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Physiological Variation in Dairy Cows under various Housing Types during South West Monsoon in Tamil Nadu, India

T. Sivakumar[1], P.T. Suraj[2] and A. Yasotha[3*]
[1]Professor and Head, Department of Livestock Production Management,
Madras Veterinary College, Chennai, (Tamil Nadu), India.
[2]Associate Professor and Head, Livestock Research Station, Thiruvazamkunnu, (Kerala), India.
[3]Assistant Professor, Department of Livestock Production Management
Veterinary College and Research Institute, Udumalpet, (Tamil Nadu), India.

(Corresponding author: A. Yasotha)*
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ABSTRACT: The housing of dairy cow tends to be the most important component in dairy farming as it should buffer the cattle from extreme climates and must reduce resultant stresses. In Tamil Nadu varying designs and construction materials are used depending upon local practice and availability. A study was carried out to assess the variation in physiological variables on dairy cows under different housing patterns in the four agro-climatic regions of Tamil Nadu *viz.* North Eastern zone, North Western zone, Western zone and Hilly zone during South West Monsoon season. Various physiological parameters of dairy animals such as rectal temperature, pulse rate, respiration rate and skin temperature were recorded in all the housing types with different roofing materials from four agro-climatic zones. The lowest rectal temperature and skin temperature were 38.05±0.12°C and 29.00±0.59°C respectively recorded under the metal sheet roofing in Hilly zone whereas the lowest pulse rate and respiration rate were recorded in North Eastern zone and Hilly zone under the thatched roofing. Hilly zone and thatched roofing were found to be ideal for rearing cross bred dairy animals during South West Monsoon season.

Keywords: Physiological parameters, South West Monsoon, dairy cow, housing.

INTRODUCTION

Dairying was the primary occupation along with agriculture in selected districts of Tamil Nadu (Yasotha *et al.*, 2018). Provision of suitable housing to dairy animals will enhance the milk production by effective utilization of labour and available resources. Selection of a suitable housing material can be difficult without data that quantify material effectiveness for heat reduction in all the season. Appropriate roofing material becomes an inevitable part of housing. Inappropriate roofing material will affect the animal health and performance and leads to huge economical loss to the farmer (Narwaria *et al.*, 2017). Severe stress to dairy animals may drastically deteriorate their physiological status. Proper animal housing facilitates optimal health, production and welfare of dairy animals (Singh *et al*., 2020). Implementing stress-reducing measures after recognizing the potential severity of a heat stress can increase their performance and reduce death losses (Eigenberg, *et al.*, 2005).

When animals were exposed to rising air temperatures, the first response observed was an increase in respiration rate. The changes in respiration rate leads to discomfort which was noticed due to exposure to greater intensity of solar radiation (Das *et al.*, 1999). To improve the production, comfort and health of housed animals feed samples to be analysed for the possible transmission of minerals from feed to faeces (Yasotha and Sivakumar, 2018). Exposure of animals to contaminants can be prevented by periodical monitoring and assessment (Yasotha *et al.*, 2021). It is necessary to assess the comfort of animals in different condition with exposure to various temperatures and solar radiation in field condition to provide a comfort zone. Much work needs to be done in identifying improved management practices and implementing within both intensive and loose housing systems. If these refinements are implemented, some of the identified system differences will potentially change (Beaver *et al.*, 2021).

Hence, a study was planned to assess the physiological variation in cross bred dairy cows reared under various housing types during South West Monsoon season in Tamil Nadu.

MATERIALS AND METHODS

The study was carried out in the four agro-climatic regions of Tamil Nadu *viz*. North Eastern zone, North Western zone, Western zone and Hilly zone. In total, 30 farmers with a minimum of five cross bred cows were selected from each agro-climatic zone with the major types of housing pattern. Housing system adopted in all the zones were classified under Thatched, Tiled, Metal, Concrete and Open shed. Physiological parameters such as rectal temperature, respiration rate, pulse rates and skin temperature were recorded between 12.00 noon and 2.00 pm in the farmers field. The rectal temperature (RT) was recorded by a clinical thermometer and measured in degrees Celsius ($^{\circ}$C). The respiration rate (RR) was recorded and expressed as breaths per minute (bpm). Pulse rate (PR) of the animals was counted and expressed as beats per minute. The peripheral skin temperature at different sites of the experimental animals, *viz*, head, neck, hump, dorsal, ventral and other regions were recorded with a non-contact infrared thermometer (MINITEMP MT4, Raytek). The data was analyzed for statistical significance using statistical package SPSS 17.

