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CORRELATION OF BODY MORPHOMETRY AND UDDER VOLUME WITH MILK PRODUCTION IN ETTAWA CROSSBREED GOATS IN NUSA TENGGARA BARAT

Korelasi Morfometri Tubuh dan Volume Ambing dengan Produksi Susu pada Kambing Peranakan Ettawa di Nusa Tenggara Barat

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ABSTRACT

Observation of body size can be used as an identification of breeders as a selection criterion of dairy goats identify superior breeding stock and optimize milk production in Nusa Tenggara Barat, with potential implications for food security. The study aimed to determine the relationship between body size and udder volume with milk production of Etawa Crossbreed goat. This study was conducted at the experimental pen of Universitas Nahdlatul Wathan Mataram in Desa Ketangga Jeraeng, Lombok Timur, with twenty-five female Etawa Crossbreeds that were lactating. This study used a survey method and measurements of body length (BL), body height (BH), chest circumference (CC), udder volume (UV) and milk production (MP). Data were analyzed using correlation and linear regression analysis. The results showed that the average of BL = 72.76 cm, BH = 66.6 cm, CC = 73.24 cm, UV = 30.31 liters and MP = 327.76 ml / day. Body length and udder volume were moderately correlated with milk production (r = 0.40-0.59). While body height and udder volume had a strong correlation with milk production (r above 0.60). From the results, it can be concluded that body length, body height and udder volume had a significant effect on milk production, and there was a positive correlation with udder volume and milk production which was classified as a moderate correlation (r = 0.40-0.59).

Keywords: *Body size, Udder volume, Milk production, Etawah crossbreed, Selection criterion*

ABSTRAK

Pengamatan ukuran tubuh dapat digunakan sebagai identifikasi bakalan/indukan yang baik untuk dijadikan seleksi kambing perah sehingga produksi susunya bisa maksimal untuk menunjang ketahanan pangan di Nusa Tenggara Barat. Tujuan penelitian untuk menganalisa korelasi antara morfometri tubuh dan produksi susu serta mengetahui hubungan antara volume ambing dan produksi susu pada kambing peranakan Ettawa (PE). Penelitian ini dilaksanakan di kandang percobaan Universitas Nahdatul Wathan Mataram di Desa Ketangga Jeraeng Kecamatan Keruak Kabuapten Lombok Timur, dengan menggunakan kambing PE betina yang sedang laktasi sejumlah 25 ekor. Metode penelitian yang digunakan adalah survei dan pengukuran terhadap panjang badan (PB), tinggi badan (TB), lingkar dada (LD), volume ambing (VA) dan produksi susu (PS). Data dianalisis dengan analisis korelasi dan regresi linier. Hasil penelitian menunjukan bahwa rata – rata PB = 72.76 cm, TB = 66.6 cm, LD = 73.24 cm, VA = 30.31 liter dan PS = 327.76 ml/hari. Variabel morfometri memiliki hubungan yang lebih kuat dan sangat signifikan (P≤0.01) terhadap volume ambing dibandingkan terhadap produksi susu. Hal ini terlihat dari nilai korelasi PB (r 0.60), TB (r 0.65), LD (r 070) dan koefisien determinasi PB (R^2 0.33), TB (R^2 0.42), LD (R^2 0.49) pada hubungan dengan volume ambing. Sebaliknya, hubungan antara variabel morfometri dengan produksi susu menunjukkan hasil yang signifikan

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(P≤0.05) kategori sedang, dengan nilai korelasi (r 0.45-0.56) dan koefisien determinasi (R^2 0.20-0.31) yang relatif lebih rendah. Lebih lanjut, hasil analisa antara volume ambing dengan produksi susu memiliki korelasi yang rendah (r 0.33) dengan koefisien determinasi sebsar 11 % dan P value 0.108 (P≥0.05) artinya tidak signifikan. Meski demikian kualitas nutrisi kambing PE menunjukan hasil yang baik dengan kandungan protein 4,1 %, lemak 5.8% , laktosa 3,7 % dan pH 6,2. Hal ini mengindikasikan bahwa susu kambing dapat menjadi alternativ untuk kebutuhan pangan yang berkulitas hanya saja perlu perbaikan manajmen sehingga produksi susunya dapat dimaksimalkan.

