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Teaser bulls response to oestrus heifers: weather influence on oestrus in barn and loose housing system

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Abstract

Effective oestrus detection is essential for optimizing fertility management on dairy farms. This study explores how weather parameters affect oestrus occurrence and the behavioural responses of teaser bulls to oestrus heifers in two housing systems: barn and loose house. Key environmental factors, such as ambient temperature and relative humidity, were monitored throughout the study. Twelve crossbred Holstein heifers were divided into two groups of six, with one group housed in a barn and the other in a loose housing system. Over 60 days, they were observed for signs of oestrus, and teaser bulls were introduced to evaluate their behaviours, including Flehmen responses and mounting attempts. Although there were significant differences in temperature and humidity between the two housing systems, the temperature-humidity index (THI) did not correlate with oestrus occurrence, challenging some previous studies. The research revealed that the loose housing system resulted in a markedly higher frequency of Flehmen responses and mounting attempts, with mean ranks of 8.14 and 8.57, respectively, compared to 4.20 and 3.60 in the barn system (p-value: 0.025 and 0.014). These results highlight the importance of housing conditions in enhancing reproductive management. Loose housing systems, by promoting more natural social interactions and behavioural displays, improve the accuracy and efficiency of oestrus detection, leading to more timely and successful inseminations and boosting overall herd productivity. Moreover, this system enhances animal welfare by reducing stress, providing greater freedom of movement and allowing for effective herd management.

Keywords: *Heifers, oestrus, teaser bull, temperature-humidity index*

Identifying cows in oestrus is a major challenge in achieving successful fertilisation. The primary aim of an oestrus detection program is to accurately identify oestrus in all cycling cows, ultimately predicting the time of ovulation. The behavioural response of teaser bulls plays a critical role in detecting oestrus in heifers, serving as a reliable and natural indicator of reproductive readiness. Understanding these behaviours is essential for optimizing breeding programs and ensuring timely artificial insemination, particularly in dairy and beef cattle management. The environment in which animals are housed can significantly influence their behaviour, stress levels, and overall welfare (Popescu *et al*., 2014).

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In confined barn systems, animals experience controlled environmental conditions, with limited space and interaction, which may affect the visibility and intensity of oestrus behaviours (Roelofs *et al*., 2005). On the other hand, loose housing systems offer a more open and less restrictive environment, potentially allowing for more natural social interactions and better expression of oestrus signals (Palmer *et al*., 2010). The varying conditions between these housing systems could lead to differences in how teaser bulls respond to heifers in oestrus, thus affecting the efficiency of oestrus detection.

In addition to housing conditions, weather parameters, including temperature and humidity, play a crucial role in reproductive performance. The temperature-humidity index (THI) integrates the effects of environmental temperature and relative humidity, measuring animal thermal stress (Dash *et al*., 2016). Higher THI levels negatively impact follicular development and the preovulatory LH surge, which can result in delayed or even absent ovulation (Roth and Wolfenson, 2016).

This study aims to compare the behavioural response of teaser bulls towards heifers in oestrus and examine the impact of weather parameters on the occurrence of oestrus in two distinct housing systems: barn and loose house systems. By identifying how housing systems influence oestrus detection accuracy, the study aims to provide insights that could enhance reproductive management practices. Understanding these dynamics is essential for improving oestrus detection methods, ultimately leading to better reproductive outcomes and overall herd productivity.

Materials and methods

The study was conducted at Livestock Research Station in Thiruvazhamkunnu, Palakkad, Kerala, situated at a longitude of 76°22′E and a latitude of 11°2′N. It was carried out over three months from February to May 2024. Twelve healthy crossbred *Holstein* heifers, aged 18 to 24 months, were chosen for the study. The feeding and management practices for these heifers were consistent with those typically followed by the other cows on the farm. The selected animals were randomly assigned to two groups.

- Group 1: Six heifers were housed in a tie barn, where they were tethered for the duration of the study.
- Group 2: Six heifers were housed in a loose house system, which allowed them to move freely within the barn (38 square meters) and the adjoining paddock (64 square meters).

The ambient temperature and relative humidity for both groups were continuously recorded using a digital logger throughout the study. The temperature-humidity index (THI) was calculated from the recorded temperature and humidity data following the method outlined by LPHSI (1990).

$$THI = dB^0F - [(0.55-0.55*RH) (dB^0F-58)$$

Where dB^0F represented the dry bulb temperature in Fahrenheit and RH denoted relative humidity as percentage.

Weekly average THI values were computed to assess the relationship between THI and the occurrence of oestrus. The heifers were observed for signs of oestrus. After missing the first heat cycle, they were closely monitored from the 17th day of the initial heat to the onset of the second heat. Detection of the onset of oestrus was based on behavioural observations, followed by the introduction of a teaser bull to evaluate responses such as Flehmen, licking, and mounting. Confirmation of oestrus was achieved through rectal palpation (Hansar *et al*., 2014)

Fig 1. Animals housed in barn house system

Fig 2. Animals housed in loose house system

The data were statistically analysed using SPSS version 24.0, with the Mann-Whitney test employed to evaluate differences in responses between the two groups of teaser bulls. Pearson correlation was applied to examine the relationship between average THI and the occurrence of oestrus in both groups.

