
Analyses of body and chest morphometric comparison between two Indonesian local poultry species

Putranto, H. D.^{1*}, Setianto, J.¹, Yumiati, Y.² and Handika, D.¹

¹Department of Animal Science, Faculty of Agriculture, Universitas Bengkulu, Bengkulu, Indonesia; ²Agribusiness Study Program, Faculty of Agriculture, Universitas Dehasen Bengkulu, Bengkulu, Indonesia.

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Abstract Indonesia is well known for its endemic fauna diversity including various aves dan poultry species, especially birds and local chickens. Sumatera island where Bengkulu province is located has varieties of endemic chickens such as balenggek chicken in West Sumatera, burgo chicken and Talang Benih duck in Bengkulu, and merawang chicken in Bangka Belitung. Burgo chicken is a crossmated species between male red jungle fowl and female kampung chicken. Unfortunately, an itemized morphometric studies to compare the size of its body part to its parental, kampung chicken, is still unrevealed yet until this present study conducted. The research results found that female burgo chicken had a smaller values of morphometrical size on body weight, chest girth, and chest length compare to kampung chicken, except for its body length. Average of burgo chicken and kampung chicken body weight, body length, chest girth and chest length were 0.7598 kg and 1.284 kg, 27.57 cm and 30.72 cm, 11.10 cm and 13.78 cm, 24.97 cm and 28.02 cm, respectively. Then, the coefficient of variation for burgo chicken and kampung chicken body weight, body length, chest girth and chest length were 17.48% and 19.58%, 7.73% and 6.67%, 8.71% and 14.44%, 6.53% and 8.32%, respectively. Furthermore based on t-test result, burgo chicken morphometrical size was significantly smaller than kampung chicken ($P < 0.05$). It can be concluded that variance of morphometric size of burgo chicken was smaller compared to kampung chicken.

Keywords: Body size, burgo chicken, kampung chicken

Introduction

Among those poultry species, chicken has been used and produced on a large number to supply human's protein necessity especially in South East Asia countries such as Indonesia, Thailand, Malaysia etc. In general, chicken meat has been consumed widely across the world as one of our protein resources, and in some part of the world it is cheaper than other type of protein such as beef, venison or seafood. The poultry potentials for its egg and meat producer functions already contribute for giant foodstuff industries growth on earth. Oloyo (2018) wrote that this industry provides tons of financial benefits, not only for industries and governments but also yield a profit for smale scale poultry entrepreneurs.

* **Corresponding Author:** Putranto, H. D. **Email:** heri_dp@unib.ac.id

In line with the development of sustainable agriculture technology, chicken is a species which has gone through various stages of domestication and scientific development process, and caused changes on its genetic potentials. Researchers are still working for its modifications in his efforts to fulfill market demands. Nowadays, the utilization of local and endemic chicken species to improve its genetic potentials or sometimes to strengthen its function as a meat producer has been commonly developed. *Putranto et al.* (2017) mentioned that in Indonesia, kampung chicken (*Gallus domesticus*), a local subspecies which was genetically closed to Sumateran red jungle fowl (*Gallus gallus gallus*) is a sample of an improved function chicken as a regular meat producer.

In Bengkulu Province of Indonesia, an endemic local chicken named Burgo is frequently promoted as a specific icon of Bengkulu. Located on western part of Sumatera island, Bengkulu Province is also well known as *Rafflesia arnoldi* land the biggest flower on earth. Furthermore, some scientific studies on Burgo were conducted and published. *Putranto et al.* (2012a) studied on burgo's genetic information particularly on maternal phylogenetic kinship with its parental, *Putranto et al.* (2012b) studied about burgo sexual hormone concentration and follicle numbers. *Putranto et al.* (2010, 2017) also conducted researches on burgo's population and developed an android method counting number of burgo in coastal area.