Kata kunci: *Ukuran tubuh, Volume ambing, Produksi susu, Kambing PE, Kriteria seleksi*

INTRODUCTION

The West Nusa Tenggara (NTB) is one of the regions with considerable livestock potential. However, livestock development programs in this area are still dominated by cattle as the main commodity, while goats remain a secondary option. Based on population data, the number of goats in NTB reached 491,609 head (BPS, 2025). Of this total, the Peranakan Etawah (PE) goat has been widely raised due to its dual-purpose function (milk and meat). This is consistent with the findings of Fauzi, M., et al. (2024), who reported that the dominant goat population structure in Sumbawa Regency is PE goats at 47.41%, mainly because of their high adaptability and dual function as both meat-type and dairy-type goats.

NTB is also one of the regions with a relatively high stunting rate. During the period 2020–2023, the stunting prevalence in NTB reached 24.6% in 2023. With various interventions implemented, the prevalence has decreased to approximately 13.39%, equivalent to 51,809 cases out of 387,065 children under five in 2025 (NTB Satu Data, 2025). Milk plays an important role in fulfilling the nutritional needs of people across all age groups. In children, milk consumption contributes to meeting nutritional requirements that support growth and help prevent stunting. In this context, goat milk has the potential to serve as an alternative source of animal protein that can improve community nutritional status and support food security.

Currently, national milk availability is still dominated by cow's milk, amounting to approximately 107,481 liters, which only fulfills around 20% of national demand (BPS, 2021). Indonesia's total milk demand reaches 4.4 million tons, of which about 80% is supplied through imports. Furthermore, the Director General of Livestock and Animal Health Services (2022) stated that the increase in domestic fresh milk production is only 2%, which does not keep pace with the 5% growth in national milk consumption. This indicates a substantial gap between milk demand and supply at the national level. In addition to cattle, PE goats also have strong potential as an alternative source of milk production.

PE goats are a crossbreed between local Kacang goats and Etawah goats, known for their high adaptability to environmental conditions in Indonesia (Febriana et al., 2018). Female PE goats have an average body length of approximately 79 cm, chest width of 19 cm, chest depth of 31 cm, body height of 53 cm, and chest circumference of 90 cm. Meanwhile, male PE goats have an average body length of about 55 cm, chest width of 23 cm, chest depth of 17 cm, body height of 57 cm, and chest circumference of 67 cm (Andiyanto, 2013). The average milk production of PE goats is 857.3 ml per head per day, with a gestation period of 147–160 days and a lactation period reaching up to 8 cycles or until approximately 7 years of age (Rusdiana, S., et al., 2015). In terms of composition, goat milk contains 0.31% calcium (Ca) and 0.98% phosphorus (P) (Fahmi Natsir, 2017), indicating competitive nutritional value compared to cow's milk.

The development of PE goats in NTB is highly promising; however, it has not yet been carried out systematically, particularly in terms of management practices and milking management to support increased regional milk production. Therefore,

measurements of body morphometrics and udder volume in dairy goats can be used as indirect indicators to predict production potential (Purwati et al., 2019). In addition, body parameters or morphometric traits can be utilized in the selection process of superior livestock (selection criteria) to improve productivity at low cost (Aduba et al., 2024). This is supported by Suranjaya et al. (2016), who stated that linear body measurements such as body length, withers height, and chest circumference can be used to estimate body weight and are correlated with production performance.

Research specifically examining the simultaneous relationship between body morphometrics and udder volume on milk production in PE goats in the NTB region is still very limited. Therefore, this study needs to be conducted to analyze the simultaneous relationship between body morphometrics and udder volume on milk production of Peranakan Etawah goats in NTB, as well as to utilize the results as a scientific basis for developing selection criteria for local dairy livestock. This study aims to analyze the correlation between body morphometrics and milk production and to determine the relationship between udder volume and milk production in PE goats, thereby contributing to the development of a more effective dairy goat selection system.

MATERIALS AND METHODS

Experimental Design and Procedures

This study employed an observational cross-sectional design using a survey approach combined with direct morphometric and production measurements of lactating PE goats.

The inclusion criteria for the study samples were: (1) lactating PE goats in active lactation period, (2) clinically healthy animals, and (3) goats managed under similar traditional farming conditions.

