

Doi: 10.21059/buletinpeternak.v44i3.57016

Growth Patterns, Body Weight, and Morphometric of KUB Chicken, Sentul Chicken and Arab Chicken

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ABSTRACT

The purpose of this research was to determine the body weight, weight gain and morphometric characteristics of several local chicken strains. The research materials were KUB chicken, Sentul chicken, and Arab chicken. The method used was an experiment with a sample of 82 chickens from each strain. Data collected include body weight, weight gain, beak length, beak width, head length, head circumference, head height, neck length, neck circumference, wing length, back length, back height, chest length, chest width, shank length, shank circumference, tibia length, tibia circumference, third finger length, and pubic bone distance. Data collected were analyzed using the average difference test (t-test). The average value vector of body measurements of chicken lines was analyzed using the T^2 -Hotelling statistical test. Main Component Analysis statistical test was used to identify the shape and size characteristics of each chicken strain. The results showed that the body weight and morphometrics of KUB chickens at 3 months were significantly different ($P < 0.05$) with Sentul chickens and Arab chickens. KUB chicken's body weight gain at 3 months was not significantly different ($P > 0.05$) from Sentul chickens, but it was significantly different ($P < 0.05$) from Arab chickens. Body weight, weight gain, and morphometrics of KUB chickens were higher than Sentul chickens and Arab chickens. The size indicator in KUB chickens was the tibia length while in Sentul chickens and Arab chickens was chest length. The characteristic of KUB chickens was the back length, Sentul chickens was tibia length, and Arab chickens was the shank circumference.

Article history

Submitted: 18 June 2020

Accepted: 19 August 2020

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Keywords: Arab chicken, Body measures, Body weight, KUB chicken, Sentul chicken, Weight gain

Introduction

Indonesia is one of the countries with the most population, so the availability of both plant and animal food is very much needed. One of the livestock that can be used as a source of animal protein is chicken. Chicken is one of the livestock that is often raised by the people of Indonesia and provides a large enough role in meeting the needs of the animal protein community. Indonesia has dozens of strains of chicken that have the potential to be developed, one of which is local chicken. Local chickens are very well known by the people of Indonesia because of their very wide distribution area. Among the many local chickens in Indonesia, several strains that are tried to be developed are Sentul chickens, KUB chickens (Kampung Unggul Balitnak), and Arab chickens.

KUB chicken is the Superior Kampung chicken of the Indonesian Agency for Agricultural Research and Development which is the result of selection from a native chicken family for 6 generations (Hidayah *et al.*, 2019). KUB chickens are raised to produce eggs and meat production.

KUB chickens have promising prospects both economically and socially because it can supply the needs of highly nutritious food and have the absorption capacity of local and regional markets (Suryana, 2017).

Sentul chicken is one type of local chicken in Indonesia that has been recognized as germplasm of Ciamis Regency through Minister of Agriculture Decree No. 689/Kpts.PD41/ 2/2013 concerning the Determination of Sentul Chickens Clumps as Indonesian Local Clumps from Ciamis (Menteri Pertanian, 2013). Sentul chicken has the potential to be developed as meat and egg-producing chicken because it has good performance in terms of productivity.

Arab chickens originating from Belgium are also called *Kriel Braekels* which are included in the superior laying hens in Belgium. Arabic chicken is one of the native chickens that have been adapted in Indonesia (Gunawan *et al.*, 2018). Arab chickens initially received less attention from breeders, but now Arab chickens have begun to be developed and increased in production. Arab chicken is one type of egg-

producing chicken that is quite potential because of its high egg production resembling the productivity of laying hens. Arabian chickens are superior laying hens classified as light type chickens with a body weight of 40 weeks reaching 2.035g (Indra *et al.*, 2013).

