

Diurnal Fluctuations in Rectal Temperature of Local Chickens During the Hot Dry Season of the Sahel Zone

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ABSTRACT

Experiments were performed on 10 local Chickens with the aim of determining their diurnal temperature fluctuations during the hot dry season (April) in Maiduguri, Borno State. The rectal temperatures (RT) were recorded with a standard clinical thermometer every hour from 06.00 to 19.00 hours. The RT of the chickens rose gradually from its minimum value of $41.3 \pm 0.1^{\circ}\text{C}$ at 07.00 hours and attained its peak value of $42.0 \pm 0.0^{\circ}\text{C}$ at 14.00 hours. The overall mean RT obtained was $41.7 \pm 0.0^{\circ}\text{C}$. The diurnal fluctuation in the RT of the local chickens was $0.7 \pm 0.0^{\circ}\text{C}$. The correlation between time of the day and RT value was not significant ($r = 0.3435$, $p > 0.05$). The result indicated a slight rhythm in the rectal temperature of the local chicken. The low diurnal range of $0.7 \pm 0.0^{\circ}\text{C}$ suggests that the hot dry season that exists in this part of the country may not be thermally stressful to the local chickens.

Key words: Diurnal fluctuations, rectal temperature, local chickens, hot dry season, Sahel zone

INTRODUCTION

The local chicken population constitutes 80% of the total world chicken population (Gueye, 1998). In Africa, there are over 800 million chickens, and of these more than 80% are local chickens (Minga *et al.*, 1989).

The local chicken (also referred to as rural chicken) is genetically unimproved and being subjected to poor traditional husbandry, with resultant inferior productivity traits including small egg size and low egg production (Minga *et al.*, 1989). In rural areas where subsistence peasantry farming is the main occupation, the local chicken assumes great importance economically, nutritionally and socially (Minga *et al.*, 1989).

The local chicken in the developing world has never been subjected to purposeful selective breeding for any particular trait, instead they have been subjected to natural selection imposed by endemic diseases, climate, nutrition and other stresses. This has created diversity in plumage type and colour, productivity, body size and disease resistance (Guovambattista *et al.*, 2001). This immense biodiversity has ensured their survival in diverse ecological zones. It is well adapted to these conditions such that the size and productivity levels match with the environmental and feed resources available (Sonaiya and Olori, 1989).

The local domestic chicken is usually reared extensively being, left to roam about and fend for themselves. They are kept under various types of management including makeshift chicken houses, kitchens and even roosting on trees (Yongolo, 1996). Often times cages are constructed for them to rest at night. Aside from the shelter provided, the chickens spend most of their time under adverse meteorological conditions. They remained predominant in African villages despite the introduction of exotic and cross bred types into the continent. This is because the peasant farmers have not been able to afford the high in-put requirement of the exotic breeds (Safalaoh, 1997). The major advantages of this group according to Horst (1988) is their rich genetic resource base which form the basis for diversification to produce a breed adopted to the tropics (Atunbi and Sonaiya, 1994). Other attributes of the rural chickens is that they are sources of income of many small farmers and landless communities (Bembridge, 1988; Mokotjo, 1990; Creevey 1991).

The Sudan-Sahelian zone falls in the tropical continental North and characterized by dry months of between four and eight months of the year (from October to May) and a short rainy season (from late June to early October).

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The mean annual rainfall is between 550 mm to 1200 mm with the highest recorded in July through August. The relative humidity is constantly below 40% except in the deep rainy season when it some times goes up to an average of 60% (Iloeje, 1981). Diurnal and seasonal temperature fluctuations are very wide, and humidity is low for most of the year and there is a high intensity of solar radiation due to dry atmosphere and clear skies (Payne, 1990). The highest temperatures do not coincide with the period of the highest sun but occur just before the onset of the season. Days are hot, and during the hot season noon temperatures of over 38°C are quite frequent (Adeleke and Leong, 1986). The body temperature is one of the important physiological parameters that could be altered during this season. It represents the resultant heat gains and heat losses of the body, and it is the single best criterion of heat gains and heat less tolerance in animals (Bianca, 1961). The rectal temperature is an index of steady state since it reaches equilibrium more slowly than other sites (Mead and Bommarito, 1949).

