



Semen Production Characteristics of Pasundan Bull at Different Body Weight

(Karakteristik produksi semen sapi Pasundan pada bobot badan yang berbeda)

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ABSTRACT. Pasundan cattle is currently proposed as a potential livestock to support national meat self-sufficiency program. However, the information regarding their reproductive performance is still very limited. This study was conducted to evaluate the semen production characteristics of Pasundan bull at different body weight. A total of 178 semen samples which were collected from one Pasundan bull were used in this study. The semen collection was done for 31 months and during this period, the body weight of Pasundan bull was classified into 4 categories, namely <400 kg, 400 to <500 kg, 500 to <600 kg, and ≥600 kg. The results showed that overall mean semen volume, semen pH, sperm concentration, total sperm, individual sperm motility, total motile sperm, post-thawing sperm motility, recovery rate of sperm motility, and frozen semen production were 5.89 ml/ejaculate, 6.69, 1.04 billion/ml, 6.04 billion/ejaculate, 55.75%, 3.40 billion/ejaculate, 40.91%, 58.20%, and 265.11 doses/ejaculate. The difference in body weight significantly affect semen volume ($P=0.001$), semen pH ($P=0.001$), sperm concentration ($P=0.043$), total sperm ($P=0.002$), individual sperm motility ($P<0.001$), total motile sperm ($P<0.001$), and frozen semen production ($P=0.004$). There was no significant effect ($P>0.05$) of body weight on post-thawing sperm motility and recovery rate of sperm motility. In conclusion, the semen production traits of Pasundan bull are improved with the increase in body weight up to 500 to <600 kg and remain stable at the body weight of ≥600 kg.

Keywords: frozen semen production, Indonesian local cattle, reproductive performance, semen cryopreservation, tropical region

ABSTRAK. Sapi Pasundan saat ini diajukan sebagai salah satu ternak potensial untuk mendukung program swasembada daging nasional. Akan tetapi, informasi tentang penampilan reproduksinya masih sangat terbatas. Penelitian ini dilakukan untuk mengevaluasi karakteristik produksi semen sapi pejantan Pasundan pada bobot badan yang berbeda. Sebanyak 178 sampel semen yang dikoleksi dari 1 ekor sapi pejantan Pasundan digunakan pada penelitian ini. Penampungan semen dilakukan selama 31 bulan dan pada periode tersebut, bobot badan sapi pejantan Pasundan diklasifikasikan menjadi 4 kategori yaitu <400 kg, 400 to <500 kg, 500 to <600 kg, and ≥600 kg. Hasil penelitian menunjukkan bahwa rata-rata volume semen, pH semen, konsentrasi sperma, total sperma, motilitas individu sperma, total sperma motil, motilitas sperma post-thawing, nilai recovery rate, dan produksi semen beku adalah 5,89 ml/ejakulat, 6,69, 1,04 miliar/ml, 6,04 miliar/ejakulat, 55,75%, 3,40 miliar/ejakulat, 40,91%, 58,20%, dan 265,11 dosis/ejakulat. Perbedaan bobot badan memberikan pengaruh terhadap volume semen ($P=0,001$), pH semen ($P=0,001$), konsentrasi sperma ($P=0,043$), total sperma ($P=0,002$), motilitas individu sperma ($P<0,001$), total sperma motil ($P<0,001$), dan produksi semen beku ($P=0,004$). Di sisi lain, bobot badan tidak memberikan pengaruh ($P>0,05$) terhadap motilitas sperma post-thawing dan nilai recovery rate. Kesimpulannya, karakteristik produksi semen sapi pejantan Pasundan meningkat seiring dengan peningkatan bobot badan hingga 500 sampai <600 kg dan tetap stabil hingga ≥600 kg.

Kata kunci: daerah tropis, penampilan reproduksi, pembekuan semen, produksi semen beku, sapi lokal Indonesia

INTRODUCTION

Pasundan cattle is the result of crossbreeding between Bali cattle and Java cattle, Madura cattle, and Sumba Ongole cattle, which has been adapted in West Java area for more than 10 generations. This cattle is recognized as one of the Indonesian local cattle through Ministerial Decree no. 1051/Kpts/SR.120/10/2014 (Ministry of Agriculture of the Republic of Indonesia, 2014). The geographical distribution of Pasundan cattle is mostly in West Java area. The dominant body color of Pasundan cattle was solid reddish-brown, while their hoof, switch of the tail, eyelid, horn, and muzzle were found to be black (Said et

al., 2017). In addition, the morphometric characteristics of adult Pasundan bulls and cows include 128.94 and 122.56 cm of withers height, 128.72 and 115.63 cm of body length, and 159.36 and 140.13 cm of chest girth, respectively (Said et al., 2017).

