Morphometric Characteristics in Local Sheep and Nonlocal Sheep

Sucik Maylinda[1](✉), Ali Mahmud[2], and S. R. Hidayat[3]

[1] Faculty of Animal Science, Universitas Brawijaya, Malang 65145, Indonesia
sucik@ub.ac.id
[2] Faculty of Agriculture and Animal Husbandry, University of Muhammadiyah Malang, Malang 65144, Indonesia
[3] Faculty of Animal Science, Universitas Brawijaya, Malang 65145, Indonesia

Abstract. The objectives of the research were to find out the morphometric characteristics (qualitative and quantitative traits) in local sheep, especially Fat-tailed sheep (JFTS) and nonlocal sheep (Texel sheep). The observation was done in 24 FTS ewe and 39 Texel ewe. Variables in this research was the qualitative characteristics of adult FTS ewe including the color of white wool, the shape of the long head, and erect/droopy ears, while in adult Texel ewe it is the color of white wool and brownish, the shape of the head is the majority medium, erect/droopy ear. Quantitative characteristic of adult FTS include head length 19.58 ± 0.82 cm, head width 12.23 ± 0.54 cm, cephalic/head index 62.68 ± 4.40%, body weight 30.17 ± 2.94 kg, wither height 62.91 ± 3.29 cm, chest girth 73.30 ± 3.58 cm, body length 60.36 ± 3.29 cm. While in adult Texel ewe include head length 16.81 ± 0.26 cm, head width 12.57 ± 0.37 cm, cephalic index 74.76 ± 1.61%, body weight 31.18 ± 3.45 kg, wither height 59.57 ± 4.15 cm, chest girth 72.87 ± 2.16 cm, body length 57.24 ± 4.45 cm. Conclusion: (1) qualitative characteristic of fat-tailed sheep and Texel are already have similarity to The Minister of Agriculture No. 2389/Kpts/LB.430/8/2012 and Texel Sheep (the Minister of Agriculture No. 2915/ Kpts/OT.140/6/2011). (2) The quantitative character both in FTS and Texel sheep are not fulfil the standard, (3) The head shape of FTS are mostly Delicocephalic (long head) and Texel sheep are Delicocephalic (48.7%) and Mesophalic (medium head/51.27%).

Keywords: Fat tail sheep · Texel sheep · Morphometric characteristic · Cephalic index

1 Introduction

Sheep are small ruminants that are often kept and bred by people in rural areas. Raising sheep in rural areas is carried out by individuals with sheep ownership in small quantities to be used as side income or savings. The advantages of sheep compared to other types of livestock are easy maintenance, good grazing, able to eat various types of grass, relatively low production costs (cheaper than goats), and do not require a large area. Sheep have adapted to survive and produce based on conditions of poor climate, poor quality feed,

E. Widodo et al. (Eds.): ICESAI 2022, ABSR 28, pp. 381–390, 2023.
https://doi.org/10.2991/978-94-6463-116-6_48

seasonal availability, lack of water, endemic and parasitic diseases that make sheep suitable for breeding in traditional production systems and minimal maintenance [1]. This makes the sheep commodity become one of the foundations in meeting the national meat needs. Based on data from the Central Statistics Agency [2], the total population of sheep in Indonesia in 2020 is 17,769,084 heads. East Java as one of the third largest small ruminant sheep breeding centers in Indonesia has a population of 1,416,969 heads. The number of population continues to increase based on the development of sheep breeds in each area which is very diverse. Sheep breeds in Indonesia are divided into two, namely local sheep and non-local sheep.

