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PJBS

ISSN 1028-8880

# Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 14 (23): 1061-1065, 2011
ISSN 1028-8880 / DOI: 10.3923/pjbs.2011.1061.1065


# Study on Pre-laying Characteristics of Three Breeds of Commercial Layers in the Derived Savannah Zone of Nigeria

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**Abstract:** This experiment was conducted to study the effect of strains on productive characteristics of three genotypes of commercial pullets: Isa Brown, Bovan Nera and Dominant Black. A total number of 300 day-old chicks (100 chicks per strain) were purchased from local hatcheries. Individual body weight and linear measurements were determined from 0-20 weeks of age. There were highly significant ($p<0.01$) strain differences in body weight, body length, thigh length, shank length, breast girth, feed conversion and feed efficiency. Bovan Nera recorded highest body weight, lowest feed conversion ratio and superior feed efficiency at maturity (20th week). Dominant Black on the other hand had lowest body weight, highest feed conversion and very low feed efficiency while Isa Brown recorded intermediate mean values for these traits. It was indicated in this study that regardless of strain, all the traits studied increased in mean values with advancing age of the birds. In addition, positive association between body weight and sexually maturity was established as Bovan Nera with the highest body weight at 20th week laid the first egg. The results also revealed the inverse relationship between feed conversion and feed efficiency. The former declined in mean values as the birds grew older while the latter increased simultaneously but the rate of change differs among strains. Bovan Nera was adjudged good and feed efficient because the strain had the highest mean values in body weight and feed efficiency ratio at maturity (20th week) and could be recommended to farmers for increased productivity, income generation and business sustainability.

**Key words:** Body weight, feed efficiency, pullet, strains, traits

## INTRODUCTION

Poultry farming is fast becoming an attractive business in Nigeria due to its short gestation and generation interval, prolificacy and lack of taboos to its production coupled with an increasing demand for its products by large segment of the populace especially during religious, local and national festivals. In order to meet this increasing demand however, there is an urgent task of developing or procuring the fastest growing strains for new entrants and long-time poultry farmers who have resources to invest in this sub-sector which generates employment opportunities for both skilled and unskilled labour. The improvement in this sub-sector will no doubt lead to increase in protein consumption and enhance the well being of the people in addition to promoting national growth and development. There is strong evidence that there are genetic differences in growth rate between strains or breed of chickens (Deeb and Lamont, 2002). Previous studies also indicated significant differences in body weight and weight gain at different ages of chickens (Leeson *et al*., 1997; Taha *et al*., 2010). Moreover, observed significant differences between strains in body weight, feed intake and feed conversion ratio had been reported (Rondelli *et al*., 2003) and differences between sexes on some performance traits such as body weight, growth rate, feed intake and feed conversion ratio (Balogun *et al*., 1997; Ajayi and Ejiofor, 2009). In chickens, growth rate can be improved through crossing different breeds together to utilize heterosis in their progenies. Shebl *et al*. (1995), Nawar *et al*. (2004) and Amin (2007) found positive heterosis in body weight at 6 and 12th weeks of age in both sexes of chicken, while Nestor *et al*. (2006) and Amin (2009) reported positive backcrossing effect on growth traits in turkey. Moreover, Mostafa and Nofal (2000) and Amin (2008, 2009) observed significant differences between sexes in body weight at different ages. Siegel and Dunnington (1987) found significant differences in the pattern of growth among strains of chickens.

Body weight according to Chambers (1990) is the most frequently used indicator for growth. Previous investigators had posited that differences in growth pattern are under genetic control and that variations exist within species (Lilja *et al*., 1985; Carborg *et al*., 2003).

There is no doubt the fact that bird's live body weight at the time of commencement of egg laying determines its age at first egg, age at peak production and the overall performance of the hen. A hen that reaches sexual maturity earlier will produce more eggs than the one that reaches maturity later. Growth rate therefore, is an important criterion in selecting for high producing hens and culling of unproductive hens from the flock. The literature is replete with information on genetic differences for feed intake, feed conversion ratio and feed efficiency. Rondelli *et al.* (2003) and Taha *et al.* (2010) found significant effect of strains on feed consumption and feed conversion ratio between broiler chicken breeds.