RESULT AND DISCUSSION

Physiological parameters of animals under various housing types in all the agro-climatic zones under the study during South West monsoon are presented in Table 1. Rectal temperature, respiration rate and skin temperature were found to differ highly significantly ($p<0.01$), where as pulse rate has shown a significant difference ($p<0.05$) between different housing systems in the North Eastern agro-climatic zones and it did not differ significantly between treatments in other three zones under study.

Table 1. Physiological parameters under different roofing system during South West monsoon in four zones (Mean ± SE).

Sr. No.	Agro-climatic region	North Eastern Zone Housing Types					North Western Zone Housing Types				
	Parameter (n=6)	Thatched	Tile	Metal	CC	Open	Thatched	Tile	Metal	CC	Open
1.	RT (°C)	38.15 ±0.09^{a}	38.37 ±0.08^{b}	38.42 ±0.05^{bc}	38.58 ±0.03^{c}	38.50 ±0.04^{bc}	38.43 ±0.06^{a}	38.53 ±0.02^{ab}	38.40 ±0.05^{a}	38.52 ±0.03^{ab}	38.50 ±0.05^{ab}
2.	PR (Beats/m)	64.33 ±7.68^{a}	72.67 ±1.15^{bc}	74.00 ±0.73^{bc}	75.00 ±0.37^{c}	73.00 ±0.73^{bc}	72.50 ±0.72^{a}	73.83 ±0.70^{a}	72.67 ±0.61^{a}	74.00 ±0.77^{a}	74.00 ±0.58^{a}
3.	RR (Breaths/m)	28.67 ±0.92^{a}	31.83 ±2.06^{b}	35.00 ±1.46^{c}	35.67 ±0.56^{c}	37.67 ±1.80^{d}	32.50 ±1.84^{a}	34.67 ±0.84^{b}	33.50 ±2.00^{a}	36.00 ±1.26^{b}	33.67 ±1.12^{ab}
4.	ST (°C)	35.55 ±0.54^{ab}	35.82 ±0.42^{ab}	35.98 ±0.52^{ab}	35.45 ±0.36^{a}	37.07 ±0.22^{c}	35.45 ±0.37^{a}	35.48 ±0.31^{a}	35.62 ±0.31^{ab}	36.72 ±0.29^{bc}	37.18 ±0.19^{c}
5.	RT (°C)	38.30 ±0.04^{a}	38.42 ±0.03^{ab}	38.43 ±0.03^{ab}	38.50 ±0.04^{b}	38.48 ±0.04^{b}	38.30 ±0.09^{b}	38.35 ±0.08^{bc}	38.05 ±0.12^{a}	38.40 ±0.03^{bc}	38.45 ±0.04^{bc}
6.	PR (Beats/m)	69.50 ±0.67^{a}	73.00 ±0.58^{a}	71.67 ±0.61^{a}	72.83 ±0.79^{a}	71.00 ±0.89^{a}	70.17 ±1.85^{a}	67.83 ±1.14^{a}	67.50 ±1.18^{a}	72.17 ±0.70^{a}	72.83 ±0.48^{a}
7.	RR (Breaths/m)	31.33 ±1.71^{a}	31.83 ±1.38^{a}	34.33 ±2.16^{b}	37.83 ±1.76^{c}	35.17 ±1.56^{b}	28.50 ±0.76^{a}	29.00 ±1.37^{a}	29.50 ±1.43^{a}	32.17 ±0.79^{a}	32.67 ±1.33^{a}
8.	ST (°C)	34.37 ±0.52^{a}	35.83 ±0.38^{ab}	36.13 ±0.33^{b}	36.45 ±0.32^{b}	36.88 ±0.43^{a}	31.72 ±0.94^{ab}	29.18 ±0.75^{a}	29.00 ±0.59^{a}	32.22 ±0.64^{b}	31.30 ±0.71^{b}

Figures with different superscript in a row differ significantly ($p<0.01$) under respective zones; Mean with different superscript in a row are significantly differ ($P<0.001$) or ($P<0.005$)

The highest rectal temperature during South West monsoon was recorded under cement concrete roofing (38.58±0.03°C), tile roofing (38.53±0.02°C), cement concrete roofing (38.70±0.04°C) and Open housing type (38.45±0.04°C) of North Eastern zone, North Western zone, Western zone and Hilly zone respectively. The lowest rectal temperature during South West monsoon was recorded under the metal sheet roofing in Hilly zone (38.05±0.12°C) and North Western Zone (38.40±0.05°C) whereas in North Eastern zone (38.15±0.09°C) and Western zone (38.30±0.04°C) it was recorded under thatched roofing house. Usually metal roof reflects heat away from the building and provides increased wind resistance when compared to other roofing materials. Further, other major contributing factor for variation in rectal temperature is variation in management (Madke *et al.*, 2010). Similar findings were also observed by Maurya *et al.* (2018) and reported that the overall rectal temperature (°C) and respiration rate (per minute) in afternoon was significantly higher in cement concrete roof.