Pasundan cattle is currently proposed as a potential meat-producing livestock to support national meat self-sufficiency program. However, the population of this breed is remained low compared to other local breeds as well as imported cattle. Consequently, the use of advanced technology is mandatory to improve the productivity of Pasundan cattle. Artificial insemination is the protocol of semen collection from the bulls followed by the semen deposition into the cow's reproductive organ. This assisted-reproductive technology is widely used worldwide due to the proven benefit to improve livestock

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productivity and genetic quality (Lamb et al., 2016; Moore and Hasler, 2017; Diskin, 2018). Due to its crucial role, the semen quality of the bulls should be evaluated before being used for artificial insemination. One factor which influences semen quantity and quality is the body weight of the bulls. Previously, it was reported that greater body weight was followed by better semen characteristics in the Holstein and Jersey bulls (Waite et al., 2019). To date, the information regarding the semen production characteristics of Pasundan bulls at different body weight is still very limited. Therefore, this study was performed to evaluate the effect of body weight on semen production characteristics of Pasundan bull.

MATERIALS AND METHODS

This study was conducted at Lembang Artificial Insemination Center, Kayu Ambon Street, Bandung, Indonesia. A total of 178 semen samples which were collected from one Pasundan bull which is used in this study. The semen collection was done for 31 months and during this period, the body weight of Pasundan bull was classified into 4 categories, namely <400 kg, 400 to <500 kg, 500 to <600 kg, and ≥ 600 kg. The bull was kept in an open-sided cage with a size of 4 x 2.5 m. The bull was fed 50 kg elephant grass, 4 kg concentrate feed, 1 kg hay, and 0.5 kg mung bean sprout daily with ad libitum drinking water throughout the experimental period.

The semen was collected using an artificial vagina. Soon after collecting, semen production characteristics were directly evaluated including semen volume, semen pH, sperm concentration, total sperm, individual sperm motility, total motile sperm, post-thawing sperm motility, recovery rate of sperm motility, and frozen semen production as

per standard protocol in artificial insemination center.

Data of semen production traits were analyzed descriptively to generate mean and standard error (SE). Data were then analyzed using non-parametric Kruskal-Wallis test. When statistical significance was found, the data were subsequently analyzed using Mann-Whitney U test to compare means. $P < 0.05$ was considered as statistical significance. All data analysis were performed using SPSS 13.0 program.

RESULTS AND DISCUSSION

The overall mean semen volume, semen pH, sperm concentration, total sperm, individual sperm motility, total motile sperm, post-thawing sperm motility, recovery rate of sperm motility, and frozen semen production of Pasundan bulls were 5.89 ml/ejaculate, 6.69, 1.04 billion/ml, 6.04 billion/ejaculate, 55.75%, 3.40 billion/ejaculate, 40.91%, 58.20%, and 265.11 doses/ejaculate. Currently, the published data about the semen production characteristics of Pasundan bulls is still very limited. The semen characteristics of Pasundan bull found in this study is comparable with other breeds. Snoj et al. (2013) reported that the semen volume, sperm concentration, and total sperm number in Limousin bulls were ranged from 2.89 to 5.11 ml/ejaculate, 1.17 to 1.37 billion/ml, and 3.85 to 6.74 billion/ejaculate, respectively, while in Holstein bulls were ranged from 3.30 to 6.10 ml/ejaculate, 1.20 to 1.44 billion/ml, and 3.99 to 8.51 billion/ejaculate, respectively. Also, Nishimura et al. (2010) noted that the mean semen volume, sperm concentration, total sperm number, and sperm motility of Japanese black bulls were 4.3 ml/ejaculate, 1.23 billion/ml, 5.31 billion/ejaculate, and 75.00%.

Table 1. Mean $\pm$ SE of fresh semen characteristics of Pasundan bull with respect to different body weight

Items	Body weight (kg)				P-value
	<400 (n=16)	400 to <500 (n=40)	500 to <600 (n=93)	≥ 600 (n=25)	
SV	5.05 $\pm$ 0.36 ^a	5.58 $\pm$ 0.26 ^a	6.40 $\pm$ 0.17 ^b	5.04 $\pm$ 0.38 ^a	0.001
Sp	6.66 $\pm$ 0.04 ^a	6.78 $\pm$ 0.02 ^b	6.68 $\pm$ 0.16 ^a	6.63 $\pm$ 0.03 ^a	0.001
SC	0.81 $\pm$ 0.09 ^a	1.05 $\pm$ 0.06 ^b	1.04 $\pm$ 0.03 ^b	1.15 $\pm$ 0.06 ^b	0.043
TS	3.93 $\pm$ 0.52 ^a	5.74 $\pm$ 0.37 ^b	6.57 $\pm$ 0.26 ^b	5.94 $\pm$ 0.62 ^b	0.002
ISM	50.63 $\pm$ 4.03 ^{ab}	45.75 $\pm$ 2.17 ^a	60.59 $\pm$ 1.28 ^c	57.00 $\pm$ 3.14 ^{bc}	<0.001
TMS	2.13 $\pm$ 0.34 ^a	2.62 $\pm$ 0.22 ^{ab}	4.01 $\pm$ 0.18 ^c	3.20 $\pm$ 0.33 ^b	<0.001

