Morphometric Comparative Study of Head Linear Surface Measurement of Thin-Tailed, Batur, Wonosobo and Garut Sheep

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Abstract

Indonesian local sheep have well adapted to the wet tropical climate of Indonesia.The aimed this study to compare the morphometric of the body and head of local sheep. The thin-tailed, Batur, Wonosobo, and Garut ewes (fighting and meat types) at 1.5-2.0 years old were used. Variables of head linear surface measurement observed consisted of akrokranion-prosthion, basion-prosthion, lower jaw length, head height, tuber facial, nasion-rhinion, entorbitale, euryon dan supraorbitale. Data was analyzed using principal component analysis. The principal component chart (clustered diagram) constructed by the components derived from the covariance matrix of variabels measured was created based on the size and shape scores of each linear surface measurement of the body and the head. The results showed that discriminators of head size and shape of Garut sheep (fighting type) was the same, namely head height. The discriminator of the head size was basion-prosthion obtained in thin-tailed and Garut sheep (meat type), that of thin-tailed and Garut sheep (meat type) was basion-prosthion, whereas that of Batur andWonosobo sheep was akrokranion-prosthion. The disriminator of head shape in thin-tailed sheep,Wonosobo and Garut sheep (meat type) was lower jaw length, whereas that of inBatur sheep washead height. Clusters of head measurement data on breed Garut sheep (fighting and meat types) separated, also on Batur andWonosobo sheep. Overlapping of head measurement data found on the clusters of thin-tailed, Garut (fighting type),Wonosobo dan Batur sheep.
Keywords: head, morphometric characteristics, principal component analysis

Introduction

Thin-tailed sheep or Javanese thin-tailed sheep are mostly found inIndonesia (Puslitbangnak 2008). Approximately 80%-85% of this sheep found in West Java and Central Java. *Kementerian Pertanian* (2011[a]) stated that the Batur sheep was a cross between thin-tailed sheep with Merino sheep with the original distribution in the Batur district that developed since 1974. Phylogeny relationship of Batur sheep was closest to Merino sheep, a bit far with Garut and thin-tailed sheep, most distant with fat-tailed sheep (Prayitno *et al*. 2011). Wonosobo sheep found in several districts in Wonosobo (Setiyawan and Lukiwati 2005). Wonosobo sheep was a crosses between Texel sheep that imported since 1957 with thin-tailed or fat-tailed (*Kementerian Pertanian* 2011[b]). Garut sheep was developed in 1864, was a cross between thin-tailed sheep with Merino and Cape sheep (possibly Africander sheep of South Africa) (Devendra and McLeroy1982). Mansjoer *et al.*(2007) reported that Garut sheep was reared as meat and fighting-types.

This study used thin-tailed, Batur, Wonosobo, and Garut sheep (meat and fighting types) at 1.5-2.0 years old. Analysis of body and head morphometrics were based on principal component analysis (PCA) (Gaspersz 1992) then visualized into the group of crowded diagram (Hayashi *et al*. 1982). Different group of crowed builded on the base of scoring in head size and head shape, which derivated from covarian matrix were able to identifed morphologycal phenotypic differences among breeds of sheep studied.

Materials and Methods

This research was conducted at Jonggol Animal Science Teaching and Research Unit (JASTRU) Faculty of Animal Science, Bogor Agricultural University, Bogor, Batur village Banjarnegara district, Surengede village Wonosobo district and Sindangprabu village Garut district, from from December 2012 to February 2013. The determination of locations was conducted by purposive sampling. The observed sheep were 19 heads of thin-tailed sheep (4 rams and 15 ewes), 26 heads of Batur sheep (7 rams and 19 ewes), 20 heads of Wonosobo sheep (3 rams and 17 ewes), 27 heads of fighting Garut sheep (15 rams and 12 ewes) and 18 heads of meat type Garut sheep (3 rams and 15 ewes). All of the observed sheep were at 1.5-2.0 years old.

The variables of head linear surface measurement observed were *akrokranion-prosthion* (X_1), *basion-prosthion* (X_2), lower jaw length (X_3), head height (X_4), *tuber facial* left-right (X_5), *nasion-rhinion* (X_6), *entorbitale* left-right (X_7), *euryon* left-right (X_8) dan *supraorbitale* left-right (X_9). All variables were measured in head surface of thin-tailed, Batur, Wonosobo, and Garut sheep (fighting and meat types). Data was analyzed using principal component analysis (PCA) with the formula suggested by Gaspersz (1992). Clustered diagram was made based on the head size scores (X axis) and the head shape scores (Y axis).