The aim of this study is to measure rectal temperature of the local (rural) chickens in order to assess their thermoregulatory capacity and the adaptability of the breed to the hot, dry season of a Sahelian environment such as Maiduguri, Borno State, Nigeria.

MATERIALS AND METHODS

Site and climatic conditions

The experiment was performed at the teaching and research farm of the University of Maiduguri, Maiduguri (11°40'N, 13°04'E) located in the Sudano-Sahelian zone of Nigeria. Measurements were taken in the month of April 2007 during the hot dry season. Meteorological data for the locality are given in Table 1. The meteorological data during the study (Table 1) showed that the minimum ambient temperature ranged between 16°C and 23°C while the maximum ambient temperature was between 38°C and 45°C. The mean wet and dry-bulb temperatures were 23.8 ± 4.2°C and 37.7 ± 1.7°C, respectively. The relative humidity was 16.0 ± 2.1 percent.

Table 1. Meteorological data of Maiduguri during the study period

Day	Ambient temperature (°C)				
	Maximum	Minimum	Wet bulb	Dry bulb	Relative humidity (%)
1	38	16	18.5	34.4	17
2	44	23	20.8	40.2	12
3	45	23	24.2	38.6	19
Mean ± SEM	43.2 ± 2.1	20.7 ± 2.3	23.8 ± 4.2	37.7 ± 1.7	16.0 ± 2.1

Data collected from Meteorological Agency Maiduguri, Borno State, Nigeria

Experimental birds

Ten local chickens, including both males and females, aged between four and seven months, were used for the experiment. They were exposed to a period of preconditioning (one week) during which the rectal temperatures were measured to accustom them to the experimental procedures. They were allowed to roam around except on the experimental days when they were kept in cages made almost entirely of wire mesh to allow for equilibrium of temperature as the ambient. The birds were fed with mashed local grains and given clean water ad libitum.

Experimental procedure

Measurements of rectal temperature (RT) were taken every hour from 06.00 to 19.00 hours throughout the period of the experiment. Recordings were taken for three different days, once per week. Rectal temperature was recorded with a standard clinical thermometer which was inserted about 3cm into the rectum and kept there for two minutes.

Statistical analysis

Student's *t*-test and correlation analysis were used to analyse the data obtained from the experiment. Data were expressed as mean ± standard errors of mean (Mean ± SEM)

RESULT

The mean minimum rectal temperature (RT) of the local chicken was 41.0 ± 0.0°C while the mean maximum RT was 42.0 ± 0.0°C. The mean diurnal range of individual minimum and maximum RT was 1.0 ± 0.0°C (Table 2)

The recorded hourly rectal temperature (Table 3) was lowest between 07.00 hours with a mean of $41.3 \pm 0.1^{\circ}\text{C}$ and highest at 14.00 and 15.00 hours $42.0 \pm 0.0^{\circ}\text{C}$. With an increase in ambient temperature, there was a concurrent increase in RT. The correlation coefficient between the ambient temperature and minimum rectal temperature ($r = 0.5307$, $p = 0.1145$) was lower than that between the ambient temperature and maximum rectal temperature ($r = 0.000$, $p = 0.9999$), neither was statistically significant.