^{a-c}different superscript shows significant difference ($P < 0.05$)

n: number of semen samples, SV: semen volume (ml/ejaculate), Sp: semen pH, SC: sperm concentration (billion/ml), TS: total sperm (billion/ejaculate), ISM: individual sperm motility (%), TMS: total motile sperm (billion/ejaculate)

Table 1 shows that the body weight of Pasundan bull significantly affect semen volume ($P=0.001$), semen pH ($P=0.001$), sperm concentration ($P=0.043$), total sperm ($P=0.002$),

individual sperm motility ($P < 0.001$), and total motile sperm ($P < 0.001$). The finding in this study was corroborated with the previous studies. Asad et al. (2004) found that the body weight of bulls significantly affects semen volume, sperm concentration, and sperm motility in AI-bulls. Gopinathan et al. (2018) also recorded that body weight had a significant effect on semen volume, sperm concentration, and sperm motility in crossbred Holstein Friesian bulls. Isnaini et al. (2019) also elucidated that the difference in body weight could influence total sperm number and individual sperm motility in beef bull sires. In another study by Devkota et al. (2008), it was

found that the body weight had a positive correlation with semen volume and sperm concentration in post-pubertal Holstein bulls.

As can be seen in Table 2, no significant effect ($P > 0.05$) of body weight was found on post-thawing sperm motility and recovery rate of sperm motility. However, frozen semen production differed among body weight categories ($P = 0.004$). In line with this finding, Gopinathan et al. (2018) also found a significant effect of body weight on frozen semen production in the dairy bull. In another study, Isnaini et al. (2019) also noted that the frozen semen production differed among beef bulls with different body weight.

Table 2. Mean $\pm$ SE of frozen semen characteristics of Pasundan bull with respect to different body weight

Items	Body weight (kg)				P-value
	<400 (n=3)	400 to <500 (n=3)	500 to <600 (n=40)	≥ 600 (n=9)	
PTSM	40.00 $\pm$ 0.00	41.67 $\pm$ 1.67	40.88 $\pm$ 0.30	41.11 $\pm$ 0.73	0.749
RRSM	57.00 $\pm$ 0.00	59.33 $\pm$ 2.33	58.23 $\pm$ 0.43	58.11 $\pm$ 1.20	0.784
FSP	140.67 $\pm$ 21.40 ^a	163.67 $\pm$ 61.81 ^{ab}	288.10 $\pm$ 94.67 ^c	238.22 $\pm$ 90.48 ^{bc}	0.004

^{a-c}different superscript shows significant difference ($P < 0.05$)

n: number of semen samples, PTSM: post-thawing sperm motility, recovery rate of sperm motility, FSP: frozen semen production

In this current study, sperm concentration, total sperm, total motile sperm, and frozen semen production of Pasundan bull were higher ($P < 0.05$) at the body weight of 500 to <600 kg and ≥ 600 kg compared to < 400 kg. In the previous studies, it was found that the increase in the body weight of bulls results in the increase in scrotal circumference and testes weight (Togun, 2009; Mahmood et al., 2014; Akumbugu et al., 2018). The greater scrotal and testicular traits indicate that the bulls have high sperm production capacity. In addition, the bulls with greater body weight also had a higher luteinizing hormone (LH) concentration (Affandhy et al., 2018). LH is one of the most crucial hormones in spermatogenesis. LH is produced in anterior pituitary gland transferred to the testes via the bloodstream (O'Donnell et al. 2017). In testes, LH stimulates Leydig cells to release testosterone (Ramaswamy and Weinbauer, 2014). Testosterone is then diffused into seminiferous tubules and initiates spermatogenesis (Walker and Cheng, 2005; Thundathil et al., 2016). For that reason, the high LH concentration is linked with the improvement of semen production traits.

CONCLUSION

This study confirms that the frozen semen production of Pasundan bull is strongly associated with body weight. Frozen semen production of

Pasundan bull is improved with the increasing of body weight up to 500 to <600 kg and remain stable at the heavier body weight.

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