Information about KUB chickens, Sentul chickens, and Arab chickens are not widely known, especially regarding their genetic potential. Genetic information is needed to determine the genetic quality of livestock which will be used as a material consideration in the selection and crossbreeding of local chickens in the future. Efforts can be made to obtain basic information about the genetic quality of livestock, it is necessary to do morphometric characterization of KUB chickens, Sentul chickens, and Arab chickens.

Morphometrics is a quantitative data collection activity that can be used to determine the level of livestock productivity, identification, and determinants of the characteristics of livestock which includes size and shape. Morphometric characteristics can be described by femur length, tibia length, maxilla length, wing length, tarsometatarsus length, tarsometatarsus circumference, third finger length (middle), and sternum length (Ashifudin *et al.*, 2017). Each type of chicken has unique characteristics both in size and body shape. Body measurements can be used to study animal growth and development. Morphometric measurements can also help the process of selection and crossbreeding between nations and types (Kurnianto *et al.*, 2013). The importance of this research is due to the lack of knowledge about morphometrics, especially in KUB chickens, Sentul chickens, and Arab chickens which can later be used as basic information for the development of local chickens in the future.

Materials and Methods

The research material is KUB chickens, Sentul chickens, and Arab chickens that are kept from the age of DOC until the age of 3 months. The number of samples was 82 heads (41 males and 41 females) from each chicken strain. The equipment used is a digital caliper, digital scales capacity of 3 kg with an accuracy of 0.01 grams, measuring tape, digital cameras, stationery, 1 unit cage, place of feed and drink, commercial feed and drinking water, vaccines, and medicines.

The method used in this study was an experiment on body measurements and body weight of KUB chickens, Sentul chickens and Arabic chickens. The Chicken breeding system in a colony cage where each strain is placed in a different cage with other strains. The size of the cage used is 4 x 3 x 1.8 m which is equipped with a place to feed, drink, and lighting. Feeding and drinking are done continuously (*ad libitum*). Measurement of body measurements and body weight is done every month and every chicken that is measured is marked on the wings. Data collected includes body weight (BW),

weight gain (WG), and morphometrics of chickens. Variables measured include beak length (BL), beak width (BW), head length (HL), head circumference (HC), head height (HH), neck length (NL), neck circumference (NC), wing length (WL), back length (BL), back height (BH), chest length (CL), chest width (CW), shank length (SL), shank circumference (SC), tibia length (TL), tibia circumference (TC), third finger length (TFL) and pubic bone distance (PBD) based according to Koch (1973) and Sisson and Grossman. (1975).

Body Weight (BB) was measured by weighing chickens with digital scales (g). Beak Length (BL) between the base of the maxilla to the tip of the maxilla, as measured by a digital calipers (mm). Beak Width (BW) was measured from the outer half of the left and right, using a digital calipers (mm). Head Length (HL) was measured from the base of the beak to the rear of the head, using a digital calipers (mm). Head Circumference (HC) was measured at the highest part of the head by using a measuring tape (cm converted to mm). Head Height (HH) was measured at the highest part of the head using a digital calipers (mm). Neck Length (NL) was measured from the first cervical vertebrae to the last cervical vertebrae using a digital caliper (cm). Neck Circumference (NC) wraps around the measuring tape around the neck (cm converted to mm). Wing Length (WL) was measured from the humeral bone to the tip of the phalanges using a measuring tape (cm converted to mm). Back Length (BL) was measured from the tip of the neck to the base of the tail using a measuring tape (cm converted to mm). Back Height (BH) was measured from the bottom of the rests to the back using a ruler (cm converted to mm). Chest Length (CL) measurement of the length of the chest (sternum) was carried out from the front of the chest to the back of the chest using a digital caliper (mm). Chest Width (CW) measurement of chest width was obtained by measuring the distance from the left to the right (widest) sternal bone using a digital calipers (mm). Shank Length (SL) was measured along the tarsometatarsus bone (shank) using a digital caliper (mm). Circumference Shank (CS) around the measuring tape at the center of the tarsometatarsus bone (shank) (cm converted to mm). Tibia Length (TL) was measured from the patella to the tip of the tibia using a digital calipers (mm) Tibia Circumference (TC) wraps measuring tape around the tibia (cm converted to mm) Third Finger Length (TFL) was measured from the base to the tip of the third finger using a digital calipers (mm). Pubic Bone Distance (JTP) is measured using digital calipers (mm).

