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Short Communication

EFFECTS OF ASCORBIC ACID ON DIURNAL VARIATIONS IN RECTAL TEMPERATURE OF PIGLETS DURING THE HOT-DRY SEASON

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INTRODUCTION

Changes in thermal environment caused by fluctuations in ambient temperature and humidity induce a variety of physiological responses in animals. Such responses have been demonstrated to induce heat stress in animals, which may result in impairment of body functions and productivity (Razhov and Komlatsky, 1989). It has been demonstrated that during heat stress, free radicals are generated in the body in large quantity such that the tissue antioxidant defence systems are exhausted. The enormous free radicals in the body during heat stress initiate lipid peroxidation in cytomembranes, (Freeman and Crapo, 1982), resulting in cell damage and death. Ascorbic acid (AA) is a naturally occurring antioxidant demonstrated to reduce the negative effects of stress by protecting lipids in cell membranes from peroxidation (Meerson, 1986). Therefore, supplemental AA may attenuate the negative responses of pigs to heat stress during the hot-dry season. Body temperature, usually measured as the rectal temperature, is an important indicator of thermal balance in the body. It is of value in assessing the status of body thermoregulatory mechanisms in animals (Bianca, 1976). The aim of the present study was to determine the effect of AA on diurnal variations in piglets during the hot-dry season prevailing in the Guinea Savannah of Nigeria.

KEY WORDS: Ambient temperature, Humidity, Ascorbic acid, Antioxidant, Thermoregulatory.

MATERIALS AND METHODS

The study was performed at the Livestock Farm of the College of Agriculture and Animal Science, Ahmadu Bello University, Kaduna, located in the Guinea Savannah of Nigeria. Fourteen apparently healthy piglets, about 4 months old, of both sexes and weighed 12 - 19 kg served as subjects. The piglets were housed in half open pen and fed spent grain with groundnut cake. Twelve hours prior to the commencement of the experiment, seven of the piglets were deprived of water. On the experimental day, at 05:45 hours, they were administered AA in their drinking water at the dose of 180mg/kg. Following total drinking of the medicated water, the piglets which served as the experimental animals, were immediately given water *ad-libitum*. The remaining seven piglets, which served as control animals, were given normal water *ad-libitum* without AA supplementation throughout the experimental period. Measurements of RT were taken every hour from 06:00 to 19:00 hours by inserting a standard clinical thermometer into the rectum of each piglet for two minutes. Each piglet was restrained easily for measurements which were completed within five minutes. Recordings were taken during the hot-dry season in April 2006 (Table I) for three days, one day per week, in an open shed. The meteorological parameters are presented in table I. The data obtained were subjected to Student's t-test and correlation analysis. Values of $P < 0.05$ were considered significant.

TABLE 1: Meteorological parameters from the study period (Mean ± SEM)

Meteorological parameter	Day 1	Day 2	Day 3	Mean ± SEM
Minimum temperature, °C	22.3 ± 1.8	22.3 ± 0.2	22.3 ± 0.2	22.3 ± 0.6
Maximum temperature, °C	33.8 ± 0.6	35.7 ± 1.3	37.2 ± 1.0	35.6 ± 1.0
Wet-bulb temperature, °C	21.6 ± 1.3	21.0 ± 0.7	21.5 ± 0.6	21.4 ± 0.2
Dry-bulb temperature, °C	32.3 ± 1.3	34.0 ± 1.2	33.1 ± 1.0	33.1 ± 0.5
Wind Direction	North-west	North-west	South-west	

RESULTS AND DISCUSSION

The overall mean RT of 38.0 ± 0.1°C (Table II) obtained in experimental piglets was significantly ($P < 0.001$) lower than that of 39.3 ± 0.1°C (Table III) recorded from control piglets. Similarly, the maximum, minimum and range values of the experimental piglets (38.3 ± 0.03, 37.7 ± 0.03° C and 0.6 ± 0.1° C, respectively) were significantly lower than the corresponding values of 40.7 ± 0.1° C, 38.7 ±0.1°C and 1.3 ± 0.1° C respectively. The mean hourly RT of the experimental piglets was maintained at a relatively constant value of 38.0°C. There was a significant and negative correlation between the hours of the day and RT values in experimental piglets ($r = -0.761$, $P < 0.01$), while that between the hour of the day and mean RT values in the control piglets was positive and insignificant ($r = 0.448$, $P > 0.05$).

