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RESEARCH ARTICLE

Pearson's Correlation Coefficient Among Thermo-Physiological and Haematological Parameters of Nigerian Goats

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Abstract

This experiment was conducted to study the relationships among thermo-physiological and haematological parameters of Nigerian goats. A total of 36 weaner goats of two breeds (West African dwarf, n=18; 9 males + 9 females) and Red Sokoto goats, n=18; 9 males + 9 females) of about 3-4 months of age were sourced for the experiment which lasted for 8 weeks. The thermo-physiological parameters include rectal temperature, pulse rate, respiratory rate, heat stress index while the haematological parameters include packed cell volume, red blood cell, white blood cell, haemoglobin, platelets, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, neutrophils, lymphocytes, monocyets and eosinophils. The data collected were analysed using Statistix Analytical software, file version 8.0. The results showed varied degrees of correlations with the highest correlation coefficient (r=0.637) found between pulse rate and respiratory rate for thermo-physiological parameters and that of haematological parameters showed that the highest correlation coefficient (r =0.991) was obtained between packed cell volume (PCV) and haemoglobin (HB) followed by packed cell volume and red blood cell (r =0.887). Pearson's correlation coefficients among thermo-physiological and haematological parameters in Nigerian goats reveal complex interrelationships and understanding these correlations is crucial for assessing the health and physiological status of Nigerian goats.

Keywords: Pearson's correlation, thermo-physiological, haematological, Nigerian goats.

1. Introduction

Pearson's correlation coefficient is a statistical measure used to assess the strength and direction of the linear relationship between two variables. Specific studies focusing solely on thermo-physiological parameters in Nigerian goats are limited, related research indicates that physiological traits can also correlate with body weight and other morphometric characteristics. For instance, heart girth has been consistently highlighted as a significant predictor of body weight across different studies (Yakubu *et al.*, 2022). Research examining haematological parameters alongside morphological traits is less prevalent, but it is crucial for understanding the overall health and productivity of the goats. The findings from this study have practical implications for goat management in Nigeria in that understanding the relationship between thermo-physiological and haematological parameters can aid in monitoring the health status of goats, allowing for timely interventions when necessary. Goats are integral to the livelihoods of many Nigerian farmers, examining the relationships between thermal comfort, physiological responses, and blood parameters can provide insights into their health and productivity and this research not only contributes to the body of knowledge regarding goat management practices in Nigeria but also aids in the development of strategies to enhance their

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resilience against environmental challenges, ensuring sustainable livestock production in the region.

2. Materials and Methods

2.1 The Study Area

This experiment was carried out at the Livestock Teaching and Research Farm of the Animal Science Department, Faculty of Agriculture, Shabu-Lafia Campus, Nasarawa State University, Keffi. Lafia is located on latitude 08^0 35″ and longitude 08^0 33″ (Ovimap, 2023). It is geographically located in the Guinea Savanna Zone of North Central Nigeria. It has mean maximum monthly temperature of 35.06 ˚C and mean minimum monthly temperature of 20.16 ˚C with a mean monthly relative humidity of 74% and the annual rainfall is about 168.90 mm (NiMet, 2023).

2.2 Sources of Experimental Materials

The grass (*Digitaria smutsii*) was sourced from the National Animal Production Research Institute (NAPRI)/Ahmadu Bello University, Shika, Zaria, Nigeria while the two legumes (groundnut haulms and cowpea husk) were sourced from farms after harvest in Lafia, Nasarawa State.

2.3 Experimental Goats and Management

Physically sound goats were randomly sourced from reputable local farms in Lafia, Nasarawa State. A total of 36 weaner goats of two breeds (West African dwarf, n=18; 9 males + 9 females) and Red Sokoto goats, n=18; 9 males + 9 females) of about 3-4 months of age were sourced from farmers for the experiment. Upon arrival, the experimental goats were allowed to acclimatize for a period of 2 weeks during which they were dewormed against parasites and vaccinated against *Peste des petits ruminants* (PPR). Diets and water were given *ad-libitum* and other routine management practices were adopted throughout the experimental period according to (Timveh *et al*., 2022).