Data that has been collected include body weight and body measurements grouped by sex, then corrected to male measurements. After that continued with analyzed using the average difference test (t-test). The average value vector of the two sex groups includes BL, BW, HL, HC, HH, NL, NC, WL, BL, BH, CL, CW, SL, SC, TL, TC, TFL, PBD were analyzed using the T^2 -Hotelling statistical test. Then do the statistical test to identify determinants of body shape and size in chickens using Principal Component Analysis (PCA) (Gaspersz, 2006). Data processing is

assisted by using Minitab statistical software version 18.

Results and Discussion

Local chicken body weight DOC-3 months

The average body weight of KUB chickens, Sentul chickens, and Arab chickens aged DOC up to 3 months are presented in Table 1. Based on Table 1 it can be seen that the average body weight of 3 months in KUB chickens is 1108.42 ± 84.52 g, in Sentul chickens is 1021.44 ± 100.42 g, while in Arab chickens is 874.57 ± 74.21 g. The average body weight of KUB chickens in this study is higher than the results of Suryana (2017) research which states the average body weight of KUB chickens at 3 months is 750 g. The average body weight of Sentul chickens in this study was higher than Kurnia (2011) research which was 532.1 g. However, the average body weight of Sentul chickens in this study is lower than Habiburrahman *et al.* (2018) research in Pelung Sentul crossbreed chickens at 3 months of age is 1193.9 gr. The average body weight of Arab chickens in this study is higher than Nataamijaya *et al.* (2003) research with an average of 700 gr. This difference in results is thought to be due to genetic, environmental, and maintenance management differences. This is in accordance with the statement of Subekti and Arlina (2011) which states that differences in body size of chickens can be caused by different environmental conditions of the origin of the seeds and different maintenance environments, as well as genetic factors.

The results of the average difference test (t-test) showed that the DOC KUB chickens weight was not significantly different ($P > 0.05$) with Sentul chickens or Arab chickens, as well as Sentul chickens not significantly different ($P > 0.05$) with Arab chickens. Body weight at 1 month of age KUB chickens was significantly different ($P < 0.05$) with Sentul chickens and Arab chickens, while Sentul chickens body weight was not significantly different ($P > 0.05$) from Arab chickens. This is due to variations in the rate of growth between individuals in the form of slow growth at the beginning of the week which then increases at the end of maintenance. At 2 months KUB chickens were significantly different ($P < 0.05$) from Sentul chickens and Arab chickens, as well as Sentul chickens body weight significantly different ($P < 0.05$) from Arab chickens. Body weight at 3 months showed that KUB chickens were significantly different ($P < 0.05$) from Sentul chickens and Arab chickens, as well as Sentul

chickens significantly different ($P < 0.05$) from Arab chickens. Based on Table 1 it can be seen that the highest body weight at DOC age, 1 month, 2 months and 3 months is KUB chickens, while the lowest body weight is Arab chickens, it can be stated that KUB chicken has a higher body weight than Sentul chickens and Arab chickens. The differences in body weight are due to differences in genetics, seedling origin, and environmental adaptation. According to Zainal *et al.* (2012) the difference in body weight in livestock shows that each breed has a different ability in growth. This occurs due to differences in the ability to adapt to the environment which is an indication of the magnitude of environmental influence on the ability to grow.

