# Morphometrics of IPB D1, IPB D2 and IPB D3 Chickens Aged 4 to 12 Weeks at Sinar Harapan Farm Sukabumi

**M. A. Rizqi[1*], C. Sumantri[2], & S. Darwati[2]**

[1]Graduate School of Animal Production and Technology, Faculty of Animal Science, IPB University
[2]Department of Animal Production and Technology, Faculty of Animal Science, IPB University
Jl. Agatis, Kampus IPB Darmaga Bogor 16680, Indonesia
*Corresponding author: rizqizaki24@gmail.com

## ABSTRACT

Research on the 11 morphometrics of IPB-D chicken in Sukabumi district has not been conducted. This study aimed to evaluate the morphometrics of IPB D1, IPB D2 and IPB D3 chickens in Sukabumi District. The design of this study was a completely randomized design with 3 levels of treatment lines namely IPB D1, IPB D2 and IPB D3 with 95% confidence interval. Treatments that had a significant effect were followed by the Tukey test. Measured morphometric parameters such as shank length, shank circumference, femur length, tibia length, breast length, breast width, breast depth, breast circumference and back length. IPB D3 chickens show that their genetic condition is not yet stable as meat type. At the age of 4 to 8 weeks, IPB-D3 chickens have a larger size in the variables of shank circumference, femur length, tibia length, breast length and breast circumference. However, at the age of 8 to 12 weeks IPB-D3 chickens have a smaller size in the variables of breast length, breast width, breast depth, breast circumference and back length. Meanwhile, IPB D1 chickens show that they are genetically stable and IPB D2 is able to adapt because of its resistance traits.

Keywords: IPB D1 chicken, IPB D2 chicken, IPB D3 chicken, morphometrics, Sukabumi Regency

## ABSTRAK

Penelitian mengenai morfometrik ayam IPB D di Kabupaten Sukabumi belum dilakukan. Penelitian ini bertujuan mengevaluasi morfometrik ayam IPB D1, IPB D2 dan IPB D3 di Kabupaten Sukabumi. Rancangan pada penelitian ini adalah Rancangan Acak Lengkap dengan 3 taraf perlakuan galur yaitu IPB D1, IPB D2 dan IPB D3 dengan selang kepercayaan 95%. Perlakuan yang berpengaruh nyata dilanjutkan uji Tukey. Parameter morfometrik yang diukur seperti panjang shank, lingkar shank, panjang femur, panjang tibia, panjang dada, lebar dada, dalam dada, lingkar dada, dan panjang punggung. Ayam IPB D3 menunjukkan bahwa kondisi genetiknya belum stabil sebagai tipe daging. Ayam IPB-D3 memiliki ukuran yang lebih besar pada variabel lingkar betis, panjang femur, panjang tibia, panjang dada dan lingkar dada ketika umur 4 sampai 8 minggu. Namun, pada umur 8 sampai 12 minggu ayam IPB-D3 memiliki ukuran yang lebih kecil pada variabel panjang dada, lebar dada, kedalaman dada, lingkar dada dan panjang punggung. Ayam IPB D1 menunjukkan bahwa kondisi genetiknya telah stabil dan IPB D2 mampu beradaptasi karena sifat ketahanan tubuhnya.

Kata kunci: ayam IPB D1, ayam IPB D2, ayam IPB D3, Kabupaten Sukabumi, morfometrik

# INTRODUCTION

The development of local chickens into superior breeds will be a valuable national asset. IPB D1 chicken is a new breed of superior local meat type chicken derived from the cross between F1 PS males (pelung x sentul) with F1 KM females (kampung x Cobb parent stock) and has been established based on Decree No.693/KPTS/PK.230/M/9/2019 by the Ministry of Agriculture (Habib *et al.* 2020). The basis for selecting meat types and local chickens (pelung, sentul, and kampung) for crossing is the genetic potential of each chicken such as meat production, egg production and disease resistance (Ulupi *et al.* 2016).