2.4 Thermo-Physiology Data Collected

The thermo-physiology data collected were rectal temperature (RT), pulse rate (PR) and respiratory rate (RR) while the heat stress index (HSI) was calculated. A digital thermometer was used to take each animal's rectal temperature. After disinfecting the sensory tip of the digital thermometer, it was placed into the rectum. This was taken out following the alarm signal and the displayed body temperature was recorded. Pulse rate was determined by counting the beats of the heart using a stethoscope per unit time, and expressed in number of beats per minute. This was achieved by positioning the stethoscope on the left side of the chest. The respiratory rate was done by counting the flanks' movements around the lower back area per minute using a stopwatch. The RT, PR, and RR were taken between the hours of 6:30 am and 9:30 am in the morning and 1:00 pm and 3:00 pm in the afternoon every day.

Heat stress index (HSI) was calculated as:

$$HSI = RR/PR \times NP/NR$$

Where; RR= actual respiratory rate; PR = actual pulse rate; NP = normal pulse rate; NR= normal respiratory rate. In both goat breeds, the basal reference value for NR was 30 breaths/minute while that of NP was 90 beats/minute (Yakubu *et al*. 2017b).

2.5 Blood Analysis

Three (3 mL) samples of blood were collected into a well-labeled sample bottles containing ethylenediaminetetraacetic acid (EDTA) for haematological analysis. The analysis was carried out at BAFAWAT Biomedical Diagnostic Laboratory Centre, Lafia, Nasarawa State, Nigeria.

2.6 Haematological Parameters

The following haematological parameters were examined: packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), haemoglobin (Hb), platelets (PLTS), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC), neutrophils (NEU), lymphocytes (LYM), Monocytes (MON) and eosonophils (EOS) were investigated by Automatic fully digital haematology Analyzer according to Indian Association of Laboratory Physicians (IALP) as reported by Tyagia (2022). Haemoglobin concentration was estimated using the haemoglobin kit adopting the procedure of Tyagia (2022).

2.7 Statistical Analysis

Data collected on the thermo-physiological and haematological parameters were subjected to Statistix Analytical software, file version 8.0 to analyse for the relationship among the parameters.

3. Results and Discussion

Pearson's correlation coefficient among thermo-physiological parameters of Nigerian goats is presented in Table 1. The correlation ranges from low to high correlation (r= 0.031-0. 637) and are positive except between pulse rate and heat stress index (r= -0.295). The highest correlation coefficient

(r=0.637) was found between pulse rate and respiratory rate followed by respiratory rate and heat stress index (r=0.537). The relationships among the thermo-physiological parameters were similar to the findings of Yakubu *et al*. (2022) who reported varied relationships between body weight, morphometric and thermo-physiological traits of indigenous pigs under tropical conditions. The corresponding high increase (P<0.01) between pulse rate and respiratory rate in the present study could be because a high pulse rate often indicates increased metabolic activity. Therefore, when the heart beats faster, it pumps more blood, which raises the oxygen demand in tissues and to meet this demand, the respiratory rate increases to facilitate greater oxygen intake and carbon dioxide expulsion (Bello *et al*., 2016). The negative relationship between pulse rate and heat stress index is because, generally, goats utilize various mechanisms to regulate their body temperature during heat stress. As heat stress increases, goats often exhibit increased respiratory rates to enhance evaporative cooling through panting and this process can lead to a compensatory decrease in pulse rate as the body prioritizes blood flow for cooling rather than maintaining a high heart rate (Adedeji, 2012). Another possible reason could be that under heat stress, metabolic rates can decrease as the body attempts to conserve energy. This reduction in metabolic activity may result in a lower pulse rate, even as the heat stress index rises. The body's focus shifts toward dissipating heat rather than sustaining high levels of activity, leading to a decrease in heart rate (Bello *et al*., 2016).

