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CONCEPTION RATE OF ARTIFICIAL INSEMINATION OF BALI CATTLE ON DIFFERENT SEMEN DEPOSITIONS

Conception Rate Hasil Inseminasi Buatan Sapi Bali pada Deposisi Semen Berbeda

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ABSTRACT

This study aims to analyze the pregnancy rate resulting from artificial insemination of Bali cattle with different semen depositions. The research method used was a field experiment with three treatments: semen deposition at positions 3, 4, and 4+ (right side/dexter side). Pregnancy rate data were evaluated through Non-Return Rate (NRR1 and NRR2), Service per Conception (S/C), and Conception Rate (CR). The study was conducted on 120 Bali cattle in Bulukumba District, South Sulawesi. The results showed an increase in NRR in semen deposition 3, 4, and 4+ during the observation period of NRR 31 – 60. Although some breeders reported arousal symptoms late, the increase in NRR indicates a good understanding of arousal detection. Semen deposition at position 3 produces the lowest NRR, which can be caused by reproductive function abnormalities, silent heat, endometritis, or late reporting by farmers. The results of the S/C evaluation showed the lowest value and the highest of CR at semen deposition 4, which means that the semen deposition was closer to the fertilization site. Semen deposition at positions 4+ on dexter side althrough closer to the fertilization site was lower results of CR than posisition 4, because sperma only toward in right tubafolopii. The effectiveness of AI is significantly impacted by accurately detecting and timing the insemination process based on the ovulation period. This study provides important information regarding AI techniques in Bali cattle that can be used to increase the population and genetic quality of beef cattle in Indonesia.

Keywords: *Artificial insemination, Bali cattle, Conception rate, Semen deposition, Service per conception*

ABSTRAK

Penelitian ini bertujuan untuk menganalisis tingkat kebuntingan hasil inseminasi buatan sapi Bali dengan deposisi semen yang berbeda. Metode penelitian yang digunakan adalah eksperimen lapangan dengan tiga perlakuan yaitu deposisi semen pada posisi 3, 4, dan 4+ (sisi kanan/sisi cekatan). Data angka kehamilan dievaluasi melalui

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Non-Return Rate (NRR1 dan NRR2), Service per Conception (S/C), dan Conception Rate (CR). Penelitian dilakukan pada 120 ekor sapi Bali di Kabupaten Bulukumba, Sulawesi Selatan. Hasil penelitian menunjukkan adanya peningkatan NRR pada deposisi semen 3, 4, dan 4+ pada periode pengamatan NRR 31 – 60. Meskipun beberapa peternak terlambat melaporkan gejala arousal, namun peningkatan NRR menunjukkan pemahaman yang baik tentang deteksi arousal. Deposisi semen pada posisi 3 menghasilkan NRR paling rendah yang dapat disebabkan oleh kelainan fungsi reproduksi, silent heat, endometritis, atau keterlambatan pelaporan oleh peternak. Hasil evaluasi S/C menunjukkan nilai terendah dan CR tertinggi pada deposisi semen 4 yang berarti pengendapan semen lebih dekat dengan tempat pembuahan. Deposisi semen pada posisi 4+ sisi dexter meskipun lebih dekat dengan tempat pembuahan mempunyai hasil CR yang lebih rendah dibandingkan posisi 4, karena sperma hanya menuju ke tubafolopii kanan. Efektivitas AI dipengaruhi secara signifikan dengan mendeteksi dan menentukan waktu proses inseminasi secara akurat berdasarkan periode ovulasi. Penelitian ini memberikan informasi penting mengenai teknik AI pada sapi Bali yang dapat digunakan untuk meningkatkan populasi dan kualitas genetik sapi potong di Indonesia.

Kata Kunci: Inseminasi buatan, Sapi Bali, *Conception rate*, Deposisi semen, *Service per Conception*

INTRODUCTION

Beef cattle play a crucial role in meeting food demands, particularly for meat consumption. However, the current supply of beef in Indonesia falls short of meeting the national demand due to an inadequate cattle population. This deficit arises from lower beef and buffalo production, totaling 436.70 thousand tons, compared to the required 695.39 thousand tons. To address this meat shortage, the government has been importing an average of 14,192.08 tons of beef monthly (BPS, 2021). In 2021, the deficit in beef and buffalo meat availability was 270.98 thousand tons, and in 2022, it amounted to 258.69 thousand tons (BPS, 2022). In response to this challenge, the Indonesian government has implemented the SIKOMANDAN program, employing reproductive biotechnology, specifically Artificial Insemination (AI). The objective of this AI implementation policy is to enhance the production and productivity of both dairy and beef cattle. According to Rusdiana and Praharani (2018), the AI program stands as the primary option for improving the population and genetic quality of cattle. The anticipated rapid increase in livestock populations is expected to fulfill domestic meat requirements and curtail national meat imports (Sudita et al., 2012).

