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Original Article

Comparison of reproductive performance of Gembrong goats and male Boerka goats

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Abstrak

Tujuan: Penelitian ini bertujuan mengetahui perbandingan performa reproduksi kambing Boerka dan kambing Gembrong.
Metode: Penelitian dilaksanakan di Loka Penelitian Kambing Potong Sei Putih, Deli Serdang, Sumatera Utara. Dalam penelitian ini digunakan kambing Boerka (n=3) dan kambing Gembrong (n=3) jantan, berumur 3 tahun dan memiliki rata-rata Skor Kondisi Tubuh (SKT) yang sama yakni 3,83±0,29. Performa reproduksi yang diamati meliputi lingkar skrotum, skor libido, dan kualitas semen secara makroskopis (volume, warna, bau, dan konsistensi) dan mikroskopis (konsentrasi, motilitas, viabilitas, dan abnormalitas). Data yang terkumpul ditabulasi dan dianalisis dengan uji t.
Hasil: Dari seluruh parameter performa reproduksi yang diperiksa diketahui hanya parameter volume semen (ml) dan konsentrasi sperma (x10^6 sel/ml) menunjukkan perbedaan yang signifikan (P<0,05) antara kambing Gembrong *vs* kambing Boerka dengan nilai masing-masing adalah 0,50±0,0 *vs* 1,0±0,20; dan 1.557±712 *vs* 4.500±317,65 sedangkan parameter lain tidak menunjukkan perbedaan yang nyata (P>0,05).
Kesimpulan: Disimpulkan bahwa volume dan konsentrasi kambing Boerka lebih tinggi dibandingkan kambing Gembrong.

Kata Kunci: Kambing Boerka; Kambing Gembrong; Libido; Lingkar skrotum; Semen

Abstract

Objective: This study aims to compare the reproductive performance of Boerka goats and Gembrong goats.
Methods: The research was conducted at the Sei Putih Slaughter Goat Research Workshop in Deli Serdang, North Sumatra. In this study, male Boerka (n=3) and Gembrong (n=3) goats, aged 3 years and having the same average Body Condition Score (BCS) of 3.83±0.29, were used. Reproductive

performance observed included scrotal circumference, libido score, and semen quality macroscopically (volume, color, odor, and consistency) and microscopically (concentration, motility, viability, and abnormalities). The data collected was tabulated and analyzed by t test.

Results: Of all the parameters of reproductive performance examined, it is known that only the parameters of semen volume (ml) and sperm concentration (x106 cells/ml) showed a significant difference ($P<0.05$) between Gembrong goats vs. Boerka goats with values of 0.50±0.0 vs. 1.0±0.20 and 1.557±712 vs. 4.500±317.65, respectively, while the other parameters did not show a significant difference ($P>0.05$).

Conclusions: It was concluded that the volume and concentration of Boerka goats were higher than Gembrong goats.

Keywords: Boerka buck; Gembrong buck; Libido; Scrotal circumference; Semen

INTRODUCTION

Gembrong goats and Boerka goats have the potential to be developed in Indonesia. Increasing the productivity of local goats can be done by cross-breeding goats that have superior genetics. Gembrong goats are also a type of local goat that has a specific appearance. In Indonesia they are only found in Bali, especially in Karangasem Regency with an endangered status. Gembrong goats have a medium body weight, bigger than Kacang goats but smaller than Ettawa goats. The color is generally dominated by white (91.6%); some are light brown and black (4.2%). They have a small head with a straight face profile that is slightly concave. Male and female goats generally have horns, but the length of the horns of female goats is relatively shorter than that of male goats. The average length of the horns of adult male goats is 16.26±2.69 cm and that of females is 5.06±1.25 cm. The ears are of medium size, always moving, and not hanging. The body weight of an adult male goat is 40.68±6.29 kg. The hair length of adult male and female goats is 19.61±6.12 and 2.92±0.64 cm, respectively. The distribution of long hair occurs in all parts of the body, with even hair on the head covering the face and ears [1].

The Boerka goat is the result of crossbreeding between male non-pure bred Boer goats and female local goats (Kacang goats). Crossing Boer goats with Kacang goats have been widely practiced by smallholder farmers. Crossing Boer with kang goats ones are expected to improve the productivity of Indonesian local goats both their growth and meat production [2]. Compared with Kacang goats, Boerka goats have relative advantages in the birth weight range of 27.78%, weaning weight of 38.31% and pre-weaning daily body weight gain of 41.43% [3].