Results and discussion

Behavioural Response of Teaser Bulls

The study recorded the teaser bull's responses to oestrus animals in barn and loose housing systems throughout the study period. It was observed that the frequencies of Flehmen responses and mounting attempts were significantly higher in the loose housing system compared to the barn (Table 1). Specifically, teaser bulls in the loose housing system exhibited a mean rank of 8.14 for Flehmen responses and 8.57 for mounting attempts, compared to 4.20 and 3.60, respectively, in the barn system. The p-values of 0.025 and 0.014 confirm these differences are statistically significant.

Diskin and Sreenan (2000) highlighted that active vasectomised teaser bulls effectively identify cows in or approaching oestrus. This supports our observation that teaser bulls are more responsive in systems that provide greater freedom of movement and environmental enrichment. Furthermore, Sankar and Archunan (2002) showed that oestrus cows' urine could induce Flehmen behaviour in bulls, corroborating our study's higher Flehmen responses in the loose housing system. Rajanarayanan and Archunan (2011) further supported this by noting that teaser bulls exhibit increased Flehmen responses to the urine of oestrus cows, attributed to the presence of 4-methyl phenol, a volatile compound associated with oestrus.

Tiwari *et al*. (2024) also observed higher frequencies of mounting attempts during the standing heat phase in Sahiwal cows, reinforcing the idea that teaser bulls are more actively engaged during peak oestrus. This suggests that the loose housing system, which may allow for more natural interactions and behavioural expressions, enhances the effectiveness of teaser bulls in detecting oestrus.

Ambient temperature

Throughout the study period, ambient temperatures in the barn and loose house were monitored hourly, with weekly averages detailed in Table 2. Both environments showed a general increase in mean temperature from week 1 to week 9, with a minor dip in week 5 relative to week 4. The highest temperature recorded in the barn was 32.25°C in week 9, and the lowest was 28.72°C in week 1. In the loose house, temperatures ranged from 32.42°C to a minimum of 29.11°C. The

Table 1. Response of teaser bull towards oestrus animals in the barn and loose house

Parameter	Barn			Loose house			p-value
	Mean rank	Median (Interquartile range)	Min-Max	Mean rank	Median (Interquartile range)	Min-Max	
Flehmen response (per 30 minute)	4.20	1 (1)	1-2	8.14	2.00 (0)	2-3	0.025*
No. of attempts to mount	3.60	1 (1)	1-2	8.57	3.00 (2)	2-4	0.014*

*Significant at 0.05 level

Table 2. Weekly average of ambient temperature (°C) in barn and loose house

Week	Barn temperature			Loose house temperature		
	Mean	Lowest	Highest	Mean	Lowest	Highest
Week 1	28.72[a]	19.70	40.20	29.11[b]	21.20	39.50
Week 2	28.95	19.60	39.70	29.36	21.00	38.20
Week 3	29.80[a]	21.80	40.30	30.29[b]	23.40	39.80
Week 4	30.02	21.90	41.10	30.51	23.50	40.60
Week 5	29.91	22.10	41.20	30.32	23.70	39.80
Week 6	30.76[a]	24.00	40.60	31.20[b]	25.10	40.40
Week 7	30.99	23.10	41.70	31.21	24.50	40.50
Week 8	31.92[a]	24.10	41.70	32.16[b]	25.40	41.10
Week 9	32.25	24.70	43.00	32.42	25.90	40.70

(a,b) means with different superscripts within a row differ significantly at 0.05 level

Table 3. Weekly average relative humidity (%) in barn and loose house

Week	Barn RH			Loose house RH		
	Mean	Lowest	Highest	Mean	Lowest	Highest
Week 1	69.65[a]	20.40	99.90	64.85[b]	21.40	90.60
Week 2	62.14[a]	16.00	99.90	58.99[b]	19.80	88.80
Week 3	70.01[a]	23.40	99.90	65.27[b]	27.50	90.00
Week 4	65.89	19.80	99.90	62.45	23.70	91.10
Week 5	72.39[a]	30.50	99.90	68.35[b]	36.30	90.30
Week 6	75.08[a]	26.40	99.90	70.40[b]	32.70	90.90
Week 7	71.76[a]	25.30	99.90	68.14[b]	30.60	89.70
Week 8	71.01[a]	21.20	99.90	67.40[b]	23.30	89.50
Week 9	69.27[a]	30.20	99.90	66.80[b]	37.90	88.00

(a,b) means with different superscripts within a row differ significantly at 0.05 level

Table 4. Number of animals in oestrus in barn and loose house according to weekly THI