Bali cattle represent a native Indonesian germplasm extensively raised across Indonesia, particularly in Sulawesi Island. This breed offers distinct advantages, characterized by its resilience, adaptability to the environment, and making it well-suited for development within the Indonesian context (Iskandar et al., 2023). Astiti (2018) reported that the excellence of Bali cattle in terms of reproduction, showcasing a fertility range of 83–86%, surpassing European cows with a fertility rate of only 60%. The gestation period spans from 280 to 294 days, achieving a pregnancy percentage of 86.56%, and exhibiting a calving interval between 15.48 and 16.28 months. The calf crop reaches approximately 83.4%, with a calf mortality rate of 3.65%, and an impressively high carcass percentage of around 56%.

There are two methods for AI techniques: the vaginal or speculum insemination method and the rectovaginal method. In cows, the rectovaginal method is commonly employed. The success of the AI program is influenced by factors such as the physiological condition of the female livestock, the skills of the inseminator, and semen deposition. Widjaja et al. (2017) reported that the AI technique with semen deposition in Peranakan Ongole (PO) cattle. The study revealed that the Conception Rate (CR) values for Cervix Utery (deposition 3), Corpus Utery (deposition 4), and Cornua Utery

(deposition 4+) were 12.5%, 37.5%, and 87.5%, respectively. The Service per Conception (S/C) values were 8.00, 2.60, and 1.14, respectively. However, information on AI results in Bali cattle with semen deposition in positions 3, 4, and 4+ (right side) is not widely known in the South Sulawesi region, particularly in Bulukumba Regency. Hence, this research was conducted to analyze the pregnancy rate resulting from artificial insemination of Bali cattle with different semen deposits.

MATERIALS AND METHODS

Research location

This research was carried out from November 2022 to February 2023 within the livestock group in the Bulukumpa subdistrict, Bulukumba Regency, South Sulawesi Province.

Research materials

This study used 120 Bali cows with the following criteria: body condition score (BCS) of 3-4 (on a scale of 1-5), normal estrous cycles, having given birth, and did not experience reproductive disorders or dystocia. The management system for their care was relatively uniform, with the cattle being released to pasture in the morning and grounded in the evening. The frozen semen of Bali cattle used in the study was produced by the Singosari Artificial Insemination Center (BIB Singosari).

The equipment used in this study included: container with liquid nitrogen (N2), small bucket, artificial insemination gun (AI Gun), plastic sheet, plastic gloves, tweezers, scissors, thermometer, stopwatch, tissue, soap, thawing container, and squeeze cage.

Experimental design

This study was an experimental field method with three treatments:

P1: 60 Bali cows were inseminated at position 3 (cervix utery).

P2: 30 Bali cows were inseminated at position 4 (corpus utery).

P3: 30 Bali cows were inseminated at position 4+ on the right side (dexter of cornua utery).

The research design involved manipulating the insemination positions to observe and compare the effects on the artificial insemination outcomes in Bali cattle.

Parameters in this study are:

1. Non-Return Rate (NRR1 and NRR2): The percentage of AI acceptors that did not return to estrus on days 18-21 (NRR1) and days 40-42(NRR2) after AI implementation (Wiranto et al., 2020).
   The formula to determine NRR is:

$$\%\ NRR = \frac{(Total\ number\ of\ inseminated\ cows\ -\ Number\ of\ cows\ returning\ to\ estrus)}{\text{Total number of inseminated cows}}\ \text{x}\ 100\%$$

2. Service per Conception (S/C) is the number of AI services performed to obtain the amount of AI acceptors pregnancies.

$$\text{S/C}\ = \frac{(\text{Service used})}{(\text{Number of pregnant heifers})}$$

3. *Conception Rate* (CR) is precentage the number of animals pregnant based on the results of the first AI services. The pregnancy examination (PKB) by rectal palpation in the first AI, divided by the total number of AI acceptors, and multiplied by one hundred to express it as a percentage.

$$CR\ = \frac{Total\ number\ of\ AI\ acceptors Number\ of\ animals\ pregnant\ on\ first\ AI}{Number\ of\ acceptors}\ \text{x}\ 100\%$$

Data analysis

The data were analyzed descriptively using Microsoft Excel software.