This endemic species of chicken was recognized as a crossbreed between male jungle fowl and female kampung chicken. Male burgo is famous as a long and beautiful crowler type of cock. Sometimes million of IDR should be paid by a chicken lover or fanciers to have a beautiful long crowler champion male. From previous studies it was also known that female Burgo has an enormous potential to be used as laying hens. The number of annual production of female Burgo eggs is not significantly different from the production of laying chicken eggs, but it is higher than the amount of production of kampung chicken eggs. An adult female burgo can produce approximately 10 to 15 eggs in a clutch, and about 60 eggs in a year (*Putranto et al.* 2012b). The average of burgo egg weight was 26.50 to 35.50 gram, and it is smaller and lighter than kampung chicken egg (Fig.1). A growing female burgo aged 1 to 9 weeks old require feed contains 18% protein to maintain its optimum growth. Among Bengkulu coastal area such as Bengkulu city, Bengkulu Utara district and Seluma district, the highest number (about 53%) of burgo chicken found in Bengkulu Utara and the lowest number found in Seluma (*Putranto et al.* 2017).

In this study, we also used kampung chicken which is classified as one of the potential local resources in supporting local house-hold income. It is very common to find Indonesian local house-hold keep kampung chicken as their main livestock. It also well known that female kampung chicken is Burgo's parental ancestry. However, kampung chicken has a wide phenotypic variations in all across the nation as its uniqueness.

Therefore, researchers believe that we need to explore deeper to benefit science and technology about kampung chicken itself. Especially, there are many ongoing studies utilize kampung chicken as genetic resources for breeding program to improve Indonesian livestock industry.

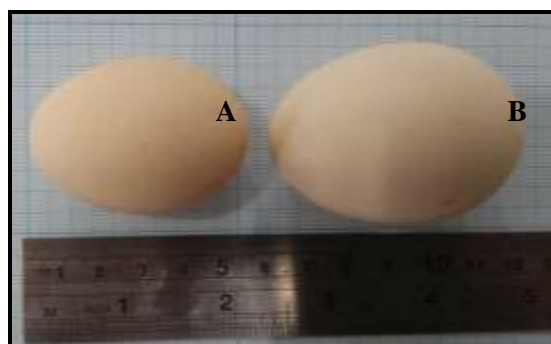


Figure 1. Burgo egg (A) is smaller and lighter than kampung chicken egg (B)

The most recent scientific information and knowledge about female burgo chicken and female kampung chicken is still very behind when compared those to latest scientific information and knowledge of other poultry species. It is estimated that variations in the morphometric characteristics of burgo and kampung chicken are still high, as we consider that female burgo chicken whose potential has not been widely explored such as morphometric characteristics.

In addition, female burgo chicken has not been widely used by the public in general. Limited studies on morphometric characteristics in burgo and female kampung chickens need to be done. Moreover, there is no specific standard for female burgo chicken characteristics, in terms of body shape and size. Furthermore, the appearance of female burgo chicken is well known varies in color and its distinctive fur pattern, and those facts are making female burgo chicken difficult to be selected for a breeding program.

This study purpose was to collect and compare the morphometric characteristics of body weight, body length, chest length and chest girth between Bengkulu's female burgo chicken and female kampung chicken. Through this activity, researchers can fulfil and completing the existing data, and can support the efforts of Burgo chicken preservation as Bengkulu's original fauna resources. The study results can support the poultry farming and as a decision-making reference for a development of future female burgo breeding program.

Materials and methods

This research was conducted for approximately 60 days of work during February to April 2018. The activities were carried out at the

Integrated Livestock Zone (ILZ) of Department of Animal Science Faculty of Agriculture Universitas Bengkulu Indonesia. The materials used in this study were total of 60 chickens divided into 30 adult female burgo chickens aged between 5 to 7 months old (Fig.2) and 30 adult female kampung chickens aged between 5 to 7 months old (Fig.3). Researchers equipped with a digital hanging scale (3 kilograms capacity and 20 grams sensitivity) to scale body weight, a 15 cm digital sigital vernier caliper (0.01 mm sensitivity) to measure body length, chest length and chest girth, and a 16 megapixel camera and stationaries.