There are two types of local sheep that are most widely bred, namely Fat Tail Sheep (FTS) and Thin Tail Sheep (TTS). Meanwhile, non-local sheep are sheep imported from other countries to be bred in Indonesia to improve genetic quality such as Dorper, Awwassi, Merino, Texel, etc. East Java is one of the third-order sheep production centers for the national population. Sheep development in East Java carried out by farmers is developing local sheep with the type of Fat Tail Sheep (FTS) or Javanese Fat Tail and non-local sheep, one of which is Texel sheep. Fat Tail Lamb (FTS) or Javanese Fat Tail has characteristics, including male body weights ranging from 44.6 kg and females around 25.8 kg, having no horns, a convex head shape, dominant body color white with coarse wool, and has a distinctive characteristic. Large tail as fat deposition in a straight or curved shape (sigmoid) (Decree of the Minister of Agriculture Number 2389/Kpts/LB.430/8/2012, 2012). While the characteristics of the Texel sheep include having excellent muscle development with an adult male body weight ranging from 90–100 kg and an adult female ranging from 50–70 kg, having no horns, a large convex head shape without wool with a black nose, white wool color. Brownish, and erect short ears [3]. The development of the two breeds of sheep has the same goal of improving genetic quality so that the population of sheep with good genetics increases and has an impact on increasing meat carcass production.

Genetic improvement of Fat Tailed Sheep (FTS) and Texel sheep was carried out by developing morphological characteristics (morphometrics) in the form of qualitative and quantitative traits. Morphometrics are body components of livestock which are measured by shape and size which are clarified by qualitative visual displays to describe certain breeds. The morphometric characteristics of livestock are important for planning, management, conservation strategies and breeding programs [4]. The results of morphometric studies, apart from being an effort to improve genetic quality, can also be used to estimate the origin of livestock to maintain germplasm in the area [5]. This study was conducted to analyse the morphometric characteristics of Fat Tailed Sheep (FTS) and Texel Sheep ewes. The benefit of the research can be information on the morphometric characteristics of female FTS and female Texel Sheep.

2 Materials and Methods

2.1 Location and Schedule of the Research

Research was done at Pujon, Malang District, East Java. Research was started from t July 2021 to November 2021. The research material used 63 female sheep consist of 24 (JFTS) and 39 Texel sheep. The animals are in adult age in both breeds (1 – 2 years old).

2.2 Methods

The research was done in many steps:

a. Measure the length of the head, using a measuring tape with an accuracy of 0.1 cm from the crista accipitalis to the os. Incicivum.
b. Measure the width of the head using a measuring tape with an accuracy of 0.1 cm from the border of the right temple to the border of the left temple.
c. Measure the chest circumference using a measuring tape with an accuracy of 0.1 cm, which is measured in a circle perpendicular to the back between the elbows of the scapula.
d. Measure height using a ruler with an accuracy of 0.1 cm measured from the back of the scapula perpendicular to the ground.
e. Measure the length of the body using a ruler with an accuracy of 0.1 cm measured from the tip of the forefoot bullet joint (tuber humerus) to the sitting bone (tuber ischirum) to the protrusion of the sitting bone.
f. Weighing sheep with a hanging scale with a capacity of 300 kg with an accuracy of 0.5 kg.
g. Measure the length of the ear using a measuring tape with an accuracy of 0.1 cm from the base of the ear to the tip of the ear
h. Observing the qualitative parameters consisting of hair color and ear shape.

The authors should provide a clear description of all processes, interventions, and comparisons. This section also should provide the type of statistical analysis used.

2.3 Research Variables

The variables observed in this study were:

a. Head length (cm) was measured from crista accipitalis to os. Incicivum used a measuring tape with an accuracy of 0.1 cm.
b. Head width (cm) was measured from the temple of the right eye to the temple of the left eye using a measuring tape with an accuracy of 0.1 cm.
c. Ear length (cm) was measured from the base to the tip of the ear using a measuring tape with an accuracy of 0.1 cm.
d. Chest circumference (cm) was measured in a circle perpendicular to the back between the elbows of the scapula using a measuring tape with an accuracy of 0.1 cm.
e. Height (cm) was measured perpendicularly from the base of the forefoot to the spine using a ruler with an accuracy of 0.1 cm.
f. Body length (cm) was measured from the protrusion of the bullet joint (tuber humerus) to the bone sitting (tuber ischirum) using a ruler with an accuracy of 0.1 cm.
g. Body weight (kg) was weighed using a hanging scale with an accuracy of 0.5 kg.
h. Wool color by observing the wool color on the body and head.
i. Shape the ear by observing the upright or sleeping shape.
j. Head index (Cranial index/Cephalic Index) is the value in describing two dimension of head of the sheep. Cranial Index = WH/LH $\times$ 100%, where LH: length of head and WH: head width.