The highest pulse rate (Mean±SE) of 75.00±0.37 beats per minute was recorded under North Eastern zone under cement sheet roofing and the lowest of 64.33±7.68 beats per minute under thatched roofing of the same zone. There was a positive relationship between temperature and pulse rate as reported by Chauhan *et al*. (1999) who observed an increase in pulse rate of animals kept in open sheds compared to closed sheds during summer. However, Sivakumar *et al*. (2018) observed variation in physiological

parameters of cows under different agroclimatic regions during summer with different roofing materials.

Respiration rate was highest under cement sheet roofing in Western zone (37.83±1.76 breaths per minute) and lowest under thatched roofing in Hilly zone (28.50±0.76 breaths per minute). Increased respiration rate is the first outward expression that a cow is responding to increased thermal load (McDowell, 1972). Respiratory rate will be increased when animals are exposed to rising air temperatures (Das *et al.* 1999). Similarly Vijayakumar *et al*. (2009) reported higher pulse rate and respiration rate in the afternoon at 2 pm than morning values which were recorded at 9 am. The difference between 12 noon and afternoon pulse rates were statistically significant (P<0.01) among the groups. The temperature recorded under cement sheet roofing was higher than thatched roofing hence pulse rate and respiration rate were highest in cement sheet roofing and lowest in thatched roofing. However, Gupta *et al.* (2004) compared three types of housing systems *viz*. loose house having asbestos roof and cemented floor (T1), loose house with mud plaster roof (T2) and village type closed barn with kuchha floor for buffalo heifers during winter and found that the average respiration rates both in the morning and afternoon were not affected (P<0.05) by the floor types.

Cows under the open housing system in North Eastern zone recorded the highest skin temperature of 37.07±0.22°C, whereas the lowest record of 29.00±0.59°C was at Hilly zone under metal sheet roofing. In open housing system, heat load on the animals are high as they are exposed directly under sunlight and solar radiation. It may be the possible cause for highest skin temperature in open housing system. The lowest skin temperature was recorded in Hilly zone under metal sheet roofing since the lowest rectal temperature during South West monsoon was recorded under the metal sheet roofing in Hilly zone (38.05±0.12°C). It is in accordance with Sivakumar *et al*. (2016) who reported that the environmental condition in hilly zone is conducive for commercial dairy farming in all the seasons.

In North Eastern zone the thatched housing was found to be more comfortable with respect to the physiological parameters. The lowest mean ± SE values of rectal temperature (38.15±0.09°C), pulse rate (64.33±7.68 beats per minute) and respiration rate (28.67±0.92 breaths per minute) were recorded under thatched roof. It is similar to the findings of Sivakumar *et al.* (2017) who stated that thatched housing is found to be the suitable one with respect to the climatic variables in North Eastern Zone of Tamil Nadu. Furthermore, Bhattacharyya and Bordoloi (2015) also opined that thatched roof was more suitable as the cows under thatched roof yielded apparently more milk than asbestos and corrugated galvanized Iron sheet.

In North Western zone the thatched housing was found to be more comfortable with respect to the physiological parameters such as the pulse rate, respiratory rate and skin temperature. In Western zone the thatched housing was found to be more comfortable with respect to the physiological parameters considering the rectal temperature, pulse rate, respiratory rate and skin temperature. Sahu *et al.* (2019) concluded that thatched roof was found to be better for dairy cows in tropical climate than asbestos roof during summer because of significantly lowering high THI and increased milk production. Comfort behaviors of dairy cows were significantly better in thatched roof than asbestos roof.

In Hilly zone the metal roofing was found to be comfortable with respect to the physiological parameters since the lowest mean ± SE value of rectal temperature (38.05±0.12°C), pulse rate (67.50±1.18 beats per minute), and skin temperature (29.00±0.59°C) were recorded under metal roofed housing.

SUMMARY

Hilly zone is suitable for cross bred dairy farming among the zone studied with respect to physiological parameters. Among the roofing materials, thatched roofing was found to be more comfortable with respect to the physiological parameters during South West Monsoon. Most of the studies showed benefits of loose housing, but the benefits of intensively housed animals and roofing materials have not been widely researched. Further studies needs to be done to explore the benefits of various roofing materials during South West Monsoon.

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