Figure 2. Female burgo chicken aged 5 to 7 months of age



Figure 3. Female kampung chicken aged 5 to 7 months of age

Samples were taken by using a purposive sampling method. Female burgo chickens used in this study were captured at the Integrated Livestock Zone (ILZ), therefore the uniformity of female chicken samples were relatively high. Those chickens were kept by an intensive management system and fed a mixture of pellet contains 30% crumble and 70% corn, 2

times a day (morning and evening) and provided an *ad libitum* drinking water.

Data were collected in direct measurements of 30 adult female burgo chickens and 30 adult female kampung chickens. The collecting data activities were repeated 2 times, and the average values were used as final data. This study was conducted in five stages which were feed preparation, cage preparation, animal preparation, research, and data analysis. All female chickens used prior the study began were confirmed in a healthy condition and aged 5 to 7 months old. We assumed there were no bone growth when chicken reached age of 5 months. Some research on morphometric studies showed that a measurement activity on adult chicken will provide more accurate results.

Observation of morphometric is performed on each individual female. Parameters were observed as body weight; it was measured by using a scale in unit of grams. This activity was carried out in morning prior the feeding time, body length, ; It was obtained by measuring the length of mandibular bone to the tip of the pygostyle bone using a measuring tape in unit of cm., chest length, it was obtained by measuring the length of sternum bone using a measuring tape in unit of cm., and chest girth; it was obtained by measuring the chest girth on the back of both wings using a measuring tape in unit of cm. Data were analysed as mean value, standard deviation and coefficient of variation. Furthermore, the comparison of morphometric characteristics of adult female burgo chickens and adult female kampung chickens were analysed by using a *t-test* and each group was considered has no similarity type.

Results

Observations on female burgo chicken and female kampung chicken morphometrics were carried out for each individual. Parameters observed in morphometric studies based on recommendations of FAO (2012) and Nishida *et al.* (1982).

Body weight

Table 1. Body weight analysis

Number	Female chicken	Body weight (kg)
1	Burgo	0.76 ±0.13
	Coefficient variation (%)	17.48
2	Kampung	1.28 ±0.25
	Coefficient variation (%)	19.58

n = 30 adult female burgo chickens and 30 adult female kampung chickens

The body weight in kilogram (kg) was shown in Table 1. The average body weight of female burgo chicken was approximately 59.4% of female kampung chicken. The coefficient variation of female burgo chicken was smaller than female kampung chicken, that means coefficient variation of female burgo chicken relatively high with a range of body weight between 0.4 to 0.9 kg.

Body length

Table 2. Body length analysis

Number	Female chicken	Body length (cm)
1	Burgo	27.57 ± 2.13
	Coefficient variation (%)	7.73
2	Kampung	30.72 ± 2.05
	Coefficient variation (%)	6.67

n = 30 adult female burgo chickens and 30 adult female kampung chickens

The body length in centimeter (cm) was shown in Table 2. The average body length of female burgo chicken was 3.15 cm shorter than female kampung chicken. The coefficient variation of female burgo chicken was higher than female kampung chicken (7.7% versus 6.7%).

Chest length

The data on average of chest length was shown on Table 3. The data of female burgo and kampung chicken chest length are in centimeter (cm). The average chest length of female kampung chicken was 2.7 cm longer than female burgo chicken. The coefficient variation of female kampung chicken was higher than female burgo chicken (14.4% versus 8.7%).

Table 3. Chest length analysis

Number	Female chicken	Chest length (cm)
1	Burgo	11.10 ± 0.97
	Coefficient variation (%)	8.71
2	Kampung	13.78 ± 1.99
	Coefficient variation (%)	14.44

n = 30 adult female burgo chickens and 30 adult female kampung chickens

Chest girth

The average of chest girth of female burgo and kampung chicken were in centimeter (cm) was shown in Table 4. Widely well known that chest girth has a strong correlation to poultry body weight. Based on the result,

we found that the average chest girth of female burgo chicken was approximately 89.4% of female kampung chicken. The coefficient variation of female kampung chicken was higher than female burgo chicken (8.3% versus 6.5%).

