



Effect of Seasonal Variation on the Hormonal Profile of West African Dwarf (WAD) Goats

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Abstract | The caprine species faces a significant challenge in maintaining homeostasis and increasing productivity due to the constantly changing climatic conditions and the increasing demand for protein in developing regions. The effect of seasonal variation on reproductive endocrinology was examined in a group of West African Dwarf (WAD) does and bucks. Throughout the study, the animals were kept in the same environment. The results showed that most hormones in the does were nominally superior during the wet season compared to the dry season, while progesterone and luteinizing hormones were significantly ($p < 0.05$) higher during the wet season. Only testosterone was significantly ($p < 0.05$) higher in the wet season compared to the dry season in WAD bucks. All other measured hormones in WAD bucks showed no clear pattern. This study hypothesized that the seasonal effect is more pronounced in the female gender than in the male. Also, both genders tend to be significantly influenced by seasonal variations regarding their reproductive physiology; thus, proper management procedures must be designed to capitalize on these findings for profitability.

Keywords | Climate change; Hormonal profile; Reproductive endocrinology; Seasonal variation; West African Dwarf goat

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INTRODUCTION

The concept of homeostasis requires that a living being's internal and external environments interact and coexist in balance. Such interactions result in exerting influence from one factor on the other. All of these factors influence the survival and productivity of living beings. For example, the growth, development, and reproduction of an animal are determined by its hormonal balance. Also, the initiation of puberty and the transition to adulthood in an-

imals is characterized by the secretion of these hormones (Oliveira et al., 2021).

As stressor and stimuli, climate factors significantly impact hormonal systems (Beckford et al., 2020; Okon et al., 2021). Therefore, a concise understanding and grasp of the effect of seasons on variations in reproductive hormones are imperative for the farmer in the management of goats, selection of breeding animals, mating ratios and their reproductive potential.

However, the influence of photoperiod is the strongest in the temperate environment in determining the seasonality of reproduction in goats. Other ambient factors, namely temperature, relative air humidity and rain distributions, are the major climatic determinants in the reproductive physiology of the tropics (Rosa and Bryant, 2003). These changes in reproductive physiology based on varying climatic conditions are mainly expressed in the doe compared to the buck (Rosa and Bryant, 2003). Therefore, an adequate grasp of goats' reproductive variations with seasons can help with management, husbandry and breeding decisions, such as selecting males and females with better reproductive performances to be the parent stock of reproductively efficient breeds in the tropics (Rosa and Bryant, 2003; Simm et al., 2020).

Several studies along this line are available in the extant literature (Salles et al., 2020; Ponraj et al., 2022); however, paucity in the number of such studies on the indigenous breed of goats in Nigeria remains a glaring fact. Furthermore, the prevailing climate change issues are of utmost importance, bringing different stimuli and stressors compared to historical records (Daramola et al., 2021). Hence, there is a need to reference past data, conduct newer research to verify and discard claims where necessary, and proffer solutions to farm holders within the current climate. Hence this study aims to evaluate seasonal effects on the hormonal profile of male and female West African Dwarf (WAD) goats and make recommendations based on observed results.

MATERIALS AND METHODS

STUDY AREA

This study was conducted at the Teachings and Research farm of Landmark University in Kwara State, located between Latitude 8° 05' and 10° 05' North and Longitude 2° 50' and 6° 05' East of Greenwich Meridian. Experimental animals were sampled from the farm and subjected to an adjustment period of one week before the start of the experiment. Animals were housed in a closed shed with sufficient ventilation to allow heat and moisture to escape in a completely randomized design. Appropriate feeding, medication and watering facilities were provided within the housing system.

ETHICAL STATEMENT

Landmark University Ethics Committee, Landmark University, Omu-Aran, Kwara State, Nigeria, approved the current study. This research also followed all applicable ethical standards for the care and use of animals.

EXPERIMENTAL ANIMALS AND SAMPLE COLLECTION

Twelve (12) West African Dwarf (WAD) goats, with an

equal number of healthy bucks and does of about 3-5 years old, were housed and sampled for the observations of hormonal changes during the dry and rainy season. The animals were maintained without replacement for the duration of the research. Whole blood (5ml) was collected via jugular venipuncture from the goats into heparin tubes at 6 hours intervals throughout the day using a needle and syringe. Blood collection was done by restricting the animal in a way that would restrict movement. Samples were collected at the peak of the rainy and dry seasons, respectively. After the blood sample was collected, blood sample was allowed to rest for 24hrs. After 24hrs, the blood sample was centrifuged at 1000RPM using a centrifuge machine. The Supernatant (serum) was decanted with a micropipette and deposited in another plain bottle. Plain bottles containing serum were stored in freezers until further laboratory procedures where Follicle Stimulating Hormone (FSH), Luteinizing Hormone (LH), Testosterone, Oestrogen and Progesterone were analyzed from the collected serum with enzyme-linked immunosorbent assay kits (Monobind Inc. Lake Forest, CA 92630, USA). These hormones were estimated using a 96-well transparent polypropylene microplate using an Alere Microplate Reader (Alere Medical Pvt Ltd, India, AM 2100).

STATISTICAL ANALYSIS

The means of the samples were compared using a t-test, with the level of significant difference set at ($p < 0.05$). The SAS program was used to conduct this analysis (version 9.4).