2.4 Statistical Analysis

The morphometric data from quantitative trait measurements were processed using descriptive statistical analysis, including: sample mean, standard deviation, coefficient of variation, cranial index, One way Anova. Data were then compared with the standard according to Qualitative Characteristics of Fat Tailed Sheep (the Minister of Agriculture No. 2389/Kpts/LB.430/8/2012 and Texel Sheep (the Minister of Agriculture No. 2915/Kpts/OT.140/6/2011). Observational data of qualitative in the field was processed with relative frequency statistics. Analysis of measurement and observation data is processed using the following formula: Relative Frequency = N/X × 100%, where N: The total observed data and X: The observed qualitative phenotype.

3 Results and Discussion

3.1 Qualitative Characteristics

Qualitative characteristics are gene expressions that cannot be measured and can only be observed in the form of shape and color. There are three qualitative observations in this study, namely color of the wool, the shape of the ears and the shape of head of the sheep.

Wool Color

Color of wool in sheep is one of the phenotypic traits that describe a particular type or breed. Assessment of the color of wool from a sheep can be done through a qualitative assessment of the parts that do not affect livestock productivity by visually comparing the dominant color of the body, ear shape, horns and tail [6]. The color of wool from sheep usually consists of one or several color mixtures depending on the type of sheep. The results of a qualitative assessment of wool color from DEG and Texel sheep are presented in Table 1.

The results of data analysis are shown in Table 1, namely FTS sheep in two age groups have white wool color which is one of the characteristics of Fat Tailed sheep. The percentage of white color in Fat Tailed sheep based on the relative frequency value is 100% white. Meanwhile, the results from observing the color of Texel sheep's wool show that there are two colors found, namely white and brownish white. The percentage

Table 1. Wool color in Fat Tailed Sheep (FTS) and Texel

Age	White				Brownish white			
	FTS		Texel		FTS		Texel	
	n	(%)	n	(%)	n	(%)	n	(%)
< 1 years	14	58.33	11	41.02	-	0.00	4	10.26
1–2 years	10	41.67	16	28.20	-	0.00	8	20.52
Total	24	100	27	69.22	-	0.00	12	30.78

Table 2. Ear Shapes in Fat Tailed Sheep and Texel

Age	Ears upright			
	FTS		Texsl	
	n	(%)	n	(%)
< 1years	14	66.67	16	38.46
1–2 years	10	33.33	23	61.54
Total	24	100	39	100

of dominant white wool in Texel sheep is 69.22% and the dominant color is brownish white with a percentage of 30.78. The distribution of wool color in both Fat Tailed and Texel sheep is dominant in the head, body, legs and tail areas.

The color of sheep's wool is influenced by the melanin content in the hair and skin. This melanin substance will be influenced by the genetics of the sheep which causes the expression of certain color patterns. The dominant white color throughout the body in Fat Tailed and Texel sheep belonged to the Tan group type 10 which was controlled by the agounti locus with dominant white wool color characteristics but not classified as albino. The brownish white color of some Texel sheep belongs to the Badgerface type 2 group which is controlled by the agouti locus with the characteristics of a brown color that spreads to all parts of the body [7]. The color of wool in both breeds are the tan and badgerface groups appears in sheep due to the inheritance of traits from the parent or mother sheep that have a tan or badgerface color pattern. In addition, the dominant white wool color pattern in Fat Tailed and Texel sheep means that there is an adaptation to a hot (tropical) environment. The color of the wool is characteristic of the sheep breed in that it reflects the color pattern of the Fat Tailed and Texel sheep breeds.

Shape of Ear in FTS and Texel Sheep

The shape of the ears of the sheep's ear with the shape of the ears of other small ruminants has a difference. The shape of the sheep's ear has three forms, namely: upright, slightly hanging and hanging [8]. The results of assessing the shape of the ears of Fat Tailed and Texel sheep are presented in Table 2.

