

VARIATION IN THE SIZE OF THE CORKSCREW-SHAPED OR SPIRAL GLANS PENIS IN LANDRACE AND DUROC BOARS**Variasi Ukuran *Corkscrew-Shaped* atau Spiral Glans Penis Babi Landrace dan Duroc****I Nyoman Wiku Wedatama^{1*}, I Nengah Wandia², I Wayan Bebas³**¹Undergraduate Student of Veterinary Medicine, Faculty of Veterinary Medicine, Udayana University, Jl. Lingkar Timur Unud, Jimbaran, Bali, 80361, Indonesia;²Veterinary Anatomy Laboratory, Faculty of Veterinary Medicine, Udayana University, Jl. Lingkar Timur Unud, Jimbaran, Bali, 80361, Indonesia;³Veterinary Reproduction Laboratory, Faculty of Veterinary Medicine, Udayana University, Jl. PB. Sudirman, Sanglah, Denpasar, Bali, 80234, Indonesia.*Corresponding author email: nyomanwikuu@gmail.com

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Abstract

Pigs are an important commodity in Bali, where the reproductive performance of boars plays a key role in productivity. The boar glans penis has a corkscrew-shaped structure that is essential for copulation; however, information regarding size variation among strains remains limited. This study aimed to identify and compare variations in spiral length, diameter, and number of turns of the glans penis in Landrace and Duroc boars. Present study employed an analytical observational design using a convenience sampling method with 12 adult boars (seven Landrace and five Duroc). Samples were collected post-mortem from a pig slaughterhouse in Bali. Morphometric measurements were performed using a digital caliper, and data were analyzed using an independent t-test ($\alpha = 0.05$). The results showed that the mean spiral length of the glans penis in Landrace boars was 39.511 ± 1.184 mm, while in Duroc boars it was 38.090 ± 0.849 mm ($p > 0.05$). The mean spiral diameter was 15.935 ± 0.948 mm in Landrace boars and 15.856 ± 1.138 mm in Duroc boars ($p > 0.05$). The number of spiral turns was identical in both strains, with a mean value of one turn. In conclusion, there were no statistically significant differences in spiral length, diameter, or the number of turns of the glans penis between Landrace and Duroc boars.

Keywords: corkscrew-shaped, glans penis, morphometry, spiral, strain pigs

Abstrak

Babi merupakan komoditas penting di Bali dengan keberhasilan reproduksi pejantan sebagai faktor utama produktivitas. *Glans penis* babi memiliki bentuk spiral (*corkscrew-shaped*) yang berperan dalam proses kopulasi, namun informasi mengenai variasi ukurannya antar strain

masih terbatas. Penelitian ini bertujuan untuk mengidentifikasi dan membandingkan variasi panjang, diameter, dan jumlah putaran spiral glans penis pada babi strain Landrace dan Duroc. Penelitian ini menggunakan desain observasional analitik dengan metode *convenience sampling* terhadap 12 ekor pejantan dewasa (7 Landrace dan 5 Duroc). Sampel diperoleh secara post-mortem dari Rumah Potong Babi di Bali. Pengukuran morfometrik dilakukan menggunakan jangka sorong digital, dan data dianalisis menggunakan uji *independent t-test* ($\alpha = 0,05$). Hasil penelitian menunjukkan bahwa rata-rata panjang spiral *glans penis* pada babi Landrace adalah $39,511 \pm 1,184$ mm, sedangkan pada Duroc $38,090 \pm 0,849$ mm ($p > 0,05$). Rata-rata diameter spiral *glans penis* pada Landrace adalah $15,935 \pm 0,948$ mm dan pada Duroc $15,856 \pm 1,138$ mm ($p > 0,05$). Jumlah putaran spiral pada kedua strain menunjukkan nilai yang sama, yaitu 1 putaran. Disimpulkan bahwa tidak terdapat perbedaan yang signifikan secara statistik pada panjang, diameter, maupun jumlah putaran spiral *glans penis* antara babi strain Landrace dan Duroc.

Kata kunci: *corkscrew-shaped*, glans penis, morfometri, spiral, strain babi

INTRODUCTION

Pigs are a strategic livestock commodity in Bali because they serve as a source of animal protein and hold significant social, cultural, and economic value. Their use in various traditional and religious ceremonies results in a relatively stable demand for pork throughout the year (Sumardani, 2021), making pig farming a sector with great potential for development. These conditions necessitate increased productivity through reproductive efficiency, where the reproductive success of boars is influenced by stress factors, genetics, and anatomical conditions of the reproductive system (Sumardani *et al.*, 2017).