The purpose of the present investigation was to evaluate the pre-laying growth traits and performance characteristics of three strains of commercial layers reared in the Derived Savannah zone of Nigeria. The objectives of this study include: A. determination of breed (s) with superior growth rates and recommending same to local farmers; B. assessment of relationship between body weight and sexual maturity in domestic chickens.

## MATERIALS AND METHODS

The study was carried out at the Animal Breeding Unit, Teaching and Research Farm, University of Ado-Ekiti between March, 2007 and August, 2007. Ado-Ekiti is situated along latitude 7°31' and 7°49' North of the Equator and longitude 5°71' and 5°27' East of the greenwich Meridian. The city falls under Derived Savannah zone. The city enjoys two separate seasonal periods namely, Rainy (May-October) and Dry (November-April) seasons.

**Management and experimental birds:** A total number of 300 day-old chicks, that is, 100 chicks each of Isa Brown (IB), Bovan Nera (BN) and Dominant Black (DB) were purchased from local hatcheries and raised on deep litter in separate pens for 140 days (20 weeks). The chicks were brooded on wood shavings using coal pot to supply heat for the first three weeks of life. Antibiotics and vitamins were administered as and when due. Also, vaccines against Infectious Bursae and Newcastle diseases were given at specified age intervals. Their beddings are made up of dry shavings to prevent coccidiosis outbreak and high level of hygiene was maintained throughout the experimental period to ensure unhindered conducive conditions for growth and to lower death rate. The birds were fed *ad libitum* with chick's mash (1-8 weeks) containing 3000 Kcal/Kg/ME, 20% CP and grower mash (8-20 weeks) containing 2450 Kcal//Kg/ME, 14% CP.

**Data collection:** Fifty birds starved overnight per breed were taken at random for weighing from the pen each time the exercise was carried out. The birds were weighed at day-old and subsequently at 4 weeks interval up to 20 weeks of age. Other linear measurements taken are body length, breast girth, shank length and thigh length. In addition, data were taken on feed intake, feed conversion ratio and feed efficiency at 4 weeks interval beginning from day one. Live body weights were weighed using sensitive scale (g) and other parts measured with tailors tape rule.

Feed conversion ratio refers to the ratio of feed (g) consumed/bird to average body weight on strain basis:

$$\text{Feed conversion ratio (FCR)} = \frac{\text{feeds (g) / bird / week}}{\text{av.bodyweight (g) / bird / week}}$$

Feed efficiency refers to the ratio of average body weight to feed (g) consumed, that is:

$$\text{Feed efficiency (FE)} = \frac{\text{av.bodyweight (g) / bird / week}}{\text{feeds (g) / bird / week}}$$

The appropriate statistical model used is:

$$Y_{ijk} = \mu + G_j + A_i + (GA)_{ij} + \varepsilon_{ijk}$$

$Y_{ijk}$ = Observation of the $k^{th}$ population, of the $j^{th}$ genotype and $i^{th}$ age
$\mu$ = Common mean
$g_j$ = Fixed effect of $j^{th}$ genotype (j = 3)
$A_i$ = Fixed effect of $i^{th}$ age (I = 6)
$(gS)_{ij}$ = Fixed genotype × age interaction effects
$\varepsilon_{ijk}$ = Random error

**Statistical analysis:** Data collected were subjected to analysis of variance and the differences between means for breed and age were separated using Duncan New Multiple Range Test as per SAS (2001).

## RESULTS AND DISCUSSION

There was no significant ($p>0.05$) effect of strains on body weight among the three breeds of commercial pullets. However, Table 2 showed that there were significant ($p<0.01$) differences among strains for body length at 4, 8, 16 and 20th week, feed conversion ratio and feed efficiency while an insignificant ($p>0.05$) breed effect was reported for body length at day-old and 12th week (Table 1).