The development of IPB D1 chicken resulted in a candidate line of IPB D2 chicken and a candidate line of IPB D3 chicken. IPB D2 chickens are selected based on immune parameters, namely ND titer $\geq$ 3 log 2 HI units which is categorized as a protective antibody titer and high Yolk Immunoglobulin (IgY) $\geq$ 9.55 mg mL$^{-1}$ (Lestari *et al.* 2021). IPB D2 chickens were formed as a female line to produce local chickens that are able to adapt to the environment. IPB D3 chicken is formed as a male line that has the trait of fast growth with quality meat that is selected based on fast body weight growth so that it has an advantage over its parents. The mineral content of Fe, Zn, Mn, and Se in IPB D3 chicken meat is 12.74 mg kg$^{-1}$; 17.48 mg kg$^{-1}$; 0.23 mg kg$^{-1}$; and 0.92 mg kg$^{-1}$ (Alfiah 2023).

Morphometrics is a quantitative trait used as a basis for selection to increase the productivity of local chickens and examine bone growth and body structure that has a significant relationship to body weight (Lukmanudin *et al.* 2018; Putri *et al.* 2020). Bone growth in poultry aged 4 to 12 weeks tends to increase then decrease at 12 to 20 weeks (Jull 1984). Quantitative traits of livestock such as morphometrics can be used to identify economic value, evaluate performance, predict body weight gain and test the relationship between characteristics of morphometric variables (Sola-Ojo *et al.* 2020; Hastuti *et al.* 2021).

Research on the morphometrics of IPB D1, IPB D2 and IPB D3 chickens in Bogor district has been conducted while no research has been conducted in Sukabumi district. This study examines the morphometrics of IPB D1, IPB D2, and IPB D3 chickens in Sukabumi District. This study is expected to provide additional information for the future development of IPB D1, IPB D2, and IPB D3 chickens.

## MATERIAL AND METHODS

### Research Time and Location

The research was conducted from December 2023 to January 2024. The research location was at CV Sinar Harapan Farm, Sukabumi District, West Java.

### Equipment and Material

The tools used are digital caliper and measuring tapes. The bird used in the study were IPB D1 11th generation, IPB D2 4th generation, and IPB D3 3rd generation. The bird used were 4 to 12 weeks old both male and female.

## Methods

Determination of chicken age refers to the recording of CV Sinar Harapan Farm. Morphometric measurements were made using a digital caliper and measuring tape. Morphometric variables measured are presented in Figure 1. Morphometric variables observed were based on FAO (2012) and Waggoner and Hutchinson (2001) as follows: 1. Shank length (X1) was measured along the tarsometatarsus bone using a digital caliper; 2. Shank circumference (X2) was measured by wrapping the measuring tape around the center of the tarsometatarsus bone; 3. Femur length (X3) was measured from the pelvic bone at the top and the tibia bone at the bottom using a caliper; 4. Tibia length (X4) was measured from the patella to the tip of the tibia using a caliper; 5. Breast circumference (X5) was measured circumferentially from the tip of the sternum and back to the original sternum using a measuring tape; 6. Breast depth (X6) was measured laterally from the center of the sternum and the center of the backbone (Columna vertebralis) using a caliper; 7. Breast width (X7) was measured by measuring the distance between the left and right sternum using a caliper; 8. Breast length (X8) was obtained by measuring the length of the sternum using a digital caliper; and 9. Back length (X9) was obtained by measuring the length from the boundary between the collar bone and the backbone to the tip of the pygostyle bone using a measuring tape.
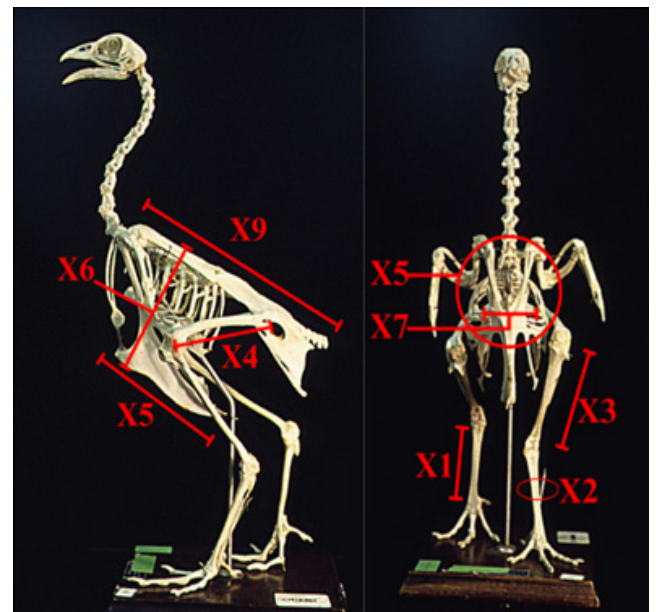


