PAT June, 2024; 20(1): 118-126 ISSN: 0794-5213

Online copy available at https://www.patnsukjournal.org/

Publication of Nasarawa State University, Keffi

ORIGINAL ARTICLE

EFFECT OF BREED TYPE ON THERMO-PHYSIOLOGICAL PARAMETERS OF RABBITS

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Abstract

The study was conducted to determine the effect of breed type on thermo-physiological parameters of rabbits. The experiment was carried out using 36 weaned rabbits (6 weeks of age), 12 from each breed: New Zealand white, Chinchilla, and Dutch. The rabbits were housed in wooden hutches inside a well-ventilated pen. They were caged individually based on breed type and were provided with commercial feed while clean drinking water was provided *ad-libitum.* The Rabbits were allowed to acclimatize for 3 weeks before the commencement of measurements of thermo-physiological parameters. Data were collected on respiratory rate, heart rate, rectal temperature and ear temperature. Data collected were subjected to one way analysis of variance using statistical package for social sciences. Results obtained indicated breed had significant effects (P<0.05) on respiratory rate, rectal and ear temperature. New Zealand white had significantly higher (P<0.05) respiratory rate at week 3 (40.50±1.26) and week 6 (47.00±1.73) compared to Dutch (34.75±1.93 and 42.50±0.96, respectively for weeks 3 and 6) and Chinchilla (32.00±1.41 and 42.25±0.25 respectively for weeks 3 and 6). Similarly, New Zealand white had significantly (P<0.05) higher rectal temperature (39.38±0.21) compared to Chinchilla (38.53±0.13) and Dutch (38.85±0.09) at week 3. Also, New Zealand white and Dutch had significantly higher (P<0.05) ear temperature (39.35±0.13 and 39.08±0.25) compared to Chinchilla (38.10±0.21) at week 5. However, breed had no significant effect (P>0.05) on heart rate whose value ranged from 132.50±1.50 to 177.00±6.96. From these findings Chinchilla and Dutch breeds which showed more stable thermos-physiological parameters, may adapt and thrive well in high temperature climates.
Keywords: Chinchilla, Dutch, New Zealand white, rectal temperature, ear temperature, respiratory rate

Introduction

Heat stress is one of the most critical stressors especially in hot regions of the world. Factors such as species, physiological status, the relative humidity, velocity of ambient air temperature and the degree of solar radiation determines animals' zones of thermal comfort. The comfort zone temperature for rabbits is around 18 to 21°C (Marai, 2001). Means by which animal maintains its body temperature is widely referred to as thermoregulation. At either higher or lower temperature, rabbit has to expend energy to maintain its body temperature. The heat load in rabbit increases by exposure to a high environmental temperature, and animals try to sustain homeothermy by using internal physiological means to help re-establish thermal balance. Rabbits use general body position, breathing rate and peripheral temperature (especially ear temperature) as three means to increase heat loss. An animal must dissipate the excessive amount of metabolic heat produced into the surrounding environment to control body temperature. This heat regulation can be achieved through different ways of heat losses such as physical, i.e. conduction, convection and radiation and/or evaporation (Collier *et al.*, 2006). The rate of exchange depends on the ability of the environment to accept heat and vapor and also on the animal production status (Maya-Soriano, 2012). When rabbits are exposed to changes in their environment that prevent them from expressing full genetic potential, consequently, such stressor is often blamed for sub-optimal productive efficiency (Dobson *et al.*, 2001). Adaptation to heat stress requires the physiological integration of many organs and systems viz: endocrine, cardio-respiratory and immune system (Altan *et al.*, 2003). Due to few functional sweat glands in rabbits, thermoregulation in rabbits is rather poor (Naqvi *et al.*, 2017). A significant part of Nigeria is characterized as humid tropic and usually subjected to extended periods of high ambient temperature and humidity. The primary non-evaporative means of cooling conduction, convection and radiation becomes less efficient with rising ambient temperature, and under such conditions, rabbits becomes increasingly reliant upon evaporative cooling in the form of sweating and panting to alleviate heat stress (Kimothi and Ghosh, 2005; Naqvi *et al.*, 2017). The objective of this study was to examine the influence of breeds on thermo-physiological parameters of rabbits.