Results and Discussion

The equation size and shape of the head surface of thin-tailed, Batur, Wonosobo, fighting-type Garut and meat-type Garut was presented in Table 1. *Basion-prosthion* (X_2) was the head size discriminator of thin-tailed sheep with correlation to the head size score of +0912, while lower jaw length (X_3) was it's head shape dicriminator with correlation to the head shape score of +0904. *Akrokranion-prosthion* (X_1) was the head size discriminator of Batur sheep with correlation to the head size score of +0969, while head height (X_4) was it's head shape discriminator with correlation to the head shape score of +0907. *Akrokranion-prosthion* (X_1) was the head size discriminator of Wonosobo sheep with correlation to the head size score of +0902, while lower jaw length (X_3) was it's head shape discriminator with correlation to the head shape score of+0836. Head height (X_4) was the head size discriminator of fighting-type Garut sheep with correlation to the head size score of+0905, while head height (X_4) was it's head shape discriminator with correlation to the head shape score of –0406. *Basion-prosthion* (X_2) was the head size discriminator of meat-type Garut sheep with correlation to the head size score of+0928, while lower jaw length (X_3) was it's head shape discriminator with correlation to the head shape score of+0965. Ozcan *et al.*(2010) stated that the size and shape of the sheep's skull varied depending on the species.

Table 1. Head size and shape equations in the sheep breeds observed

	Thin-tailed sheep
Size equation	$Y_1 = 0.501X_1+0.553X_2+0.184X_3+0.498X_4+0.117X_5+0.117X_6+0.082X_7+0.297X_8+0.195X_9$
Shape equation	$Y_2 = -0.144X_1-0.006X_2+0.854X_3-0.236X_4-0.090X_5-0.016X_6-0.278X_7+0.024X_8+0.330X_9$
	Batur sheep
Size equation	$Y_1 = 0.702X_1+0.632X_2+0.129X_3+0.163X_4+0.120X_5+0.129X_6+0.102X_7+0.108X_8+0.110X_9$
Shape equation	$Y_2 = -0.194X_1-0.179X_2+0.288X_3+0.865X_4+0.110X_5+0.035X_6+0.180X_7+0.194X_8+0.124X_9$
	Wonosobo sheep
Size equation	$Y_1 = 0.554X_1+0.469X_2+0.290X_3+0.504X_4+0.171X_5+0.066X_6+0.196X_7+0.161X_8+0.190X_9$
Shape equation	$Y_2 = -0.032X_1-0.216X_2+0.870X_3+0.017X_4-0.211X_5+0.068X_6-0.331X_7-0.164X_8-0.100X_9$
	Fighting-type Garut sheep
Size equation	$Y_1 = 0.440X_1+0.582X_2+0.029X_3+0.596X_4+0.098X_5+0.074X_6+0.105X_7+0.265X_8+0.125X_9$
Shape equation	$Y_2 = 0.556X_1+0.225X_2+0.253X_3-0.737X_4+0.046X_5-0.007X_6+0.093X_7+0.114X_8+0.095X_9$
	Meat-type Garut sheep
Size equation	$Y_1 = 0.507X_1+0.580X_2-0.003X_3+0.535X_4+0.055X_5+0.047X_6+0.129X_7+0.257X_8+0.180X_9$
Shape equation	$Y_2 = 0.229X_1-0.018X_2+0.907X_3-0.078X_4+0.076X_5+0.222X_6-0.087X_7-0.236X_8-0.020X_9$

Akrokranion-prosthion (X_1), *basion-prosthion* (X_2), lower jaw length (X_3), head height (X_4), *tuber facial* left-right (X_5), *nasion-rhinion*, (X_6), *entorbitale* left-right (X_7), *euryon* left-right (X_8), *supraorbitale* left-right (X_9)

Clustered data of sheep breeds observed in Figure 1 showed separation clusters between sheep breeds of fighting-type Garut and meat-type Garut sheep, as well as between Wonosobo and Batur sheep. Separation of the clusters happened because of differences in head shape score, indicating that the head to be inherit. This was accordance with statement of Saparto (2004) that the cranium was inherit to the trait of a breed, so that every breed had a different size of cranium.