Figure 1. Morphometrics Measured

## Data Analysis

The design in this study is a completely randomized design (unbalanced data) with 3 levels of treatment lines namely IPB D1 chicken, IPB D2 chicken and IPB D3 chicken. Data were analyzed for variance (ANOVA) based on age group and sex at 95% confidence interval based on PROC GLM procedure. Treatments with significant effect were followed by Tukey's test. The mathematical model according to Mattjik and Sumertajaya (2013) is as follows.

$$Yi = \mu + Ai + \varepsilon ij$$

Description:
Yi = observed value (morphometric);
$\mu$  = general mean value;
Ai = effect of line at the i-th level (IPB D1, IPB D2 and IPB D3); and
$\varepsilon i$j = effect of error.

## RESULTS AND DISCUSSION

### General Condition of the Research Location

CV. Sinar Harapan Farm (SHF) is one of the smallholder farms that has collaborated with the Faculty of Animal Science, IPB University as a multi-site test site and IPB D1 chicken development in the aspects of cultivation and product processing since 2016. SHF is located in Cirambutan RT009/RW002, Panumbangan Village, Central Jampang Sub-district, Sukabumi District (Figure 2).

Jampang Tengah sub-district has a wet climate type with an means rainfall of 2500-3000 mm year-¹. SHF is located int the highlands so the temperature in the research location is low at night. Temperatures that are too cold or hot will cause stress to livestock and reduce productivity (Astuti and Jaiman 2019). A decrease in ambient temperature below a lower critical temperature (zone of hypothermia) will cause a decrease in body temperature and result in death (Hillman *et al.* 1985).

The housing system at SHF is open house with the IPB D1, IPB D2 and IPB D3 chicken rearing system carried out intensively with a colony cage model (Figures 3a and 3b) without differentiating between males and females. Chickens aged 4 - 8 weeks are housed in colony cages made of wooden plywood and illuminated with rice husks (Figure 3a). Chickens aged 8-12 weeks were housed in wooden postal-style colony cages without litter and lighting (Figure 3b).

Drinking water was provided ad libitum, while feeding was done twice a day in the morning and evening. The feed used was a mixture of starter phase commercial feed (60%) and rice bran (40%) for chickens aged 4 to 8 weeks, while chickens aged 8 to 12 weeks were fed rice bran and fish meal (5%-10%). The amount of daily feed was adjusted to the needs according to age. During the research period, there was a scarcity of feed resources at the end of the dry season.

### Shank Length

The results showed that differences in lines in 8-week-old hens showed a significant effect (P<0.05). While in other age groups, both males and females show no difference because they have the same genetic composition. Differences in breeding objectives between IPB D2 and IPB D3 chickens also affect morphometric differences. IPB D3 chickens were formed as a male line selected based on fast growth traits. Therefore, IPB D3 chickens have a larger



Figure 2. Research Location



Figure 3. Colony Cage a) 4-8 week b) 8-12 week

Table 1. Means shank length of IPB D1, IPB D2 and IPB D3 chicken in Sukabumi District

| Age (week) | Shank Length (mm) | | | | | |
|---|---|---|---|---|---|---|
| | IPB D1 | | IPB D2 | | IPB D3 | |
| | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD |
| | Male | | | | | |
| 4 | 9 | 42.81±3.65 | 12 | 44.42±2.75 | 9 | 45.31±4.70 |
| 6 | 12 | 48.68±2.56 | 6 | 49.88±2.84 | 15 | 51.59±3.53 |
| 8 | 16 | 56.69±5.44 | 19 | 55.12±4.10 | 13 | 57.77±6.26 |
| 10 | 14 | 66.22±4.81 | 13 | 66.36±4.77 | 8 | 64.76±4.24 |
| 12 | 13 | 73.06±5.66 | 10 | 75.96±5.48 | 13 | 71.62±5.75 |
| | Female | | | | | |
| 4 | 11 | 37.42±2.69 | 10 | 38.86±5.93 | 11 | 39.54±3.43 |
| 6 | 13 | 43.25±3.57 | 9 | 44.87±3.75 | 20 | 43.58±3.16 |
| 8 | 17 | 50.45±2.94[ab] | 23 | 48.99±3.87[b] | 13 | 53.99±5.28[a] |
| 10 | 16 | 60.69±4.11 | 16 | 60.36±3.49 | 9 | 58.18±3.05 |
| 12 | 11 | 69.44±4.72 | 14 | 68.63±6.19 | 21 | 66.16±4.89 |

Note: Means in the same row with different superscripts differ significantly (P<0.05); n = number of samples (bird); SD = Standard Deviation.

