# ADAPTIVE POTENTIALS OF RABBIT (*ORYCTOLAGUS CUNICULUS*) GENOTYPES TO HEAT STRESS IN SEMI-ARID, NIGERIA

**I.O. Suleiman* and I.U. Zango**
Department of Animal Science, Bayero University Kano-Nigeria
**Corresponding Author E-mail: sionotu.asc@buk.edu.ng*

**ABSTRACT**
*Rabbit production under the tropical condition is affected by environmental stress mainly from the effect of high ambient temperatures and high humidity, low wind speed and solar radiation. This study was conducted to investigate the adaptive potentials of rabbit genotypes in the semi-arid environment. A total number of forty-eight rabbits from two genetic groups were used. Rectal temperature, respiratory rate, pulse rate and heat stress index were measured in Chinchilla and Dutch rabbit genotypes during late dry season (LDS) and early rainy season (ERS). GLM procedure in SAS was used to analyze data whereby age, breed, sex and season were factors and heat stress indices were the variables. The results showed that breed of rabbit had a significant effect ($p<0.01$) on respiratory and pulse rates with Chinchilla 97.78±1.05 breath/minute and 141.66±1.46 breath/minute respectively while Dutch 92.41±1.08 breath/minute and 134.66±12.68 breath/minute respectively. Breed had no effect ($p>0.01$) on rectal temperature and heat stress index. The respiratory rate was significantly higher among female rabbits compared to their male counterpart (96.59±1.65breath/minute vs 93.59±1.08 breath/minute). Age has also significant ($p<0.01$) effect on the rectal temperature, pulse rate and respiratory rate. Eight weeks old rabbits had higher means values. The heat stress index obtained during the early rainy season was higher ($p<0.01$) than that obtained during the late dry season (2.20±0.02 vs 1.99±0.01). At the end of the study, Chinchilla rabbits were found to be more prone to heat stress than Dutch rabbits.*
**Key words: Adaptive Potentials, Heat Stress, Genotypes**

## INTRODUCTION

European rabbit (*Oryctolagus cuniculus*) is the only representative of its genus living in present-day Europe and North Africa, and all domestic rabbits are descendants of this species which have over 300 breeds of that differ in size, coat color, length of ears and type of fur (Dorozynska and Maj, 2020). United States Department for Agriculture (USDA) has classified rabbits according to weight, size and type of pelt. Small rabbits weigh about 1.4-2kg at maturity, medium breeds 4-5.4kg, and large breeds 6.4-7.3kg (USDA, 1972). Dutch and and Chinchilla are among the most popular breeds kept in Nigeria. However, Performance and quality traits of rabbit are determined both environmentally and genetically (Ding *et al.,* 2019). Heat stress has severe impact on rabbit performance because they have difficulty getting rid of excess heat. The interaction between genetic and environmental factors plays a vital role in livestock adaptation process. The environment surrounding an animal at any particular instance influences the amount of heat exchange between the animal and the environment. Under tropical climatic conditions, high temperature and relative humidity are major environmental factors that result in heat stress which in turn influence productivity and physiological development. In such an environment, rabbits are susceptible to heat stress. Since they have few functional sweat glands and have difficulty in eliminating excess body heat (Marai *et al.,* 2002). Heat stress in rabbits evokes a series of drastic changes in their biological functions and leads to the impairment of both production and reproduction (Maraj *et al.,* 1991; Fernandez *et al.,* 1994; Maraj *et al.*, 1999). High temperature affects spermatogenesis, reducing the volume and concentration of ejaculates and also affects sperm motility (Lebas, 1986). Ondruska *et al.* (2011) reported that total and daily feed intake, feed conversion ratio and total daily gain in body weight for growing rabbits were affected negatively by elevated temperature. In a thermally stressful environment in which heat production of the animal exceeds the heat loss, an increasing amount of heat is stored in the animal. This results in increased body temperature. These indices; rectal temperature, respiratory rate and pulse rate are the major thermos-physiological traits indicating heat stress in animals (Butswat *et al.,* 2000). Therefore, this study was conceived to unravel the adaptive potentials of two genetic groups of rabbit to heat stress indices.