Table 4. Chest girth analysis

Number	Female chicken	Chest girth (cm)
1	Burgo	24.97 ± 1.64
	Coefficient variation (%)	6.53
2	Kampung	28.02 ± 2.33
	Coefficient variation (%)	8.32

n = 30 adult female burgo chickens and 30 adult female kampung chickens

***t*-test results**

The results of the *t*-test showed that the morphometric characteristics of female burgo chickens and female kampung chicken were significantly different ($P < 0.05$) (table 5). This can be seen by the average size of body length and body weight of female burgo chickens which is smaller than that female kampung chicken, except for chest length.

Table 5. *t*-test results

Morphometrics	Female burgo chickens		Female kampung chickens	
	Average ± SD ¹	(CV) ²	Average ± SD ¹	(CV) ²
BW (kg) ³	0.75 ± 0.13 ^a	(17)	1.28 ± 0.25 ^b	(19)
BL (cm) ⁴	27.57 ± 2.13 ^a	(7)	30.72 ± 2.05 ^b	(7)
CL (cm) ⁵	11.10 ± 0.96	(9)	13.78 ± 1.99	(14)
CG (cm) ⁶	24.97 ± 1.64 ^a	(6)	28.02 ± 2.33 ^b	(8)

¹Standart deviation

²Coefficient variation (%)

³Body weight

⁴Body length

⁵Chest length

⁶Chest girth

Discussion

This study would be the first scientific report on Indonesian local poultry, especially Sumateran island endemic chicken subspecies, on its morphometric characteristics. Results of this study can fit up to the most recent scientific information of Indonesian and the world fauna resources.

The average body weight in adult female burgo chickens and adult female kampung chicken were 0.75 kg and 1.28 kg, respectively. Nishida *et al.* (1982) found that average of female kampung chicken body weight was

1.20 kg. This results was 0.08 kg higher than previous result. However, when compared to Mansjoer (1985) which resulted an average of body weight was 1.39 kg, result of the study was about 0.11 kg lower. Furthermore, Mulyono and Pangestu (1996) reported the average of body weight of female kampung chicken was 1.38 kg, and the result of the study was 0.09 kg lower. Then, Arlina and Afriani (2003) reported that the average of body weight of female kampung chicken was 1.08 kg, and our results higher at 0.2 kg. The differences between those numbers could be caused by genetic factors and environmental factors. This result is supported by Yatim (1991), who wrote that variations in an individual could be caused by genetic and environmental variations.

The coefficient variation of adult female burgo chicken body weight was still relatively high at 17.48% with a range of body weight varies between 0.49 to 0.94 kg. According to Nasoetion (1992), the population considered similar when the coefficient of variation value was between 5 to 15%. Female burgo chicken seems has a low homogeneity, however it was higher than female kampung chickens which have a coefficient variation of 19.58% with a range of body weight between 1.16 to 1.48 kg. Sidadolog and Sasongko (1990) said that the standard deviation of local chicken body weight was averaged at 25%. This statement was supported by Hasnelly (2004), which stated that characteristics growth of kampung chickens are varied from 15.26 to 22%. Based on this statement, the application of female burgo chicken selection based on body weight is quite effective because its high level of uniformity (similar).

Data of body length showed that average of adult female burgo chicken body length was 27.57 cm. Compared to Rafian (2017), the study result was 1.25 cm higher than his founding which was 26.32 cm. This is consistent to Nozawa (1980), who wrote that the diversity of animal body size is caused by genetic and environmental factors. The average of adult female kampung chicken was 30.72 cm. Mansjoer (1985) reported that the average body length of female kampung chicken was 32.55 cm, the result was 1.83 cm shorter. While Lubis (2007) found the average of body length of female kampung chicken was 31.75 cm, then the study result was 1.03 cm shorter. It is possible due to some differences in genetic, environmental factors and the age of chickens at the time of measurement conducted.