The characteristics of the Boerka goat are that it has a dominant white coat color, the coat color pattern consists of two colors, the dominant color is striped and the head is dark brown, has a convex front line, horns, the ears hang down and the back is dominantly concave both female and male goats. The Boerka goats have the ability to grow and gain body weight better than Kacang goats. In addition, Boerka goats are able to adapt to tropical-wet conditions with moderate amount of feed [4].

Efforts to improve the reproductive quality of goats can be done in various ways, one of which is through artificial insemination (AI) technology. The success of the AI program for livestock is highly dependent on the quality of the semen ejaculated by a male. Isnaini *et al*. [5] reported that improving the quality of semen will increase the success of a female to be pregnant after insemination. Semen quality is determined by a macroscopic test (color, volume, pH, and consistency) and microscopic test (motility, morphology, and concentration) [6]. In addition, semen quality can be related to scrotal circumference and libido. Scrotal circumference is related to the potential for spermatozoa and testosterone production. Testicular size is positively related to semen quality, male ability to mate with multiple females and high fertility [7]. The ability of a male to mate with a female is related to the male's libido, which is influenced by testosterone levels [8].

Semen quality is influenced by several factors, including: male age, genetics, temperature and season, ejaculation frequency and diet. The population of Gembrong goats have declined and threatened with extinction. One of the possibilities of declining the population in Gembrong goats is low productivity, particularly in male goats. Assessment of male goat productivity is based on semen quality and libido and possibly related to genetics. In this study, the semen quality and libido of Gembrong goats were compared to Boerka goats, which had relatively good productivity. This study focused on the differences in male breeds. Several reports indicate that differences in male breeds in cattle [9], goats [10,11], and sheep [12] affect the quality of semen produced. Differences in reproductive performance of Gembrong and Boerka goats have not been reported.

MATERIALS AND METHODS

Research methods

This study used three-year-old male Boerka (n=3) and Gembrong (n=3) goats with the same average Body Condition Score (BCS) of 3.83±0.29. Parameters tested were semen quality (macroscopic and microscopic), scrotal circumference and libido. Macroscopic examination of semen quality includes volume, color and consistency. Microscopic examination of semen quality includes concentration, motility, viability, and abnormalities.

Semen collection and libido assessment

Semen collection, libido observations, and measurements of scrotal circumference were carried out in the morning at 08.00 WIB. Semen collection was done using an artificial vagina, while the scrotal circumference was done using a measuring tape. The collected semen was accommodated immediately for macroscopic and microscopic examination [13].

Goat libido was assessed at the time of semen collection based on scores ranging from 0-10 for 10 minutes: Score 0, not attracted; 1, attracted only once; 2, attracted more than once; 3, attracted throughout the test; 4, one time riding or trying, no ejaculation; 5, twice climbing or trying, no ejaculation; 6, more than two times climbing or trying, no ejaculation; 7, one time ejaculation, no further attraction; 8, one ejaculation followed by attraction; 9, double ejaculation, no further attraction; 10, two ejaculations followed by attraction (including ascending and/or ejaculation) [14].

Semen volume and color

Volume and color measurements can be seen directly on the scale tube.

Semen consistency

Semen consistency was observed by tilting the tube slowly. Good semen has almost the same or more thickness than milk, while poor semen has the same consistency as coconut water.

Concentration

Calculation of sperm concentration was carried out using a haemocytometer. Semen was sucked until it reached point 0.5 and then a 0.2% eosin solution was sucked until it reached 101. This was then homogenized. Concentration was calculated by dripping the mixture into the Neubauer counting chamber that already had a cover glass, then observed using a microscope. Concentration was obtained by counting the number of spermatozoa contained in a small box of 5 pieces. The formula for calculating the concentration of spermatozoa is: N x 200 x 5 x 10,000.

