

BREED VARIATION IN THERMOREGULATORY PARAMETERS AND THEIR CORRELATED RESPONSES IN SOME SELECTED INDIGENOUS CATTLE

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ABSTRACTS

The study, breed variation in thermoregulatory parameters and their correlated responses in some selected indigenous cattle was conducted to evaluate breed differences in thermoregulatory parameters of four Nigerian indigenous breeds of cattle (Bunaji, Rahaji, Bokoloji and Adamawa Gudali). A total of eighty (80) cattle were used for the experiment (20 from each breed). Data were taken three times within the period of three months (August- October) and were subjected to ANOVA using SAS software. Parameters measured were rectal temperature, respiratory rate, pulse rate and Heat Tolerance Coefficient. There were significant ($p < 0.05$) effect of breed all the parameters measured except ($p > 0.05$) rectal temperature. Bokoloji recorded the highest in respiratory rate (21.80 beats/minutes) and Heat Tolerance Coefficient (1.91) while the highest recorded value for pulse rate (22.10) was in in Bunaji. The correlation coefficient between parameters shows that significant ($p < 0.05$; $r = 0.40- 0.49$) positive relationship exist between HTC and RR in all the breeds studied. Also, significant ($p < 0.05$; $r = - 0.29- 0.31$) negative relationship exist between PR and RT except for the positive relationship ($p < 0.05$; $r = 0.73$) in Rahaji breed. It was concluded that Bokoloji and Bunaji breeds of indigenous cattle are more reactive to heat stress than Rahaji and Adamawa Gudali. Also, correlated responses within breed for thermoregulatory parameters can be maximized for selecting animals for improved heat tolerance.

Key words: breed, thermoregulation, indigenous, cattle

INTRODUCTION

Tropical cattle are known for their ability to tolerate heat while maintaining standards of milk yield, reproduction, and disease resistance (Atrian and Aghdam, 2012). Thermo-tolerance in cattle is one of the desired adaptive ability of tropical cattle. Cow demonstrate certain physiological responses when under heat stress. It was reported that any change in the environmental conditions, as is the case during heat stress, threatens the normal metabolic balance and usually produces a positive feedback once the temperature is above the upper critical temperature (UCT) (Hayes *et al.*, 2009; Atrian and Aghdam, 2012). Some physiological traits are related to the ability of the animal to cope with heat stress (Garner *et al.*, 2016). For example, sweating rate, rectal temperature and respiration rate increase when animals are exposed to warm environment (Garner *et al.*, 2016; Rashamol *et al.*, 2018). Inclusion of these heat tolerance indicator traits in large-scale phenotype recording systems for selecting thermo-tolerant animals appears rather problematic in terms of logistics and costs (Nguyen *et al.*, 2016).

High producing cattle have been reported to suffer more from heat stress than low producing cattle (West, 2002; Nayak *et al.*, 2018). Heat-tolerant cows, ranked according to a genomic breeding value of heat tolerance based on milk yield, showed lower values of physiological indicators (core body temperature, rectal and intra-vaginal temperature) than heat-sensitive cows (Macciotta *et al.*, 2016). Heat stress causes changes in phenotypic and genotypic traits in livestock and is quantified by the measurement of physiological responses such as respiration rate (RR), rectal temperature (RT), skin temperature (ST), pulse rate (PR) and sweating rate (SR) (Rashamol *et al.*, 2018). Among the physiological parameters RR, RT and ST are identified as the biomarkers for quantifying the heat stress impact on livestock (Shaji *et al.*, 2016).

Some physiological parameters were reported to be associated with thermo-tolerance in Indian Thartarker cattle, Angus cattle, Holstein- Friesian cross bred and Deoni cattle raised in India and Sahiwal cows in India. But there are dearths of information on the thermos-tolerant ability of the Nigerian indigenous cattle. Therefore, this paper seeks to present the thermo-tolerance of four selected indigenous cattle using physiological biomarkers.

MATERIALS AND METHODS

Study location: The study will be conducted in some selected dairy herds in Adamawa State. Adamawa State is located at an altitude of 200 to 300 metres, between latitude 9°20' and 9°33'N and longitude 12°30' and 12°50' E. It is bordered by Borno State to the North West, Gombe to the West and Taraba to the South West and has an Eastern border with Cameroun Republic. It has average daily minimum and maximum temperatures of 23.2 and 35.2°C respectively. The average annual rainfall is 718.1 millimetres and relative humidity, 44.2 %. It occupies an area of 39,742.12 square kilometres. (National Bureau of Statistics, 2010; Ovimaps, 2018).

SOURCES OF EXPERIMENTAL ANIMALS AND MANAGEMENT

Eighty (80) clinically healthy dairy cows made up of twenty (20) each of Adamawa Gudali, Red Bororo, Sokoto Gudali and Bunaji of similar ages in selected Farms in Adamawa State were used for the experiment. The experiment spanned the period of three months (August- October). These The animals that will be used were in their first parity and early lactation stage (1-60) days.

