Physiological responses in pigs on antioxidant supplementation during summer and winter

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Received: 03-03-2017 Received: 06-05-2017 DOI:10.18805/ijar.B-3401

ABSTRACT

The objective of the study was to assess the variability in the physiological responses of growing pigs on melatonin and vitamin E supplementation during summer and winter seasons. 36 nos. of weaned crossbred (Hampshire X Assam local) female pigs were selected for the study. Eighteen (18) animals were subjected to treatment separately during summer and winter. The selected animals were divided into three groups, with six pigs in each group, consisting of the control group (Treatment 1), a second group comprising of animals fed with melatonin (Meloset) @3 mg/animal (Treatment 2) and a third group in which the animals were fed Vitamin E (Evion) @100 mg (Treatment 3), for both the seasons. The rectal temperature, respiration and pulse rate differed significantly (P<0.01) between seasons. There was also significant difference (P<0.01) in the mean pulse rate between treatment.

Key words: Antioxidants, Physiological, Pigs, Summer, Winter.

INTRODUCTION

Domestic animals in general and swine in particular are susceptible to heat stress because they possess little to no functional sweat glands (Curtis, 1983). In addition, pigs maintain more subcutaneous fat compared to other species and this prevents effective heat dissipation (Mount et al., 1979). Due to inadequate sweat glands, pigs depend on panting as their primary mechanism of heat dissipation (Patience et al., 2005), especially if they don’t have access to a wallowing area. The normal body temperature of the pig is 39.2°C (102.5°F) and at ambient temperatures above 22°C heat stress indicators such as increased respiration rates, and rectal temperatures are observed (Huynh et al., 2005). Nienaber and Hahn (2007) suggest that fast growing animals near market weight are at increased risk of severe heat stress because of increased metabolic heat due to genetic selection for enhanced lean tissue accretion rates. A 2.1% increase in lean tissue correlates with a metabolic heat production increase of 18.7% (Brown-Brandl et al., 2004). Pigs respond to warm temperatures by increasing respiration rate, maximizing their surface area by laying on the ground, as well as increasing water intake. According to Marple et al., (1974), severe physiological changes can be observed in pigs with a rectal temperature reaching 41.5°C (106.7°F). This temperature can be potentially fatal, especially in finishing hogs and lactating sows which have decreased ability to dissipate heat

MATERIALS AND METHODS

The experiment was approved by the Institutional Animal Ethics Committee constituted as per the article number 13 of the CPCSEA rules laid down by the Government of India and conducted following the code of ethics for animal experimentation.

Period of work: The experimental study was carried out during two different seasons: summer (June - August, 2014) and winter (December, 2013 - February, 2014).

Experimental design: The present experiment included 36 nos. of weaned, healthy and uniform sized crossbred (Hampshire X Assam local) female pigs. Eighteen (18) animals were subjected to treatment separately during summer and winter. The selected animals were divided into three groups with six pigs in each group consisting of the control group (Treatment 1), animals of one group was fed melatonin (Meloset) @3 mg/animal (Treatment 2) and the other group was fed Vitamin E (Evion) @100 mg (Treatment 3) for both the seasons.

Physiological parameters: Rectal temperature was recorded with a digital thermometer by keeping the thermometer in contact with the rectal mucosa for about 2 minutes and
expressed in degree celsius. Pulse rate was recorded by feeling the coccygeal artery and expressed in min⁻¹. Respiration rate were recorded by visual observation of the inward and outward abdominal movement and expressed in min⁻¹. The datas were recorded twice daily at weekly interval at 7 AM in the morning and at 4:00 PM in the evening and average was calculated as the final reading. Care was taken to induce minimum disturbance to the animals.

**Statistical analysis:** Data were analysed using SPSS-10 software (SPSS Corporation, USA). Different parameters are presented as mean ± SEM. Significance was assessed through ANOVA and level of significance was set at P<0.01.

**RESULTS AND DISCUSSION**

The mean rectal temperature, respiration rate and pulse rate in the three treatment groups during different seasons (summer and winter) are presented in Table 1.

**Rectal temperature:** The mean rectal temperature was lower during winter in the three treatment groups. Statistical analysis revealed significant difference (P<0.01) in the rectal temperature between seasons.

The present findings are in close accordance with the findings reported by Huynh et al. (2005) who reported that the rectal temperature was affected by increasing temperature. Until the temperature reached 26.1°C, the rectal temperature of pigs was constant at an average of 39.3°C. Above that inflection point, it increased 0.13°C/°C. Also the present findings are in close proximity with the findings reported by Quiniou and Noblet (1999) who reported that the rectal temperature in the multiparous lactating sows was found constant between 18 and 22°C (38.6°C) but it increased at higher temperature (39-39.4°C between 25 and 29°C). Rectal temperature increases when the physiological mechanism of an animal fails to negate the excessive heat load. It might be due to temperature associated with the season which could exceed the comfort zone of the animals, resulting in imbalance in the heat energy produced and dissipated.