Table 2. Means shank circumference of IPB D1, IPB D2 and IPB D3 chickens in Sukabumi District

| Age (week) | Shank Circumference (mm) | | | | | |
|---|---|---|---|---|---|---|
| | IPB D1 | | IPB D2 | | IPB D3 | |
| | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD |
| | Male | | | | | |
| 4 | 9 | 20.77±4.02 | 12 | 21.50±1.51 | 9 | 22.44±2.01 |
| 6 | 12 | 21.83±5.47[b] | 6 | 24.50±1.05[a] | 15 | 24.47±1.96[a] |
| 8 | 16 | 26.19±2.20 | 19 | 26.74±1.66 | 13 | 27.08±1.55 |
| 10 | 14 | 29.07±2.08 | 13 | 29.46±1.61 | 8 | 29.50±1.07 |
| 12 | 13 | 33.32±2.24 | 10 | 34.00±2.05 | 13 | 32.38±1.26 |
| | Female | | | | | |
| 4 | 11 | 16.92±5.39 | 10 | 19.50±2.01 | 11 | 19.45±2.34 |
| 6 | 13 | 17.36±2.77 | 9 | 22.44±0.53 | 20 | 22.30±1.38 |
| 8 | 17 | 24.35±1.46[b] | 23 | 24.22±1.17[b] | 13 | 25.85±2.12[a] |
| 10 | 16 | 26.38±1.02 | 16 | 27.19±1.42 | 9 | 27.56±1.59 |
| 12 | 11 | 29.45±2.07 | 14 | 29.64±0.93 | 21 | 29.57±1.12 |

Note: Means in the same row with different superscripts differ significantly (P<0.05); n = number of samples (bird); SD = Standard Deviation.

body size. IPB D2 chickens are formed as a female line that is selected based on endurance traits, so they tend to have a relatively smaller body size. Zerjal *et al.* (2021) reported that the immune system of livestock is highly dependent on metabolic resources to work optimally. This causes the immune system to compete with other biological processes that require nutrients and energy such as production or growth.

### Shank Circumference
The results showed that the means shank circumference of 6-week-old roosters had a significant difference (P<0.05), while the hens showed a significant difference (P<0.05) at 8 weeks of age. This occurs because of the selection process in IPB D1 chickens that produce

prospective IPB D2 and IPB D3 chicken lines. Measurement of shank circumference is often done in animal husbandry research to estimate body weight in chickens because there is a positive correlation between the two. The results of research by Lisnahan *et al.* (2020) stated that shank length and shank circumference have a positive correlation with body weight. The longer and larger the diameter of the shank bone, the greater the body weight that can be supported. This is in accordance with the opinion of Lukmanuddin *et al.* (2018) that chickens that have large shank bones will be able to support a large body.

### Femur Length
The results showed that different lines had a significant effect on femur length (P<0.05). This is because

Table 3. Means femur length of IPB D1, IPB D2 and IPB D3 chickens in Sukabumi District Sukabumi

| Age (Week) | Femur Length (mm) | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | IPB D1 | | IPB D2 | | IPB D3 | |
| | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD |
| | Male | | | | | |
| 4 | 9 | 46.26±3.35 | 12 | 48.85±2.67 | 9 | 46.76±3.53 |
| 6 | 12 | 51.28±2.62[b] | 6 | 53.13±2.46[ab] | 15 | 56.06±3.46[a] |
| 8 | 16 | 60.39±5.39[ab] | 19 | 57.80±3.81[b] | 13 | 61.94±4.73[a] |
| 10 | 14 | 68.97±4.45 | 13 | 70.37±3.73 | 8 | 67.34±4.86 |
| 12 | 13 | 79.34±5.04 | 10 | 80.14±4.34 | 13 | 75.47±5.60 |
| | Female | | | | | |
| 4 | 11 | 41.75±3.08 | 10 | 43.81±3.89 | 11 | 43.64±2.89 |
| 6 | 13 | 47.85±3.46 | 9 | 50.28±3.00 | 20 | 49.32±3.33 |
| 8 | 17 | 55.57±4.19[ab] | 23 | 53.14±2.91[b] | 13 | 57.79±3.90[a] |
| 10 | 16 | 60.03±4.53 | 16 | 66.06±8.28 | 9 | 62.43±1.86 |
| 12 | 11 | 74.58±4.30 | 14 | 72.90±4.76 | 21 | 72.30±5.23 |

Note: Means in the same row with different superscripts differ significantly (P<0.05); n = number of samples (bird); SD = Standard Deviation.