THERMOREGULATORY DATA COLLECTION

Rectal temperature (RT): This was taken using a digital thermometer. The sensory tip was disinfected and inserted into the rectum at the display of L⁰C by a thermometer (which is an indication that the thermometer was set for temperature reading) and was removed by the sound of alarm signal. It was recorded in ⁰C.

Respiratory rate (RR): This was determined by counting the number of flank movements per minute. It was measured by placing the fingertips on the femoral arteries of the hind limb for 1 minute. It was recorded in beats/minute

Pulse rate: this was taken by using placing a stethoscope at the

Heat tolerance coefficient (HTC): HTC was calculated based on heat tolerance index developed by Benezra, (1954). The formula is based on both respiration rate and rectal temperature.

$$HTC: RR/23 + RT/38.33$$

Data Analyses

Statistical model

The statistical model for the experiment is as given below;

$$Y_{ij} = \mu + B_i + e_{ij}$$

Where; μ = general mean, B_i = i^{th} fixed effect of breed; e_{ij} = experimental error

STATISTICAL ANALYSIS

The data collected on thermoregulatory parameters was subjected to analysis of variance (ANOVA) using General Linear Model of (SAS) (2002) while significant difference was separated using Duncan Multiple Range test (Duncan, 1955). The degrees of relationship between all pairs of thermoregulatory parameters was computed for all the animals within each breed groups using CORR procedure of the SAS (2002) statistical package.

RESULTS AND DISCUSSION

Table 1 shows the breed variation in thermoregulatory parameters of four selected indigenous breeds of cattle. There were significant ($p < 0.05$) effect of breeds on the parameters measured except for rectal temperature ($p < 0.05$). Bokoloji recorded the highest in respiratory rate (21.80 beats/minutes) and Heat Tolerance Coefficient (1.91) while the highest recorded value for pulse rate (22.10 beats/minutes) was in Bunaji. Respiration rate which is the intake of oxygen and elimination of carbon dioxide under thermo-neutral condition that leads to evaporation and dissipation of moisture from the respiratory tract to maintain thermal balance (Rashamol *et al.*, 2018) has been considered as one of the critical biomarkers for determining heat stress in farm animals. Breed variation in RR was also reported by Sailo *et al.* (2017), the RR were reported to be 15.738 in Sahiwal and 15.779 in Karan Fries cattle during winter. In another study, Valente *et al* (2015) reported a higher RR in Angus cattle (104 breaths/ minute at 37°C) during a heat stressed condition. Heat tolerance coefficient measures the adaptability of an animal during heat stress. Hence lower HTC may indicate an improved thermo-tolerance which had been useful in genetic improvement in cattle (Kumar *et al.*, 2017). From this study therefore, Rahaji is the most adaptable breed in the studied area.

Table 1: Breed variation in thermoregulatory parameters of some selected indigenous breeds of cattle in Nigeria

Parameters	Bunaji	Rahaji	Bokoloji	Adamawa Gudali
RT (°C)	37.84	36.98	36.96	36.80
RR (beat/min.)	18.30 ^b	18.00 ^b	21.80 ^a	19.70 ^{ab}
P. R	22.10 ^a	16.90 ^b	16.10 ^b	16.80 ^b
HTC	1.78 ^{ab}	1.75 ^b	1.91 ^a	1.82 ^{ab}

Table 2: Correlation among thermoregulatory breeds of cattle

Breed	RT	RR	PR	HTC
Bunaji				
RT		0.23	-0.29*	0.40*
RR			-0.71**	0.98**
PR				-0.72**
HTC				
Rahaji				
RT		-0.61**	0.73**	-0.43*
RR			-0.43*	0.98**
PR				-0.29*
HTC				
Bokoloji				
RT		0.31*	-0.31*	0.49*
RR			-0.09	0.98**
PR				-0.15
HTC				
A. Gudali				
RT		0.23	-0.29*	0.40*
RR			-0.71**	0.98**
PR				-0.72**
HTC				

Table 2 shows the correlation among the various measured thermoregulatory parameters of the selected breeds. Significant ($p < 0.05$; $r = 0.40$ - 0.49) positive relationship exist between HTC and RR in all the breeds studied. Also, significant ($p < 0.05$; $r = -0.29$ - 0.31) negative relationship exist between PR and RT except for the positive relationship ($p < 0.05$; $r = 0.73$) in Rahaji breed. Parameters that are positively correlated suggest that a significant increase in one parameter will result in significant increase on the other correlated parameter (vice- versa). The high positive correlation observed among thermoregulatory parameters (RR and RT) suggest that these traits are influenced by the same gene (pleiotropy) (Fayeye, 2014; Abbaya *et al.*, 2018).

CONCLUSION

It was concluded that Bokoloji and Bunaji breeds of indigenous cattle are more reactive to heat stress than Rahaji and Adamawa Gudali. Also, correlated responses within breed for thermoregulatory parameters can be maximized for selecting animals for improved heat tolerance.

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