Table 1: Least square means showing breed effect on body weight of commercial pullets

| | Body weight (g) | | | | | |
|---|---|---|---|---|---|---|
| Genotype | BW0 | BW4 | BW8 | BW12 | BW16 | BW20 |
| IB | 28.4±0.37 | 232±4.14$^{a}$ | 567±9.41$^{a}$ | 762±11.96 | 1116.5±12.33$^{b}$ | 1422.3±17.24$^{b}$ |
| BN | 28.8±0.37 | 205±4.14$^{b}$ | 532±9.41$^{b}$ | 756±11.96 | 1160±12.33$^{a}$ | 1499.6±17.24$^{a}$ |
| DB | 28.2±0.37 | 211±4.14$^{b}$ | 530±9.41$^{b}$ | 773±11.96 | 1081.8±12.33$^{c}$ | 1412.6±17.24$^{b}$ |

abc: Means along columns with different superscripts are significantly different at p<0.01, BW0-BW20: body weight of birds from 0-20 weeks. IB: Isa Brown BN: Bovan Nera DB: Dominant Black

Table 2: Least square means showing breed effect on linear measurements of commercial pullets

| | | Linear measurements | | | | | |
|---|---|---|---|---|---|---|---|
| Traits | Breeds | Week 0 | Week 4 | Week 8 | Week 12 | Week 16 | Week 20 |
| Body length (cm) | IB | 9.73±0.88 | 13.9±0.16$^{b}$ | 21.5±0.19$^{a}$ | 24.6±0.19 | 26.8±0.16$^{ab}$ | 27.8±0.19$^{b}$ |
| | BN | 8.25±0.88 | 14.6±0.16$^{a}$ | 21.2±0.19$^{a}$ | 24.8±0.19 | 26.4±0.16$^{b}$ | 28.3±0.19$^{a}$ |
| | DB | 8.21±0.88 | 14.8±0.16$^{a}$ | 14.8±0.19$^{b}$ | 24.6±0.19 | 27.1±0.16$^{a}$ | 28.3±0.19$^{a}$ |
| Thigh length cm) | IB | 2.64±0.03 | 5.72±0.08$^{a}$ | 8.93±0.09$^{a}$ | 10.2±0.08$^{ab}$ | 11.7±0.08$^{b}$ | 12.7±0.07$^{b}$ |
| | BN | 2.63±0.03 | 5.45±0.08$^{b}$ | 8.26±0.09$^{b}$ | 10.03±0.08$^{b}$ | 11.9±0.08$^{ab}$ | 13.0±0.07$^{a}$ |
| | DB | 2.64±0.03 | 5.87±0.08$^{a}$ | 5.87±0.09$^{c}$ | 10.4±0.08$^{a}$ | 12.1±0.08$^{a}$ | 13.0±0.07$^{a}$ |
| Shank length(cm) | IB | 1.86±0.02$^{a}$ | 3.8±0.04$^{a}$ | 5.43±0.05$^{a}$ | 6.34±0.05$^{b}$ | 8.33±0.74 | 7.69±0.05$^{b}$ |
| | BN | 1.79±0.02$^{b}$ | 3.6±0.04$^{b}$ | 5.44±0.05$^{a}$ | 6.30±0.05$^{b}$ | 7.32±0.74 | 7.76±0.05$^{b}$ |
| | DB | 1.9±0.02$^{a}$ | 3.85±0.04$^{a}$ | 3.85±0.05$^{b}$ | 6.49±0.05$^{a}$ | 7.33±0.74 | 7.99±0.05$^{a}$ |
| Breast girth (cm) | IB | 3.75±0.42 | 7.41±0.08$^{a}$ | 9.38±0.1$^{a}$ | 10.93±0.1$^{a}$ | 17.3±1.51 | 16.9±0.1$^{b}$ |
| | BN | 4.73±0.42 | 6.37±0.08$^{b}$ | 8.0±0.1$^{b}$ | 9.84±0.1$^{c}$ | 13.8±1.51 | 17.3±0.1$^{a}$ |
| | DB | 3.83±0.42 | 7.26±0.08$^{a}$ | 7.26±0.1$^{c}$ | 10.5±0.1$^{b}$ | 14.3±1.51 | 17.3±0.1$^{a}$ |
| Feed intake (g) | IB | | 105±0.00 | 157±0.00 | 220±0.00 | 288±0.00 | 450±0.00 |
| | BN | - | 105±0.00 | 157±0.00 | 220±0.00 | 288±0.00 | 450±0.00 |
| | DB | | 105±0.00 | 157±0.00 | 220±0.00 | 288±0.00 | 450±0.00 |
| Feed conversion | IB | | 0.46±0.01$^{b}$ | 0.28±0.01$^{b}$ | 0.29±0.004 | 0.26±0.003$^{b}$ | 0.32±0.004$^{a}$ |
| | BN | - | 0.52±0.01$^{a}$ | 0.30±0.01$^{b}$ | 0.29±0.004 | 0.25±0.003$^{c}$ | 0.30±0.004$^{b}$ |
| | DB | | 0.51±0.01$^{a}$ | 0.76±0.01$^{a}$ | 0.29±0.004 | 0.27±0.003$^{a}$ | 0.32±0.004$^{a}$ |
| Feed efficiency | IB | | 2.21±0.04$^{a}$ | 3.61±0.06$^{a}$ | 3.47±0.05 | 3.88±0.04$^{b}$ | 3.16±0.04$^{b}$ |
| | BN | - | 1.95±0.04$^{b}$ | 3.39±0.06$^{b}$ | 3.44±0.05 | 4.03±0.04$^{a}$ | 3.33±0.04$^{a}$ |
| | DB | | 2.01±0.04$^{b}$ | 1.35±0.06$^{c}$ | 3.52±0.05 | 3.76±0.04$^{c}$ | 3.13±0.04$^{b}$ |