Table 4. Means tibia length of IPB D1, IPB D2 and IPB D3 chickens in Sukabumi District Sukabumi

| Age (week) | Tibia Length (mm) | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | IPB D1 | | IPB D2 | | IPB D3 | |
| | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD |
| | Male | | | | | |
| 4 | 9 | 61.61±5.06 | 12 | 65.88±3.48 | 9 | 63.01±5.89 |
| 6 | 12 | 68.59±2.59[b] | 6 | 70.72±3.46[ab] | 15 | 73.97±4.34[a] |
| 8 | 16 | 81.56±7.90 | 19 | 77.78±6.37 | 13 | 84.03±7.78 |
| 10 | 14 | 95.56±6.66 | 13 | 94.52±5.03 | 8 | 92.14±7.66 |
| 12 | 13 | 109.45±7.51 | 10 | 109.66±6.79 | 13 | 103.77±7.14 |
| | Female | | | | | |
| 4 | 11 | 54.14±3.10 | 10 | 57.05±6.18 | 11 | 57.49±4.53 |
| 6 | 13 | 62.65±4.39 | 9 | 67.19±5.38 | 20 | 65.27±4.22 |
| 8 | 17 | 73.94±5.95[ab] | 23 | 70.77±4.76[b] | 13 | 77.08±6.08[a] |
| 10 | 16 | 87.64±5.67 | 16 | 88.03±6.12 | 9 | 86.06±2.40 |
| 12 | 11 | 102.26±5.64 | 14 | 99.75±7.45 | 21 | 99.13±7.17 |

Note: Means in the same row with different superscripts differ significantly (P<0.05); n = number of samples (bird); SD = Standard Deviation.

IPB D2 and IPB D3 chickens are the result of selection from IPB D1 chickens. IPB D2 chickens are selected based on endurance traits and IPB D3 chickens are selected based on fast growth traits (Lestari *et al.* 2021). Therefore, IPB D3 chickens have a relatively larger morphometric than IPB D1 and IPB D2 chickens. The femur is the bone that connects the pelvis (acetabulum) to the patella and plays an important role in supporting body weight and leg movement. The femur is a typical long bone and is quite thick and twisted. The proximal end has a prominent head that enters loosely into the acetabulum. The distal end carries a deep pulley-shaped surface for the patella (kneecap) and two convex condyles that articulate with the lower leg bones. The femur bone can be used as a selection variable and body weight estimator. This is because femur length has a strong positive correlation to body weight.

**Tibia Length**

The results showed that the means tibia length of 6-week-old roosters and 8-week-old hens was different (P<0.05). The results of research by Sola-Ojo *et al.* (2020) showed that the means tibia length was significantly influenced by differences in lines in meat type chickens. This difference occurs due to selection in an individual animal. The tibia bone is a shin bone which is a lower locomotor device that includes a pipe bone. The tibia bone consists of the tibia and fibula bones and joints directly ventral to the tarsal bone and forms the tibiotarsal joint (Komi *et al.* 2021). Pulcini *et al.* (2021) argue that the morphology of the

Table 5. Means breast length of IPB D1, IPB D2 and IPB D3 chicken in Sukabumi District Sukabumi

