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Circadian rhythm of hyla F_1 progeny and grower non- descript rabbits as affected by physiological parameters under the tropical conditions of Nigeria

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ABSTRACT

Circadian rhythm of physiological variables such as rectal temperature (RT), respiratory rate (RR) and heart rate (HR) were evaluated in the guinea savannah zone of Nigeria on three genetic groups (Hyla purebred, Hyla crossbred and grower non descript rabbits) at 64 days of age. Temperature humidity index (THI) was determined from the readings of AT and RH. Physiological and environmental readings were taken at 08:00 h to 10:00h in the mornings and 16:00 h to 18:00 h in the evenings from February through November, 2011. THI in the mornings was averaged 24.2 ^{o} C while evenings THI was averaged 27.8 ^{o} C. The THI values estimated averaged 27.3 ^{o} C during the cool period and 28.7 ^{o} C during the hot period. Overall, the results obtained indicated that THI in the evening was higher ($P < 0.05$) by 14% than THI in the morning. Also, THI in the hot was higher ($P < 0.05$) than THI in the cool season by 5%. There were significant ($P<0.05$) differences in the cycle of the day for all the thermoregulatory parameters (RR, HR, RT and ET) across the studied breed. The grower non descript rabbits showed the least values for both hour of the day for all the thermoregulatory parameters. In conclusion, grower non-descript rabbits had developed a better mechanism to adapt faster compared to the temperate Hyla rabbit during both cycles of the day.

1. Introduction

Fundamental to nearly all of man's and animal's cyclical activities, such as work, rest, or meal taking, is the daily alternation of light and darkness. The same alternation is also critical in the operation of many physiological variables such as body temperature. These repeating cycles, whose length is generally about 24 hours, are known as circadian rhythms (Encarta Encyclopedia, 2011). Rabbit, as a homoeothermic animal can regulate body heat production through several means such as physiological, morphological, biochemical and behavioural means to maintain a constant body temperature (Marai and Habeeb, 1994). The rabbits thermo-neutral zone temperature is around 18 – 21 ^{o}C (Habeeb *et al.,* 1997). Increase in ambient temperature directly impaired overall growth and reproductive performance of rabbits (Okab *et al.,* 2008). Finzi *et al*., (1994) reported that rabbit physiological parameters such as body temperature and respiratory rate are relatively high early in the morning then decreases progressively to increase again until late afternoon. Usually there is dearth of information on the effect of circadian rhythm on physiological variables on rabbits in Nigeria. This research is therefore designed to examine the circadian activities of Hyla F_1 progeny and grower non descript rabbits as affected by physiological parameters under the tropical conditions of Nigeria.

2. Materials and methods

Forty Hyla rabbits which was subdivided into two genetic groups of twenty each of Hyla purebred and crossbred and eight non-descript rabbits at 64 days old, were set in cages. The trial was conducted in the rabbitry of National Animal Production Research Institute (NAPRI), Shika, Kaduna State. Parameters measured were Respiratory Rate (RR), Heart Rate (HR), Rectal Temperature (RT) and Ear Temperature (ET). Measurements were taken at 08.00 to 10.00h and 14.00h to 16.00h of the day Bi-monthly measurements for hot and cool periods of the season was taken. Rectal and Ear Temperature were measured with a digital thermometer. The ear temperature was measured by placing the digital thermometer in direct contact with the central area of the auricle. RR was measured by visually counting the flank movement for one minute. HR was measured using a stethoscope. Environmental readings such as Ambient Temperature (AT) and Relative Humidity (RH) of the rabbitry micro-climate were taken daily from February through November, 2011. Readings were estimated with the following procedures. The temperature-humidity index (THI), an indicator of thermal comfort level for animals in an enclosure was calculated according to LPHSI, (1990) which was modified for rabbit by Marai *et al*., (2001) and given as:

THI = t - [(0.31 – 0.31 x RH) (t – 14.4)]

Where RH = relative humidity /100. t = temperature. The values of THI obtained for the temperate and tropical region are classified as: <27.8^{o}C = absence of heat stress, 27.8 - 28.9^{o}C = moderate heat stress, 28.9 – 30 ^{o}C = severe heat stress and above 30 ^{o}C = very severe heat stress (7).

3. Statistical analysis

$Y_{ij} = u + B_i + H_j + S_k + e_{ij}$

Y_{ij} = Observation of I th animal group

u = population mean

B_i = fixed effect of I th breed (I = Hyla purebred, Hyla crossbred and grower non descript)

H_j = fixed effect of j th period (J = morning: evening period)

S_k = fixed effect of season (K = hot and cool)

e_{ij} = random error (0, δ^2_e).

Data were analyzed using GLM procedure of SAS due to unequal sample size. Significant ($P<0.05$) differences in means were separated using Duncan Multiple Range Test.