The exclusion criteria included: (1) goats with signs of illness or reproductive disorders, and (2) goats not producing milk during the observation period.

The sampled goats were generally in similar lactation stages (early to mid-lactation), with relatively comparable parity and age ranges based on farmer records. Feeding management was relatively uniform, consisting of locally available forage and supplementary feed, although variations typical of smallholder systems were present and are acknowledged as a limitation.

Time and Location of the Study

This research was conducted at the experimental goat barn of Nahdlatul Wathan University Mataram, located in Ketangga Jeraeng Village, Keruak District, East Lombok Regency.

Sebelah Utara : Kecamatan Sakra
Barat Sebelah Selatan : Kecamatan Jerowaru Sebelah Barat : Kabupaten Lombok Tengah Sebelah Timur : Selat Alas

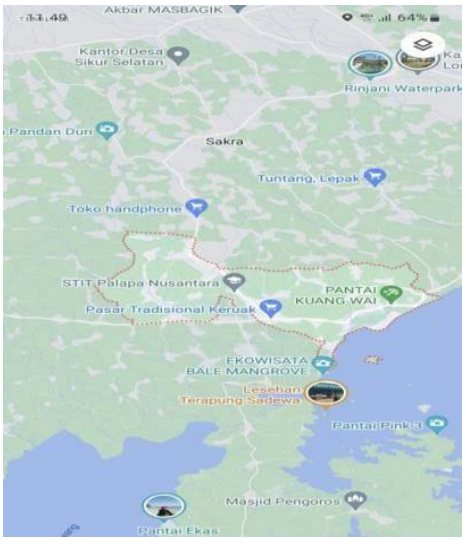

Figure 1 Maps Kecamatan Kruak

East Lombok Regency is located at the easternmost part of Lombok Island, geographically positioned between 8–9° South Latitude and 116–117° East Longitude, with a total area of 2,679.88 km², consisting of 1,605.55 km² of land and 1,074.33 km² of marine area. The topography of East Lombok ranges from 0 to 3,726 meters above sea level, with temperatures ranging from 22–32°C and humidity levels between 70–82% (East Lombok Profile, 2020).

East Lombok consists of 21 districts, one of which is Keruak District. Keruak District comprises 15 villages, namely Sapit, Setungkep Lingsar, Senyiur, Batu Putik, Selebug Ketangga, Keruak, Ketangga Jeraeng, Dane Rase, Pijot, North Pijot, Tanjung Luar, Ketapang Raya, Mongtong Belae, and Pulau Meringkik, with a total area of 40.49 km².

Similar to other districts, Keruak District has a variety of livestock, including cattle, goats, sheep, and buffalo. The goat population in Keruak District is 9,989 head, distributed across 15 villages (BPS, 2014), making it the third-largest among the 21 districts in East Lombok Regency.The research was conducted in four villages within Keruak District, namely Keruak Village, Ketangga Jeraeng Village, Jurid Village, and Pijot Village.

Research Materials

The materials used in this study consisted of 25 lactating PE (Peranakan Etawah) goats in their lactation period, with a milking frequency of twice daily. The equipment used included a Butterfly measuring tape for measuring body circumference, a measuring stick for measuring body length and withers height, a 2-liter container for measuring udder volume, and 500-ml and 1-liter graduated cylinders for measuring milk yield.

Research Methods

Preparation Stage

The study began with a survey and preparation of all tools and materials required for data collection.

Measurement Stage

This stage was divided into three categories:

Body Measurements; Body measurements included body length, withers height, and chest circumference; **Body length** was measured from the third to the fourth thoracic vertebra using a measuring stick or measuring tape (cm). **Withers height** was measured from the highest point of the withers to the ground using a measuring stick (cm). **Chest circumference** was measured by wrapping a measuring tape around the thoracic cavity perpendicular to the body axis (cm) (Adriani, 2011).

Udder Measurements;

Udder volume was measured before and after milking using a 2-liter plastic container and the overflow water method based on Archimedes' principle (Pribadiningtyas et al., 2012). However, this method may have limitations in accurately capturing udder volume in animals with asymmetrical udder morphology, which could introduce minor measurement bias.