**Respiration rate:** The mean respiration rate was lower during winter in the three treatment groups Statistical analysis revealed significant difference (P<0.01) in the mean respiration rate between seasons.

The present findings are in close proximity with the findings of Huynh et al. (2005) who reported that with increasing temperature respiration rate remained constant at an average of 32 breaths / min until the inflection point (on average 22°C) which increased by an average of 13 breaths /min/°C in pigs. Similar findings have been reported by Quiniou and Noblet (1999) who found that respiration rate in multiparous lactating sows increased from 26 to 124 breaths/min between 18 and 29°C and this indicates that the evaporative critical temperature was below 22°C. The increase or decrease in respiration rates is an adaptive mechanism of an animal to maintain homoeothermic. In domestic animals respiration rate increases due to the activation of thermoreceptors in the skin when they are exposed to higher ambient temperature (Hafez, 1968). Such activation of the receptors in turn sends neural signals to the hypothalamus that increases respiratory activity to accelerate heat loss from the body by respiratory evaporation (Al-Haidary, 2004). An evaporative heat loss from the respiratory tract is regarded as one of the primary mechanism for maintenance of heat balance to maintain the internal body temperatures (Marai et al., 2007)

**Pulse rate:** The mean pulse rate was comparatively lower during winter in the three treatment groups. Statistical analysis revealed significant difference (P<0.01) in the mean pulse rate between treatment and between seasons.

<p>| Table 1: Rectal temperature (°C, mean± se),respiration rate (breaths/min, mean± se) and pulse rate (beats/min, mean± se) in the different treatment groups during summer and winter season |</p>
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rectal Temperature</th>
<th>Winter (Mean±SE)</th>
<th>Aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGGREGATE</td>
<td>39.128±0.0127°</td>
<td>38.978±0.0043b</td>
<td>38.963±0.012b</td>
</tr>
<tr>
<td>1</td>
<td>39.163±0.0255°</td>
<td>38.776±0.0092b</td>
<td>38.970±0.0158b</td>
</tr>
<tr>
<td>2</td>
<td>39.103±0.0198°</td>
<td>38.807±0.0063b</td>
<td>38.955±0.0121b</td>
</tr>
<tr>
<td>3</td>
<td>39.118±0.0204°</td>
<td>38.813±0.0064b</td>
<td>38.965±0.0124b</td>
</tr>
<tr>
<td>AGGREGATE</td>
<td>39.128±0.0127°</td>
<td>38.978±0.0043b</td>
<td>38.963±0.0078</td>
</tr>
<tr>
<td>1</td>
<td>61.99±0.380°</td>
<td>43.52±0.234a</td>
<td>52.76±0.445a</td>
</tr>
<tr>
<td>2</td>
<td>62.47±0.375°</td>
<td>43.31±0.221a</td>
<td>52.89±0.455a</td>
</tr>
<tr>
<td>3</td>
<td>61.82±0.359°</td>
<td>43.24±0.208a</td>
<td>52.53±0.439a</td>
</tr>
<tr>
<td>AGGREGATE</td>
<td>62.09±0.214°</td>
<td>43.36±0.128a</td>
<td>52.73±0.258</td>
</tr>
<tr>
<td>1</td>
<td>75.09±0.129°</td>
<td>71.98±0.084a</td>
<td>73.53±0.101a</td>
</tr>
<tr>
<td>2</td>
<td>75.27±0.123°</td>
<td>72.65±0.103a</td>
<td>73.96±0.097a</td>
</tr>
<tr>
<td>3</td>
<td>75.77±0.122°</td>
<td>72.50±0.115a</td>
<td>74.13±0.108a</td>
</tr>
<tr>
<td>AGGREGATE</td>
<td>75.37±0.073°</td>
<td>72.38±0.059b</td>
<td>73.88±0.059</td>
</tr>
</tbody>
</table>

Values having same superscript do not differ significantly
The present findings are in close proximity with the findings reported in The Normal Animal 4-H Veterinary Science Project Book (2010) where the pulse rate in pigs were in the range of 60 to 80 per minute. Similar pulse rate was reported by Peter et al. (2014). They reported a pulse rate of 60-90 beats/min adult pigs but also suggested that the rates increase rapidly if the animals are stressed. The concomitant increase in the pulse rate along with the RR and the RT could be considered as an intrinsic physiologic mechanism. It reflects the homeostasis of circulation along with the general metabolic status.

CONCLUSION

The experiment conducted reveals the effect of seasonal stress on the physiological performance of the animal as well as the antioxidant action. It also shows the performance of the strong homeostatic processes that protects the animals against stress.

ACKNOWLEDGEMENTS

The authors are thankful to College of Veterinary Science, Assam Agricultural University and NRC on Pig, Rani, Guwahati for providing the facilities.

REFERENCES


The Normal Animal 4-H Veterinary Science Project Book, Unit I, Lesson III: Body Temperature, Pulse and Respiration Rate pages 16 to 20 (2010)