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Short Communication

ASSOCIATION BETWEEN PARITY AND DAYS IN MILK ON OESTRUS EXPRESSION AND THEIR INFLUENCE ON ARTIFICIAL INSEMINATION OUTCOMES IN DAIRY COWS

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SUMMARY

A study involving 67 cows revealed that oestrus behaviour was prevalent in early and mid-lactation (38.3% each) and less prevalent during late lactation (22.4%). Artificial insemination (AI) was conducted across all lactation groups, with mid-lactation cows representing the majority at 84.6% (22/26; *N* = 67). Primiparous cows (34.3%, *N* = 66) and cows in their third or higher parity (35.8%, *N* = *66*) were more likely to express oestrus. However, AI was predominantly conducted in primiparous cows (82.6 % or 19/23 cows, *N* = 66) and less in cows in their third parity and above (70.8 % or 17/24 cows, *N* = 66). Chi-square analysis showed no significant association between AI outcomes and parity or lactation stage. Enhanced oestrus detection can improve breeding outcomes and farm productivity.

Keywords: artificial insemination, cows, oestrus, parity, lactation

INTRODUCTION

Oestrus detection in dairy cows is essential for timely artificial insemination (AI), which raises the likelihood of conception, thus maximising reproductive efficiency, shortening the calving interval, and ultimately increasing farm productivity. Nonetheless, the cow's oestrus expression, reproductive state, and energy balance are all influenced by parity and days in milk (DIM) (Walter et al., 2022).

This study aims to establish the association between parity, DIM, and the expression of oestrus behaviours, and how these factors influence AI outcomes in cows on a commercial dairy farm. Elucidating the association between these elements may help farmers make better cow-breeding decisions, improve oestrus detection accuracy, and reduce reproductive losses.

MATERIALS AND METHODS

The study was conducted on 67 dairy cows in a commercial farm in the state of Pahang, Malaysia (GPS coordinates: 3.027623842200593, 103.1193253461224714), with a total population of 1,200 cattle. Approximately 40% of the cows were open/cyclic. An observational, quantitative (cross-sectional) research design with purposive sampling was used. All methods used in this study were approved by the Institutional Animal Care and Use Committee (IACUC), Universiti Putra Malaysia (UPM/IACUC/AUP-U027/2024).

Cows were identified for the breeding assessment based on their past oestrus cycle records. Cows were monitored for oestrous behaviour such as standing to be mounted by other cows (primary sign) and mounting other cows (secondary sign)(Reith and Hoy, 2018). Manual observations and video recordings of oestrus activity were performed in the holding area before milking by the same observer twice daily in the morning and evening. Repeated observations help avoid missed oestrus and shorten the interval from the probable onset of oestrus to the time of AI whilst ensuring data collection during peak oestrus activity (De Silva et al., 1981). Cows exhibiting oestrus behaviours were identified and recorded in a heat-to-AI form.

Descriptive statistics were used to summarise the distribution of DIM and parity across the observed population. Normality tests on the data were not performed since the variables are categorical. Frequency distributions were calculated for oestrous expression across DIM (early lactation: ≤120 DIM, mid-lactation: 121-200 DIM, and late lactation: >200 DIM) and parity (Primiparous, Second, and Third-and-Above) (Hovey, 2018). Separate frequency distributions were calculated for AI outcome (i.e., done vs. not done) across DIM and parity. A Chi-square test was used to determine the association between parity, DIM categories, and AI outcome. Statistical significance is reached when $p < 0.05$. Data were analysed using SPSS version 27.

RESULTS

The frequency distribution of cows at different parities exhibiting oestrus behaviour is shown in Figure 1. Primiparous cows (n = 23, 34.3%) and cows in their third

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and above parity (n = 24, 35.8%) constitute the two large groups exhibiting oestrus.

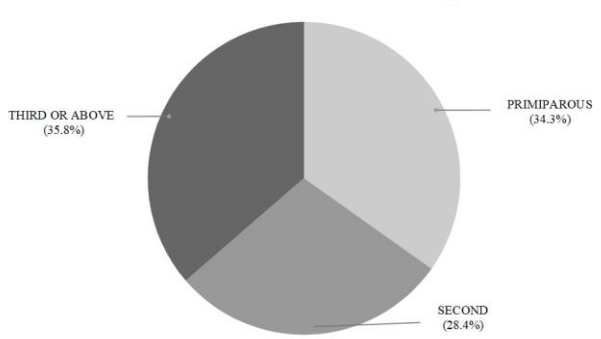

Figure 1. Frequency distribution (%) of cows (n=66) exhibiting oestrus behaviour at different parities. One cow with incomplete parity record was omitted from the observation.

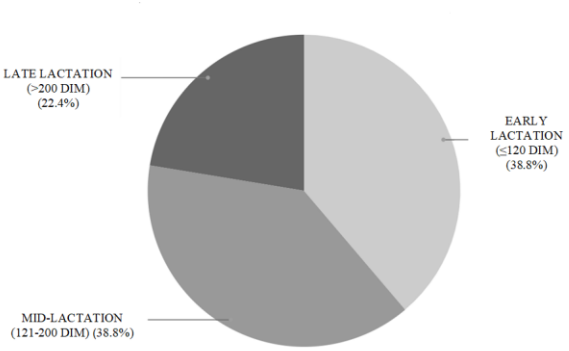

Figure 2. Frequency distribution (%) of cows (n=67) exhibiting oestrus behaviour at different DIM.