Milk Milking Procedure ; Milking is the process of extracting milk from the udder to obtain optimal milk yield. The milking process consisted of three stages: pre-milking, milking, and post-milking (Sasongko, 2012). Milk production in this study was measured once daily due to the prevailing traditional management practices in the study area, where farmers generally do not apply standardized twice-daily milking. Although twice-daily milking is recommended for optimal production measurement, the approach used in this study reflects actual field conditions.

This limitation may lead to underestimation of total daily milk yield; therefore, the results should be interpreted as indicative of relative production rather than absolute production potential. Despite these limitations, the study provides valuable baseline data for morphometric-based selection under smallholder conditions.

Data Analysis

Prior to conducting parametric analysis, data normality was tested using the Shapiro–Wilk test. Variables with normal distribution ($p > 0.05$) were further analyzed using Pearson correlation and linear regression analysis. In addition, multicollinearity among the independent morphometric variables was assessed to ensure the validity of the regression models. The interpretation of regression and correlation results was based on both the correlation coefficient and statistical significance level.

RESULTS AND DISCUSSION

A. PE Goats as an Alternative for Food Security

The nutritional quality of PE goat milk can be observed from the chemical analysis results presented in the table below:

Table 1 Nutritional Quality of PE Goat Milk

Variabel	Value	Goat	Cow
Protein	4,1 %	4,6 %[a], 5.27%[b]	3,8 %[a]
Fat	5,8 %	2,5 %[a], 5 %[b]	5,0%[a]
Lactose	3,7 %	3,69 % [b]	4,7
Ph	6,2	6.5	

Source: (a Arif et al.,2018, b Setiawan et al., 2013)

From the table above, it was found that the protein content of goat milk was 4.1%, which is lower than the results reported by Arif et al. (2018) (4.6%) and Setiawan et al. (2013) (5.27%), but higher than cow milk protein content (3.8%) (Arif et al., 2018). The lactose content in this study was 3.7%, which is almost similar to other goat milk studies (3.69%), but lower than cow milk (approximately 4.5%). This is consistent with the general characteristic that goat milk contains slightly lower lactose than cow milk. Lower lactose content is often associated with better digestibility for the human digestive system.

Goat milk has high value as an alternative source to meet nutritional needs and food security. The lower values obtained in this study compared to previous studies may be due to traditional farming systems with limited feed provision. Milk protein is formed from concentrate feed consumed by livestock, which is then synthesized by rumen microbes into amino acids. These amino acids are absorbed in the small intestine and transported through the blood to the mammary secretory cells (Uteri et al., 2012).

Rosmiati et al. (2025) stated that goat milk is highly suitable for malnourished children due to its high mineral content, good protein quality, and easily digestible fatty acids. Compared to cow milk, goat milk also offers various health benefits, including its potential role in treating asthma, hepatitis, tuberculosis, anemia, muscular disorders, and gastric disorders (R.F. Christi et al., 2018).

Figure 2. Measurement of Chest Circumference and Body Height in PE Goats

The observations also showed that 28% of goats were milked, while 72% were not milked out of a total sample of 25 goats. Some lactating PE goats were not utilized for milk production and were only used to nurse their offspring. This is mainly due to limited knowledge of proper lactation management techniques for PE goats and a lack of awareness regarding their economic potential. Goat milk is not yet widely consumed, particularly in the Lombok region. It is generally only known among certain groups and is more commonly used for traditional medicinal purposes.

From a market demand and pricing perspective, particularly in Mataram City, goat milk packaged in 250 ml bottles is sold at a price range of IDR 30,000 to IDR 40,000. At this price level, dairy goat farming has promising economic potential. Milk production in Lombok shows strong prospects for development. The expansion of PE goat farming can be carried out on a larger scale due to its relatively lower capital requirements compared to dairy cattle farming. In addition, goats have better adaptability to environmental conditions in Lombok Island.

