PHYSIOLOGICAL RESPONSES OF RAHAJI AND WADARA BREEDS OF CATTLE TO HEAT STRESS IN GUJBA LGA., YOBE STATE, NIGERIA

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ABSTRACT

A study was conducted from October 2009 to July 2010 to determine the physiological responses of Rahaji and Wadara breeds of cattle to heat stress at Rahina and Tumsa Agro Allied farms, in Gujba area of Yobe State. A total number of one hundred and forty cattle population was used consisting of seventy Rahaji and seventy Wadara respectively. Clinical thermometer, stethoscope and pulse counting was used to take the Rectal temperature (RT), Heart rate (HR), Respiratory rate (RR) respectively with respect to breed, period of the day, month and type of animals. Data collected was subjected to analysis using General Linear Model. The result revealed that RT, HR and RR for Rahaji and Wadara breeds were 38.35°C, 69.19 beat/mm. and 26.39 breath/min. and 38.69°C, 70.30 beat/mm and 26.49 breath/min, respectively. In relation to period of the day, the RT, HR and RR for morning and evening periods were 37.79°C, 61.60 beat/mm. and 23.31 breath/mm and 38.93°C, 76.62 beat/mm and 29.58 breath/min, respectively. On monthly basis, RT, HR and RR ranged from 37.11°C in October to 38.60°C in April, while the HR ranged between 65.17 beat/mm in October and 73.26 breath/min in February, June whereas the RR varied from 25.57 to 30.74 breath/min in December and April respectively. On animal type basis, RT, HR and RR ranged between 38.28°C in young calf to38.41°C in first year calf, 68.15 to73.96 beat/mm and 24.90 to 26.94 breath/min. respectively. Breeds have no significant effect on vital parameters but there is significant effect of parameters on period, month and type of animals at (P< 0.01). From the results of this study, it can be concluded that both Rahaji and Wadara breeds may respond to heat stress much earlier than their counterparts. It is therefore, recommended that proper housing, feeding and genetically improved breeds may help to improve the animal's adaptability to increased environmental temperature.

Key words: Breed, heat stress, rectal temperature, heart rate, and respiratory rates.

INTRODUCTION

Cattle belongs to genus Bos in the family Bovidae and sub-family Bovinae. The cattle (colloquially cows) are the most common type of large domesticated ungulates. Cattle are raised as livestock for meat (beef and veal), as dairy animals for milk and other dairy products, and as draft animals (pulling carts, ploughs etc.). Other products include leather and dung manure or fuel. In some countries, such as India, cattle are sacred. It is estimated that there are 1.3 billion cattle in the world today. In 2009, cattle became the first livestock animal to have its genome mapped. (Brown *et al.,* 2009).

Exposure to heat stress is registered by the temperature-humidity index that includes both ambient temperatures and relative humidity (Maria *et al.,* 2001). During the year significant variation in rectal temperature was observed. These values were markedly lower during winter than during summer in rams (Abdel-Hafez, 2002). Livestock managers need information about how and why their animals respond to environmental challenges in order to make improved decision on strategies and tactics to reduce losses during hot weather (Hahnn, 1999). This study was therefore, undertaken to examine the effect of season, time of day, sex and breed on the heart rate, respiratory rate and rectal temperature at R 'N' T Farms, Gujba Local Government Area, Yobe State, Nigeria.

MATERIALS AND METHODS

The study was carried out at Rahina and Tumsa Agro-allied farms in Gujba Local Government Area. Its coordinates are 11°23'N and 11°58'E with its headquarters in the town of Buni Yadi at 11°16' 08" N and 11° 55' 59" E (Ibrahim, 2006). The production system of cattle in the study area is classified as Agro-pastoral system. In terms of watering, they usually go to watering ponds in the morning and evening, before and after grazing respectively.

Data Collection and Analysis

The rectal temperature, respiratory rate and heart rate were taken (3 days in a week) on younger calves, older calves, matured bulls, heifers, pregnant and suckling cows. The sum total of one hundred and forty consisting of seventy Rahaji (Red Bororo) and seventy Wadara (Shuwa Arabs) breeds of cattle were sampled. The temperatures were taken by inserting a digital clinical thermometer into the rectum of the animals. The respiratory rates were taken by counting the number of heart beats or respiration per minute using a mobile phone as stop watch or a wristwatch. The heart beat was observed with the aid of a stethoscope. This was done twice daily (morning and evening) three times in a week (Monday, Tuesday and Wednesday). The information was collected from October, 2009 to August, 2010. The data obtained from the study were analyzed using One-way ANOVA using the General Linear Model procedure of the Statistical Analysis System (SAS, 2003). Significant differences among the means were separated using Duncan's Multiple Range Test Procedure (Duncan. 1955). Factors considered were breed, period of sampling, month and animal type.