| Age | Breast Length (mm) | | | | | |
|---|---|---|---|---|---|---|
| (week) | IPB D1 | | IPB D2 | | IPB D3 | |
| | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD |
| | | | Male | | | |
| 4 | 9 | 49.67±5.46 | 12 | 51.75±3.90 | 9 | 50.07±3.87 |
| 6 | 12 | 54.90±3.45[b] | 6 | 57.20±2.15[ab] | 15 | 60.17±3.43[a] |
| 8 | 16 | 63.30±3.94 | 19 | 62.56±5.05 | 13 | 65.32±3.12 |
| 10 | 14 | 73.59±3.90 | 13 | 73.20±3.47 | 8 | 70.92±3.78 |
| 12 | 13 | 84.00±6.22 | 10 | 83.83±4.66 | 13 | 78.17±6.79 |
| | | | Female | | | |
| 4 | 11 | 45.53±3.89 | 10 | 45.29±4.41 | 11 | 46.27±4.43 |
| 6 | 13 | 50.08±3.17 | 9 | 52.58±4.12 | 20 | 52.68±3.75 |
| 8 | 17 | 58.77±3.65[ab] | 23 | 55.82±2.97[b] | 13 | 62.05±5.38[a] |
| 10 | 16 | 67.08±3.68 | 16 | 65.74±3.35 | 9 | 65.04±4.00 |
| 12 | 11 | 76.09±5.48[a] | 14 | 72.50±4.19[ab] | 21 | 71.05±5.12[b] |

Note: Means in the same row with different superscripts differ significantly (P<0.05); n = number of samples (bird); SD = Standard Deviation.

Table 6. Means breast width of IPB D1, IPB D2 and IPB D3 chicken in Sukabumi District

| Age | Breast Width (mm) | | | | | |
|---|---|---|---|---|---|---|
| (week) | IPB D1 | | IPB D2 | | IPB D3 | |
| | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD |
| | | | Male | | | |
| 4 | 9 | 31.14±3.35 | 12 | 29.55±3.47 | 9 | 31.63±2.31 |
| 6 | 12 | 35.99±2.82 | 6 | 32.93±2.70 | 15 | 33.19±2.91 |
| 8 | 16 | 36.27±5.56 | 19 | 36.17±2.76 | 13 | 35.22±2.12 |
| 10 | 14 | 38.74±2.30 | 13 | 36.98±3.59 | 8 | 37.32±2.04 |
| 12 | 13 | 43.40±3.52[a] | 10 | 41.58±1.42[ab] | 13 | 40.45±1.33[b] |
| | | | Female | | | |
| 4 | 11 | 28.79±3.01 | 10 | 28.62±4.41 | 11 | 28.75±4.08 |
| 6 | 13 | 31.34±3.30 | 9 | 28.78±2.23 | 20 | 30.49±2.07 |
| 8 | 17 | 33.33±3.45 | 23 | 33.26±2.93 | 13 | 34.39±2.04 |
| 10 | 16 | 35.97±2.52 | 16 | 36.01±2.90 | 9 | 34.68±2.51 |
| 12 | 11 | 38.62±2.61 | 14 | 38.69±2.05 | 21 | 37.50±2.07 |

Note: Means in the same row with different superscripts differ significantly (P<0.05); n = number of samples (bird); SD = Standard Deviation.

tibia bone is influenced by the body weight of the chicken. The morphology of the tibia is a critical factor in the health and mobility of meat types.

### Breast Length

The results showed that the difference in lines had a significant effect (P<0.05) on the length of the breastbone of males aged 6 weeks, while in females aged 8 and 12 weeks there was a significant difference (P<0.05). Male IPB D3 chickens at 6 weeks of age had a significantly larger size than IPB D1 chickens. This is because IPB D3 chickens are selected based on fast-growing traits as meat-producing chickens. Therefore, large breast size and proportional to the body is an indicator of superior meat types. The results showed that in 8-week-old IPB D3 hens had a larger means

breast length, but when 12 weeks old had a smaller size. This indicates that IPB D3 chickens are not yet stable because they have not been released as a line. IPB D1 chickens have adapted to the environmental conditions in Sukabumi District because it has reached 11 generations so that its genetic condition is stable.

### Breast Width

The results showed that male IPB D3 chickens were significantly smaller (P<0.05) than IPB D1 chickens. This indicates that the genetics of IPB D3 chickens are not yet stable because they are still candidate lines. The release of lines is at least up to 5 generations with the aim that the livestock is genetically stable. Breast width is the main indicator of the size of the pectoralis muscle which is the