Weight gain of local chicken

The weight gain of KUB chickens, Sentul chickens, and Arab chickens at the age of DOC – 3 months are presented in Figure 1. Based on the different tests the average body weight gain of DOC KUB chickens was not significantly different ($P > 0.05$) with Sentul chickens and with Arab chickens. The weight gain of 1 - 2 months KUB chickens were significantly different ($P < 0.05$) with Sentul chickens and Arab chickens, as well as Sentul chickens body weight gain was significantly different ($P < 0.05$) with Arab chicken. Body weight gain of 2 - 3 months KUB chickens were not significantly different ($P > 0.05$) with Sentul chickens but significantly different ($P < 0.05$) from Arab chickens, while Sentul chickens body weight gain was significantly different ($P < 0.05$) with Arab chickens.

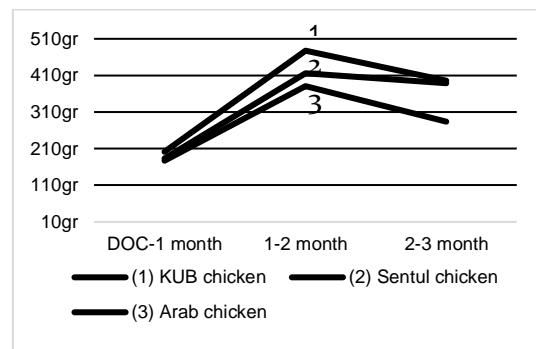


Figure 1. Graph of weight gain of local chicken bodies.

Figure 1 shows that the average weight gain of KUB chickens, Sentul chickens, and Arab chickens from DOC - 3 months of age in a row are KUB chickens was 201.44 ± 37.92 g, 477.51 ± 56.75 g, and 395.27 ± 103.09 g. The average

Table 1. Average body weight of local chickens

Age	Local Chicken		
	KUB chicken	Sentul chicken	Arab chicken
DOC (g)	34.20±3.09 ^a	33.85 ±2.53 ^a	33.45±3.33 ^a
1 month (g)	235.64±38.63 ^a	217.06±42.88 ^b	210.50±35.28 ^b
2 months (g)	713.15±66.75 ^a	632.88±85.10 ^b	591.20±55.11 ^c
3 months (g)	1,108.42±84.52 ^a	1,021.44±100.42 ^b	874.57±74.21 ^c

Different letter superscripts on the same line for each type of chicken mean significantly different ($P < 0.05$).

weight gain of Sentul chickens was 183.21±42.91 g, 415.82±95.84 g, and 388.57±100.39 g. While the average body weight gain of Arab chickens was 177.04±36.55 g, 380.70±53.15 g, and 283.37±80.58 g. The weight gain of KUB chickens, Sentul chickens, and Arab chickens continue to increase or grow rapidly at the age of 1 - 2 months and decrease at the age of 2 - 3 months. This is in line with the opinion of Urfa *et al.* (2017) which states the growth of chicken body weight will be fast and reach a specific weight at a young age.

Weight gain is an important factor to consider in observing chicken performance. KUB chickens have the highest body weight gain compared to Sentul chickens and Arab chickens both at the age of DOC - 1 month, 1 - 2 months and 2 - 3 months, which means livestock genetics can influence body weight growth. Kub chickens is a cross chicken from the selection of female Kampung chickens in West Java to increase livestock productivity through crossing between lines to get a high level of heterosis. This is consistent with the opinion of Daud *et al.* (2017) which states that one of the factors that can influence chicken body weight gain is the genetic factor of each chicken strain.

Morphometric characteristics of local chickens at 3 months

From the results of this study regarding the body measurements (morphometrics) of KUB chickens, Sentul chickens, and Arab chickens, the average and different test results are obtained based on the measured parameters as in Table 2.