4. Results

The temperature humidity index for both cycle of the day was shown in Fig 1. THI in the mornings was averaged 24.2 ^{o}C while evenings THI was averaged 27.8 ^{o}C. The THI values estimated averaged 27.3 ^{o}C during the cool period and 28.7 ^{o}C during the hot period. Overall, the results obtained indicated that THI in the

evening was higher (P < 0.05) by 14% than THI in the morning. Also, THI in the hot was higher (P < 0.05) than THI in the cool season by 5%. The results of the thermoregulatory parameters are shown in Table 1. There were significant (P<0.05) differences in the cycle of the day (morning and evening) for all the thermoregulatory parameters (RR, HR, RT and ET) across the studied breed. The grower non-descript rabbits showed the least values for both hour of the day for all the thermoregulatory parameters.

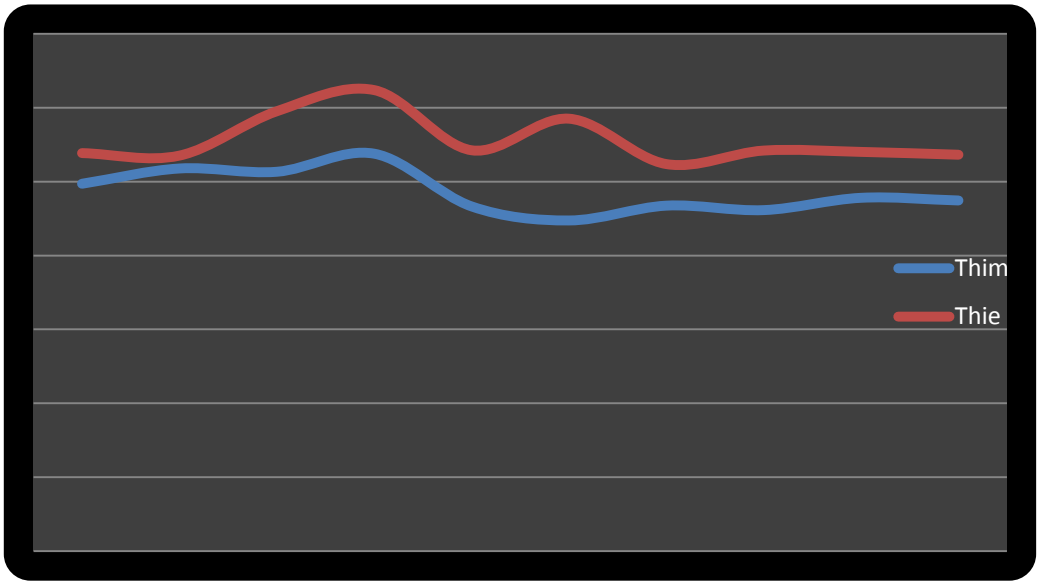

Figure 1: Monthly Temperature Humidity Index inside the Rabbitry during the Experimental Period. Thie-Temperature-humidity index evening, Thim- Temperature-humidity index morning, THI-Temperature Humidity Index.

Table 1
Thermoregulatory parameters as affected by circadian rhythm.

Genotypes	H	RR (r.p.m)	HR (b.p.m)	RT (^{o}C)	ET (^{o}C)
HNP	8.0	96.33± 1.58^{b}	104.63±1.32^{b}	38.87 ± 0.06^{b}	36.03 ± 0.11^{b}
	16.0	101.33±1.71^{a}	105.63±1.19^{a}	39.10 ± 0.04^{a}	36.51 ± 0.11^{a}
NCP	8.0	94.13±2.17^{b}	107.63±2.89^{b}	38.78 ± 0.09^{b}	35.33 ± 0.43^{b}
	16.0	99 ±2.18^{a}	111.03±1.59^{a}	39.18 ± 0.04^{a}	36.31 ± 0.18^{a}
GND	8.0	90.17±4.33^{b}	107.17±3.25^{b}	38.78 ± 0.09^{b}	35.33 ± 0.43^{b}
	16.0	97.42±5.04^{a}	107.58±3.39^{a}	39.00 ±0.10^{a}	36.00 ± 0.35^{a}

$^{a\,b\,c}$ Means within the same column having the same letter are not significantly(P>0.05) different.. GND – Grower non descript rabbits. RR-Respiratory rate; HR= Heart rate; RT-Rectal temperature; ET- Ear temperature, b.p.m-breadth per minutes; b.p.m- beat per minutes. HNP= Hyla purebred; NCP = Hyla crossbred.