abc: Means along columns with different superscripts are significantly different. IB: Isa Brown BN: Bovan Nera DB: Dominant Black

**Effect of breed on body weight of commercial pullets:** There was no significant (p>0.05) effect of strain on hatch weight of chicks at day-old (BW0). However, body weight from fourth week (BW4) till the twentieth week (BW20) showed significant (p<0.01) difference among the strains. At fourth and eight week (BW4, BW8), IB recorded the highest significant body weight while BN and DB were similar in mean values. This implies that IB was heavier at fourth to eight weeks of age than BN and DB. The three strains had similar body weights at twelve week (BW12) of age, that is, no significant (p>0.05) differences in body weight at 12th week. Body weight at 16th week (BW16) showed that BN (1160+12.33 g) recorded the highest significant mean values, intermediate in IB (1116.5+12.33 g) and DB (1081.8+12.33 g), being the lowest. At 20th week, BN (1499.6+17.24 g) also recorded the highest mean values while IB (1422.3±17.24 g) and DB (1412.6±17.24 g) were similar (Table 1).

The significant differences observed in growth rate in these strains at four weeks interval is an indication that strains have different genetic potentials for growth and that the three strains studied have different ancestors. The obtained results were consistent with the findings of Leeson *et al.* (1997), Ajayi and Ejiofor (2009) and Taha *et al.* (2010) who reported marked strain and breed differences for body weight. BN at 20th week was heavier than IB and DB with 77.3 g (5.2%) and 87 g (5.8%), respectively and reached sexual maturity earlier than the two strains. That is, BN was the first to lay egg and this might be due to its highest body weight at 20th week. The other two strains laid their first eggs after terminating the experiment, that is, after 20th week. The results showed that body weight of laying birds determines the age at which the first eggs are laid and not the age of the birds per se. In general terms, birds increased in body weight consistently with advancing age across the different strains.

**Effect of breed on linear measurements and feed consumption of commercial pullets:** Table 2 showed that there were significant (p<0.01) differences among strains for body length at 4, 8, 16 and 20th week while an insignificant (p>0.05) effect was reported at day-old and 12th week. For example, at 16th week, DB (27.06+0.16 cm) and IB (26.77+0.16 cm) were similar and superior (p<0.01) to BN (26.46+0.16 cm). However, at 20th week, BN (28.27+0.19 cm) recorded significantly higher mean values

than IB (27.76+0.19 cm) and DB (28.29+0.19 cm). This was in agreement with the findings of Ojedapo *et al.* (2006) who reported significant differences in body length among three commercial layer strains. The obtained results on body length showed that strains or breeds of commercial pullets differ significantly in body length. The results also indicate that these three strains have different ancestors and differ in genetic constitution.