Motility

Spermatozoa motility was observed by dripping spermatozoa on an object glass and adding one drop of physiological NaCl, which was then observed under a microscope with a magnification of 40 x 10. The number of motile sperm was calculated based on the movement of spermatozoa, namely fast progressive (A), slow progressive (B), circular (C), and vibration (D). The formula for determining the percentage of spermatozoa motility is:

$$\% \text{ Motility} = \frac{A}{A + B + C + D} \text{ x } 100\%$$

Viability

Examination of the viability of spermatozoa was carried out by dripping one

drop of spermatozoa in an object glass and adding one drop of eosin staining. Smear preparations were made and fixed on a sprite lamp, after which they were examined using a microscope with a magnification of 40 x 10. Dead spermatozoa absorbed red color, while live spermatozoa did not absorb color or were white.

$$\% \text{ Live} = \frac{L}{L + D} \text{ x } 100\%$$

L = Number of life spermatozoa
D = Dead spermatozoa

Abnormality

Observation of spermatozoa abnormalities was carried out by making a review preparation first, dripping one drop of spermatozoa on a glass object and dripping eosin. The preparation was then fixed on a sprite lamp and observed using a light microscope with a magnification of 40 x 10. Morphological examination was carried out based on the deformity or abnormality of the spermatozoa, including primary abnormalities (small/large head size, double head or double tail, and abnormal head shape) and secondary abnormalities (head split, tail severed at the neck or midway, and tail folded). Spermatozoa being observed consisted at least 200 cells and counting was carried out using the formula:

$$\% \text{ Abnormal} = \frac{X}{X + Y} \text{ x } 100\%$$

X = Number of abnormal
Y = Normal spermatozoa

Research parameters

Parameters being observed were comparison of semen quality of Gembrong and Boerka goats macroscopically (volume, color, PH, consistency, scrotal circumference measurement, libido assessment) and microscopically (concentration, mass movement, individual movement, viability, abnormality).

Data analysis

The data collected were tabulated and analyzed by means of the average test. To compare scrotal circumference, libido and semen quality of Gembrong and Boerka goats, a t-test was used.

RESULTS

Evaluation of the reproductive performance of Gembrong and Boerka goats which includes scrotal circumference, libido, and semen quality (macroscopic and microscopic) is presented in Table 1.

DISCUSSION

The average scrotal circumference of Gembrong goats was 25.5±1.32 cm while the average scrotal circumference of Boerka goats

Table 1. Average (±SD) scrotal circumference, libido score, semen quality, and testosterone concentration in Gembrong and Boerka goats

Indicator	Gembrong goats	Boerka goats
BCS	3.83±0.29[a]	3.83±0.29[a]
Scrotum circumference (cm)	25.5±1.32[a]	23.0±1.0[a]
Libido score	6.0±2.0[a]	8.0±0.0[a]
Semen macroscopic parameters		
Volume (mL)	0.50±0.0[a]	1.0±0.20[b]
Color	Cream	Cream
Smell	Typical	Typical
Consistency	Thick	Thick
Semen microscopic parameters		
Concentration (106 cells/mL)	1,557±712[b]	4,500±317.65[a]
Motility (%)	79.16±2.64[a]	73.79±2.24[a]
Viability (%)	87.34±2.41[a]	77.33±9.47[a]
Abnormalities (%)	1.44±1.42[a]	1.49±0.81[a]
Testosterone concentration (ng/mL)	4.64±1.95[a]	2.87±1.96[a]

a,b Different superscripts in the same column indicate significant differences (P<0.05)

was 23.0±1.0 cm (P>0.05). The size of the scrotal circumference in these two goats is relatively the same as the Saburai goats, i.e. 24.8±1.8 cm [15] and Kejobong goats, i.e. 24.06±1.39 cm [7], and smaller compared to the scrotal circumference of the Peranakan Ettawa (PE) goats, i.e. 26.4±0.9 cm [16]. The insignificant difference between the scrotal circumference of the Gembrong and Boerka goats may be related to the body weight of the two goats and their relatively similar age. This is in accordance with the statement of Aissanou and Ayad [17], that testicular size is related to body weight and age. The increase in the age of livestock will affect the increase in the size of the scrotal circumference. The size of the scrotal circumference will continue to increase and reach its maximum size when the animal reaches a certain age [7].