One key component is the spiral-shaped (corkscrew-shaped) glans penis, which adapts to the female cervix (annular folds), facilitates penetration and cervical locking, and triggers the ejaculatory reflex (Knox, 2003; Dekrismar *et al.*, 2022). This structure plays a crucial role in semen deposition and male fertility, making it suitable for morphometric analysis. Variations in reproductive traits are influenced by genetic differences among strains (Savić & Petrović, 2015).

This study focused on two breeds commonly raised in Bali, Landrace and Duroc, which differ in genetic characteristics and reproductive performance. Landrace pigs are known to have a relatively high semen volume and sperm motility (Sumardani *et al.*, 2019), whereas Duroc pigs are superior in growth and feed efficiency but have relatively lower ejaculatory performance (Savić & Petrović, 2015; Zhou *et al.*, 2023). These differences suggest that variations in reproductive organ morphometry, including the size of the penile glans spiral, may differ among strains.

However, to date, no specific data are available on the variations in the length, diameter, and number of turns of the penile glans spiral in Landrace and Duroc boar strains. Therefore, this study aimed to provide preliminary data on penile glans spiral morphometry as a basis for further research on boar reproduction.

RESEARCH METHODS

Research Subjects

The penile glans of male pigs (*Sus scrofa domesticus*) from two strains commonly used for natural mating in Bali, namely, Landrace and Duroc, were the subjects of this study. Samples were selected using convenience sampling based on the availability of animals meeting the criteria, namely, healthy adult males aged ≥ 3 years, with information obtained from owner records and records at the pig slaughterhouse. The total sample consisted of 12 pigs, comprising

seven Landrace pigs and five Duroc pigs. Morphometric measurements were performed post-mortem after the animals were slaughtered in accordance with applicable procedures; thus, live animal observation was not involved.

Research Design

This study employed an analytical observational design to systematically describe the morphological characteristics of reproductive organs without experimental treatment. Sampling was conducted using convenience sampling based on the availability of animals that met the criteria, namely, healthy male pigs aged ≥ 3 years. The sample consisted of 12 pigs (*Sus scrofa domestica*), including seven Landrace strain pigs and five Duroc strain pigs, obtained from the Darmasaba Pig Slaughterhouse in Bali.

Morphometric measurements were performed post-mortem after the animals were slaughtered according to standard procedures; thus, not involving observations of live animals were not observed. The penis was aseptically removed from the corpus penis using sterile equipment and cleaned with 0.9% physiological NaCl solution to remove residual tissue and blood. This procedure was performed to maintain the integrity of the samples and prevent contamination. The parameters observed included the length of the glans penis spiral, the diameter of the glans penis spiral, and the number of glans penis spiral turns.

Research Variables

The independent variables in this study were the pig boar breeds, Landrace and Duroc. The dependent variables included variations in the size of the spiral (corkscrew-shaped) structure on the glans penis, including the length of the glans penis spiral (mm), diameter of the glans penis spiral (mm), and number of turns in the glans penis spiral. The control variables in this study included the age of the boars (≥ 3 years old, adult), the animals' health status (healthy), and the rearing environmental conditions.

Operationally, the penile spiral (corkscrew-shaped) is defined as the structure of the male pig's glans penis that twists in a spiral pattern in an anti-clockwise direction (counterclockwise), starting from the left when observed from the base of the glans penis. This parameter was measured based on the length, diameter, and number of spiral turns of the glans penis (Figure 1). Pig strains are defined as the type or breed of pig determined based on the owner's or breeder's records as well as observable phenotypic characteristics, namely the Landrace and Duroc strains.

Data Collection Method

Data collection in this study was conducted through direct observation, without experimental treatment. Data were obtained from morphometric measurements of the glans penis of male pigs collected post-mortem from a pig slaughterhouse in Bali; thus, no live animals were used in this study. The samples consisted of penile organs from male pigs of the Landrace and Duroc breeds, with a total of 12 samples comprising seven Landrace and five Duroc pigs.

After slaughter, the penile organs were carefully excised from the corpus penis to the border with the glans penis as the measurement site. The collection was performed aseptically using a surgical knife sterilized with alcohol and personal protective equipment. The samples were then cleaned using a 0.9% physiological NaCl solution to remove residual blood and tissue, allowing the spiral structure of the glans penis to be observed clearly. Subsequently, macroscopic observations were conducted to ensure the absence of anatomical abnormalities, and documentation was performed using a digital camera as supporting data.

Morphometric measurements were performed using a digital caliper with a precision of 0.01 mm. The parameters measured included the length of the glans penis spiral, the diameter of the glans penis spiral, and the number of turns in the glans penis spiral. Length was measured from the base to the tip of the glans penis, diameter was measured at the widest part of the spiral, and the number of turns was counted visually based on the number of complete turns in the spiral structure.