Based on Table 2 the average difference test results showed that the body measurements of KUB chickens were significantly different

($P < 0.05$) with Sentul chickens and Arab chickens, as well as the body measurements of Sentul chickens were significantly different ($P < 0.05$) with Arab chickens. The highest average body measurements are KUB chickens, while the lowest average body measurements are Arab chickens. This means that KUB chickens have a higher meat production capability than Sentul chickens and Arab chickens. This indicates that KUB chickens are more directed to the broiler-type, although according to Suprijatna (2010) local chickens are dual-purpose chickens but can be selected for specific business purposes as the broiler or layer types. Selection towards meat-based on the body weight of chickens is shown by the properties of linear body surface size which are closely correlated with body weight. This difference in body size is thought to be a result of the genetic influence of livestock because the environmental conditions in which the research has been attempted are almost the same, so the real difference in body size parameters is thought to be caused by genetic diversity. Following the opinion of Rajab and Papilaya (2012) variations in chicken, body size can be caused by the influence of different genetic, environmental, and climatic conditions.

***T*²-Hotteling test**

The *T*²-Hotteling test was used to determine the similarities and differences in body measurements between the two groups of livestock. *T*²-Hotteling test results of body size of KUB chickens, Sentul chickens, and Arab chickens can be seen in Table 3.

Based on *T*²-Hotteling statistical test shows that the KUB chickens body measurements are significantly different ($P < 0.01$) compared to Sentul

Table 2. Morphometric characteristics of local chickens at 3 months

Body Measurements	KUB chicken	Sentul chicken	Arab chicken
BL (mm)	34.76±1.61 ^a	32.32±1.51 ^b	30.07±1.63 ^c
BW (mm)	7.84±0.50 ^a	7.08±0.69 ^b	6.37±0.54 ^c
HL (mm)	40.27±1.86 ^a	36.37±1.11 ^b	34.18±1.67 ^c
HC (mm)	32.30±2.10 ^a	30.25±1.66 ^b	28.52±1.56 ^c
HH (mm)	109.68±4.21 ^a	103.22±5.23 ^b	99.97±4.23 ^c
NL (mm)	125.83±5.24 ^a	117.27±6.69 ^b	96.78±5.80 ^c
NC (mm)	83.32±5.84 ^a	78.36±5.26 ^b	72.56±4.03 ^c
WL (mm)	190.07±6.42 ^a	180.02±7.40 ^b	172.69±6.47 ^c
BL (mm)	208.17±7.63 ^a	190.78±6.89 ^b	179.52±5.12 ^c
BH (mm)	265.76±8.50 ^a	241.50±8.58 ^b	227.42±5.75 ^c
CL (mm)	121.21±6.16 ^a	113.29±6.84 ^b	105.42±4.84 ^c
CW (mm)	56.39±4.31 ^a	52.30±3.13 ^b	48.58±4.50 ^c
SL (mm)	79.25±6.75 ^a	72.87±5.87 ^b	67.32±4.17 ^c
SC (mm)	42.07±2.29 ^a	38.39±2.52 ^b	35.17±1.84 ^c
TL (mm)	118.58±6.96 ^a	111.12±4.83 ^b	106.47±5.49 ^c
TC (mm)	95.71±7.07 ^a	90.15±5.49 ^b	84.42±5.25 ^c
TFL (mm)	62.88±5.43 ^a	55.67±4.77 ^b	51.49±3.45 ^c
PBD (mm)	14.74±0.58 ^a	14.99±0.91 ^b	15.44±0.91 ^c

Different letter superscripts on the same line for each type of chicken mean significantly different ($P < 0.05$), BL = Beak Length, BW = Beak Width (BW), HL = Head Length, HC = Head Circumference, HH = Head Height, NL = Neck Length, NC = Neck Circumference, WL = Wing Length, BL = Back Length, BH = Back Height, CL = Chest Length, CW = Chest Width, SL = Shank Length, SC = Shank Circumference, TL = Tibia Length, TC = Tibia Circle, TFL = Third Finger Length and PBD = Pubic Bone Distance.

Table 3. *T*²-Hotteling Test for local chicken body measurements

Body Measurements	Statistics <i>T</i> ² Hotteling	F Value	P Value	Conclusion
KUB-S	375.9094	16.9681	0.00	**
KUB-A	1,530.389	69.0800	0.00	**
S-A	826.1915	37.2934	0.00	**

KUB = Kampung Unggul Balitnak chicken, S = Sentul chicken, A = Arab chicken. ** = Significantly Different ($P < 0.01$).

