MULTIVARIATE ANALYSIS OF THE MORPHOLOGICAL TRAITS OF FEMALE DUCK, MUSCOVY-DUCK AND MULE-DUCK

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ABSTRAK

Tujuan penelitian ini adalah mengevaluasi karakteristik morfometrik pada unggas air betina. Materi yang digunakan dalam penelitian ini adalah 90 ekor itik, 90 ekor entok dan 90 ekor tiktok di Kecamatan Bulukumba Kabupaten Brebes. Parameter yang diukur adalah panjang maxilla, panjang leher, panjang tubuh, lingkar dada, panjang sayap, panjang dada, panjang femur dan panjang tibia. Data yang diperoleh dianalisis menggunakan program Statistical Analysis System ver. 9.1. Entok secara umum memiliki rataan ukuran tubuh terbesar, diikuti tiktok, kemudian Itik. Panjang dada dan lingkar dada merupakan variabel pembeda morfologi tubuh antara itik, entok dan tiktok betina. Jarak genetik entok dan tiktok lebih dekat (3,97) dibandingkan itik dengan tiktok (14,10) dan entok dengan itik (24,73). Tingkat kesalahan terkecil dalam pengelompokan jenis ternak adalah itik yaitu 1% diikuti oleh tiktok sebesar 2% dan entok 3%.

Kata kunci: itik, entok, tiktok, morfometrik

ABSTRACT

The objective of this study was to evaluate the characteristics of morphometrical measurements in the female waterfowls. The animals used in this research were 90 ducks , 90 muscovy-ducks and 90 mule-ducks in Bulukumba district of Brebes regency, Central Java, Indonesia. Parameters measured were maxilla length, neck length, body length, chest circumstance, wing length, chest length, femur length and tibia length. The data were analyzed using the Statistical Analysis System ver. 9.1. Muscovy-duck generally had the largest of size, followed by mule-duck and then duck. The most discriminant variables were showed by chest length and chest circumstance. Muscovy-duck and mule-duck had closest genetic distance (3.974870) than both of the distance between duck and mule duck (14.10), and muscovy-duck and duck (24.73). The smallest errorness level in grouping was showed in duck 1% followed by 2% in mule-duck and 3% in muscovy-duck.

Keywords: duck, muscovy-duck, mule-duck, morphometric

INTRODUCTION

Consumer demand for livestock products increase from year to year, in which those demand is not yet met by the production. This situation is supported by increased public awareness of the importance of animal protein needs. Duck (*Anas plathyrhynchos*), muscovy-duck (*Cairina moschata*) and mule-duck are the sources of animal protein which are very potential to be developed and are expected to meet the needs of poultry meat.

Duck, muscovy-duck and mule-duck are waterfowl and as a source of eggs and meat product. Indonesia has a variety of local ducks that are spread almost in all parts of Indonesia which adjusted its name with the name of the area and geography. According to Brahmantiyo *et al.* (2003), Indonesia has many kinds of local ducks such as Mojosari-duck , Tegal-duck , Bali-duck and Alabio-ducks, that each has advantages. Muscovy-duck or Manila-duck has a body size larger than ducks . Muscovy-duck has a horizontal body shape and good nature (Srigandono, 1997; Widodo and Purnama, 2004; and Sutiyono, 2012). Mule-duck is a hybrid of the duck with muscovy-duck that has higher growth rate than broiler (Widodo and Purnama, 2004; Marie-Etancelin, 2008; and Sutiyono, 2012).

Morphometric is a morphological measure-

ments on the body length of certain bones in living things. Body size is a good indicator of value and has a fairly close correlation with the live weight trait (Suparyanto *et al*., 2004).

Morphometric measurements can also help to facilitate the selection and crossing between breeds and types of livestock (Sumantri *et al*., 2007; Setiaji *et al*., 2012; Kurnianto *et al*., 2013). The knowledge about the body sizes in ducks, muscovy-duck, and mule-duck is very important, therefore the research on it needs to be done. The purposes of this study were to evaluate morphometric characteristics of females duck, muscovy-duck, and mule-duck. The benefits of this research are to be used as baseline information for the females' development of duck , muscovy-duck and mule-duck as a source of meat and eggs by the farmer community.