Data Analysis

Data from observations and morphometric measurements of the glans penis of male pigs, including spiral length, spiral diameter, and number of spiral turns, were analyzed using an independent samples t-test to determine the differences between two independent groups: Landrace and Duroc pigs. The analysis was conducted by comparing the mean values of each variable at a 95% confidence level with a significance level (α) of 0.05. The decision criteria were determined based on the p-value, where $p < 0.05$ indicates a significant difference, while $p \geq 0.05$ indicates no significant difference between groups.

RESULTS AND DISCUSSION

Results

The length of the penile glans spiral in Landrace and Duroc pigs was analyzed using an independent samples t-test to determine any differences between the two breeds. The results of the analysis showed no statistically significant difference between the two breeds ($p > 0.05$), although there was variation in the values among individual pigs. The average length of the penile glans spiral in Landrace pigs was 39.511 ± 1.184 mm, whereas in Duroc pigs, it was 38.090 ± 0.849 mm (Table 1).

The diameter of the penile glans spiral exhibited a similar pattern. The results of the independent samples t-test indicated that there was no statistically significant difference between the two strains ($p > 0.05$). The mean diameter of the penile glans spiral in Landrace pigs was 15.935 ± 0.948 mm, whereas in Duroc pigs, it was 15.856 ± 1.138 mm (Table 1). Meanwhile, the number of spiral turns of the penile glans in both strains was also analyzed using the same test and showed no significant difference ($p > 0.05$). The average number of spiral turns in Landrace and Duroc pigs was the same, that is, one (Table 1, Figure 2).

Discussion

This study examined morphometric variations in the corkscrew-shaped glans penis of Landrace and Duroc boars, which are commonly raised in Bali as natural sires. The selection of these two strains was based on differences in genetic background, body morphological characteristics, and reproductive and production performance. Anatomically, the pig penis is of the fibroelastic type, consisting of the penile root, body, and glans, with an erection mechanism dominated by penile elongation and straightening of the sigmoid flexure. These characteristics result in relatively limited changes in diameter during erection, making the structure of the glans penis, particularly the spiral portion, a critical component of the copulation process.

The results of this study indicate that the length of the glans penis spiral in Landrace pigs (39.511 ± 1.184 mm) tended to be greater than that in Duroc pigs (38.090 ± 0.849 mm), although the difference was not statistically significant. This value is higher than that reported for wild boars, which only reached 23.7 ± 0.4 mm (Teja, 2019). This difference is likely due to species differences (domestic vs. wild), genetic selection, and environmental factors. A similar pattern was observed for the diameter of the penile glans, where Landrace (15.935 ± 0.948 mm) was slightly larger than Duroc (15.856 ± 1.138 mm), and both were significantly

larger than the diameter reported for wild boars at 4.1 ± 0.3 mm (Teja, 2019). This indicates that domestication and selection for reproductive performance may contribute to an increase in the morphometric size of the reproductive organs.

Regarding the number of spiral turns of the penile glans, both strains showed identical results: one full turn with no variation. This uniformity indicates the conservation of a structure related to physiological function, specifically in providing mechanoreceptor stimulation to the cervix, which plays a role in triggering the ejaculatory reflex (Knox, 2003). Thus, the number of spiral turns tends to be physiologically maintained because it plays a direct role in successful copulation and semen deposition.

In addition to genetic factors, the morphometric size of reproductive organs is influenced by age and body weight through hormonal regulation, particularly testosterone, which plays a role in the growth of reproductive tissues (Tonga, 2024). This relationship is consistent with previous studies that have shown a positive correlation between body weight and the size of reproductive organs such as the testes. However, in this study, although the sample had a relatively uniform age and body weight, small variations were still found, indicating that strain-specific genetic factors play a dominant role in determining the morphometric characteristics.

Although Landrace and Duroc pigs exhibit general differences in body morphological characteristics, such as body length and production efficiency, the results of this study indicate that these differences are not accompanied by significant differences in penile glans morphology between the two breeds. This is consistent with the statement by Moughan *et al.* (2012) that genetic variation between strains does not always significantly impact organs with essential physiological function. Thus, penile glans morphometry, particularly the spiral structure, exhibits a stable and conservative pattern of development.

The morphometric approach used in this study provides an initial overview of the reproductive anatomy of male pigs and its potential association with genetic factors. The uniformity in size and spiral structure of the glans penis across strains indicates that external reproductive organs exhibit a high degree of stability, suggesting that morphological variations in the body do not necessarily reflect variations in reproductive organs. These findings are important for understanding the reproductive aspects of male pigs and serve as an initial reference for further research examining the relationship between morphometry and fertility in boars.