The result showed that the relative frequency of the Fat-Tailed and Texel's ear shapes is 100% of the total population. The shape of the Fat Tailed and Texel sheep's ears is upright and the auricles are facing forward. The shape of the earlobe of the Fat Tailed sheep has a larger size, long, wide, upright and sideways. In Texel sheep, the small earlobe is not indented and upright. The type of earlobe also affects the upright or hanging shape. The bigger the sheep's ears, the greater the potential for hanging ears. In the classification of the shape of the auricle, it is divided into two forms (i) short with curled auricles, small and short in size, (ii) medium with wide and long auricles, rounded ear tips and clearly visible ear canals [9]. Ear shape is also influenced by health factors. Sick sheep can cause the ears to hang for a while. The condition that requires qualitative

Table 3. Shape of head in FTS and Texel

Breed	Ages	*Dolicochephalic* (long)		*Mesophalic* (medium)		*Brachycephalic* (short)	
		n	(%)	n	(%)	n	(%)
FTS	< 1 years	14	58.33	-	-	–	-
	1–2 years	10	41.67	-	-	–	-
Texel	< 1 years	12	30.76	4	10.25	-	-
	1–2 years	7	17.94	16	41.02	-	-

Tabel 4. Mean of Body Weight in FTS and Texel sheep

Breed	Age	n	Body Weight (Kg)	
			Mean ± SD (Kg)	CV
FTS	< 1 years	14	22.03 ± 2.82a	12.79%
	1–2 years	10	30.17 ± 2.94a	13.13%
Texel	< 1 years	16	12.02 ± 2.41a	12.02%
	1–2 years	23	31.18 ± 3.45b	11.06%

Different notation in the same column means the result is highly different significantly ($P < 0.01$).

observation of the shape of the sheep's ear should be carried out on healthy sheep, so that there is no misperception in the process of observing the shape of the ear.

Shape of Head in FTS and Texel

The shape of the head of the sheep is influenced by the shape of the skull. The shape also affects the outline of the sheep's face. The shape of the sheep's head is divided into three groups, namely Dolicocephalic (Long), Mesophalic (Medium) and Brachycephalic (Short) [10]. The results of observations of the head shape of Fat Tailed and female Texel sheep are presented in Table 3.

3.2 Quantitative Characteristics

Body Weight of Adult FTS and Texel Sheep

The results of the data analysis in Table 4 show that the average body weight of Fat Tailed sheep and Texel sheep experienced an increase in body weight with increasing age of the sheep ($P < 0.01$). The trend of increasing body weight of Fat Tailed and Texel sheep can be seen from the notation on the average. The high level of diversity in body weight data (>10%) is due to several factors ranging from maintenance management, environment, age and genes. Genetics in sheep will result in changes due to mutation, selection, in breeding, out breeding, genetic drift [11]. The high diversity in the < 1 year age group is also a sign of fluctuations in body weight gain according to genetics supported by adequate nutrition. The highest body weight gain occurs at the age of 6–7 months [12].

Table 5. Mean of Chest Girth in FTS and Texel sheep

Breed	Ages	n	Chest Girth (cm)	
			Mean ± SD (cm)	CV
FTS	< 1 Years	14	64.84 ± 3.47a	5.35%
	1–2 years	10	73.30 ± 3.58a	4.88%
Texel	< 1 years	16	59.91 ± 4.82a	8.04%
	1–2 years	23	72.87 ± 2.16b	4.11%

Different notation in the same column means the result is highly different significantly ($P < 0.01$).

The body weight of the sheep used as broodstock must be in accordance with the applicable regulations so that the selection of the broodstock can ensure that there are no hormonal disturbances during reproduction. Fat-tailed female lambs in the 1–2 year old group had an average seedling body of 30.17 ± 2.94 kg, when compared with the average body weight data. Decree of the Minister of Agriculture no. 2389/Kpts/LB.430/8/2012, the Fat Tail sheep used in this study were in accordance with the standards. Meanwhile, Texel sheep at the age of 1–2 years have an average body weight of 31.18 ± 3.4 kg, when compared to the average body weight of Texel sheep in Wonosobo Decree of the Minister of Agriculture no. 2915/Kpts/OT.140/6/2011, the Texel sheep used in this study still did not meet the body weight criteria. The low body weight in ewes is associated with the activity of the hormone estrogen which can interfere with growth and even cause it to stop growing [13]. The body weight of Fat Tailed and Texel bentina sheep which can be classified as small body weight also affects the body size of the sheep. Body weight has a close relationship with body length, chest circumference, and shoulder height [14]. This causes the sheep that have a large body weight will be divided by the size of the other large body parts as well. In line with Maylinda and Busono [15], the high level of correlation between the chest circumference and body weight is due to the chest circumference being directly related to the abdomen and chest which are part of the carcass.

