the genetic determination of growth rate has correlated effects on puberty (19). Research had also revealed that PWFE of local chickens are predictable (R^2=0.78) from hatch weight (20). However, studies on prediction of early sexual maturity traits such as FI11, FIFE, WG11, PWFE and PAFE in commercial chicken stock were sparse in literature.

Table 5: Step-wise regression equations for prediction of feed consumption, weight gain, pullet weight at first egg and pullet age at first egg in Bovan Nera and Isa Brown parent stock chickens reared in Ibadan

Trait	GTY	Equation Model: $Y= \mu + \alpha X_1 + \beta X_2$	SE	t-value	Adj. R^2	Model Sig.	VIF	DW	CV	Comments
FI11	BN	$Y= 3.41$	0.214	15.97	0.000	-	0.000	2.052	30.68	-
	IB	$Y= -3.25 + 0.053X_1$	1.501	4.04	0.447	0.0008	1.000	1.848	18.99	X_1=PAFE
FIFE	BN	$Y= -49.36 + 0.75X_1 + 0.62X_2$	35.585	2.91 2.11	0.332	0.0056	1.001 1.001	1.785	12.73	X_1=PAFE X_2=FI10
	IB	$Y= 58.14 + 4.28X_3$	5.190	1.33	0.327	0.0050	1.000	1.977	5.93	X_3=FI11
WG11	BN	$Y= -2.084 + 1.0X_4 – 1.0X_5$	0.000	Inf.	0.900	0.0001	1.024	-	0.00	X_4=PWFE X_5=PW10
	IB	$Y= -4.43 + 1.0X_4 – 1.0X_5$	0.000	Inf.	0.900	0.0001	1.000	-	0.00	
PWFE	BN	$Y= 1.89 + 1.0X_5 + 1.0X_6$	0.000	Inf.	0.900	0.0001	0.486	-	0.00	X_5=PW10 X_6=WG11
	IB	$Y= 2.015 + 1.0X_5 + 1.0X_6$	0.000	Inf.	0.900	0.0001	1.333	-	0.00	
PAFE	BN	$Y = 94.210 + 0.03X_4 + 0.302X_7$	20.536	2.28 2.61	0.350	0.0042	1.021 1.021	2.016	5.38	X_4=PWFE X_7=FIFE
	IB	$Y= 83.39 + 6.63X_3 + 0.022X_6$	8.930	2.83 2.11	0.536	0.0006	1.312 1.312	2.507	5.54	X_3=FI11 X_6=WG11

NOTE: PW10=Pullet weight at 10th week (grams); PAFE=Pullet age at first egg (days); FI10= Feed Intake at 10th week (grams), FI11= Feed Intake from 11th week to first egg (kg); FIFE= Feed intake at first egg (grams); WG11= Pullet weight gain from 11th week to First egg (grams)

Conclusions and applications

1. At the 10th week of life, there were significant differences in FIFE, WG11, PWFE and PAFE between strains within 801-900g body weight category.
2. From 11th week to first-egg, significant differences in FIFE, PWFE and PAFE were obtained between strains (body weight category:755-765g) at 3.1-4.0 kg feeding level.
3. Pullets should be managed to meet a minimum target body weight of 800g at 10 weeks to aid skillful breeding and management to first egg.
4. Implication of results is that BN and IB should be skillfully managed to reach a minimum body weight of 1436-1504 and 1151-1351gm and minimum age of 116-121 and 103-115 days respectively before the first egg is layed in the humid tropics of Ibadan.
5. Weight gain from 11th week to first egg and pullet weight at first egg could be predicted in both strains effectively at 10th week. This would aid proper technical management of commercial and breeding stocks.

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Statement of Animal Rights.

All applicable international, national, and/or institutional guidelines for the care and use of animals were followed. The manuscript does not contain clinical studies or patient data.

Conflict of Interest Statement: The author declares no conflict of interest.

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