CONCLUSIONS AND SUGGESTIONS

Conclusions

Based on the results of this study on the morphometric variations of the corkscrew-shaped glans penis in male pigs of the Landrace and Duroc strains, it can be concluded that there were no statistically significant differences in the length and diameter of the glans penis spiral between the two strains. The average length of the penile glans spiral was 39.511 ± 1.184 mm in Landrace and 38.090 ± 0.849 mm in Duroc, while the diameter was 15.935 ± 0.948 mm in Landrace and 15.856 ± 1.138 mm in Duroc. Furthermore, the number of penile glans spiral turns in both strains was the same, namely one full turn without variation, with an anti-clockwise direction starting from the left when observed from the base of the penile glans. These results indicate that the morphometry of the penile glans spiral was relatively uniform in both strains.

Suggestions

Further research could involve a more detailed examination of the morphology of the female pig's cervix, particularly regarding the number of cervical coils or folds. This study is important for providing a more comprehensive understanding of the anatomical structure of the female

reproductive tract and its potential to support successful reproduction in pigs. The reason is that the spiral coils or folds of the female pig's cervix serve to adapt to the spiral shape of the male's glans penis during copulation, aid in semen deposition, protect the uterus from potential contamination, and regulate sperm transport to the upper reproductive tract.

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Tables

Table 1. Morphometric Characteristics of the Glans Penis in Different Pig Breeds

Pig Breed	Spinal Length (mm)	Diameter (mm)	Number of Spiral Turns of the Glans Penis
Landrace (n = 7)	39.511 ± 1.184 ^a	15.938 ^a	1 ^a
Duroc (n = 5)	38.090 ± 0.849 ^a	15.856 ^a	1 ^a

Note: Values with the same superscript letter (^a) within the same column indicate no statistically significant difference between groups ($p > 0.05$).

Figures

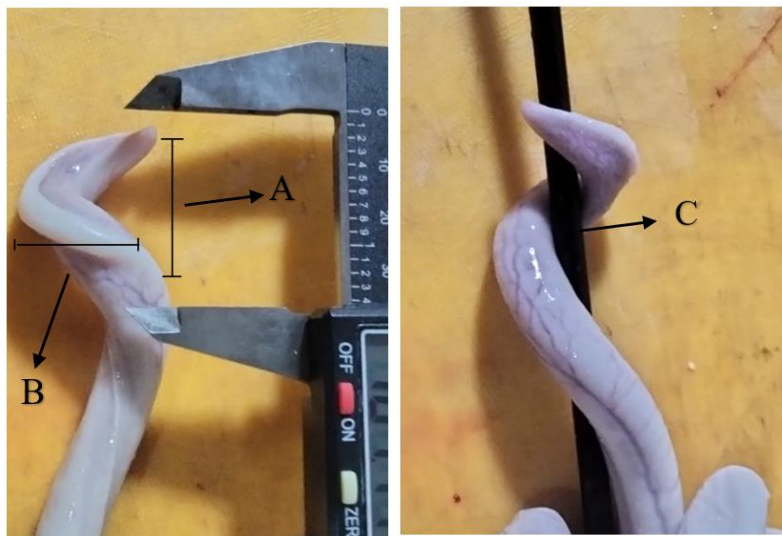


Figure 1. Measurement of length (A) and diameter (B), and determination of the number of spiral turns (C) of the glans penis.

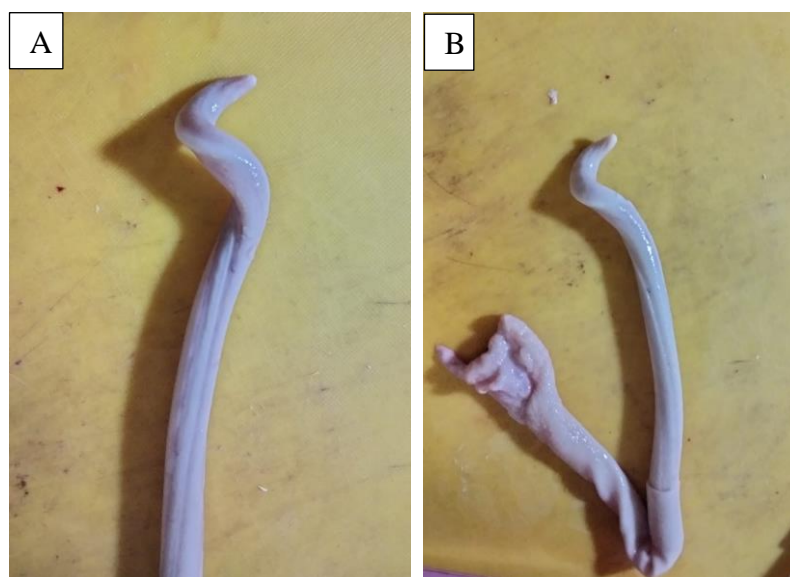


Figure 2. Anatomical differences in the glans penis of Duroc pigs (A) and Landrace pigs (B).