Coefficient variation analysis on adult female burgo chicken body length can be classified as medium with value of 7.73% (ranged between 24.82 to 32.07 cm). It seems adult female burgo chicken has a high homogeneity, however, it was lower than adult female kampung chicken body length coefficient variation which was 6.67% and ranged between 26.01 to 33.09 cm. This result showed that body length of adult female kampung chicken was relatively similar.

The third parameter in this study was chest length. According to Kusuma (2002), chest length is the length of the sternum bone. The data

showed that the average length of adult female burgo chicken chest was 11.10 cm and ranged between 8.40 to 12.17 cm. For adult female kampung chicken, the average of chest length was 13.78 cm. Adult female burgo chicken chest length was smaller than adult female kampung chicken. Mansjoer (1985) reported that the average chest length of female kampung chicken was 12.65 cm. This previous study result was approximately 1.1 cm higher than our result.

It seems that genetic and environmental factors also become a reason for this result. Hardjosubroto (2002) wrote that individual appearance or production is influenced by genetic and environmental factors. The coefficient variation of adult female burgo chicken chest length was 8.71%. It is smaller than the coefficient variation of adult female kampung chicken which is 14.44%. The length of adult female burgo chicken chest as a neophyte resource can be considered similar.

Kusuma (2002) wrote that definition of chest girth is a body circumference measured from behind the base of the wing. Tanudimadja *et al.* (1983) wrote that chest girth has a correlation to female and male body weight. The average of adult female burgo chicken chest girth was 24.97 cm with a range of 22.04 to 28.45 cm. The average value and the highest value in adult female burgo chicken chest girth were not far enough when compared to adult female kampung chicken average chest girth value (28.02 cm). Based on this fact, it is assumed that adult female burgo chicken has a potentiality to be used as a dual-purpose poultry species. Potential to become a meat producer and also as an egg producer chicken. Furthermore based on value, the coefficient variation of adult female burgo chicken chest girth was relatively smaller than adult female kampung chicken. It was 6.53% versus 8.32% (Table 4). It indicated that adult female burgo chicken chest girth can be considered as similar (uniform).

The t-test results showed that the morphometric characteristics of adult female burgo chicken significantly different to adult female kampung chicken ($P < 0.05$), except for its chest length. It was obviously seen by the value of average body weight, body length and chest girth data. Generally, adult female burgo chicken morphometric characteristics were smaller than its parental adult female kampung chicken. Adult female burgo chicken morphometric diversity in this study was almost similar to results of Rafian (2017). The previous researcher found that female burgo morphometric characteristics such as body weight was 0.75 kg and body length was 25.57 cm.

In general, the average of bone growth increased at the age of 4 to 12 weeks, and from the age of 12 to 20 weeks the average of bone growth decreased or can be assumed that there was no more growth after 5 months of age. Furthermore, a changes in body weight indicated the development of young chicken body, while changes in body measurement indicates growth and development of body parts (Noor, 2008). When a

chicken reached its body maturity, there were, only few changes occur in bones. The bone measurements can provide more accurate results for body size, and it can be used to observe the morphometric characters.

Based on the results, it can be seen that the morphometrics of adult female burgo chickens and adult female kampung chickens in Bengkulu Province were significantly different (Table 5). The differences probably caused by high variation of phenotypic properties and the presence of genetic interactions with the environment (Noor, 2008). The nature and environmental conditions in each cage were relatively similar, as well as the management system for each cage was relatively similar too. Noor (2008) wrote that animal variation caused by genetic diversity and environmental diversity, as well as the diversity that arises due to interactions between genetic factors and environmental factors. According to Suryana and Hasbianto (2008), productivity of chicken varies and depends on the management system and individualistic diversity. Intensive management provides better results compared to traditional and semi-intensive management system. In addition, animal that has a high genetic quality requires to be maintained in a good environment and they can produce optimally.

It is suggested that in order to distinguish between female burgo and its parental female kampung chicken in their *in situ* and *ex situ* habitat especially in Bengkulu, it can be used two methods. Firstly it can cull a female burgo based on its distinctive fur pattern and color. Secondly based on its morphometric characteristics, female burgo body size is smaller than female kampung chicken.

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