RESULTS AND DISCUSSION

Evaluation of Artificial Insemination based on Non-Return Rate (NRR)

The success of artificial insemination (AI) is commonly gauged by monitoring the Non-Return Rate (NRR), where cattle that exhibit no signs of returning to estrus are presumed pregnant. Higher NRR percentages signify a greater success rate in achieving and sustaining pregnancies through artificial insemination. Susilawati et al. (2022) reported that cows are considered pregnant if no signs of estrus reappear within 8 to 35 days or 60 to 90 days after AI treatment. Similarly, Verroto et al. (2016) emphasized that Non-Return Rate (NRR) serves as a crucial indicator of livestock fertility, providing a swift assessment of reproductive performance without waiting for birth or parturition. This underscores the significance of NRR in promptly evaluating the reproductive success of artificial insemination programs.

In this study, observations were conducted during two Non-Return Rate (NRR) intervals. The first NRR (NRR 1st) period (NRR 1-21 days) involved assessments from day 18 to day 30 after artificial insemination. The second NRR (NRR 2nd) period (NRR 22-42 days) encompassed evaluations from day 31 to day 60, with rectal palpation performed for pregnancy diagnosis. During the first NRR period, NRR observations for semen deposition in positions 3, 4, and 4+ on the dexter side were 83.33%, 96.67%, and 90%, respectively. In the second NRR period, observations for positions 3, 4, and 4+ on the dexter side were 61.67%, 86.67%, and 83.33%, respectively (Table 1).

Table 1. Non-Return Rate on different deposition semen of Artificial Insemination

Deposition semen	Number of cows	NRR^{1st}		NRR^{2nd}	
		n	%	n	%
3	60	53	88.33	37	61.67
4	30	29	96.67	26	86.67
4+	30	27	90	25	83.33

Deposition 3: semen placement at position 3 (cervix utery). Deposition 3: semen placement at position 4 (corpus utery). Deposition 4^{+}: semen placement at position 4^{+} or deep insemination (corpus utery) on dexter side.

Significant NRR values were observed in semen deposition in the uterine corpus (position 4) and the base of the uterine cornua (position 4+) on the dexter side, with rates of 86.67% and 83.33%, respectively. The NRR observations in this study revealed that NRR2nd was lower than NRR1st, attributed to several factors such as silent heat (Yekti et al., 2019), endometritis (Mahendra, 2023), ectoparasites and endoparasites, and early embryo mortality (Saifuddin et al., 2018). Silent heat refers to a cow's estrus that is not clearly manifested, leading breeders to mistakenly assume pregnancy. Another contributing factor is endometritis, which prevents embryo implantation in the uterus. These findings significantly contribute to understanding the influence of semen deposition positions on NRR and highlight effective strategies for improving reproductive outcomes in Bali cattle.

Evaluation of AI Success on Service per Conception and Conception Rate

Service per Conception (S/C) represents the number of artificial inseminations conducted to achieve pregnancy in a herd (Setiawan, 2018). According to Ervandi et al. (2019), the S/C value can be determined by comparing the number of services with the frequency. In this research, highly favorable results were obtained, with S/C scores for deposition 3, 4, and 4+ on the dexter side being 1.37, 1.11, and 1.27, respectively. These scores meets the criteria (Susilawati, 2011), indicating an optimal Service per Conception (S/C) value between 1.6 and 2.0. A lower S/C value suggests improved

fertility and heightened reproductive efficiency in the cattle.

The effectiveness of S/C values can be attributed to the inseminator's selective approach, wherein inseminations are exclusively performed on cattle exhibiting peak estrus symptoms. These signs include a red and swollen vulva, transparent mucus discharge, frequent urination, and a lifted tail. Insemination is carried out within 12 hours after clear signs of estrus. Pemayun, Trilaksana, and Budiasa (2023) reported the highest pregnancy percentage in Bali cattle when artificial insemination (AI) was conducted 24 hours after estrus (100%). However, statistically, there was no significant difference ($P > 0.05$) compared to AI performed 12 hours after estrus, resulting in a pregnancy rate of 75%. According to Susilawati (2013), the success of artificial insemination is highly contingent on the timing of insemination. The accuracy of insemination timing is closely linked to the timing of ovulation, occurring approximately 6 hours after the end of estrus (Nuryadi, 2014).