Table 4. Equation determining determinant of body size and shape with total diversity and eigenvalue in chickens

Type	Equation	KT (%)	λ
KUB chicken	Body Size = $0.256 \text{ BL} + 0.239 \text{ BW} + 0.206 \text{ HL} + 0.177 \text{ HC} + 0.245 \text{ HH} + 0.244 \text{ NL} + 0.243 \text{ NC} + 0.241 \text{ WL} + 0.176 \text{ BL} + 0.174 \text{ BH} + 0.250 \text{ CL} + 0.259 \text{ CW} + 0.262 \text{ SL} + 0.223 \text{ SC} + \mathbf{0.263 \text{ TL}} + 0.243 \text{ TC} + 0.257 \text{ TFL} + 0.253 \text{ PBD}$	61.60%	11.08
	Body Shape = $0.132 \text{ BL} + 0.301 \text{ BW} - 0.118 \text{ HL} - 0.426 \text{ HC} - 0.149 \text{ HH} - 0.350 \text{ NL} - 0.287 \text{ NC} - 0.113 \text{ WL} + \mathbf{0.379 \text{ BL}} + 0.245 \text{ BH} + 0.268 \text{ CL} + 0.077 \text{ CW} + 0.215 \text{ SL} - 0.206 \text{ SC} + 0.185 \text{ TL} - 0.216 \text{ TC} + 0.066 \text{ TFL} - 0.030 \text{ PBD}$	6.70%	1.21
Sentul chicken	Body Size = $0.243 \text{ BL} + 0.200 \text{ BW} + 0.187 \text{ HL} + 0.234 \text{ HC} + 0.250 \text{ HH} + 0.243 \text{ NL} + 0.246 \text{ NC} + 0.216 \text{ WL} + 0.230 \text{ BL} + 0.227 \text{ BH} + \mathbf{0.262 \text{ CL}} + 0.248 \text{ CW} + 0.261 \text{ SL} + 0.236 \text{ SC} + 0.225 \text{ TL} + 0.252 \text{ TC} + 0.257 \text{ TFL} + 0.208 \text{ PBD}$	72.90%	5.00
	Body Shape = $-0.111 \text{ BL} - 0.453 \text{ BW} - 0.646 \text{ HL} + 0.023 \text{ HC} + 0.124 \text{ HH} + 0.085 \text{ NL} - 0.031 \text{ NC} + 0.289 \text{ WL} + 0.027 \text{ BL} - 0.059 \text{ BH} + 0.177 \text{ CL} + 0.002 \text{ CW} + 0.029 \text{ SL} - 0.052 \text{ SC} + \mathbf{0.389 \text{ TL}} + 0.073 \text{ TC} - 0.187 \text{ TFL} + 0.164 \text{ PBD}$	13.11%	8.95
Arab chicken	Body Size = $0.254 \text{ BL} + 0.250 \text{ BW} + 0.245 \text{ HL} + 0.254 \text{ HC} + 0.250 \text{ HH} + 0.201 \text{ NL} + 0.234 \text{ NC} + 0.209 \text{ WL} + 0.258 \text{ BL} + 0.250 \text{ BH} + \mathbf{0.263 \text{ CL}} + 0.258 \text{ CW} + 0.258 \text{ SL} + 0.239 \text{ SC} + 0.221 \text{ TL} + 0.203 \text{ TC} + 0.194 \text{ TFL} + 0.176 \text{ PBD}$	60.50%	7.30
	Body Shape = $-0.271 \text{ BL} - 0.255 \text{ BW} - 0.053 \text{ HL} - 0.067 \text{ HC} - 0.063 \text{ HH} - 0.014 \text{ NL} - 0.106 \text{ NC} - 0.100 \text{ WL} + 0.046 \text{ BL} - 0.315 \text{ BH} - 0.067 \text{ CL} - 0.002 \text{ CW} + 0.001 \text{ SL} - 0.093 \text{ SC} + 0.384 \text{ TL} + \mathbf{0.461 \text{ TC}} + 0.417 \text{ TFL} + 0.424 \text{ PBD}$	10.89%	1.31

