

SEASONAL EFFECT ON SEMEN CHARACTERISTICS OF MURRAH BUFFALO BULLS RAISED UNDER TROPICAL CLIMATE

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ABSTRACT

This study was carried out to evaluate the seasonal variation on semen characteristics of Murrah buffalo bulls in Indonesia. A total of three Murrah buffalo bulls were included in this study. The semen was collected once a week during the rainy season (from January to April and from October to December) and the dry season (from May to September). Immediately after collection, the semen volume, sperm concentration, total sperm output, individual motility, post-thawing motility, and straw production were evaluated. The results showed that the season did not change ($P>0.05$) the semen volume, individual motility, and post-thawing motility. However, sperm concentration, total sperm output, and straw production were decreased in the dry season ($P<0.05$) as compared to the rainy season. In conclusion, several semen characteristics of Murrah buffalo bulls may vary depending on the season of collection. The semen collection during the rainy season is more profitable than the dry season.

Key words: artificial insemination, *Bubalus bubalis*, dry season, rainy season, semen cryopreservation

ABSTRAK

Penelitian ini bertujuan mengevaluasi pengaruh musim terhadap karakteristik semen kerbau Murrah di Indonesia. Sebanyak 3 kerbau Murrah jantan digunakan pada penelitian ini. Semen dikoleksi dengan frekuensi satu minggu sekali selama musim hujan (dari bulan Januari sampai April dan dari bulan Oktober sampai Desember) dan musim kemarau (dari bulan Mei sampai September). Evaluasi volume semen, konsentrasi sperma, total sperma, motilitas individu, motilitas pasca thawing, dan produksi straw dilakukan segera setelah semen dikoleksi. Hasil penelitian menunjukkan bahwa musim tidak memberikan pengaruh ($P>0,05$) terhadap volume semen, motilitas individu, dan motilitas pasca thawing. Akan tetapi, konsentrasi sperma, total sperma, dan produksi straw mengalami penurunan pada musim kemarau ($P<0,05$) dibandingkan musim hujan. Kesimpulan penelitian ini adalah bahwa beberapa karakteristik semen kerbau Murrah bervariasi tergantung pada musim. Penampungan semen kerbau Murrah selama musim hujan lebih menguntungkan dibandingkan musim kemarau.

Kata kunci: inseminasi buatan, *Bubalus bubalis*, musim kemarau, musim hujan, kriopreservasi semen

INTRODUCTION

Buffalo has a great potency to support Indonesian meat demand due to their unique capability to convert coarse feed from agriculture by-product into nutritious food. Buffalo meat is almost comparable to beef, in terms of physicochemical characteristics, nutrient content, and palatability (Abdolghafour and Saghir, 2014), so that it could be easily accepted by the consumer. However, their population growth is still very low. In 2014, the buffalo population was 1.34 thousand heads, while in 2018 became 1.36 thousand heads. Besides, their contribution to the national meat production also relatively low compared to other livestock. Buffalo only contributes about 31.6 thousand tons, while cattle and broiler chicken contribute about 496.3 thousand tons and 2.14 million tons of total meat production, respectively (Directorate General of Livestock and Animal Health, 2018).

To increase the buffalo population in Indonesia, the superior bull sires are needed both in terms of their genetic quality and semen productivity. In addition, the use of artificial insemination also beneficially increased reproductive efficiency so that it could accelerate the growth of the buffalo population. However, it should be underlined that the semen quality is greatly influenced by environmental factors. Previous reports showed that dry season in the tropical region leads to decrease sperm quality in cattle (Isnaini *et al.*, 2019) and bucks

(Van Tilburg *et al.*, 2014; Olurode *et al.*, 2018). Since buffalo have dark skin, sparse coat, and poor sweating ability (Marai and Haebe, 2010), their resistance to heat stress become lower than other livestock. In this study, the seasonal variation on semen characteristics of Murrah buffalo bulls raised under tropical climate was evaluated.

MATERIALS AND METHODS

Experimental location

This study was performed at Lembang Artificial Insemination (AI) Center, which was located at 06°49'S and 107°37'E. The environmental data including mean temperature, maximum temperature, relative humidity, rainfall, and sunshine duration were taken from geophysics station close to the AI center. Temperature-humidity index were measured with a formula of $0.8 \times \text{mean temperature} + (\text{relative humidity}/100) \times (\text{mean temperature} - 14.4) + 46.4$. According to the rainfall data, the climatic condition was divided into the rainy season (from January to April and from October to December) and the dry season (from May to September).

Animals

A total of 3 Murrah buffalo bulls were included in this study. The bulls were kept under similar management and feeding condition. The feed was

offered according to Table 1, while drinking water provided *ad libitum*. The semen was collected once a week by using an artificial vagina. Immediately after collection, semen volume was measured using graduated scaled vial. Sperm concentration was quantified using a spectrophotometer. Total sperm output was calculated by semen volume x sperm concentration. Individual and post-thawing sperm motilities were measured using a microscope with 400x magnification. The semen which had individual motility below 70% or post-thawing motility below 40% was discarded. Straw production was calculated by total sperm output/25 million.