MATERIALS AND METHODS

Materials and Data Collection

A total of 270 birds of the females sex comprising 90 ducks, 90 muscovy-ducks and 90 mule-ducks were used in this study. These animals were reared by farmers under the traditional system at Bulukumba District of Brebes Regency in Central Java, Indonesia. Purposive sampling method was applied to determine the location based on population density of the waterfowl breeds.

The data were collected by measuring from each part of the females' body of duck, muscovy-duck and mule-duck. The following traits that were measured in all animals were Maxillary length (ML), Neck length (NL), Body length (BL), Chest circumference (CC), Wing length (WL), Chest length (CL), Femur length (FL) and Tibia length (TL).

Data analysis

The data obtained were compiled and analyzed using the Statistical Analysis System program 9.1 (SAS, 1990). Univariate analysis covering the proc means and the General Linear Model (GLM) followed by a multivariate analysis including Canonical Discriminant Analysis (Candisc) were used to analyze and to compute squared Mahalonobis distance. Phenogram illustrating distance among breeds was constructed by UPMA (Unweighted Pair Group Method with Arithmetic Mean) of MEGA-5 (Tamura *et al*., 2011). Principle Component Analysis (PCA) is a data reduction technique to examine the modes of variation of a multivariate random variable in high dimension. Discriminant Component Analysis (DISCRIM) procedure of SAS (1990) was performed to determine percentage assignment of individuals into their own population.

RESULTS AND DISCUSSION

The differences on body sizes of female waterfowl breeds based on the results of the General Linear Model (GLM) body size analyis that distinguishes among ducks , muscovy-duck and mule-duck were the length of the maxilla, long neck, chest length, wing length and chest circumference ($P<0.05$) (Table 1) . The longest maxilla was found in duck (5.157±0.490) cm, followed by mule-duck (4.711±0.410) cm and muscovy-duck (4.468±0.421) cm. The longest neck was found in duck (17.711±1.504) cm, followed by mule-duck (14.186±1.084) cm and muscovy-duck (13.767±1.223) cm. The longest chest was muscovy-duck (14.316±1.172) cm followed by mule-duck (12.757±0.932) cm, and duck (10.886±1.127) cm.

The longest chest circumference was found in muscovy-duck (34.649±1.801) cm, followed by mule-duck (32.406±5.835) cm, and duck (30.783±2.435) cm. The longest wing was found in muscovy-duck (29.113±2.710) cm, followed by mule-duck (28.257±2.091) cm, and duck (26.477±1.665) cm. Wing length of muscovy-duck is longer than the mule-duck and duck, because the body size and body weight of muscovy-duck are greater. In accordance with Supriyanto (2003) that increasing the length of the wing is followed by an increase in the body size which indirectly will increase the body weight. The sizes of these variables showed a significant difference ($P<0.05$).

Body length in the muscovy-duck (25.181±1.514) cm did not show significant difference from mule-duck (25.223±1.378) cm but significantly different from body length of duck (24.472±1.257) cm. The femur length of mule-duck (7.543±2.244) cm was not significantly different from muscovy-duck (7.299±0.944) cm, but significantly different from femur length of duck (6.301±0.623) cm. The length of the tibia in duck (10.189±1.092) cm was not significantly different from the mule-duck (10.403±0.924) cm but significantly different from muscovy-duck (9.673±1.411) cm. According to Brahmantiyo *et al*. (2003) distinguishing variable on body

Table 1. The Diferences of Body Sizes among Duck, Muscovy-duck and Mule-duck.

Variable	Female Waterfowls		
	Duck (90)	Muscovy-duck (90)	Mule-duck (90)
	.....cm		
Maxilla length	5.157±0.490[a]	4.468±0.421[c]	4.711±0.410[b]
Neck length	17.711±1.504[a]	13.767±1.223[c]	14.165±1.105[b]
Chest length	10.886±1.127[c]	14.316±1.172[a]	12.757±0.932[b]
Body length	24.472±1.257[b]	25.181±1.514[a]	25.223±1.378[a]
Chest circumference	30.783±2.435[c]	34.649±1.801[a]	32.406±5.835[b]
Wing length	26.477±1.665[c]	29.113±2.710[a]	28.257±2.091[b]
Femur length	6.301±0.623[b]	7.299±0.944[a]	7.543±2.244[a]
Tibia length	10.189±1.092[a]	9.673±1.411[b]	10.403±0.924[a]

The different superscript at the same row among breeds are significantly different (P<0.05).