Materials and Method

The experiment was carried out at the Livestock Teaching and Research Farm of the Faculty of Agriculture, Shabu-Lafia Campus, Nasarawa State University Keffi. The State falls within the

Southern Guinea Savannah Zone of Nigeria. Lafia lies between latitude 7^0 and 9^0 North and Longitude 7^0 and 10^0 East. It has a climate typical of the tropical zone because of its location. It has a temperature ranging from 20˚C in October to 36˚C in March while rainfall varies from 13.73 cm in some places to 14 cm in others (Faculty of Agriculture Weather Station, 2023)

Experimental design and management of experimental animal

The design of the experiment was completely randomize design. A total of 36 weaned rabbits (6 weeks old), 12 from each breed (New Zealand white, Chinchilla, and Dutch) were replicated three times with 4 rabbits per treatment. The rabbits were purchased from National Veterinary Research Institute, Vom, Plateau State, Nigeria. Wooden hutches were used to house the rabbits inside a well ventilated pen. Before the arrival of the rabbits, the hutches were thoroughly washed, disinfected and allowed to dry for 3 days. On arrival, the rabbits were administered anti stress (vitalyte) through drinking water. The rabbits were caged individually based on breed in clearly marked hutches and were provided with commercial broiler finisher feed and clean drinking water *ad-libitum.* The rabbits were allowed to acclimatize in the rabbitry unit for 3 weeks before the commencement of measurements of thermos-physiological parameters which was taken every week for 6 weeks.

Data collection

Respiratory rate

This was measured by counting the rise and fall (inhalation and exhalation) of the rabbit chest and it was recorded in breath per minutes (bpm).

Heart rate

Stethoscope was placed over the rabbit chest near the heart and the heart beat (lub-dub pairs) was recorded in beats per minute (bpm) according to (Nascimento *et al.* (2020)).

Rectal temperature

Clinical thermometer was gently inserted into the rabbit rectum to a depth of about 1-2 inches. The displaced reading on thermometer was recorded in degree Celsius (ºC) based on Nascimento *et al.* (2020) procedure.

Ear temperature

Clinical thermometer was placed gently into the ear canal and the temperature displayed on the thermometer was recorded in degree Celsius (ºC) as reported by Jones (2017).

Data analysis

All data collected was subjected to analysis of variance using statistical package for social sciences at 5% level of significant. Mean was separated using Duncan Multiple range test.

Results

Effects of breeds on thermo-physiological parameters of rabbits

The effect of breed type on respiratory rate of rabbits is presented in Table 1. Breed had no significant (P>0.05) effect on respiratory rate except at weeks 3 and 6. At weeks 3 and 6, New Zealand white (40.50±1.26 and 47.00±1.73) had significantly higher (P<0.05) respiratory rate compared to Dutch (34.75±1.93 and 42.50±0.96) and Chinchilla (32.00±1.41 and 42.25±0.25) breed of Rabbit.

Table 2 present the effects of breed on heart rate of rabbits. Breed had no significant (P>0.05) effect on heart rate. However, the value varied from 167.25±2.63 (**T_3**) to 177.00±6.96 (**T_1**) in week 1, 139.50±0.96 (T_3) to 154.00±9.45 (T_2) in week 3 and 132.50±1.50 (T1) to 139.50±3.30 in week 6 of the study.

Table 1: Effect of breed type on respiratory rate of rabbits

Respiratory rate	**T_1**	**T_2**	**T_3**	**P-Value**

Week 1	42.00±6.48	37.25±2.29	37.00±1.22	0.629
Week 2	40.75±2.46	38.25±3.32	35.00±2.08	0.356
Week 3	40.50±1.26[a]	32.00±1.41[b]	34.75±1.93[b]	0.011
Week 4	44.50±1.90	43.50±4.72	45.50±1.71	0.904
Week 5	45.50±2.63	41.50±0.50	46.50±1.19	0.142
Week 6	47.00±1.73[a]	42.25±0.25[b]	42.50±0.96[b]	0.029

T_1= New Zealand white, T_2= Chinchilla, T_3= Dutch, [ab]= values within the same row with different superscripts are significantly different at 5 percent probability.