Table 7. Means breast depth of IPB D1, IPB D2 and IPB D3 chickens in Sukabumi District

| Age (week) | Breast Depth (mm) | | | | | |
|---|---|---|---|---|---|---|
| | IPB D1 | | IPB D2 | | IPB D3 | |
| | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD |
| | Male | | | | | |
| 4 | 9 | 55.61±4.90 | 12 | 58.11±3.35 | 9 | 57.39±4.42 |
| 6 | 12 | 63.27±2.83 | 6 | 63.72±3.33 | 15 | 66.89±4.65 |
| 8 | 16 | 69.26±4.38 | 19 | 69.06±4.80 | 13 | 71.21±4.03 |
| 10 | 14 | 78.40±3.27 | 13 | 79.75±4.16 | 8 | 76.24±4.07 |
| 12 | 13 | 88.02±5.56[ab] | 10 | 90.08±4.31[a] | 13 | 84.30±5.16[b] |
| | Female | | | | | |
| 4 | 11 | 49.64±2.84 | 10 | 50.99±5.23 | 11 | 52.22±3.35 |
| 6 | 13 | 55.25±4.10[b] | 9 | 61.29±3.53[ab] | 20 | 58.52±3.78[a] |
| 8 | 17 | 65.99±4.39[ab] | 23 | 64.25±4.88[b] | 13 | 68.73±5.66[a] |
| 10 | 16 | 73.48±4.19 | 16 | 73.47±2.65 | 9 | 71.30±2.95 |
| 12 | 11 | 82.82±6.26 | 14 | 80.75±5.15 | 21 | 80.10±5.77 |

Note: Means in the same row with different superscripts differ significantly (P<0.05); n = number of samples (bird); SD = Standard Deviation.

Table 8. Means breast circumference of IPB D1, IPB D2 and IPB D3 chickens in Sukabumi District

| Age (week) | Breast Circumference (mm) | | | | | |
|---|---|---|---|---|---|---|
| | IPB D1 | | IPB D2 | | IPB D3 | |
| | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD |
| | Jantan | | | | | |
| 4 | 9 | 136.11±12.73[b] | 12 | 145.67±10.22[ab] | 9 | 143.44±8.70[a] |
| 6 | 12 | 150.83±8.28[b] | 6 | 155.33±4.37[b] | 15 | 165.20±7.95[a] |
| 8 | 16 | 174.50±11.14 | 19 | 173.26±8.36 | 13 | 180.62±10.69 |
| 10 | 14 | 199.43±9.55 | 13 | 197.15±7.99 | 8 | 195.50±4.96 |
| 12 | 13 | 223.08±13.79[a] | 10 | 221.50±8.21[ab] | 13 | 210.31±13.03[b] |
| | Betina | | | | | |
| 4 | 11 | 121.18±8.81 | 10 | 128.00±11.63 | 11 | 134.73±10.56 |
| 6 | 13 | 138.15±8.88[b] | 9 | 151.22±4.41[a] | 20 | 146.35±7.06[a] |
| 8 | 17 | 161.35±9.27[b] | 23 | 162.26±9.17[b] | 13 | 171.46±8.72[a] |
| 10 | 16 | 183.62±10.88[ab] | 16 | 188.25±8.16[a] | 9 | 177.67±3.64[b] |
| 12 | 11 | 206.09±13.43 | 14 | 204.43±10.58 | 21 | 197.81±10.66 |

Note: Means in the same row with different superscripts differ significantly (P<0.05); n = number of samples (bird); SD = Standard Deviation.

most valuable muscle in chickens. Breast size can be used as an indicator to determine the amount of meat produced because most of the muscles are found in the chicken breast. Therefore, breast width can be used as a selection parameter for meat-producing chickens. This is according Badaruddin *et al.* (2021) chicken breast has more meat muscles that attach to the breastbone than any other parts of the bone.

### Breast Depth

The results showed that female IPB D3 chickens were significantly larger (P<0.05) at 6 and 8 weeks of age, while males were significantly smaller (P<0.05) at 12 weeks of age. This indicates that the genetic condition of IPB D3 chickens is not stable and has not been able to adapt to environmental conditions in Sukabumi District compared

to its parent IPB D1 chickens. Breast measurement aims to determine the volume of the pectroralis muscle as the largest producer in chickens. In addition, breast size has a strong positive correlation with body weight so that it can be used as a variable to predict body weight (Hastuti *et al.* 2021). This is in accordance with the opinion of Badaruddin *et al.* (2021) that a strong positive correlation between body size and body weight can be used as a parameter to estimate body weight.