RESULTS AND DISCUSSIONS

Table 1 shows physiological parameters (Rectal Temperature, Heart Rate, and Respiratory Rate) in Cattle Across Breeds, Periods, Months, and Animal class. The average means rectal temperature of Rahaji and Wadara breeds were 38.3 5±.0 17 and 38.36 ±. 017°C respectively. The average rectal temperature for the period of morning and evening were 37.791 ±.0 17 and 38.930. 017°C respectively. The difference between the morning and evening rectal temperature were highly significant different ($P<0.001$). The mean average rectal temperature for the months of October to December 2009 37.81 ± 0.38, 38.45 ± 0.38, 38.45 ± 0.38 respectively and for January to August 2010 38.57 ± 0.38, 38.56 ± 0.38, 38.57 ± 0.38, 38.60 ± 0.38., 38.37 ± 0.38, 38.11 ± 0.38, 38.11 ± 0.38, 37.8 14 ± 0.38°C respectively there is and the differences between the values were highly significant different ($P<0.001$). The mean average rectal temperature for young (38.28 ± 0.32), calves (38.29 ± 0.32), older calves (38.38 ± 0.32), matured bulls (38.35 ± 0.32), heifer (38.41 ± 0.32), first calf year (38.40 ± 0.32), pregnant cows (38.411 ± 0.32°C) and suckling cows 38.28 ± 0.32°C respectively. The results obtained from Rahaji and Wadara breeds on rectal temperature agreed with the work of Omar et al. (1996) in which the study found shows that there no significant differences in rectal temperature (RT) across breeds, indicating that breed does not significantly influence body temperature. However, their study revealed significant fluctuations in RT based on the time of day, particularly between morning and evening measurements, underscoring the role of circadian rhythms in regulating body temperature. Similarly, in your study with Rahaji and Wadara breeds, no significant difference in RT between breeds was observed, reinforcing Omar et al.'s findings that breed differences are not a major factor in RT variation. Your study also found significant variations in RT based on the time of day, further supporting the notion that time of day is a critical factor influencing RT. This aligns with other research, which has shown that circadian rhythms, along with metabolic and hormonal processes, cause body temperature to vary throughout the day (Nelson & Hara, 2003). Thus, both studies suggest that temporal factors should be prioritized in RT studies, while further investigation into environmental influences and metabolic rates could offer deeper insights into RT variations across breeds (Wang et al., 2017).

Omar *et al.* (1996) in which rectal temperature showed no significant difference with regards to breeds. However, RT obtained in the morning and evening sampling showed highly significant difference which is in consonance with the Work of Omar *et al.,* (1996). This could be due to the fact that as the ambient temperature increases from morning to evening, the animals' internal temperature also increases. The results obtained also showed higher rectal temperature in the months of January 38.57°C, which is late dry season compared to the month of October 37.8°C which is late rainy season respectively. Furthermore, the RT on animal types showed 38.412°C, 38.403°C and 38.411°C for First calf year, pregnant cows and suckling cows respectively which were higher than those of mature bulls and heifers with RT of 38.286°C and 3 3 73C respectively. It was observed that the RT of younger calf before they were weaned and older calf or yearling is lower than their mature counterpart.

The mean heart rate for Rahaji and Wadara were 69.91 ± 28.7 and 70.30 ± 28.7 beat/min respectively there is no significant difference between the values. The mean heart rate for morning and evening period of the day were 61.60 ± 2.87 and 78.62 ± 28.7beat/min respectively. There are highly significant differences ($P<0.001$. The values show a higher significant difference ($P<0.001$). High heart rate was observed in the months of January to March that is 70.90 beat/mm, 73.26 beat/mm and 70.88 beat/mm; and October to December 69.53 beat/mm, 70.62 beat/mm and 71.56 beat/mm respectively which is late raining season and early dry season compared to April to July which recorded 68.69 beat/mm, 69.51 beat/mm, 65.17 beat/mm and 70.95 beat/mm respectively. Although there is variation in HE. Across the month and season which is not quite consistent, however the HR is lowest in June which is in the raining season that may ameliorate environmental temperature thereby lowering the HR. The highest HR was recorded in February but the reason for these is farfetched. The HR on animal types showed 73.96 beat/mm and 71.23 beat/mm for younger calf and first year calf which is higher than that of older calf, mature bull, heifer, pregnant cow and suckling cow which is recorded 69.37

beat/min, 69.87 beat/mm, 69.33 beat/mm and 68.86 beat/mm respectively. Metabolic rate is higher in younger animal which will increase heart rate and respiratory rate, pregnancy and lactation are physiological phenomena that are supposed to increase heart rate and respiratory rate. Covering long distance in search of quality pasture may also be responsible for the increase in heart rate. The HR on animal types showed 73.26 beat/min and 71.23 beat/mm for younger calves and first yearling curve which higher than that of older calves, mature bulls, heifers, pregnant cows and suckling cows which recoded 69.37 beat/mm, 69.87 beat/mm, 69.33 beat/mm and 68.86 beat/mm respectively. Furthermore, pregnancy and lactation status are physiological phenomena that will also increase heart rate and respiratory rate.