Table 2: Effect of breed type on Heart Rate of rabbits

Heart Rate	T1	T2	T3	P-Value
Week 1	177.00±6.96	174.25±3.61	167.25±2.63	0.372[NS]
Week 2	149.25±4.48	155.00±7.60	139.50±3.77	0.191[NS]
Week 3	145.00±4.20	154.00±9.45	139.50±0.96	0.276 [NS]
Week 4	147.50±3.77	142.50±4.79	146.75±4.53	0.696 [NS]
Week 5	138.00±1.15	146.00±3.16	146.00±3.56	0.123 [NS]
Week 6	132.50±1.50	139.00±1.12	139.50±3.30	0.095 [NS]

T1= New Zealand white, T2= Chinchilla, T3= Dutch, NS= Not Significant

Table 3 presents the effect of breed type on rectal temperature of rabbits. Breed type had no significant ($P>0.05$) effects on rectal temperature of rabbits except at week 3 where New Zealand white had significantly ($P<0.05$) higher rectal temperature (39.38±0.21) compared to Chinchilla (38.53±0.13) and Dutch (38.85±0.09) breeds.

The effect of breed type on ear temperature on rabbits presented in Table 4, indicated that breed had no significant ($P>0.05$) effect on ear temperature of rabbits except at week 5. New Zealand white (39.35±0.13) and Dutch (39.08±0.25) had significantly higher ($P<0.05$) ear temperature compared to Chinchilla (38.10±0.21).

Table 3: Effect of breed type on Rectal Temperature of rabbits

Rectal Temperature	T1	T2	T3	P-value
Week1	38.73±0.20	39.68±0.28	39.58±0.37	0.088[NS]
Week 2	39.20±0.22	39.80±0.22	39.63±0.28	0.252[NS]
Week 3	39.38±0.21[a]	38.53±0.13[b]	38.85±0.09[b]	0.009*
Week 4	38.55±0.13	37.93±0.03	38.43±0.56	0.406 [NS]
Week 5	39.08±0.33	38.75±0.06	38.58±0.08	0.254 [NS]
Week 6	38.73±0.09	38.53±0.05	39.15±0.34	0.143 [NS]

T1= New Zealand white, T2= Chinchilla, T3= Dutch, *= Significant, NS= Not Significant, ab= values within the same row with different superscripts are significantly different.

Table 4: Effect of breed type on Ear Temperature of rabbits

Ear Temperature	T1	T2	T3	P-value
Week 1	38.95±0.23	39.23±0.39	39.33±0.23	0.662[NS]
Week 2	38.85±0.26	39.50±0.38	39.10±0.33	0.404[NS]
Week 3	38.95±0.17	38.63±0.30	39.10±0.36	0.516 [NS]
Week 4	38.35±0.22	38.48±0.14	39.13±0.27	0.061 [NS]
Week 5	39.35±0.13[a]	38.10±0.21[b]	39.08±0.25[a]	0.005*
Week 6	38.33±0.31	38.25±0.34	38.68±0.48	0.719 [NS]

T1= New Zealand white, T2= Chinchilla, T3= Dutch, *= Significant, NS= Not Significant, ab= values within the same row with different superscripts are significantly different.

Discussion

The New Zealand White rabbits consistently displayed a higher respiratory rate compared to Chinchilla and Dutch breeds particularly at week 3 and 6. The values obtained for respiratory rate in this study, strongly agreed with the range of 30 to 60 breaths per minute reported by Harcourt-Brown (2002). Respiratory rate obtained in this study fall within the normal range. The slightly higher respiratory rate observed in New Zealand white rabbits could be an indication that the breed, have more active thermoregulatory response to manage body temperature, under heat stress especially when handling metabolic activities. This observation agreed with the report of

Nascimento *et al.* (2020) who noted that rabbit breeds with high metabolic activity tend to exhibit increased respiratory rates as a means of dissipating heat.

Heart rate measurements showed no statistically significant differences across the three breeds, suggesting that heart rate may be a stable parameter across breeds under similar environmental conditions. The value obtained in this study for heart rate falls within the range of 130 to 325 beats per minute reported by Harcourt-Brown (2002) as the normal range for heart rate in rabbits. This finding is similar to the report of Martínez-Paredes *et al.* (2019), who found heart rate to be relatively stable despite fluctuations in ambient temperature. McNeill *et al.* (2017) suggested that genetic factors might influence heart rate differently across breeds.

New Zealand White exhibit higher rectal temperatures compared to Chinchilla and Dutch rabbits in the present study. The values obtained for the rectal temperature for rabbits in this study strongly agreed with the value (38.5 to 40.0°C) reported by Smith (2018). Although all breeds maintained rectal temperatures within this range, New Zealand White demonstrated slightly elevated rectal temperatures. This could be possibly due to their larger body size and associated surface area-to-volume ratio as similarly noted by Szendrő *et al.* (2018).