RESULTS AND DISCUSSIONS

Nominal superiority in the mean measure of hormonal concentration was obtained for FSH, Testosterone and Estradiol during the wet season over the dry season in WAD does (Table 1). The concentration levels of progesterone and LH hormones were significantly ($p < 0.05$) higher in the wet season compared to the dry season. This observed trend indicated the palpable effect of season on hormonal concentration and body homeostasis though most were not significant ($p > 0.05$). The absence of significant differences in the concentration of hormones in studied WAD does may be due to certain factors, such as the small sample size and the nature of such hormones as FSH, testosterone and estradiol/estrogen. These hormones had already fulfilled their function in stimulating and enhancing sexual maturity, entering the anestrus period while entering a decline. Progesterone and LH were in the active operation phase in the wet season, when the does are more liable to get pregnant.

Also, LH has been shown to be released in a pulsatile pattern, the frequency of LH pulses varying according to

Table 1: Seasonal effect on the hormonal profile in WAD Does observed in the present study

Parameters	Mean ± Se (Dry Season)	Mean ± Se (Wet Season)	P -Value
FSH (mIU/ml)	0.563 ± 0.16	0.648 ± 0.15	0.7064
Testosterone (ng/ml)	0.233 ± 0.10	0.278 ± 0.11	0.7354
Estradiol (pg/ml)	136.7 ± 14.15	140.2 ± 23.29	0.2983
Progesterone (ng/ml)	1.620 ± 0.27	3.507 ± 1.73	0.0009
LH (mIU/ml)	2.918 ± 15.47	4.020 ± 0.91	0.0001

Means within rows with (p<0.05) are significantly different, FSH - Follicle Stimulating Hormone, LH - Luteinizing Hormone.

Table 2: Seasonal effect on the hormonal profile in WAD Bucks observed in the present study

Parameters	Mean ± Se (Dry Season)	Mean ± Se (Wet Season)	P -Value
FSH (mIU/ml)	1.072 ± 0.29	1.015 ± 0.14	0.3779
Testosterone (ng/ml)	1.077b ± 0.28	1.903a ± 0.74	0.05
Estradiol (pg/ml)	112.0 ± 22.99	115.8 ± 12.73	0.2201
Progesterone (ng/ml)	1.308 ± 0.37	1.240 ± 0.32	0.7532
LH (mIU/ml)	4.245 ± 0.63	5.677 ± 0.73	0.2677

Means within rows with (p<0.05) are significantly different. FSH - Follicle Stimulating Hormone, LH - Luteinizing Hormone.

the season and the stage of the cycle (Yuthasastrakosol et al., 1975; Baird et al., 1976; Scaramuzzi and Baird, 1977; Martensz and Scaramuzzi, 1979; Terqui et al., 1980 cited in Thimoier, 1981). Van der Klein et al. (2020) reported that climatic parameters such as solar radiation, relative humidity, length of the day, rainfall, temperature, and even the direction in which the wind blows could have a major impact on the neuroendocrine and behavioural response of an organism.

Due to the physiology of the males, the effect of seasonal effects on hormonal concentration is less pronounced, and the major negative influence is only noted in poor spermatogenesis and libido. Hence the observed values in Table 2 for WAD bucks in the wet and dry seasons only showed a significant (p<0.05) difference in testosterone level, with superiority noted in the wet as compared to the dry season. Unlike what was obtained with the does, all other comparisons had no clear pattern regarding the influence of season. In light of this result, it becomes imperative to note that adapted animals in their indigenous climes would show less variation in homeostasis and productivity compared to when in different environments. Therefore, studying the influence of seasonal effects on the reproductive endocrinology of the WAD goats in temperate environments may open up a new variety of information to further understand their genetics, adaptability and productivity. Thomas et al. (2015) posited that endocrinological profiles and libido are critical components in evaluating breeding soundness in males and its related semen quality parameters.

Pant et al. (2003) investigated factors influencing testicular development in Buffalo bulls. The study posited that

seasons influence the libido, testicular size and hormonal secretion through photoperiod and/or changes in temperature, humidity index and rainfall in male animals. Heat stress decreases the secretion of reproductive hormones. Follicle-stimulating hormone (FSH) and luteinizing hormone (LH) are essential for spermatogenesis and androgen synthesis. Observed results in WAD bucks differed from the findings of Ponraj et al. (2022), who reported “that Season has a significant effect on endocrinological profiles and libido scores in male Andaman local goats, which in turn induces significant effects on the production and reproduction performances. Goats in Andaman and Nicobar Islands are perennial breeders; however, available literature speculates that some seasonality prevailed as similar to other tropical goat breeds” while the performance of does in regards to the tested hypothesis agreed with the findings of Ponraj et al. (2022). This shows that despite variations in sample size, location of the experiment, and differences in breeds, amongst other pertinent factors, seasonality is a significant factor that influences the productivity of WAD goats and hence must be factored into the management equation and breeding objectives to boost productivity. For both the WAD does and bucks, serum endocrinological status aligned with the trend of the positive influence of rainfall and feed availability in the tropics on goat productivity.

CONCLUSION AND RECOMMENDATIONS

This study concludes that due to the high adaptability of WAD goats to the country’s environment, seasonal influ-

ence on reproductive endocrinology was very minimal but more pronounced in females. Studies that quantify the relationship between production economics and seasonal variation's impact on reproduction need to be carried out to assess at what threshold seasonal variation becomes inimical to the farmer's goal. Also, further studies using the same breed and other breeds of interest with a greater sample size in the Nigerian climate should be embarked upon to establish a clear impact of seasonal variation on endocrinology and reproduction in indigenous goats.

CONFLICT OF INTEREST

No conflict of interest in any form either with the authors or with the entire process of the research.

NOVELTY STATEMENT

The research gives insight into the effects of seasonal variation on WAD goats in Nigeria.

AUTHORS CONTRIBUTION

1 & 3 = Conceptualization, investigation, funding acquisition, data analysis, investigation, writing original draft,
1&2 = funding, supervision, project administration,

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