Different letter superscripts on the same line for each type of chicken mean significantly different ($P < 0.05$). BL = Beak Length, BW = Beak Width (BW), HL = Head Length, HC = Head Circumference, HH = Head Height, NL = Neck Length, NC = Neck Circumference, WL = Wing Length, BL = Back Length, BH = Back Height, CL = Chest Length, CW = Chest Width, SL = Shank Length, SC = Shank Circumference, TL = Tibia Length, TC = Tibia Circle, TFL = Third Finger Length and PBD = Pubic Bone Distance.

chickens and Arab chickens, Sentul chickens body measurements are significantly different ($P < 0.01$) from Arab chickens. Differences in livestock body size are thought to be caused by genetic differences. This is following the opinion of Hikmawaty *et al.* (2014) which states that livestock body sizes may differ from one another due to the possibility of differences in diversity due to genetic potential, origin location, maintenance, and mating systems applied in the area. Based on the T2-Hotteling test it can be concluded that KUB chickens have the largest body measurements compared to Sentul chickens and Arab chickens, while Arab chickens have the smallest body measurements.

Principal component analysis

The equations determining the size and shape, total diversity, and eigenvalues of KUB chickens, Sentul chickens, and Arab chickens at 3 months based on principal component analysis are presented in Table 4. Based on the results of the size equation in Table 4, it can be seen that the total diversity of the first main component which is equalized with the size of the KUB, Sentul and Arab chickens respectively are 61.60%, 72.90% and 60.50% with Eigenvalue 11.08, 5.00 and 7.30. The total diversity of the second main components which is equal to the form in KUB chickens, Sentul chickens, and Arab chickens respectively are 6.70%, 13.11%, and 10.89% with Eigenvalues 1.21, 8.95, and 1.31.

Variable body measurements that affect the size identifier in KUB chickens are TL but Sentul and Arab chickens are CL. This means that the length of the tibia and chest length is a measure of size in KUB chickens, Sentul chickens, and Arab chickens because it has the largest contribution to the size score in the body size equation.

Variable body measurements of KUB chickens, Sentul chickens, and Arab chickens that influence the shape identifiers respectively are BL, TL, and TC. This means that the back length, the

length of the tibia, and the circumference of the shank are the hallmarks of the shape of the chicken because it has the largest contribution to the shape equation. This is following the opinion of Candrawati (2007) argues that identification is done by finding the characteristics of each type of local chicken based on the size and shape which is calculated by the statistical method of Principal Component Analysis (PCA). The shape is strongly influenced by genetics, while the size is more influenced by the environment or regional topography. Analysis of the Principal component (PCA) is one way to find out the discrimination between the size and body shape of chickens. Mariandayani *et al.* (2013) added that the analysis of the main components of phenotypic parameters can be used to determine morphometric parameters that indicate the nation's markers and are referred to as the nation's differentiator variables.

Conclusions

Body weight, weight gain, and body measurements of KUB chickens are higher than Sentul chickens and Arab chickens. The highest weight gain from DOC - 3 months of KUB chickens, Sentul chickens, and Arab chickens were at 1 - 2 months. The size indicator of KUB chickens was tibia length while in Sentul chickens and Arab chickens were chest length. The shape indicator of KUB chickens is back length, Sentul chickens is tibia length, and Arab chicken is the shank circumference.

Acknowledgment

Thank you to the supervisor Dr. Ir. Gushairiyanto, M. Si. and Dr. Ir. Depison, M. P. who has guided this research directly and author grateful to teammates who have contributed to this research.

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