Clustered data of sheep breeds observed was found overlapping among thin-tailed, fighting-type Garut and Batur sheep, also between thin-tailed and Wonosobo sheep. It showed similarities between the head of the sheep breeds.The similarity of head morphometric of sheep breeds to be inherit as a result of a common ancestor, ie. thin-tailed sheep. According to Mulliadi (1996) fighting-type Garut sheep was the result of a cross between Merino sheep from Australia, Kaapstad sheep from South Africa and thin-tailed sheep. According to *Surat Keputusan Menteri Pertanian* (2011) Batur sheep was a cross between Merino

and thin-tailed sheep. Wonosobo sheep was the result of a cross between Texel and thin-tailed or fat-tailed sheep.

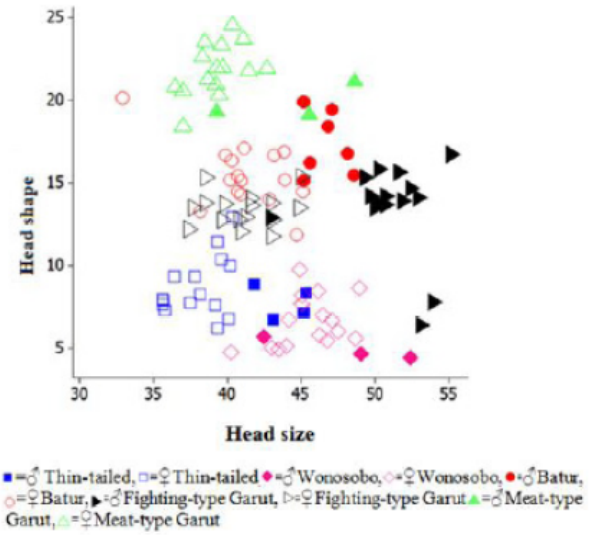

Figure 2. Head clustered diagram of thin-tailed, Batur, Wonosobo, fighting-type Garut and meat-type Garut sheep data

Separation clustered data of head size and shape on fighting-type Garut and meat-type Garut sheep as a result of breeding different directions. Head shape discriminator of fightying-type Garut sheep head was different to meat-type Garut sheep. Head height of fighting-type Garut sheep possibilities associated with gore trait, farmers were indirectly selecting head height as a tool in the ram to defend it self during fighting. Disscriminator of head shape was similar to that of head size in fighting-type Garut sheep ie. head height, indicating that this sheep had its own characteristics at head height. Lower jaw length was a head shape discriminator of meat-type Garut sheep that indirectly associated with the ability of sheep to ruminate. Selection wanted specific organs to function in accordance with desired trait.

Overlapping data between fighting-type Garut and thin-tailed sheep because some data from females overlaped each other, but not in males. This indicated that the selection in the direction of fighting-type Garut sheep was clearly visible on head of a male. Differences in the direction of selection in fighting-type Garut and meat-type Garut sheep resulted in the differences in discriminators of head size and shape.

Head size discriminator of Batur and Wonosobo sheep, which indicated that the two breeds of sheep had similar direction (meat-type sheep). Separation clustered data of these two breeds happened due to differences in head shape, each characterized by a different discriminator. Aggressiveness trait of fighting-type Garut was also found in Batur sheep. This was shown by it's clustered data which overlapping with fighting-type Garut sheep. Batur sheep closely genetically related to fighting-type Garut sheep (Prayitno *etal.* 2011). In addition to as sheep meat, Batur sheep was kept as pet sheep that often exhibited in the contests.

Lower jaw length was discriminator of thin-tailed, Wonosobo and meat-type Garut sheep. Lower jaw plays a role in the process of taking of food forage and mastication or rumination in sheep. The difference among selection direction between pet sheep (fighting-type Garut or Batur sheep contest) and meat-type sheep indirectly were shown by the difference in quality of feed. Quality of forage in pet sheep was better than that of meat-type sheep. Selection of high quality forage with a low fiber content was given to fighting-type Garut and Batur sheep, so that the function of the lower jaw of these two breeds of sheep was not as good at thin-tailed, Wonosobo and meat-type Garut sheep.

Conclusion

Head size discriminator of thin-tailed and meat-type Garut sheep was *basion-prosthion*, while that of Batur and Wonosobo sheep was *akrokranion-prosthion*. Head shape discriminator of thin-tailed,

Wonosobo and meat-type Garut sheep was lower jaw length, while that of Batur and fighting-type Garut sheep was head height. Head size and shape discriminators of fighting-type Garut sheep were the same, namely head height. Clustered data of head size and shape separated between fighting-type Garut and meat-type Garut sheep and between Batur and Wonosobo sheep. Clustered data of head size and shape of thin-tailed overlapped with fighting-type Garut, Wonosobo and Batur sheep, while meat-type Garut separated from thin-tailed sheep.

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