Table 2. Eigenvector of Each Principal Component Analysis.

Variable	PC 1	PC 2
Maxilla length	-0.035938	-0.069767
Neck length	-0.191197	-0.530120
Chest length	0.202609	0.352336
Body length	0.029395	0.146867
Chest circumference	0.893771	-0.320260
Wing length	0.205512	0.668396
Femur length	0.277717	-0.121287
Tibia length	-0.045264	-0.066071

morphology of the ducks that the most influential was the length of the femur and tibia.

Distinguishing on Female Waterfowl Breeds

Table 2 shows eigenvectors of PC1 and PC2 for female waterfowl breeds. In morphometric application of PCAs, PC1 was acceptable as a "size" vector and PC2 as a "shape" vector as reported in livestock (Sumantri *et al*., 2007; Setiaji *et al*., 2012 and Kurnianto *et al*., 2013) and waterfowl (Widodo and Purnama, 2004; Marie-Etancelin, 2008; and Sutiyono, 2012). Based on the results of principal component analysis note that the chest circumference showed a large positive number and followed by the length of femur, wing and chest. The chest circumference on Principal Component 1 (0.893771) provide a large positive number and on Principal Component 2 (-0.320260) has a relatively large negative value, so the chest circumference can be used as a differentiating variables for the body sizes and body shapes among waterfowl breeds. This result is a correlation or a combination of all the variables measured on the body sizes from the maxilla length to the tibia length.

According to Ismoyowati *et al*. (2006) the chest circumference is one of the characteristics that are closely related to meat production, so layer duck has the chest circumference that is relatively smaller. While the length variables of the maxilla, neck, wing and tibia can not be used as a differentiating variable between duck, muscovy-duck and mule-duck. The assumption is based on the results of the analysis of PC1 and PC2 which shows a negative value.

Grouping Map on Female Waterfowl Breeds

The results of principal component analysis are shown in Figure 1. It can be seen a dividing line among the duck, muscovy-duck and mule-duck observed, in which PC1 and PC2 indicated the body size and the body shape . The grouping of the muscovy-duck was seen in the positive both in PC1 and PC2, it indicated that the size and shape of muscovy-duck has a great body . In

Table 3. Genetic Distance among Duck, Muscovy-duck and Mule-duck

Breeds	Duck	Muscovy-duck	Mule-duck
Duck	0	24.73030	14.10275
Muscovy- duck	24.73030	0	3.974870
Mule-duck	14.10275	3.97487	

Table 4. The Level of Misclassification among Duck, Muscovy-duck and Mule-duck.

Breeds	Duck	Muscovy-duck	Mule-duck
Duck	89 (98.89)	0 (0)	1 (1.11)
Muscovy-duck	0 (0)	87 (96.67)	3 (3.33)
Mule-duck	0 (0)	2 (2.22)	88 (97.78)

Number in bracket is the percentage waterfowl

accordance to Srigandono (1997) that muscovy-duck has a large body with almost standing position (horizontal) which is one of the traits of poultry meat. It was stated by Widodo and Purnama (2004) and Sutiyono (2012) that the muscovy-duck was poultry meat. Grouping the duck was seen in the negative PC1 and positive PC2, it can be interpreted that the ducks have small phenotypic size, but the body shape is quite large. Grouping the mule-duck was seen positive in PC1 and in PC2 was negative, it can be interpreted that the mule-duck has a fairly large body size but small body shape.

Genetic Distance among Female Waterfowl Breeds

Based on the analysis of genetic distances between duck, muscovy-duck, and mule-duck (Table 3), the genetic distance between the duck and muscovy-duck was 24.73030, the duck and mule-duck was 14.10275, and for muscovy-duck and mule-duck was 3.974870. Phylogeny tree is presented in Figure 2. According to Wu *et al.* (2008), based on genetic distance of Peking duck, Cherry valley and Aobaixing located in one cluster, while muscovy-duck is beyond the cluster. It was stated by Su and Chen (2009) that the genetic distance is influenced by the breeds and the level of gene heterozygosity. Sutiyono (2012) reported the closeness of the genetic distance between muscovy-duck and mule-duck, because both display the same type of waterfowl, that is the body tends to flat or horizontal. Futhermore, Marie-Etancelin (2008) stated that genetic distance between duck and muscovy-duck is due to the size and shape of the body, in which the duck is greater than the muscovy-duck . Ducks have a body shape like bottles upright or vertical and slender (Srigandono, 1997), while Sopiyana *et al*. (2006) and Raji *et al.*, 2009) stated that Tegal-duck has body characteristic like a bottle upright, not horizontal like muscovy-duck Data of the body size can be used to estimate the genetic distance (Brahmantiyo *et al.*, 2003; Muzani *et al*., 2005; Sumantri *et al*., 2007) using discriminant analysis through statistical Mahalanobis distance .