TABLE II: Hourly fluctuations in rectal temperature of Large White piglets administered with vitamin during the hot-dry season, °C (n=7)

Hour	*Mean SEM*	*Minimum*	*Maximum*	*Range*
06:00	38.0 ± 0.02	37.8	38.2	0.4
07:00	38.0 ± 0.03	37.8	38.3	0.5
08:00	38.1 ± 0.03	37.8	38.5	0.5
09:00	38.0 ± 0.03	37.9	38.1	0.2
10:00	38.0 ± 0.1	37.6	38.5	0.9
11:00	38.3 ± 0.04	37.8	38.4	0.6
12:00	38.0 ± 0.03	37.8	38.2	0.4
13:00	38.0 ± 0.1	37.6	38.4	0.8
14:00	38.0 ± 0.1	37.6	38.5	0.9
15:00	38.0 ± 0.04	37.6	38.4	0.8
16:00	38.0 ± 0.1	37.8	38.2	0.4
17:00	38.0 ± 0.03	37.8	38.3	0.5
18:00	38.0 ± 0.1	37.8	38.4	0.6
19:00	37.9 ± 0.04	37.6	38.4	0.8
Mean ± SEM	38.0 ± 0.1	37.7 ± 0.03	38.3 ± 0.03	0.6 ± 0.1

TABLE III: Hourly fluctuations in rectal temperature of control (Non supplemented with AA during hot - dry Season) (n=7)

Hour	Mean ±SEM	Minimum	Maximum	Range
06:00	39.0 ± 0.1	38.4	39.8	1.4
07:00	38.9 ± 0.1	38.2	39.9	1.7
08:00	39.1 ± 0.1	38.6	39.9	1.3
09:00	39.4 ± 0.1	38.8	39.8	1.0
10:00	39.3 ± 0.1	38.7	39.9	1.2
11:00	39.4 ± 0.1	38.9	40.0	1.1
12:00	39.4 ± 0.1	38.7	39.9	1.2
13:00	39.4 ± 0.1	38.9	40.0	1.1
14:00	39.4 ± 0.1	38.8	40.0	1.2
15:00	39.4 ± 0.1	38.7	40.2	1.5
16:00	39.4 ± 0.1	38.7	39.9	1.2
17:00	39.3 ± 0.1	38.7	39.9	1.4
18:00	39.2 ± 0.1	38.7	40.1	1.2
19:00	39.2 ± 0.1	38.6	40.03	1.5
Mean ± SEM	39.3 ± 0.1	38.7 ± 0.1	40.7 ± 0.1	1.3 ± 0.1

The correlation coefficients between hour of the day and maximum RT in experimental and control piglets were 0.186 ($P > 0.05$) and 0.635 ($P < 0.01$) respectively. There was a significant and negative relationship between the minimum and maximum RT in experimental pigs ($r = -0.673$, $P < 0.01$), while that in control piglets was positive and insignificant ($r = 0.261$, $P > 0.05$). The correlation between the minimum and the hourly range in RT values was negative for both the experimental and control piglets ($r = -0.941$, $P < 0.001$ and $r = -0.812$, $P < 0.001$, respectively), while that between the maximum RT and hourly range in RT was positive ($r = 0.842$, $P < 0.001$) for both experimental and control piglets ($r = 0.352$, $P > 0.05$). The correlation coefficients between the meteorological parameters and RT values were negative and highly significant for the experimental, but positive in the control piglets. An exception was the relationship between the wet bulb temperature (WBT) and RT, which was positive and insignificant in experimental piglets, but negative and significant in control piglets. The results showed that the ambient temperature values ranging between 22.3 and 37.2° C recorded during the hot-dry season was predominantly outside the zone of thermal comfort of 14 - 25° C for the pig (Bazhov and komlatsky, 1989). The control and the experimental piglets maintained their RT values within the established normal range of 38 - 40.0°C for the pig (Zaytsev *et al.*, 1971).

It was evident that Large White breed of pigs has established relatively stable thermoregulatory mechanisms capable of combating the high ambient temperature and humidity of the hot-dry season. The results showed that the Large White pigs have adapted to the hot-dry season in the Guinea Savannah of Nigeria. The fact that maximum RT of 40.7 °C was close to the upper limit of the normal RT range for the pigs, suggest that a further increase in the ambient temperature may result in hyperthermia and impair the thermoregulatory mechanisms of the pigs.

The findings demonstrated the hypothermic effect of AA in pigs subjected to high ambient temperature. Thus, supplementation with AA may be beneficial in maintaining low RT of piglets in the Guinea Savannah of Nigeria. The fact that there was positive and significant relationship between the RT and dry-bulb temperature was an indication that RT values in the control piglets during the hot-dry season were more related to the ambient temperature in control piglets than in the experimental piglets. The classical diurnal fluctuations in RT of control piglets was in agreement with the findings of Zaytsev *et al.* (1971) that RT varies with the hour of the day and the ambient temperature; that is, a positive correlation exists between the hour of the day and RT values. However, the RT values obtained in the present study indicated that the ambient temperature which was outside the zone of comfort of the pig, has a pronounced effect on the hourly

fluctuation in the RT values. Based on the findings of the present study, AA may be of value in reducing the adverse effects of heat stress on health and productivity of pigs during the hot-dry season.

CONCLUSION

In conclusion, ascorbic acid reduces body temperature in pigs exposed to high ambient temperature and humidity, and may ameliorate adverse effects of heat stress on health and productivity of pigs during the hot-dry season in the Guinea Savannah of Nigeria.

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