The average libido score of the Gembrong goats was 6.0±2.0 while the average libido score of the Boerka goats was 8.0±0.0 (P>0.05). Although not significant, Boerka goats tend to have higher libido scores than Gembrong goats. These findings support the results of Hafizuddin *et al*. [14] study, which report that differences in libido scores can be due to differences in goat breeds. Kondracki *et al*. [18] state that genetics plays a role in determining libido, in addition to environmental factors that influence its expression. These factors affect libido through sexual activity. This has been proven both at the time of the direct libido test and during the mating paddock. The ability of a male to mate a female is related to the male's libido which is influenced by testosterone levels [8]. Although Boerka goats have a relatively higher libido, the testosterone concentration of Gembrong goats tend to be higher than Boerka goats (P>0.05) with values (ng/mL) of 4.64±1.95 and 2.87±1.96, respectively. Gembrong goats' relatively high testosterone concentration cannot be used as a reference for high fertility because testosterone concentration has a negative correlation with semen volume and spermatozoa concentration.

The average volume (ml) of Gembrong goat semen was 0.50±0.0 while the volume of Boerka goat semen was 1.0±0.20 (P<0.05). When compared with other breeds of goats, the semen volume of the Gembrong goat is relatively lower. Saburai goat semen volume is 0.78±0.4 ml [15], Kejobong goat semen volume is 0.60±0.20 ml [7], and Boer goat semen volume is 0.70±0,21 ml [19]. Variations in semen volume can be caused by differences in breed, age, body size, and collection frequency [20].

Semen color has a close relationship with the consistency and concentration of spermatozoa. A fading or lighter color of semen can be an indicator that the consistency of the semen is thinner and the concentration of spermatozoa will be lower. The semen of the Gembrong and Boerka goats in this study had a cream color, so they had a medium to thick consistency [21]. The smell of the semen of the Gembrong and Boerka goats in this study was expressed as a typical smell. This is in accordance with the statement of Riyadhi *et al*. [22], that the smell of semen is expressed by a typical smell.

Consistency is the degree of viscosity and can be checked by vibrating the tube containing the semen. Good semen has almost the same degree of viscosity or is slightly thicker than milk, while poor semen, both in color and thickness, is the same as coconut water [23]. Observations showed that the semen of Gembrong goats and Boerka goat were both thick in consistency. The thicker the semen, the higher the sperm concentration [20].

The average sperm concentration (10^6 cells/ml) of Gembrong goat was 1,557±712 while the volume of Boerka goat semen was 4,500±317.65 (P<0.05). The difference in concentration values can be influenced by breed differences [24]. The results of this study support the report of Aerens *et al*. [25] that there are differences in the concentration of spermatozoa between breeds of cattle. Average concentration (million/ml) of the spermatozoa of Limousin, Simmental, Ongole, Brahman, and Bali cattle are 1,403,366±409.2, 1,845,556±421.3, 1,651,884±540.3, 1,263,934±621.6, and 361.33±316.3, respectively. The difference in the concentration of spermatozoa among male cattle are thought to be due to the different genetic qualities of each male.

The percentage of motile (progressively moving) spermatozoa can be used as a measure of the ability to fertilize an ovum [26]. The results showed that the average individual movement (of motile sperm) of the

Gembrong goats was 79.16%, which tended to be higher than that of the Boerka goats, which was 73.79% (P>0.05). Aerens *et al*. [25] also reported the opposite in cattle, that breed differences would affect the motility of spermatozoa. This may be due to differences in the availability of energy sources in the form of fructose, glycerylphosporilcholine (GPC), and sorbitol which cause different motility of spermatozoa [25].

Live sperm in this study was indicated by the presence of sperm that did not absorb the dye derived from eosin. This is in accordance with the opinion of Susilawati [20], that the dead cells absorb the dye of eosin, so that under the microscope it is clear the difference between the cells that absorb the dye and the cells that do not absorb the dye. The results showed that the average live sperm of the Gembrong goats was higher at 87.34% compared to the average live sperm of the Boerka goat, which was 77.33% (P>0.05). Good sperm quality has a high percentage of live sperm and the number of dead sperm is not more than 15%.

The average spermatozoa abnormality (%) of semen in Gembrong goats was 1.44±1.42 while the spermatozoa abnormality (%) of Boerka goats was 1.49±0.81 (P>0.05). The level of abnormal spermatozoa is an important factor because many normal spermatozoa also have a longer viability than abnormal sperm. Normal spermatozoa have the ability to fertilize before losing their motility [27,28].

CONCLUSION

It was concluded that the volume and concentration of Boerka goats were higher than Gembrong goats.

CONFLICT OF INTEREST

The authors declare no conflict of interest with any organization regarding the material discussed in the manuscript.

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