Regarding thigh length, the strains differed ($p<0.01$) significantly in all the age intervals except at day-old (Table 2). For instance, at 20th week, DB (12.97+0.07 cm) and BN (12.95+0.07 cm) recorded higher mean values than IB (12.73+0.07 cm). It was observed in this study that the rate of thigh development increased with advancing age of the birds across the three strains. Shank length also increased in size with advancing age of the birds and it differed among the strains studied (Table 2). At 2th week, DB (7.99+0.05 cm) had higher mean values than IB (7.69+0.05 cm) and BN (7.76+0.05 cm). This implies that DB shank was longer than other two strains' shank. The result agreed with the findings of Ajayi and Ejiofor (2009) who reported significant strain differences in shank length of chickens.

Results in (Table 2) represented least square Means±Standard errors of the effect of different strains on breast girth from 4-20th weeks. There was highly significant ($p<0.01$) effect of strains on this production trait in commercial pullets. Day-old mean value was not significant ($p>0.05$) among the three strains. At maturity (20th week), BN (17.32+0.1 cm) and DB (17.33+0.1 cm) recorded similar mean values and were superior to IB (16.99±0.1 cm). The results indicate that BN and DB are broad breasted birds at maturity and this could be used to differentiate them from other strains being used for commercial purposes. A general increase in breast width was observed with advancing age of the birds across the three strains during the observed period. The result was consistent with the findings of Ajayi and Ejiofor (2009) who reported significant strain differences in breast girth of chickens.

The feed intake (Table 2) was the same and there was no significant ($p>0.05$) difference among the strains studied. The birds across the strains were given the same quantity of feeds based on their weekly requirements and the amount increased as they advanced in age and this explained the reason why there was no significant difference in feed intake from 0-20 weeks. The result was not in agreement with those obtained by Leeson *et al.* (1997) and Taha *et al.* (2010) who reported marked differences in feed consumption among different strains.

Table 2 also showed that there were significant ($p<0.01$) differences among different strains for feed conversion from 4-20th week. DB recorded highest mean values during the age intervals while BN had the lowest mean value even at maturity. It simply infers that DB was a poor converter of feed to meat and BN appeared to be good converters of feed to meat. Feed conversion for all strains was highest during first few weeks (0-4 weeks) of age of the birds, decreased between 8-16th week and went up again thereafter. The reason for this might not be unconnected with the pattern of growth of these birds. Their rate of growth seemed very slow at early stages of growth (0-4 weeks), accelerates during growing phase (8-16 weeks) and decelerates at finishing phase (16-20 weeks). The strain differences for feed conversion obtained in this study were closely related to the results found in literature (Rondelli *et al*., 2003; Taha *et al*., 2010).

In this study (Table 2), there were significant strain differences for feed efficiency during the observed period (4-20 weeks). At 20 weeks of age, BN (3.33±0.04) recorded the highest mean values for feed efficiency while IB (3.16±0.04) and DB (3.13±0.04) had the lowest mean values. This implies that the former was a good converter of feed to meat than the latter. In addition, contrary to what was reported for feed conversion, feed efficiency was low at early stages of growth (0-4 weeks), increased in mean values during growing phase (8-16 weeks) and declined at later stage (16-20 weeks). It was observed that the strain with the highest feed conversion ratio recorded the lowest mean values in feed efficiency while the strain with the lowest feed conversion had the superior mean values for feed efficiency. The results of this study corroborates the findings of Adebambo *et al.* (2008) and Olawumi and Dudusola (2011) who reported significant breed differences in feed efficiency of various breeds.

## CONCLUSIONS

- Both genotype and age of birds had significant ($p<0.01$) effects on body weight, linear measurements and other production traits of commercial pullets being reared in this agro-climatic zone
- The hatch weight of the chicks of different strains was not significantly ($p>0.05$) different
- Bovan Nera genotype recorded the highest body weight at maturity ($20^{th}$ week), lowest feed conversion, superior feed efficiency and laid the first egg
- The study revealed that feed efficiency and feed conversion ratio are related but in a reverse manner, that is, as one (feed efficiency) increases with advancing age of the birds, the other (feed conversion) decreases in value simultaneously
- Bovan Nera genotype therefore, appeared productive and feed efficient when compared to Isa Brown and Dominant Black and could be recommended for farmers in this zone for commercial production of point-of-lay birds

**ACKNOWLEDGMENT**

The author is indebted to the Staff of Teaching and Research Farm, Ekiti State University, Ado-Ekiti for their support and assistance during the period of data collection.

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