### Breast Circumference

The results showed that the treatment of different lines showed a significant effect (P<0.05) on the means breast circumference. This is in accordance with the research of Sam and Okon (2023) that different lines have

Table 9. Means back length of IPB D1, IPB D2 and IPB D3 chickens in Sukabumi District

| Age (week) | Back Length (mm) | | | | | |
|---|---|---|---|---|---|---|
| | IPB D1 | | IPB D2 | | IPB D3 | |
| | n | Mean ± SD | n | Mean ± SD | n | Mean ± SD |
| | Male | | | | | |
| 4 | 9 | 78.27±4.11 | 12 | 81.80±8.17 | 9 | 84.07±2.54 |
| 6 | 12 | 88.62±6.38 | 6 | 90.55±9.01 | 15 | 91.36±7.47 |
| 8 | 16 | 99.91±6.05 | 19 | 96.05±7.30 | 13 | 98.85±7.16 |
| 10 | 14 | 106.16±5.78 | 13 | 106.42±4.50 | 8 | 103.41±6.65 |
| 12 | 13 | 121.08±7.12a | 10 | 115.64±6.47ab | 13 | 111.62±8.04b |
| | Female | | | | | |
| 4 | 11 | 76.74±8.59 | 10 | 72.90±9.22 | 11 | 76.69±6.72 |
| 6 | 13 | 81.73±4.78 | 9 | 81.59±4.76 | 20 | 83.89±5.22 |
| 8 | 17 | 92.81±7.74 | 23 | 90.24±7.91 | 13 | 91.42±6.73 |
| 10 | 16 | 102.56±6.23a | 16 | 99.83±3.58a | 9 | 94.74±3.65b |
| 12 | 11 | 113.48±5.58a | 14 | 109.59±6.59ab | 21 | 106.14±8.03b |

Note: Means in the same row with different superscripts differ significantly (P<0.05); n = number of samples (bird); SD = Standard Deviation.

a significant effect on body size. This is because IPB D2 and IPB D3 chickens are the result of selection from IPB D1 chickens. The body size that is commonly used as an indicator of muscle growth and estimating body weight is breast circumference (Ashifudin *et al.* 2017). Breast circumference is one of the important dimensions in chicken morphometrics. Measurement of breast circumference aims to distinguish lines in chickens. Meat type breeds generally have a larger breast circumference than layer breeds. This is because meat type lines are focused on producing meat. The breast dimension is the place of the most muscle deposition in chickens.

### Back Length

The results showed that the treatment of different lines showed a significant effect (P<0.05) on the means breast circumference. This is in accordance with the research of Sam and Okon (2023) that different lines have a significant effect on body size. This is because IPB D2 and IPB D3 chickens are the result of selection from IPB D1 chickens. The body size that is commonly used as an indicator of muscle growth and estimating body weight is breast circumference (Ashifudin *et al.* 2017). Breast circumference is one of the important dimensions in chicken morphometrics. Measurement of breast circumference aims to distinguish lines in chickens. Meat type breeds generally have a larger breast circumference than layer breeds. This is because meat type lines are focused on producing meat. The breast dimension is the place of the most muscle deposition in chickens. The results showed that the means back length of male IPB D1 chickens was significantly longer (P<0.05) than IPB D2 and IPB D3 at 12 weeks of age. In females, IPB D1 chickens were significantly longer (P<0.05) than IPB D2 and IPB D3 chickens at 10 and 12 weeks of age. This indicates that IPB D1 chickens have been able to adapt to environmental conditions and are stable. Measurement of back length aims to assess the growth and development

of the chicken body. The results of research by Putri *et al.* (2020) that back length is a characteristic of the body shape of KUB chickens and native chickens. Differences in the size and body shape of livestock lines are due to genetic and environmental factors (Putri *et al.* 2020). In addition, back length is also used as a variable to predict body weight because it has a positive correlation. This is in accordance with the opinion of Ukwu *et al.* (2014) that back length has a positive correlation with body weight in local chickens.

### CONCLUSION

IPB D3 chickens show that their genetic condition is not yet stable as meat type. At the age of 4 to 8 weeks, IPB-D3 chickens have a larger size in the variables of shank circumference, femur length, tibia length, breast length and breast circumference. However, at the age of 8 to 12 weeks IPB-D3 chickens have a smaller size in the variables of breast length, breast width, breast depth, breast circumference and back length. Meanwhile, IPB D1 chickens show that they are genetically stable and IPB D2 is able to adapt because of its resistance traits.

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