B. Body Size and Milk Production of PE Goats

From the 25 PE goats measured in the Ketangga Village area, East Lombok Regency, the following results were obtained:

Table 2. Average Body Measurements, Udder Size, and Milk Production

Variabel	Mean Value	Standar value
Body Length (cm)	72.76 ± 5.12	64.14[a]
Withers Height / Body Height (cm)	66.6 ± 5.30	54.42[a]
Chest Circumference (cm)	73.24 ± 6.16	73.21[a]
Udder Volume (liter)	30.31 ± 0.98	20.29-24.05[b]
Udder Volume (liter)	327.76 ± 47.90	511-736[b]

Saucer : a SNI (2018), b Darmayani et al (2020)

From Table 2 above, it is known that the average body length of PE goats was 72.76 cm, which is higher than the SNI standard value. In addition, the obtained body height value of 66.6 cm is also higher than the SNI standard (SNI, 2008). The chest circumference value of 73.24 cm is almost similar to the applicable SNI standard. The udder volume obtained was 30.31 liters, which is higher than the results of previous studies (Damayani et al., 2020). Milk production was measured only once per day, with an average value of 327.76 ml/day. This result is lower than previous studies. This is due to the fact that most PE goats in the study location were not subjected to intensive milking, and therefore have not yet shown optimal production results. Meanwhile, standard milking management is generally carried out twice a day (Febriana et al., 2018).

Table 2 also presents the results of normality and multicollinearity tests. The normality test results showed that Body Length (0.20), Body Height (0.18), Chest Circumference (0.09), and Udder Volume (0.08) were normally distributed, while Milk Production (0.03) was not normally distributed. However, the multicollinearity test results indicated that there was no serious multicollinearity problem, so the regression analysis between variables could be continued. The milk production value is still relatively low. This is because the goats studied are PE goats that are traditionally raised by farmers, who generally do not yet apply proper lactation management. In general, differences in milk production are influenced by body size, chest circumference, shoulder height, and udder volume of each animal, as well as other factors such as environment and management practices (Santoso, 2020). Milk production is influenced by both external and internal factors. External factors include feed, environment, and management practices, while internal factors include genetics and hormonal status (Suryandari et al., 2023).

C. Relationship Between Body Length (BL), Udder Volume (UV), and Milk Production (MP)

Prior to regression analysis, assumption testing was conducted. The results of the normality test showed that Body Length (p = 0.20), Body Height (p = 0.18), Chest Circumference (p = 0.09), and Udder Volume (p = 0.08) were normally distributed, whereas Milk Production (p = 0.03) did not fully meet the normality assumption. Therefore, interpretations involving milk production were made with caution. In addition, multicollinearity assessment among the morphometric variables indicated no serious multicollinearity problem; thus, the regression analysis was considered appropriate. However, regression analysis was retained as it is generally robust to minor deviations from normality. The regression results are presented in Table 3.

The results of measurements on body length in relation to udder volume and milk production are presented as regression equations in the table below:

Table 3. Regression Equation, Correlation Coefficient (r), Coefficient of Determination (R^2), and P-value of Body Length (BL), Udder Volume (UV), and Milk Production (MP)

Body Morphometry		Regression Equation	r	R^2 (%)	P value
BL and UV	a	y = 21,44+0,12x	0,60	0.33	0.0014
	b	y = 21.46+012x + 0.00063x^2	0.60	0.36	0.007
BL and MP	a	y= -33.19+4.94x	0.50	0.25	0.0098
	b	y= -70,68 + 4,73x+ 1,74x^2	0.50	0.25	0.037

Note: a. Linear regression
b. Non-linear regression

The results of the linear regression analysis showed that body length and udder volume had a strong correlation (r = 0.60), a coefficient of determination (R^2 = 0.36), and a P-value of 0.0014, indicating a significant result. This indicates that there is an effect of body length on udder volume. Body length in goats plays an important role in the development of udder volume. This is because body length reflects the overall body size, which is related to tissue growth capacity, including mammary gland tissue. Goats with greater body length generally have a larger body capacity, which allows more optimal udder development. The results also show that this relationship can be categorized as fairly strong and significant, meaning that body length can be used as one of the selection indicators in dairy goats to support increased milk production capacity through better udder development.

Table 3 shows that the relationship between body length and milk production has a moderate correlation (r = 0.50), with 25% of milk production being influenced by body length. However, based on the P-value, the result is statistically significant. Body length in Peranakan Etawah (PE) goats has a positive relationship with milk production, although the correlation is not very strong. This result differs from the study of Febriana et al. (2018), which reported that milk production and udder volume did not increase along with an increase in body length.