## MATERIALS AND METHODS

The study was conducted at the Rabbitry Unit of the Teaching and Research Farm, Department of Animal Science, Bayero University Kano. Kano-State lies between longitude 9°30' and 12°30' north and latitude 9°30' and 8°42' east of the Sudan savannah zone of Nigeria. Forty-eight rabbits were used for the study which include twenty-four standard Chinchilla and twenty-four Dutch at eight weeks of age, which comprise of twenty-four bucks and twelve-four does. Their average weights were 564.5g and 592.25g for Chinchilla and Dutch, respectively. The animals were sourced from Horticultural Research Institute, Bagauda of Kano-State. The animals were kept in wire hutches with each compartment of 44x49x31 $cm^3$. The hutches were constructed with wire mesh that allows waste to drop on the floor easily. They were fed formulated pelleted diet. Feed and clean water were provided *adlibitum*. The study lasted for eight weeks. The data collected were collected during late dry season and early rainy season, these include:

1. Rectal temperature: This was taken using digital thermometer. The sensory tip was disinfected and inserted carefully into the rectum to about an inch and slightly tilted to the side of rectal wall, at a display of L°C. It was removed after the sound of the alarm signal. The displayed body temperature was then recorded.
2. Respiratory rate: This was determined by counting the number of flank movement per minute.
3. Pulse rate: This was determined for each animal by placing the fingertips on the femoral arteries of the hindlimb for one minute.
4. Heat stress index (H): This was derived from the relationship between the pulse rate and the respiratory rate together with their normal average values.
   H = (AR/AP)*(NP/NR). Where H = heat stress index, AR = average respiratory rate, AP = Average pulse rate, NP = normal pulse rate and NR = normal respiratory rate (Oladimeji *et al.,* 1996).

**Statistical Analysis**

The data collected were analyzed using general linear model (GLM) in SAS version 9.1.2. Significant means were separated through Least Significant Difference (LSD) considering levels of significance at P<0.01.

## RESULT AND DISCUSSION

The result showed that the breed of rabbits had highly significant effect (p<0.01) on respiratory rate and pulse rate with Chinchilla 97.78±1.05 breath/minute and 141.66±1.46 breath/minute respectively while Dutch 92.41±1.08 breath/minute and 134.66±12.68 breath/minute respectively. However, Breed had no effect (p>0.01) on rectal temperature and heat stress index. On the other hand, age had a significant effect on rectal temperature, respiratory rate and pulse rate while heat stress index was not affected with age. Eight weeks old rabbits had higher means values while seven weeks old rabbits had the least values. Female rabbit was found significantly higher than male in terms of respiratory rate, pulse rate and rectal temperature. The heat stress index obtained during the early rainy season was significantly higher (p<0.01) than that obtained during the late dry season (2.20±0.02 vs 1.99±0.01). It could be noted that breed and age have effect on adaptability to heat stress. Exposure to high ambient temperature induces rabbits to balance heat load with the environment by using different means to dissipate their latent heat as much as possible. The animals pant in order to increase body cooling by respiratory evaporation since the major evaporator or heat loss mechanism is panting. According to Kendall and Webster (2009), it is commonly used as an indicator of thermal comfort. Rabbit production under tropical conditions is affected by environmental stress mainly from the effect of high ambient temperatures and high humidity, low wind speed and indirect solar radiation (Fadare *et al.,* 2021). The results of the study were in agreement with the same study on rabbits conducted in the humid region of the country by Fadare *et al.* (2021). Similarly, Gebremedhin *et al.* (2008) reported that rectal temperature is perhaps the most reliable indicator of thermal heat stress because it drives other heat stress alleviating mechanisms. On the other hand, with respect to season, Oladimeji *et al.* (1996) reported a significant difference in rectal temperature, respiratory rate and pulse rate during the hot dry season over the cold season (harmattan season). This was confirmed in the study as higher rectal temperature observed in the late dry season might be due to high ambient temperature and relative humidity associated with the season and could exceed the comfort zone of the animals, resulting in imbalance in the heat energy produced and dissipated. This are in consonance with the reports of Alhidary *et al.* (2012) and Lallo *et al.* (2011). On sex related thermal comfort, Butswat *et al.* (2000) reported that female had significantly higher values in thermal indices than their male counterpart which were also in congruent with this study. It could be concluded that the factors are very important in determining adaptability in rabbit genotypes where Chinchilla were more prone to heat stress that their Dutch counterpart.

**Table 1: Least square means for physiological parameters as influenced by breed and age**

| Factors | Respiratory Rate (Breaths/minute) | Pulse Rate (Beats/minute) | Rectal Temp. (°C) | Heat Stress index |
|---|---|---|---|---|
| **Breed** | | | | |
| Chinchilla | $97.78\pm1.05^a$ | $141.66\pm1.46^a$ | 37.03±0.02 | 2.09±0.01 |
| Dutch | $92.41\pm1.08^b$ | $134.66\pm1.68^b$ | 36.70±0.01 | 2.10±0.01 |
| **Age** | | | | |
| 7 weeks | $93.50\pm1.08^b$ | $132.38\pm1.47^b$ | $36.57\pm0.02^b$ | 2.17±0.02 |
| 8 weeks | $96.05\pm1.05^a$ | $141.63\pm1.68^a$ | $37.09\pm0.03^a$ | 2.07±0.01 |

Means in the same column with different superscript are significantly different (P<0.01)