Table 2. Variation in rectal temperature of local chickens

S/N of birds	Sex	Rectal temperature ($^{\circ}\text{C}$)			Mean \pm SEM
		Minimum	Maximum	Range	
1	M	40.4	42.0	1.6	41.6 ± 0.1
2	F	41.2	42.0	0.8	41.7 ± 0.1
3	M	41.0	42.0	1.0	41.7 ± 0.1
4	F	41.0	42.0	1.0	41.7 ± 0.0
5	M	41.0	42.0	1.0	41.6 ± 0.1
6	M	41.2	40.2	0.8	41.7 ± 0.0
7	M	40.2	40.2	1.8	41.7 ± 0.1
8	F	40.8	40.2	1.2	41.7 ± 0.0
9	M	41.2	40.2	0.8	41.7 ± 0.0
10	M	41.2	40.2	0.8	41.7 ± 0.0
Mean \pm SEM		41.0 ± 0.0	42.0 ± 0.0	1.0 ± 0.0	41.7 ± 0.0

Note : each minimum and maximum record is a mean of three readings.

Table 3. Diurnal variation in rectal temperature of the local chickens

Time (hour)	Rectal temperature ($^{\circ}\text{C}$)			Mean \pm SEM
	Minimum	Maximum	Range	
06.00	41.8	41.9	1.1	41.7 ± 0.1
07.00	40.4	41.7	1.3	41.3 ± 0.1
08.00	40.8	41.7	0.9	41.4 ± 0.0
09.00	41.1	41.9	0.8	41.6 ± 0.0
10.00	41.3	42.0	0.7	41.7 ± 0.0
11.00	41.2	42.0	0.8	41.8 ± 0.0
12.00	41.2	42.0	0.8	41.9 ± 0.0
13.00	41.4	42.0	0.6	41.9 ± 0.0
14.00	41.5	42.0	0.5	42.0 ± 0.0
15.00	41.7	42.0	0.3	42.0 ± 0.0
16.00	41.0	42.0	1.0	41.8 ± 0.0
17.00	41.4	42.0	0.6	41.7 ± 0.0
18.00	41.3	41.7	0.4	41.5 ± 0.0
19.00	41.2	41.7	0.5	41.5 ± 0.0
Mean \pm SEM	41.2 ± 0.0	41.9 ± 0.0	0.7 ± 0.0	41.7 ± 0.0

Note: each minimum and maximum record is a mean of three readings

The overall mean RT obtained during the entire period of investigation was $41.7 \pm 0.0^{\circ}\text{C}$ (Tables 2 and 3). The extreme minimum and Maximum individual temperatures recorded were 40.2°C and 42.0°C respectively.

The RT minima and maxima together with the standard errors and ranges shown in Table 3 indicated the extent of variation at each hour of observation. Table 2 showed the extent of variation recorded throughout the day in each bird. Although the local chickens showed a similar diurnal pattern, there were differences between them. Minimum values were comparatively low in some and comparatively high in others.

DISCUSSION

The result of this study indicated a diurnal rhythm in the RT of the local chickens. The RT increased from 41.3 ± 0.0 °C at 07.00 hours and attained a peak value of 42.0 ± 0.0 °C at 14.00 and 15.00 hours. This finding accorded with the results of previous investigations into the rectal temperature of adult fowl in the tropics by Squibb (1959).

The diurnal range of RT could serve as a measurement of how stressful the meteorological condition is to animals including birds. If the diurnal range is less than 1 °C, the weather is established as not stressful; however, ranges above 1 °C are considered stressful (Ojo and Ligari, 2006). The diurnal range of less than 1 °C recorded in the present study indicated therefore, that the hot dry season prevalent during the study period was not thermally stressful to local chickens. The low relative humidity of $16.0 \pm 2.1\%$ obtained during the study period could additionally work to reduce thermal stressfulness as adduced by Ojo and Caleb (2006). Usually, the hot dry season is characterized by very low relative humidity in the Sahelian zone which makes the prevailing high ambient temperature tolerable and subsequently less stressful.

In general, the RT values obtained in this study were predominantly within the normal range of 40.2 - 43.0 °C for the species (Susan and Mays, 1998), and they followed a pattern associated with the diurnal fluctuations in activities and ambient air temperature characteristic of most animals.

In conclusion the RT of the local chickens during the hot dry season of the Sahelian region of Nigeria showed a slight diurnal variation of 0.7 °C suggesting that the weather was not thermally stressful to the local chicken.

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