Linear Measurements (Chest Girth, Body Length and Body Height)

Chest circumference is part of the livestock body measurement that can be used as a substitute parameter for body weight. Chest circumference has a close relationship with body weight. The increase in body weight of the sheep is accompanied by an increase in other body sizes, both bones and muscles, which causes the size of the chest circumference that grows sideways to increase. The results of the data analysis on the chest circumference of Fat Tailed and Female Texel sheep are presented in Table 5.

Body height usually has a high correlation value with body weight. Shoulder height in sheep is related to bone growth in the leg area. Shoulder height also reflects the criteria of a particular breed. The results of the analysis of the average shoulder height of the Fat Tailed Sheep and the Female Texel are in Table 6.

Data analysis in the table show that the increase in age in Fat Tailed and Texel sheep has a very significant effect on body length ($P < 0.01$) (Table 7). The trend of increasing body length in the age group < 1 year and 1–2 years can be seen from the notation on

Table 6. Mean of Body Height in FTS and Texel sheep

Breed	Ages	n	Body height (cm)	
			Mean ± SD (cm)	CV
FTS	< 1 years	14	57.53 ± 7.33	12.73%
	1–2 years	10	62.91 ± 3.29	4.33%
Texel	< 1 years	16	51.03 ± 2.55a	5.00%
	1–2 years	23	59.57 ± 4.15a	6.96%

Tabel 7. Mean of Body Length in FTS and texel sheep

Breed	Ages	n	Body Length (cm)	
			Mean ± SD (cm)	CV
FTS	< 1 years	14	53.41 ± 4.37a	8.18%
	1–2 years	10	60.36 ± 3.29a	5.45%
Texel	< 1 years	16	49.28 ± 3.72a	7.55%
	1–2 years	23	57.24 ± 4.45 a	7.77%

Different notation in the same column means the result is highly different significantly ($P < 0.01$).

the average size. The level of body length diversity in Fat Tailed and Texel sheep in the < 1 year age group was quite high. This diversity indicates that the increase in body length of Fat Tailed and Texel sheep has a significant increase at the age of < 1 year. The increase in body length in sheep experiences peak growth at the age of 5–6 months [16]. The increase in body length of the sheep indicates the growth of the spine.

The average body length of adult Fat Tail sheep in the study when compared with the average body length of Fat Tailed sheep based on (decision) had met the criteria. While the body length of the Texel sheep in this study had a short body length compared to the average body length of the adult Texel Wonosobo sheep from the data. The Texel sheep in the study were shorter in body length, which could be attributed to genetic influences from the parents. The Texel sheep in this study were indicated to have genetics that regulate growth more dominantly than the Thin Tail sheep elders, so the posture of the Texel sheep is smaller. In addition, the small posture can also be associated with nutritional factors and hormone performance in female sheep. In ewes that have high levels of the hormone estrogen, bone growth slows down due to the closed bone growth plate [13].

4 Conclusions

The qualitatif trait of FTS is similar with standard Characteristics of Fat Tailed Sheep (the Minister of Agriculture No. 2389/Kpts/LB.430/8/2012) and Texel Sheep (the Minister of Agriculture No. /Kpts/OT.140/6/2011). The quantitative traits for both breeds (JFTS

and Texel sheep) do not accord to issued by Quantitative Characteristics of Javanese Fat Tailed Sheep (JFTS) (the Minister of Agriculture No. Kpts/LB.430 /8/2012) and Texel Sheep (the Minister of Agriculture No. 2915/Kpts/OT.140/6/2011). The head shape of JFTS is 100% dolicocephalos (long head) and Texel sheep is Dolicocephalic 48.7% (longhead) and Mesophalic 51.27% (medium head). It could be mean the Texel sheep in that location is not purebred but it was crossed with Local sheep especially with Thin Tailed Sheep (the Texel sheep are imported from Wonosobo).