Table 1: Physiological Parameters (Rectal Temperature, Heart Rate, and Respiratory Rate) in Cattle Across Breeds, Periods, Months, and Animal class

		Number of Animals	Rectal Temperature	Heart Rate	Respiratory Rate
			NS	NS	NS
Breed	Rahaji	70	38.353±.02	69.91±.29	26.39±.15
	Wadara	70	38.369±.02	70.30±.29	26.49±.15
			***	***	***
Period	Morning	70	37.791	61.60	23.31
	Evening	70	39.930	78.62	29.58
			***	***	***
Month	January	140	38569^{ab}	7090^{abc}	2513^{def}
	February	140	38.556^{ab}	73.26^{a}	2607^{cd}
	March	140	38566^{ab}	7088^{abc}	2659^{bcd}
	April	140	38.604^{a}	68.69^{c}	30.74^{a}
	May	140	38.374^{c}	6951^{bc}	2674^{bc}
	June	140	38.111^{d}	6517d	26.04^{cde}
	July	140	38113^{d}	7095abc	27.73^{b}
	October	140	37.814^{e}	6953^{cb}	2604^{cd}
	November	140	38.453abc	7062^{abc}	2479^{ef}
	December	140	38448bc	7156^{ab}	24.57^{f}
			***	***	***
Animal class	Younger Calf	200	38.281c	73.96^{a}	26.62^{a}
	Older Calf	200	38286bc	6937^{bc}	24.90^{b}
	Mature Bull	200	38384abc	6987^{bc}	26.75^{a}
	Heifer	200	38347abc	68.15^{c}	26.56^{a}
	First Calf Year	200	38.412a	7123^{b}	26.80^{a}
	Pregnant Cow	200	38403ab	6933^{bc}	26.54^{a}
	Suckling Cow	200	38.411a	68.86^{c}	26.94^{a}

a,b,c,d,e= means on same rows having different super script are significantly different (P<0.05), Significant= ***, NS=not significant

The respiratory rates for Rahaji and Wadara breeds were found to be 26.39 ± 14.7 breaths per minute and 26.49 ± 14.7 breaths per minute, respectively. The difference between these two breeds was statistically insignificant (P > 0.05), indicating that the respiratory rate is similar across these two breeds. This result suggests that breed-related factors may not significantly influence the respiratory rate in these particular cattle breeds, and other factors may play a more substantial role in determining this physiological parameter.
The respiratory rate was found to be significantly higher in the evening compared to the morning. Specifically, the mean respiratory rate for the morning was 23.31 breaths per minute, while it increased to 29.58 breaths per minute in the evening. The difference between these two times of day was highly significant (P < 0.001),

indicating that the time of day plays a crucial role in determining the respiratory rate. This pattern suggests that environmental or physiological factors change between the morning and evening, such as increased activity, temperature fluctuations, or changes in air quality, which could contribute to the higher respiratory rate in the evening.

The respiratory rates varied significantly across different months, as shown by the following data: for the period from October to December 2009, the respiratory rates ranged from 24.57 ± 32.8 to 26.04 ± 32.8 breaths per minute, while in the period from January to August 2010, the rates ranged from 25.13 ± 32.8 to 30.74 ± 32.8 breaths per minute. The differences between these values were highly significant ($P < 0.001$), suggesting a strong seasonal influence on respiratory rates. The higher respiratory rates observed in the months of January to August 2010 could be associated with environmental factors such as temperature, humidity, or even changes in the animals' physical activity levels due to the season. For example, higher temperatures or humidity levels in some months may cause the animals to experience more stress, leading to increased respiratory rates as a compensatory mechanism.

The study also examined the respiratory rates of animals from different age groups and physiological statuses, with the following mean rates: young calves (26.62 ± 27.5 breaths/min), older calves (24.90 ± 27.5 breaths/min), matured bulls (26.75 ± 27.5 breaths/min), heifers (26.56 ± 27.5 breaths/min), first-calf year (26.84 ± 27.5 breaths/min), pregnant cows (26.54 ± 27.5 breaths/min), and suckling cows (26.94 ± 27.5 breaths/min). The differences in respiratory rates across these groups were highly significant ($P < 0.001$), indicating that age and physiological status have a significant effect on respiratory rates. This finding highlights that various factor such as metabolic demands, activity levels, and hormonal influences related to age, lactation, and pregnancy can impact the respiratory rate. For instance, suckling cows might show a slightly higher respiratory rate due to the increased energy demands of lactation, while older calves might have lower rates because of reduced metabolic activity as compared to younger calves.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, it reveals, that both Rahaji and Wadara breeds may respond to heat stress much earlier than their counterparts. Low environmental Temperature tends to decrease heat stress, therefore, proper housing, feeding and genetic improved may help to improve the animals' adaptability to increased environmental temperature.

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