**Table 2: Least square means for physiological parameters as influenced by sex and season**

| Factors | Respiratory Rate (Breaths/minute) | Pulse Rate (Beats/minute) | Rectal Temp. (°C) | Heat Stress index |
|---|---|---|---|---|
| Sex | | | | |
| Female | $96.59\pm1.65^a$ | $142.09\pm1.47^a$ | $37.14\pm0.02^a$ | 2.07±0.01 |
| Male | $93.59\pm1.08^b$ | $134.22\pm1.68^b$ | $36.70\pm0.01^b$ | 2.13±0.02 |
| Season | | | | |
| LDS | $91.92\pm0.88^b$ | 138.78±2.46 | 37.29±0.03 | $1.99\pm0.01^b$ |
| ERS | $98.22\pm0.65^a$ | 137.53±2.19 | 37.29±0.03 | $2.20\pm0.02^a$ |

Means in the same column with different superscript are significantly different (P<0.01). LDS=Late dry season, ERS=Early raining season.

## CONCLUSION

The study showed that these genetic groups of rabbit are adapted under the tropical condition. The heat stress index obtained during the early rainy season was higher (p<0.01) than that obtained during the late dry season (2.20±0.02 vs 1.99±0.01). At the end of the study, Chinchilla rabbits were found to be much more affected than Dutch.

## REFERENCES

**Alhidary, A.I., Shini, S., Al-Jassim, R.A.M. and Gaughan, J.B. (2012)**. Physiological Response of Australian Merino Weathers Exposed to High Heat Load. *Journal of Animal Science* 90(1) 212-220.

**Butswat, I.S., Mbap, S.T. and Ayibantoye, G.A. (2000).** Heat Tolerance of Sheep in Bauchi, Nigeria. *Tropical Agriculture (Trinad)* 77(4) 265-268.

**Ding H., Zhao H., Cheng G., Yang Y., Wang X., Zhao X., Qi Y. and Huang D. (2019)**. Analyses of Histological and Transcriptome Differences in the Skin of Short-Hair and Long-Hair Rabbits. *BMC Genomics*: 20, 140.

**Dorozynska, K and D. Maj, D. (2020).** A Review on Rabbits: Their Domestication and Molecular Genetics of Hair Coat Development and Quality. *Journal of Animal Genetics,* 52, 10-20.

**Fadare, A.O., Oni, T., Olatunji, L.A. and Mesogboriwon, O.A. (2021).** Genetic adaptive potentials of four breeds of rabbit to heat stress in the humid tropics. *Nigerian Journal of Animal Production,* 43(1) 93-99.

**Fernandez, C.I., Blas, E. and Concha, C. (1994).** Growth and some Carcass Traits of Adult Rabbits under high ambient Temperature. World Rabbit Science 2, 147-151.

**Gebremedhin, K.G., Hillman, P.E., Lee, C.N., Collier, R.J., Willard, A.J.D. and Brown-Brandl, T.M. (2008).** Sweating Rate of Dairy Cows and Beef Haifers in Hot Conditions. *Transactions of the American Society of Agricultural Engineers,* 51, 2167-2178.

**Kendall, P.E. and Webster, J.R. (2009).** Seasonal and Physiological status affects the circadian body temperature rhythm of dairy cows. *Livestock Science*, 125. 155-156.

**Lallo, C.H.O., Paul, I. and Bourne, G. (2011).** Thermoregulation and performance of British Anglo-Nubian and Saanen goats reared in an intensive system in Trinidad. *Tropical Animal and Health Production*, DOI 10.1007/s11250-011-9924-z

**Lebas, F., Coudert, P., Rouvier, R. and Rochambeau, H. (1986).** The Rabbit: Husbandry, Health and Produuction. FAO, United Nation, Rome. 234-236.

**Marai, I.F.M., Abd El-Samee, A.M. and El-Gafarry, M.N. (1991).** Criteria of response and adaptation to high temperature for reproduction and growth traits in Rabbits. *Option Mediterrancennes, Serree* A, 17, 127-134.

**Marai, I.F.M., Habeeb, A.A.M. and Farghaly, H.M. (1999)**. Productive, Physiological and Biochemical changes in imported and locally born Friesian and Holstein lactating cows under hot summer conditions of Egypt. *Tropical Animal Health and Production,* 31, 233-243.

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

**Oladimeji, B.S., Osinowo, O.A., Alawa, J. and Hambolu, J.O. (1996).** Estimation of average values for pulse rate, respiratory rate and rectal temperature and development of heat stress index for adult Yankasa Sheep. Bulletin of Health Production, 45, 105-107.

Ondruskal, L., Rafay, J., Okab, A.B., Ayoub, M.A., Al-Haidhary, A.A., Samara, E.M., Parkanyi, V., Chrastinoval, L., Jurcik, R., Massanyi, P., Lulac, N. and Supuka, P. (2011). Influence of elevated ambient temperature upon some physiological measurements of New Zealand Rabbits. Veterinarni medicana, 56, (4): 180-186.