Statistical analysis

Data of semen characteristics of Murrah buffalo bulls were analyzed using analysis of variance in SPSS 13.0 Program. Data were presented as mean followed by the standard error (SE). Data were considered to be statistically significant at $P < 0.05$.

RESULTS AND DISCUSSION

Table 2 summarizes the climatic condition during experimental periods. The overall mean values of monthly temperature, maximum temperature, relative humidity, and temperature-humidity index were almost constant throughout the year with the coefficient of variation were 1.56, 2.20, 5.08, and 0.73%, respectively. On the other hand, rainfall and sunshine duration, as expected, were clearly distinct between seasons, with lower rainfall and higher sunshine duration were observed in the dry season. The degree of variation of climatic condition found in this study was corroborated with the previous finding. In a tropical area of Mexico (20°58'N), the little variation in annual temperature and relative humidity were

detected, which were ranged from 26.00 to 27.80° C and 63 to 83%, respectively (Cárdenas-Gallegos *et al.*, 2012). In Thailand (16.3°N), it was reported that the maximum temperature relatively constant among seasons, which was ranged from 32.10 to 35.30 ° C (Koonjaenak *et al.*, 2007). Whereas, the large variation in rainfall was observed in Brazil (3°53'S) with 198.63 and 1.07 mm in rainy and dry seasons, respectively (Van Tilburg *et al.*, 2014).

Table 3 presents the semen characteristics of Murrah buffalo bulls in the rainy and dry season. Semen volume, individual motility, and post-thawing motility were similar ($P > 0.05$) between seasons. However, sperm concentration, total sperm output, and straw production decreased in the dry season ($P < 0.05$) as compared to the rainy season. Previously, Bhakat *et al.* (2015) also observed that the sperm concentration of Murrah buffalo bulls was decreased in the summer as compared to the rainy season. The reduction of semen characteristics may be associated with the climatic change in the dry season. The higher environmental temperature together with the higher sunshine duration might possibly elevate the testis temperature which will be followed by higher reactive oxygen species generation and then could impair spermatogenesis thus resulting in the lower sperm concentration (Soren *et al.*, 2016; Golher *et al.*, 2018; Silva *et al.*, 2018). Consequently, total sperm output and straw production would be reduced.

The reduction of sperm concentration, total sperm output, and straw production in dry season indicated that the season should be used as a crucial factor in determining proper management condition. Since the reduction of these traits was possibly associated with the oxidative damage caused by heat stress, antioxidant intervention seems to be beneficial to alleviate this deleterious effect. Previously, vitamin E injection showed a beneficial effect to improve semen quality in

Table 1. The daily feed composition of Murrah buffalo bulls

Feedstuff	Composition (kg/day)
Elephant grass (<i>Pennisetum purpureum</i>)	65
African grass hay (<i>Cynodon plectostachyus</i>)	1
Concentrate feed*	4
Mung bean sprout (<i>Vigna radiata</i>)	0.5

*Concentrate feed contained 16% crude protein and 65% total digestible nutrient

Table 2. Summary of the climatic condition during experimental periods

Climatic condition	Rainy	Dry	Overall
Mean temperature (° C)	23.61±0.16	23.62±0.15	23.62±0.11
Maximum temperature (° C)	28.98±0.21	29.56±0.29	29.22±0.19
Relative humidity (%)	79.35±1.08	74.50±1.62	77.33±1.13
Temperature-humidity index	72.55±0.17	72.16±0.27	72.39±0.15
Rainfall (mm)	251.46±53.78	93.18±33.44	185.51±40.54
Sunshine duration (minutes)	250.89±12.06	353.52±24.37	293.65±19.21

Table 3. Seasonal variation on semen characteristics of Murrah buffalo bulls

Semen characteristics	Rainy season (n = 95)	Dry season (n = 93)
Semen volume (mL)	4.40±0.18	4.39±0.17
Sperm concentration (billion/mL)	1.22±0.03 ^b	0.91±0.03 ^a
Total sperm output (billion)	5.20±0.23 ^b	3.89±0.17 ^a
Individual motility (%)	65.79±1.27	63.55±1.41
Post-thawing motility (%)	41.12±0.29	41.91±0.39
Straw production (unit/collection)	209.54±9.04 ^b	151.13±5.43 ^b

^{a, b}Different superscripts within the same column indicate significant differences ($P < 0.05$)

bulls under testicular heat stress (Losano *et al.*, 2017). In addition, the installation of the showering facility in the bull station may also be an alternative, since it may help lowering body temperature so that the adverse effect of high environmental temperature on spermatogenesis will be reduced. As previously reported by Hoque *et al.* (2018), the application of multiple showering during the hot season could allow higher frozen semen production for AI.

CONCLUSION

The present study provides evidence that the semen characteristics of Murrah buffalo bulls may vary depending on the season of collection. The semen collection during the rainy season is more profitable than in the dry season.

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