The overall Service per Conception (S/C) value in this study surpasses that reported by Widjaja et al. (2017), who obtained S/C values of 8.00, 2.60, and 1.14 for deposition 3, 4, and 4+ in Ongole crossbreed cattle. Notably, in our research on Bali cows, the S/C value for deposition on position 4+ demonstrated a superior value of 1.14 compared to the results of Widjaja et al. This improvement can be attributed to the fact that semen deposition in position 4+ is limited to the right side only, preventing spermatozoa from meeting the ovulated egg in the left ovary.

The S/C value for semen deposition in position 4 is 1.23, indicating a better value than the research results of Widjaja et al., (2017) which obtained S/C values for deposition 3, 4, and 4+ were 8.00; 2.60; 1.14 respectively in Ongole crossbreed cattle. However, deposition semen in position 4^+ (dexter side) obtained S/C value was lower than in position 4, because the semen deposition in position 4^+ on the right side so that spermatozoa only can meet then fertilized ovum which is from the right ovarium.

Conception rate (CR) is the number of cattle that become pregnant at the first AI based on the results of the pregnancy examination (PKB). According to Costa et al. (2016) and Yekti et al. (2018), that CR value is percentage of conception rates shows the percentage of cows that become pregnant after the first insemination. Therefore, the CR value is used as an indicator to measure livestock fertility. Determining the percentage of CR through singing the rectal palpation method is carried out at 90 days (3 months) of pregnancy after the first AI.

Table 2. CR and S/C value on different deposition semen of Artificial Insemination

Deposisi	CR (%)	Nilai S/C
3	56.67	1,37
4	83.33	1,11
4^{+kanan}	76.67	1,27

Deposition 3: semen placement at position 3 (cervix utery). Deposition 3: semen placement at position 4 (corpus utery). Deposition 4^+: semen placement at position 4^+ or deep insemination (corpus utery) on dexter side.

Table 2. showed the highest CR values in cows inseminated at position 4 or corpus uterus were 83.33%, followed by position 4+ (dexter side), and position 3 were 76.67% and 56.67%, respectively. Semen containing spermatozoa which inseminated at position 4 (corpus utery) is closer to the fertilization site, namely the Ampulla Isthmus Junction (AIJ) of the fallopian tube, so sperm can save energy and there is a greater chance that the spermatozoa will meet the ovum and fertilize it The study observed that semen deposition in the right cornua uteri (position 4+ dexter side) exhibited a lower value compared to position 4. This difference is attributed to the fact that when semen is deposited in the corpus uteri (position 4), spermatozoa can move towards both the right and left cornua uteri, facilitating encounters with ova ovulated from either the right or left ovary. This phenomenon is further explained by the higher productivity

of the right ovary, where approximately 60% of ova are ovulated (Nuryadi, 2014). The Conception Rate (CR) observed in Bali cattle in this study for semen deposition at position 4 and position 4+ (dexter side) demonstrated a commendable CR, reported to be higher than the CR in Peranakan Ongole (PO) cattle, recorded at 58.79% (Wiranto et al., 2020).

According to Astiti (2018), one of the advantages of Bali cows is that fertility ranges from 83–86%. A good CR value according to Isnaini and Fazrien (2020) is 60–70%. Several factors that influence the CR values are the accuracy of estrus detection, the physiological condition of the acceptor, the nutrition, and skill of the inseminator as well as the deposition of semen. The acceptor used in this research has BSC value of 3–4, it is assumed that the feed/nutrients are enough. Meanwhile, the inseminators involved in this research are inseminators with more than 20 years of experience, indicating a high level of expertise. These factors contribute to the higher CR observed in Bali cattle in comparison to the mentioned studies.

CONCLUSION

The selection of the semen deposition position is pivotal for the success of artificial insemination in Bali cattle. Semen deposition in position 4 demonstrated the highest conception rate and the lowest Service per Conception (S/C). This superiority can be attributed to the proximity of semen in this position to the meeting point of sperm and ovum. It allows sperm to reach both fallopian tubes and cornua uteri, thereby increasing the likelihood of successful fertilization with ova from either ovary.

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