References

1. Hailemariam, F., Gebremicheal, D., and Hadgu, H.: Phenotypic characterization of sheep breeds in Gamogofa zone. Agriculture and Food Security 7(1), 1-7 (2018).
2. Central Statistics Agency: Peternakan dalam Angka 2020. Badan Pusat Statistik, Jakarta (2020).
3. Ramos, I. O., de Rezende, M. P. G., Carneiro, P. L. S., de Souza, J. C., Sereno, J. R., Bozzi, R., and Malhado, C. H. M.: Body conformation of Santa Inês, Texel and Suffolk ewes raised in the Brazilian Pantanal. Small Ruminant Research 172, 42-47 (2019).
4. FAO: Phenotypic characterization of animal genetic resources. FAO Animal Production and Health Guidelines No. 11, Rome (2012).
5. Heryani, L. G. S. S., Susari, N. N. W., dan Gunawan, I. W. N. F.: Variabel komponen utama pada morfometrik sapi putih taro berdasarkan pengukuran badan. Buletin Veteriner Udayana 10(1), 93–99 (2018).
6. Abdurrahman, A. M., and Setiasih, S.: Application of morphological index in the assesment of type and function of fat tail sheep in Sapudi Island. Biotropika: Journal of Tropical Biology 5(3), 110–113 (2017).
7. Inounu, I. S. M. E. T. H., Ambarawati, D., and Mulyono, R. H.: Pola warna bulu pada domba Garut dan persilangannya. JIT 14(2), 118-130 (2009).
8. Depison, Putra, W. P. B., Gushairiyanto, Alwi, Y., and Suryani, H.: Morphometrics characterization of thin-tail sheep in lowland and highland areas. Tropical Animal Science Journal 44(4), 386–398 (2021).
9. Komariah, D. J. Setyono, dan Aslimah.L Karakteristik kuantitatif dan kualitatif kambing dan domba sebagai hewan qurban di Mitra Tani Farm. Buletin Peternakan 39(2), 84 – 91 (2015).
10. Popoola, M. A., and Oseni, S. O.: Multifactorial discriminant analysis of cephalic morphology of indigenous breeds of sheep in Nigeria. Slovak Journal of Animal Science 51(2), 45-51 (2018).
11. Gunawan, A., R. Mulyono, dan C. Sumantri.: Identifikasi ukuran tubuh dan bentuk tubuh domba garut jenis aduan dan jenis daging dan persilangan garut berdasarkan analisis komponen utama. Animal Production 11, 8–14 (2011).
12. Subhandiawan, H.: Persamaan laju pertumbuhan domba lokal jantan dan betina umur 1-12 bulan yang ditinjau dari panjang badan dan tinggi pundak (kasus peternakan domba di Kampung Nenggeng, Desa Neglasari, Kecamatan Darangdan, Kabupaten Purwakarta, Jawa Barat). Students e-Journal Universitas Padjajaran 5(4), 1-6 (2016).
13. Holman, B. W. B., A. Kashani and A. E. O. Malau-Aduli.: Growth and body conformation responses of genetically divergent Australian sheep to spirulina (Arthrospira plantensis) supplementation. American Journal of Experimental Agriculture 2(2), 160-173 (2012).
14. Tama, W. A., Nasich, M., dan Wahyuningsih, S.: Hubungan antara lingkar dada, panjang dan tinggi badan dengan bobot badan kambing Senduro jantan. Jurnal Ilmu-Ilmu Peternakan (Indonesian Journal of Animal Science) 26(1), 37–42 (2016).

15. Maylinda, S. and W. Busono.: The accuracy of body weight estimation in fat tailed sheep based on linear body measurements and tail circumference. Jurnal Ilmu-Ilmu Peternakan 29(2), 193-199 (2019).
16. Sumantri, C., Einstiana, A., Salamena, J. F., dan Inounu, I.: Keragaan dan hubungan phylogenik antar domba lokal di Indonesia melalui pendekatan analisis morfologi. JITV 12(1), 42–54 (2007).