The values for ear temperatures obtained in this study falls within the range of 38.5 to 39.5°C reported by Jones (2017). Chinchilla rabbits showed significantly lower ear temperatures compared to New Zealand White and Dutch breeds. This may indicate a more efficient peripheral cooling mechanism in Chinchilla rabbits compared to Dutch and New Zealand. Differences in peripheral blood flow could account for the observed ear temperature variations. García-Diego *et al.* (2018) emphasized that vascularization differences among breeds, may impact ear temperature regulation. This assertion seemingly aligned with present findings that Chinchilla rabbits may possess enhanced adaptability in high temperature environments.

Conclusion

The results obtain from this study showed that breed had significant effects on all the thermo-physiological parameters of rabbits except heart rate. The New Zealand White rabbits consistently displayed a higher respiratory rate compared to Chinchilla and Dutch breeds particularly in week 3 and 6. Similarly, New Zealand White exhibited higher rectal temperature compared to Chinchilla and Dutch rabbits. The heart rate measurements showed no statistically significant differences across the three breeds. However, Chinchilla rabbits showed significantly lower ear temperatures compared to New Zealand White and Dutch breeds. From these findings, it could be concluded that Chinchilla and Dutch, may be more heat-tolerant than New Zealand white, because they exhibited more stable thermos-physiological parameters, vis-a-vis better adaptability to high-temperature climates thus better productivity.

REFERENCES

Altan, Ö., Pabuçcuoğlu, A., Altan, A., Konyalioglu, S., and Bayraktar, H. (2003). Effects of heat stress on oxidative stress, lipid peroxidation and some stress parameters in broilers. *British Poultry Science*, 44(4), 545-550.

Collier, R. J., Dahl, G. E., and VanBaale, M. J. (2006). Major advances associated with environmental effects on dairy cattle. *Journal of Dairy Science*, 89(4), 1244-1253.

Dobson, H., Smith, R. F., Royal, M. D., Knight, C. H., and Sheldon, I. M. (2001). The high-producing dairy cow and its reproductive performance. *Reproduction in Domestic Animals*, 36(1), 7-17.

Faculty of Agriculture Weather Station (2023). Faculty of Agriculture Shabu-Lafia campus, Nasarawa State University Keffi.

García-Diego, F. J., Blas, E., and Pascual, J. J. (2018). Effect of breed and temperature on peripheral blood flow in rabbits. *Veterinary Science Journal*, 108(2), 432-439.

Harcourt-Brown, F. M. (2002). Textbook of Rabbit Medicine. Butterworth-Heinemann, p. 114.

Jones, B. (2017). Monitoring rabbit vital signs: Ear temperature measurement. *Journal of Veterinary Science*, 10(4), 215-217.

Kimothi, P., and Ghosh, T. K. (2005). Understanding animal responses to heat stress in tropical climates. *Journal of Animal Physiology and Nutrition*, 89(9-10), 320-329.

Marai, I. F. M., and Habeeb, A. A. M. (2001). Temperature-humidity effects on growth performance of farm animals. *Journal of Animal and Veterinary Advances*, 6, 72-81.

Martínez-Paredes, E., Ródenas, L., Pascual, J. J., and Blas, E. (2019). Physiological responses and productive performance of rabbits in fluctuating temperatures. *Animal Science Journal*, 90(2), 205-212.

Maya-Soriano, M. J. (2012). Heat stress and its effect on physiological functions in rabbits. *World Rabbit Science*, 20(3), 57-64.

McNeill, S. A., Magee, D., Lavery, U., and Logan, C. (2017). Genetic influences on physiological processes: Implications for rabbit breeding programs. *Journal of Animal Science*, 95(4), 1568-1579.

Naqvi, S. M. K., Tripathi, M. K., Joshi, A., Das, A. K., Singh, V. K., and Chaudhary, U. B. (2017). Impacts of heat stress on growth and adaptability in tropical rabbits. *Indian Journal of Animal Sciences*, 87(2), 125-133.

Nascimento, H. V. S., de Oliveira, S. R. M., and Ribeiro, J. S. (2020). Physiological and behavioral responses of rabbits to different thermal environments: A review. Revista Brasileira de Saúde e Produção Animal, 21.

Smith, J. (2020). Rabbit classification. Encyclopedia of Animal Biology, 15(3), 85-90.

Szendrő, Z., Matics, Z., Gerencsér, Z., Nagy, I., and Odermatt, M. (2018). Review of the factors influencing body temperature of rabbits. IOP Conference Series: *Earth and Environmental Science*, 108(1), 012017.