The frequency distribution of cows with different DIM and showing oestrus behaviour is shown in Figure 2. Cows that exhibited oestrus behaviour were in their early (≤120 DIM) or mid-lactation (121-200 DIM) stages, with each contributing equally (n = 26, 38.8%) to the observation.

Following oestrus behaviour display, AI was performed on 82.6% of cows in the primiparous group (19/23, n = 66), 78.9% of cows in their second parity (15/19, n = 66), and 70.8% of cows in the third-and-above parity groups (17/24, n = 66). One cow with an incomplete parity record was omitted from the observation. Regardless, the association between parity and the AI outcome was not significant [$\chi 2(2, n = 66) = 1.0$, $p = 0.616$].

Data from the present study indicated that AI was performed on cows in oestrus during the early (80.8% or 21/26 cows, n = 67) and mid-lactations (84.6% or 22/26 cows, n = 67), and less frequently during late lactation (60.0% or 9/15 cows, n = 67). Cumulatively, AI was performed on 77.6% of cows across all DIM categories. The association between the AI outcomes across DIM categories (early, mid, late) was, however, not significant [$\chi 2$ (2, n = 67) = 3.6, p = 0.619].

DISCUSSION

Cows exhibit standing heat approximately 12–18 hours after the onset of heat (DuPonte, 2007). Artificial insemination is usually performed at the end of the standing heat to allow sperm capacitation during the ovulation stage. Hence, failure to detect the cow's display of oestrus behaviour results in missed heat, causing reproductive losses and reduced profitability. Furthermore, missed oestrus due to inaccurate detection resulting from silent oestrus and poor record keeping may further contribute to the loss.

Oestrus behaviour expression in cows is affected by parity and DIM (Walter et al., 2022). The present study demonstrated that primiparous and third-and-above parity cows exhibited oestrus at higher rates than second-parity cows. These findings agree with those of Yamamoto et al. (2018). However, the present results indicated that, although not significant, oestrus expression during the second parity was numerically less intense than during the first parity and lower than that of cows on their third parity and above.

Artificial insemination is recommended for cows in heat during mid-lactation due to the consistent expression of oestrus behaviour (Walter et al., 2022). However, results from the present study indicated that oestrus expression was equally pronounced during early and mid-lactation. The differences in observation may be associated with the type of farm management, the accuracy of detection, and differences in climate and temperature across the experimental settings. The effects of the latter factors on the expression of oestrus behaviour warrant further research. Nonetheless, the reduction in oestrus behaviour among cows in late lactation may suggest suppression of such behaviour due to physiological changes such as hormonal fluctuations, energy demands of milk production, and stress (Leliveld et al., 2023).

The term "AI performance rate" refers to the success of the artificial insemination process, indicated by increased conception and pregnancy rates in livestock. However, the AI outcomes are dependent upon, amongst other factors, precise oestrus identification and accurate timing of AI. The AI performance rates in primiparous cows are reportedly low due to silent heat, weaker oestrus signs, and longer anoestrus periods. Aside from having good oestrus behaviour expression, second parity cows achieve higher AI performance rates due to their stable regular oestrus cycles. On the other hand, multiparous cows at their third parity and beyond may exhibit low AI performance rates due to age-related fertility issues and health problems such as mastitis and lameness, despite consistent oestrus behaviour (Neave et al., 2017; Fodor et al., 2019; Walter et al., 2022). Results from the present study indicated that AI was performed on cows regardless of parity, contrary to the evidence-based findings on its effect on performance rates reported in the literature. The differences observed in the present results obtained with other similar studies may be due to individual farm practice and preference.

Cows in late lactation (>200 DIM) may still show signs of oestrus, but the animal's reproductive system is undergoing transition into the dry period. During this

stage, cows start to conserve energy and gain weight in preparation for the next calving cycle (Moran, 2005). Hence, the AI performance rate at this stage is lower compared to the early and mid-lactation stages.

The present results indicated that AI was performed on cows in late lactation, but the percentage, although non-significant, was numerically lower compared to the cows in early and mid-lactation groups. Regardless, there is no significant relationship between the different stages of DIM and AI outcomes, whereby AI was performed across all DIM groups.

The data on the type of oestrus, last AI, AI count, rectal temperature, body condition score (BCS), and how these factors affect the conception rates of each cow in the present study post-AI were, however, not available for further analysis.

CONCLUSION

Oestrus behaviours were expressed consistently across DIM groups and parities. The latter factors were not significantly associated with AI outcomes. However, the decision to implement AI regardless of parity or DIM is dependent upon the farm's preference, practice, and economic readiness. Regardless, it is important for farmers to follow AI protocols that are tailored to the parity status and DIM of each cow, as improper timing of AI based on these factors lowers the conception and pregnancy rates, increases calving intervals, induces health risks specifically to the reproductive systems, eventually lowering milk yield, and reduces genetic improvement of the herd. Nonetheless, an in-depth exploration of additional factors influencing AI success in the farm, such as cow physiology, environmental conditions, and staff expertise, is warranted.

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CONFLICT OF INTEREST

None of the authors of this paper has any financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

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