Grouping of Errornes Level

Grouping error rate (errorness level) in duck, muscovy-duck and mule-duck can be seen in Table 4. The smallest error rate is in the grouping of ducks (1%) , followed by mule-duck (2%) and muscovy-duck (3%). This suggests that the presence of misclassification rate of morphometric size resemble duck like mule-duck is about 1%, the rate of misclassification morphometric size resembling mule-duck like muscovy-duck is 2%, and a misclassification rate of morphometric size resembling muscovy-duck like mule-duck is 3%. Observation on duck, muscovy-duck and mule-duck indicated the small

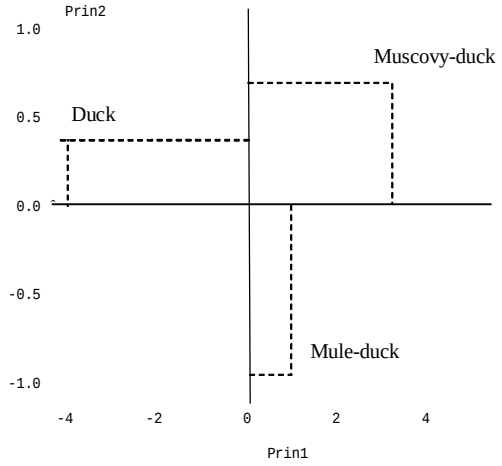

Figure 1. Breed Pool Based on Body Measurements and Shapes of Female Waterfowls

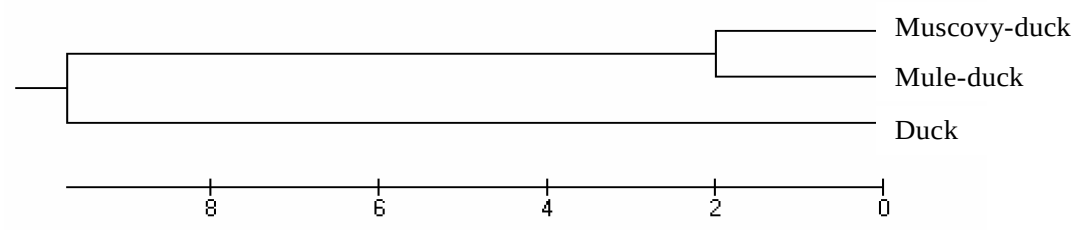

Figure 2. Dendrogram Constructed on Mahalanobis Distance of the Waterfowl Breeds

possibility of a mixture of other breeds because the level of error in grouping was relatively small and a large percentage of similarity in the types of ducks, muscovy-duck and mule-duck. According to Brahmantiyo *et al*. (2003) and Muzani *et al*. (2005), the great similarities in the body characterics show the small mixture of characteristics with other breeds. Indonesian native ducks have common characteristics that are the body in a standing position looks like a bottle, slim, having small head, and small neck (Srigandono, 1997; Muzani *et al*., 2005; Johari *et al*., 2013). Poultry research center has developed the performance of local duck by crossing with other breeds to get the ideal duck with superior quality and good production for egg and meat (Brahmantiyo *et al*., 2003; Supriyanto *et al*., 2003; Sulaiman and Rahmatullah, 2011; Johari *et al*., 2013).

CONCLUSION

Muscovy-duck generally has the largest average characteristics of body size, followed by mule-duck, and then duck. The chest circumference, femur length, wing length and chest length are good differentiator variables used to differentiate females body morphometric of waterfowl breeds. Duck has small phenotypic size and enough large of shape, muscovy-duck has the size and shape of a large body, while mule-duck has a fairly large body size but small body shape. The genetic distance between muscovy-duck and mule-duck are closer compared to duck and mule-duck, also duck and muscovy-duck. The smallest error rate in grouping was duck than followed by mule-duck and muscovy-duck.

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