Table 1. *Pearson's correlation coefficient among thermo-physiological parameters of Nigerian goats*

	RT	PR	RR	HSI
RT	×	0.291^{**}	0.273^{**}	0.031^{NS}
PR		×	0.637^{**}	-0.295^{NS}
RR			×	0.537^{**}
HSI				×

**= Significant at 0.01, *= Significant at 0.05, NS= Not significant, RT= Rectal temperature (°C), PR= Pulse rate (beats/minute), RR= Respiratory rate (breaths/minute), HSI= Heat stress index

Table 2 represents the Pearson's correlation coefficient among haematological parameters of Nigerian goats. The results showed various degrees of relationships with both positive and negative, low to high correlation, coefficients, having significant (P<0.05; 0.01) and some with no significant difference. The highest correlation coefficient (r =0.991) was obtained between packed cell volume (PCV) and haemoglobin (HB) and the next was between packed cell volume and red blood cell (r =0.887). The observed relationships are similar with the findings of Shittu *et al*. (2016) on the haematological and serum bio-chemical parameters of West African Dwarf and Kalahari Red goats in the humid tropics. As observed in the present study, packed cell volume had highly positive (P<0.01) correlations with red blood cells and haemoglobin because a rise in PCV typically indicates an increase in the number of circulating RBCs and since haemoglobin is contained within these RBCs, an increase in RBCs directly contributes

Table 2. *Pearson's correlation coefficient among haematological parameters of Nigerian goats*

	PCV	**RBC**	**WBC**	**HB**	**PLTS**	**NEU**	**LYM**	**MCV**	**MCH**	**MCHC**
PCV	×	0.887^{**}	0.035^{NS}	0.991^{**}	0.280^{NS}	0.417^{NS}	0.023^{NS}	-0.697^{*}	0.699^{*}	0.113^{NS}
RBC		×	0.302^{NS}	0.895^{**}	0.406^{NS}	0.170^{NS}	0.322^{NS}	-0.838^{**}	-0.737^{*}	0.273^{NS}
WBC			×	-0.010^{NS}	0.036^{NS}	0.005^{NS}	0.128^{NS}	-0.236^{NS}	-0.453^{NS}	0.409^{NS}
HB				×	0.260^{NS}	0.414^{NS}	0.036^{NS}	-0.686^{*}	-0.589^{NS}	0.112^{NS}
PLT					×	-0.381^{NS}	0.378^{NS}	-0.480^{NS}	-0.250^{NS}	0.074^{NS}
NEU						×	-0.839^{**}	0.263^{NS}	0.156^{NS}	0.439^{NS}
LYM							×	-0.628^{NS}	-0.564^{NS}	-0.281^{NS}
MCV								×	0.711^{*}	0.118^{NS}
MCH									×	0.123^{NS}
MCHC										×

**= Significant at 0.01, *= Significant at 0.05, NS= Not significant, PCV= Packed cell volume (%), RBC= Red blood cell (10^{12}/L), WBC=White blood cell (10^{9}/L), HB= Haemoglobin (g/dl), PLTS= Platelets (10^{9}/L), NEU= Neutrophils (%), LYM= Lymphocytes (%), MCV=Mean corpuscular volume (fl), MCH= mean corpuscular haemoglobin (pg), MCHC=mean corpuscular haemoglobin concentration (g/L), fl= femtoliters, pg= pictograms, (g/dl)= grams per decilitre, %= Percent, L = microliter, g/L= Grams per litre

to higher HB levels. This relationship is fundamental, as haemoglobin's primary role is oxygen transport, which is crucial for maintaining overall health and metabolic function in goats. The negative relations between PCV, RBC, WBC, HB and PLT with MCV could be because increased destruction of red blood cells can lead to elevated WBC and platelet counts as the body responds to anaemia. The compensatory mechanisms may result in lower MCV values due to the production of smaller red blood cells. Elevated WBC counts often indicate an inflammatory response. Inflammatory cytokines can stimulate bone marrow activity, increasing WBC and platelet counts while simultaneously affecting RBC production and size, leading to lower MCV (Tihić-Kapidžić *et al.,* 2021).