4. Discussion

THI in the cool was averaged 24.2 ^{o}C and 28.7 ^{o}C during the hot period. This range exceeded some of the ranges reported in literature at similar periods (Marai, *et al.,* 2005). In the study conducted by Marai *et al*., (2005),, a THI value of 17.3 ^{o}C for mild period and 28.8 ^{o}C for hot period was reported in the subtropical climate of Egypt. Adenkola *et al*., (2009) reported low THI in the morning and late evening hour, while it was very high in afternoon alongside windy and dusty conditions. The observed differences could be due to environmental differences. THI in the cool period indicated absence of heat stress and exposure to moderate heat stress in the hot period. The increase in thermoregulatory parameters for both cool and hot periods in grandparent and F_1 progeny Hyla rabbits were in agreement with the result obtained by Farghly, (2011), who observed that heat stress was apparent in the rabbits during the hot period due to failure of thermoregulatory mechanism. Marai *et al*., (2005) reported breed differences in thermoregulatory parameters during the mild and hot periods for NZW and CAL rabbits. The RT and ET values obtained are within the established normal range of 38.6 – 39.5 ^{o}C and 24 - 30 ^{o}C for domestic rabbits (Willmer *et al.,* 2000). The RR observed for both grandparent and F_1 progeny Hyla rabbits were higher than the established normal range of 35 – 50 ^{o}C and the

HR was lower compared to the establish value of 130 – 260 beats/min for domestic rabbits (Willmer *et al.,* 2000). The observed differences could be due to stress-induced hyperthermia. The adverse effect of the very severe heat stress conditions on the Hyla rabbits physiological background studied were similar to the results reported by many workers and recently reviewed by Marai *et al.,* (2002). The significant increase in each of the thermoregulatory parameters was similar to the results of Habeeb *et al.,* (1997). Rabbits use general body position, breathing rate and peripheral temperature, especially ear, as three devices to modify heat loss. However, respiration and ear are the most important dissipation pathways. Marai and Habeeb (1994) indicated that between 0 - 30^{o}C, latent heat evacuation is only controlled by altering the breathing rate. Higher values were observed for HR, RR, RT and ET for F_1 progeny Hyla rabbits at 14.00h compared to 8.00h of the day. The diurnal variations agreed with the observation made by Piccione and Caola, (2002), who demonstrated that such a fluctuation was driven by biological clock in the hypothalamus.

5. Conclusion

Grower non-descript rabbits had developed a better mechanism to adapt faster compared to the temperate Hyla rabbit during both cycles of the day under the tropical conditions of Zaria in Kaduna State.

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References

Adenkola, A.Y., Ayo, J.O., Sackey, A.K.B., 2009. Ascorbic acid-induced modulation of rectal temperature in pigs during harmattan season. J. Therm. Biol., 34 (3),pp. 152-154.

Encarta Encyclopedia, 2011. Study tools, a Multimedia Encyclopedia, Dictionary and an Atlas. Microsoft Student with Encarta Premium, DVD.

Farghly, M.F.A., 2011. Using light flashes programme as a tool to avoid the hot weather effect on growth performance of New Zealand White rabbits. Egyptian Poul. Sci., 31 (11), pp. 437-451.

Finzi, A., Morera, P., Kuzminsky, G., 1994. Acclimatisation and repeatability of thermotolerance parameters in rabbits. *Proceedings of the 4th Congress of the World Rabbit Science Association*. Budapest, Hungary, pp. 419-424.

Habeeb, A.A.M., El-Masry, K. A., Aboulnaga, A. I., Kamal, T.H., 1997. The effect of hot summer climate and level of milk yield on blood biochemistry and circulating thyroid and progesterone hormones in Friesian cows. *Arab Journal of Nuclear Sciences and Applications* 29,pp. 161–173.

Livestock and Poultry Heat Stress Indices, 1990. Agricultural Engineering Guide. Clemson University Press, Clemson Science, 29634, USA.

Marai, I .F. M., Habeeb, A. A. M., 1994. Thermoregulation in rabbits. *Options Mediterraneennes*: 8, pp. 33–41.

Marai, I.F.M., Ayyat, M.S., Abd El-Monem, U.M., 2001. Growth performance and reproductive traits at first parity of New Zealand White female rabbits as affected by heat stress and its alleviation under Egyptian conditions. *Tropical Animal Health and Production*, 33, pp. 1-12.

Marai, I.F.M., Habeeb, A.A.M., Gad, A.E., 2002. Rabbits' productive, reproductive and physiological performance traits as affected by heat stress: a review. *Livestock Production Science,* 78, pp. 71-90.

Marai, I.F.M., Habeeb, A.A.M., Gad, A.E.,2005. Tolerance of imported rabbits grown as meats animals to hot climate and saline drinking water in the sub-tropical environment of Egypt. *Proceedings of the British Society of Animal Science.* 81, pp. 115-123.

Okab, A.B., El-Banna,S.G., Koriem, A. A.,2008.Influence of environmental temperature on some physiological and biochemical parameters of male New Zealand rabbits. *Slovak Journal of Animal Science 41*, 2008, pp 12-19.

Piccione, G., Caola, G.,2002. Biological rhythm in livestock. *Journal of Veterinary Science*, 3,pp.145-157.

Willmer, P., Stone,G., Johnston, J., 2000. Environmental physiology of animals. 1sted. Blackwell Scientific Publications, Oxford, pp. 672.