Body length is one of the morphometric measurements in PE goats. Animals with larger morphometric size generally have better body capacity to consume and utilize nutrients from feed, thereby supporting more optimal milk synthesis. In addition, larger body size is usually accompanied by better udder development, which indirectly can increase milk production. However, although body length has an effect, other factors such as genetics, feed, and management practices also play an important role in determining overall udder size and function. This is in accordance with Suryandari et al. (2023), who stated that milk production is influenced by both internal and external factors. Internal factors include genetics and the physiological condition of the animal, while external factors include feed, environment, and management practices. Body size such as body length is included as an indicator of physiological potential that can support milk production.

D. Relationship Between Withers Height (WH), Udder Volume (UV), and Milk Production (MP)

The relationship between Withers Height (WH), Udder Volume (UV), and Milk Production (MP) can be seen in Table 4 below:

Table 4. Regression Equation, Correlation Coefficient (r), Coefficient of Determination (R^2), and P-value of Withers Height (WH), Udder Volume (UV), and Milk Production (MP)

Body Morphometry		Regression Equation	r	R^2 (%)	P value
WH dan UV	a	y= 22.44+0.11x	0.65	0.42	0.00044
	b	y=66.63+5.26x-2.95x^2	0.56	0.31	0.015
WH dan MP	a	y= 0.42 +4.91x	0.56	0.31	0.0037
	b	y=22.44+0.123x-0.0010x^2	0.65	0.34	0.0022

Note: a = linear regression relationship
b = non-linear regression relationship

The results of the regression analysis in Table 4 show that one of the morphometric traits of PE goats, namely withers height (WH), has a strong correlation with udder volume (r = 0.65), with a coefficient of determination (R^2) of 42%, which is categorized as moderate, and a P-value ≤ 0.01, indicating a highly significant effect. The quadratic regression equation also shows the model $y = 66.63 + 5.26x - 2.95x^2$, with a moderate correlation (r = 0.56), R^2 = 31%, and P-value = 0.015 (significant).

Table 4 also shows that withers height (WH) and milk production (MP) have a moderate correlation (r = 0.55), with a coefficient of determination (R^2 = 0.31) and a P-value of 0.0037 (P ≤ 0.01), indicating a highly significant relationship. These results indicate that body height plays a more important role in the development of the udder than in directly influencing milk production, which is also affected by other factors such as genetics, feed, and management practices.

The results of this study are consistent with several previous studies, which reported that body size, including body height, has a strong relationship with udder development but only a moderate effect on milk production. Taufik et al. (2008) reported a strong correlation between udder volume and milk production, while Febriana et al. (2018) stated that not all body measurements have a substantial effect on milk production. This suggests that body size contributes more to supporting udder development rather than directly determining milk production, which is also influenced by other factors such as feed, genetics, and management practices.

E. Relationship Between Chest Circumference (CC), Udder Volume (UV), and Milk Production (MP)

The relationship between chest circumference, udder volume, and milk production can be seen in Table 5 below:

Table 5. Regression Equations, Correlation Coefficient (r), Coefficient of Determination (R^2), and P-value of Chest Circumference (CC), Udder Volume (UV), and Milk Production (MP)

Body Morphometry		Regression Equation	r	R^2 (%)	P *value*
CC dan UV	a	y=22.41+0.1x	0.70	0.49	0.000084
	b	y=22.39+0.10x+0.0002x^2	0.70	0.49	0.00053
CC dan MP	a	y=80.62+3.37x	0.45	0.20	0.023
	b	y=61.02+3.28x+0.87x^2	0.45	0.20	0.078

Note: a = linear regression
b = non-linear regression

From Table 4, it is known that chest circumference (CC) has a strong correlation (r = 0.70) with udder volume (UV), while the correlation between chest circumference and milk production is moderate (r = 0.45). Based on the coefficient of determination

(R^2), chest circumference shows a moderate influence of 49% on both udder volume and milk production. Furthermore, the P-value indicates a highly significant result (P = 0.000084) for the relationship between chest circumference and udder volume, and a significant result (P = 0.023) for the relationship between chest circumference and milk production.

This is in accordance with Fitriani and Widayati (2020), who stated that the use of morphometric parameters such as chest circumference can be applied in the selection of PE goat does to improve milk production. They suggested integrating chest circumference data, udder volume, and milk production records in genetic selection programs. However, the relationship between chest circumference, udder volume, and milk production is indicative rather than absolute. Other factors such as genetics, feeding management, milking frequency, and lactation stage also have significant effects on milk productivity in PE goats.