4. Conclusion

Pearson's correlation coefficients among thermo-physiological and haematological parameters in Nigerian goats reveal complex interrelationships and could be influenced by several factors. Therefore, understanding these correlations is crucial for assessing the health and physiological status of goat populations in Nigeria.

5. References

1. Adedeji, T.A. (2012). Effect of Some Qualitative Traits and Non-Genetic Factors on Heat Tolerance Attributes of Extensively Reared West African Dwarf (WAD) Goats. *International Journal of Applied Agricultural and Apicultural Research,* 8 (1): 68-81.
2. Bello, S.A., Akintunde, O.G., Sonibare, A.O., Otesile, E. B (2016). Effect of Sex, Age and Time of the Day on Vital Parameters of Apparently Healthy West African Dwarf Goats in Abeokuta, Nigeria. *Alexandria Journal of Veterinary Sciences*, 49 (2): 18-23. DOI: 10.5455/ajvs.209718.
3. Nigerian Meteorological Agency (NiMet) (2023). Nigerian Meteorological Agency, Lafia, Nasarawa State, Nigeria Proceedings. In Geographic Perspective on Nasarawa Company Keffi, Nasarawa State.
4. Ovimaps (2023). Ovi map location: Ovi earth imagery. Accessed on: 4th July 2023 (latitude.to/satellitemap/ng/nigeria/135458/Lafia).
5. Shittu, O.O., Amole,T.A., Okwelum, N., Odeyemi, J.A., Toviesi, D.P., Ojo, V.I.O., Oluwatosin, B.O., Smith, O.F. and Osinowo, O.A. (2016). Haematological and Serum Bio-Chemical Parameters of West African Dwarf and Kalahari Red Goats in the Humid Tropics. *Nigerian Journal of Animal Science,* (2):305 314.
6. Tihić-Kapidžić, S., Čaušević, A., Fočo-Solak, J., Malenica, M., Dujić, T., Hasanbegović, S., Babić, N., Begović, E. (2021). Assessment of hematologic indices and their correlation to hemoglobin A1c among Bosnian children with type 1 diabetes mellitus and their healthy peers. *Journal of Medical Biochemistry*, 40(2):181-192. doi: 10.5937/jomb0-25315.
7. Timveh, J.T., Yakubu, A. and Alu, S.E. (2022). Effects of breed and sex on the adaptive profile of tropical goat. *Acta Fytotechnica et Zootechnica*, 25(1):24–33. http://www.acta.fapz.uniag.sk.
8. Tyagia, S., Mutreja, P., Bajaj, R. and Singh, D. (2022). Haemoglobin Levels Estimation using Aspen Hb Meter. *International Journal of Advanced Pharmaceutical Sciences and Research*, 2: 5-8. 10.54105/ijapsr.B4006.022222.
9. Yakubu, A., Durven, G.L. and Hagan, J. (2022). Multivariate analysis of body weight, morphometric and thermo-physiological traits of indigenous pigs under tropical conditions. *Genetics and Biodiversity Journal,* 6 (1): 91-104. DOI: 10.46325/gabj.v6i1.202.
10. Yakubu, A., Salako, A.E., De Donato, M., Peters, S.O., Takeet, M.I., Wheto, M. and Okpeku, M. (2017b). Association of SNP variants in MHC-Class II DRB gene with thermo-physiological indices in tropical goats. *Tropical Animal Health and Production*, 49(2): 323–336. http://dx.doi.org/10.1007/s11250-016-1196-1.