Week	Barn		Loose house	
	Average THI	No. of animals in oestrus	Average THI	No. of animals in oestrus
1	77.56	5	78.16	1
2	77.06	1	67.07	2
3	79.59[a]	1	66.04[b]	2
4	79.14[a]	3	64.60[b]	2
5	80.23[a]	0	63.39[b]	3
6	82.19[a]	2	62.36[b]	4
7	81.73[a]	1	61.49[b]	1
8	83.00[a]	2	60.77[b]	3
9	83.44[a]	0	60.196[b]	2

(a,b) means with different superscripts within a row differ significantly at 0.05 level

significantly higher average temperature recorded in the loose house compared to the barn ($p<0.01$) suggests that the loose house environment may be more susceptible to external temperature fluctuations. This is consistent with findings of Morton *et al*. (2007), who observed that elevated ambient temperatures can negatively impact reproductive traits in cattle. The increase in temperature could potentially elevate stress levels in the animals, though this did not appear to influence the occurrence of oestrus significantly in the current study.

Relative humidity (RH)

Relative humidity was monitored hourly in both the barn and loose house (Table 3), throughout the study, the second week recorded the lowest relative humidity in both settings. The relative humidity of the barn was consistently 3-4 percent higher than the loose house. A statistically significant difference ($p<0.01$) was noted between the weekly average relative humidity levels in the barn and the loose house.

Impact of THI on oestrus occurrence

The weekly count of animals in oestrus, based on the THI recorded each week in both the barn and loose house, is presented in Table 4. The results of the present study showed that the barn experienced its peak THI of 83.44 in the ninth week and its minimum of 77.06 in the second week. In contrast, the loose house recorded its highest THI of 78.16 during the first week and its lowest THI of 60.196 in the ninth week. Although the THI in the loose house was higher than in the barn during the initial week, it was lower for the remainder of the study period. A significant difference ($p<0.01$) was noted between the weekly average THI values of the barn and the loose house. The study found no significant correlation between the average THI and the occurrence of oestrus in animals within either housing system during the study period. These findings contrast with studies such as those by Schuller *et al.* (2017) and Tippenhauer *et al*. (2021), suggesting that higher THI levels negatively impact oestrus expression.

Table 4 shows that, over the entire study period, more animals in the loose house group came into oestrus than those in the barn. The higher number of animals coming into oestrus in the loose house compared to the barn may be attributed to the more natural environment provided by the loose house. Studies by Palmer *et al*. (2010) and Sveberg *et al*. (2013) support this finding, indicating that

animals in more open, less confined environments exhibit more pronounced oestrus behaviours. The loose house system, by allowing greater female-female interaction and more freedom of movement, may enhance the expression of oestrus signs, making it easier to detect compared to the more confined barn setting (Sveberg *et al*., 2013).

Conclusion

This study highlights the significant impact of housing systems on the behavioural response of teaser bulls to oestrus heifers and the influence of ambient weather parameters on the occurrence of oestrus. The findings reveal that teaser bulls demonstrate significantly higher rates of Flehmen responses and mounting attempts with heifers housed in a loose system than those in a barn. This increased responsiveness in loose housing can be linked to more natural social interactions and less restrictive environments, which likely enhance the visibility of oestrus behaviors. Moreover, while ambient temperature and relative humidity levels differed significantly between the barn and loose house, these variations did not notably affect the occurrence of oestrus. Interestingly, the barn's THI was higher for most of the study period, yet this did not correlate with a reduced number of oestrus events. Contrary to previous studies, this research found no significant correlation between THI and oestrus occurrence, indicating that other factors, such as the housing environment, may play a more critical role in oestrus detection. These results suggest that loose housing systems may improve the accuracy and efficiency of oestrus detection. The study highlights the role of housing conditions in refining reproductive management practices. By creating a more open and enriched environment for heifers, dairy farms can potentially boost the effectiveness of teaser bulls in detecting oestrus, leading to more timely and successful inseminations. Therefore, adopting loose housing systems could significantly benefit oestrus detection programs and enhance overall reproductive management and herd productivity. The welfare of farm animals is a growing concern for researchers as well as policy makers due to growing consciousness on animal sentience. Even though use of teaser bull is an age-old technique, it goes well with the modern welfare principles because of the naturalness involved. This study hence upholds the welfare as a tool to enhance productivity without compromising animal freedom. But still to arrive at conclusive evidence to prove the high advantage of loose houses in detecting oestrus better and reducing incidence of silent heat, more comprehensive studies in different climatic zones and with different breeds are required. Also, these findings highlight the need for future research to explore the specific environmental and behavioural factors in different housing systems that optimise reproductive outcomes. Further studies could investigate the long-term effects of not only loose houses but also various housing systems possible on the herd fertility, welfare, and productivity, while also examining how modern technological advancements could complement these systems to refine oestrus detection and overall reproductive management.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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