According to Santoso (2020), body measurements such as body length, chest circumference, and shoulder height are related to the physiological capacity of livestock in utilizing feed and supporting milk production.

F. Relationship Between Udder Volume (UV) and Milk Production (MP)

Table 6. Regression Equations of Udder Volume (UV) and Milk Production (MP)

Body Morphometry	Regression Equation	r	R^2 (%)	P value
UV dan MP	y= -156.09+15.95x	0.33	0.11	0.108

Note: a = linear pattern relationship

Based on the results of the simple linear regression analysis between udder volume and milk production, the equation obtained was y = -156.09 + 15.95x, which indicates a negative relationship. Furthermore, the correlation value (r) of 0.33 falls into the weak category. The coefficient of determination (R^2) of 0.11 indicates that 11% of the variation in the dependent variable is explained by the independent variable. A P-value > 0.05 indicates that the relationship is not statistically significant.

These results are also consistent with a previous study (Febriana et al., 2018), which obtained a regression equation of y = -308.42 + 1.11x, where the P-value of 0.59 indicated that there was no significant effect between udder volume and milk production. However, another study (Taufik et al., 2008) showed different results, reporting a strong relationship between udder volume and milk production with r = 0.799 and R^2 = 0.639, indicating a strong correlation between udder volume and milk yield. Copate et al. (2006) stated that many factors influence milk production, one of which is udder volume. Their study showed that udder globulousness is a stronger indicator than udder length in predicting milk production, with r = 0.79 (strong correlation).

The non-significant results of this study may be caused by several factors, including management practices, feeding, and genetic quality of the animals. This is in line with Budiarsana (2005), who stated that livestock performance is influenced by several complex factors such as feeding management and environmental conditions. Another influencing factor is that the observed goats were PE goats whose genetic quality had not yet been identified, and there was also no regular milking management applied to PE goats in West Nusa Tenggara, particularly in East Lombok Regency. Fitriyah et al. (2024) stated that genetic factors play a very important role in determining goat quality, including production ability. Superior genetics shape animal characteristics such as optimal body growth, good udder structure, and higher lactation capacity.

CONCLUSION

Based on the results of regression and correlation analyses, morphometric traits of Peranakan Etawah (PE) goats—namely body length (BL), body height (BH), and chest circumference (CC)—showed relationships with both udder volume and milk production, although with varying strengths. Morphometric variables exhibited stronger

and highly significant associations (P ≤ 0.01) with udder volume, as indicated by correlation coefficients of BL (r = 0.60), BH (r = 0.65), and CC (r = 0.70), and coefficients of determination ranging from 0.33 to 0.49.

In contrast, the relationships between morphometric variables and milk production were moderate, with correlation values ranging from r = 0.45 to 0.56 and coefficients of determination between 0.20 and 0.31. Although some of these relationships were statistically significant (P ≤ 0.05), they were generally weaker than those observed for udder volume. These findings suggest that body size traits are more closely associated with udder development than with milk production itself.

Furthermore, the relationship between udder volume and milk production was weak (r = 0.33) and not statistically significant (P = 0.108), indicating that udder volume alone cannot reliably predict milk yield under the conditions of this study.

From a practical perspective, morphometric traits such as body length and body height may serve as useful early selection indicators in dairy goat breeding programs, particularly for improving udder development. However, optimization of milk production in PE goats requires improved management practices, including feeding, milking frequency, and overall herd management. In addition, the nutritional composition of PE goat milk observed in this study (protein 4.1%, fat 5.8%, lactose 3.7%, and pH 6.2) indicates its potential as a high-quality alternative food source.

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AUTHOR CONTRIBUTION

Conception and design of the research, Ni Made Andry Kartika; Acquisition of data, Yuni Mariani; Analysis and/or interpretation of data, Nefi Andriana Fajri; Drafting the manuscript, Ni Made Andry Kartika; Critical revision, Abyadul Fitriyah. The most recent version of this manuscript has been read and approved by all authors.

CONFLICT OF INTEREST

There are no personal or financial ties to other individuals or groups that can improperly affect the work. Furthermore, there is no personal or professional interest of any kind in any company, service, or product that may be interpreted as influencing the information in this paper.

AVAILABILITY OF DATA

Data is available on request from the authors.

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