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Observation on Temperature and Scrotal Circumference of *T. brucei* and *T. congolense* Infected West African Dwarf and Red Sokoto Goats

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Abstract: Four groups each having four West African Dwarf (WAD) or Red Sokoto Goats(RSG) were either experimentally challenged with single T. *brucei*, T. *congolense*, mixed T. *brucei* and T. *congolense* parasites or left as uninfected controls. The all male goats were kept individually in cubicles under fly-proof pen in a 2 x 4 factorial design, blocked against sex and weight at 15 Kg ± 2 Kg. They were fed a ration comprising mixture of cut grasses and concentrate while water was provided adlibitum. Rectal temperatures were taken daily for seven weeks post infection while scrotal circumference was taken fortnightly. Mean ± (SD) rectal temperatures were higher in infected animals than controls (RSG 38.07 ± 0.03^{d} and WAD 38.05 ± 0.03^{d}) with the highest values occurring in the *T. brucei* infected group (RSG 41.28 ± 0.48^{a} and WAD 41.37 ± 0.50^{a}). Change in mean scrotal circumference generally decreased from controls, the values following an inverse relationship between the two breeds by increasing in one breed as it decreased in the other on equivalent infection. Observed differences in rectal temperatures of infected animals could reflect variation in pyrogen inducing ability of the different inoculums. However, the pattern of change in scrotal circumference showed a general decrease in mean scrotal circumferences (cm) from controls that were WADtb 15.82 ± 0.87, WADtbc 16.44 ± 0.33, WADtc 17.33 ± 0.34, RSGtb 17.80 ± 0.23, RSGtc 18.02 ± 0.59 and RSGtbc 19.24 ± 0.49.

Key words: Trypanosome Infection · Goats · Rectal Temperature · Scrotal Circumference

INTRODUCTION

Temperature implies relative warmth or coolness of a body which is not a measure of the body's heat content but rather the average kinetic energy of its molecules resulting from their motions [1]. In animals such as goat, body temperature is an important indicator of health [2]. Temperature changes in the entire animal or part of its body are caused by a variety of factors including changes in environmental conditions and activity of pyrogens or fever inducing agents. An example of such environmental change is use of prolonged insulation material over the scrotum of bucks which was reported to increase heat generation with consequent induction of degenerative changes and alopecia of scrotal skin [3]. These pyrogens are either exogenous factors from infectious pathogens like microorganisms and protozoa or endogenous factors, essentially cytokines from phagocytes like the interleukins, tumor necrosis factors (TNF), interferons e.t.c. Wikipedia [4].

Trypanosomes, piroplasma and Anaplasma are protozoans which along with other infectious agents act as exogenous pyrogens. However, they do not themselves produce fever directly but act indirectly by releasing endogenous pyrogens from leucocytes which then cause the disturbances like hyperthermia and cellular swelling [5]. Therefore intermittent fever is recognised as one of the well known primary clinical signs of trypanosome infections in addition to anaemia [6]. Clinical diagnosis is usually done in trypanosom following due suspicion or during routine investigation practice within endemic areas. This clinical diagnosis focuses among other things on temperature as a measure of fever and pallor of mucous membrane as a measure of anaemia although these entities are unspecific and not pathognomonic [7].

The scrotum which houses testicles is one important organ for attainment of an increase in animal flock sizes. Unlike humans, domestic animals go about naked but the crucial nature of their testicular tissue makes it one of the

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anatomically very protected structures. Testicles remain outside scrotum within abdominal cavity of birds as well as uni- or bilateral crytorchid ruminants whose normal counterparts experience testicular descent into scrotum in middle of foetal life. [8]. Situated away from the core body axis, the ruminant scrotum being a dependent organ operates as testosterone and spermatozoa factory [9] at an optimum temperature which is 4-7°C below general body temperature [10].

This naturally insulates it from extreme body temperatures but the metabolically very active testicular cells are still susceptible to injury by disease factors. Scrotal and testicular tissue of goats under trypanosome infection show degenerations, sperm abnormalities and alopecia of scrotal skin [11]. In Trypanosoma equiperdum (dourine) of equids, gross oedema of the genitalia including these structures is a very marked clinical manifestation [12]. Recently Okubanjo *et al.* [13] reported variation in scrotal sizes of rams infected with Trypanosoma congolense. However, clinical pictures in trypanosom generally vary partly with parasite strain, breed of host and management Radostits *et al*. [14]. The objective of this work was therefore to assess comparative changes in temperature and scrotal circumference of male RSG and WAD goats following their infection with *T. brucei, T. congolense* and mixed inoculums of the two parasites. It was also to find existence of any correlation between the change in temperature and scrotal circumference as a result of these infections.

MATERIALS AND METHODS

Determination of Rectal Temperature: The bulb of digital thermometer was inserted into the and left to beep. Temperature was read and bulb cleaned in alcohol for use on another animal.

Determination of Scrotal Circumference: Scrotal tape was used to measure the size of scrotum at their greatest diameter.

Statistical Analysis: Data was analysed using Analysis of variance (ANOVA) with significance determined at ($P < 0.05$).

RESULTS

The result shows no significant difference ($P > 0.05$) between temperature of control West African Dwarf (WAD) and Red Sokoto Goat (RSG). But there was significant difference ($P < 0.05$) between the controls and infected animals as has been reported by Adeiza *et al*. [15].

The finding of decreased scrotal circumferences of infected animals relative to controls agreed with observation of Anosa [7] that trypanosome infections caused decrease in testicular tissue.

After male goats attain puberty at 8 months reproductive activity remain constant but seasonal variations can occur with change in day length appearing

Table 1: Temperature (°C) of West African dwarf and Red Sokoto goats infected with T. *brucei* and *T. congolense*

Temperature Inoculum	WAD	RSG
Control	38.05 ± 0.03^{d}	38.07 ± 0.03^{d}
T.brucei	41.37 ± 0.50^{a}	41.28 ± 0.48^{a}
T.congolense	41.12 ± 0.04^{cd}	41.21 ± 0.05^{cd}
Mixed infection	41.17 ± 0.04^{abc}	41.19 ± 0.05^{abc}

Note: Mean ± SE across column with different superscripts are significantly different with a > b > c > d. Mean separation done with Duncan Multiple Range test.

Table 2: Scrotal/Testicular Circumference (cm)

Treatments (Mean±SE)	*RSG_T. congolense*	WAD_*T. congolense*	RSG_*T. brucei*	WAD_*T. brucei*	RSG_mixed infection	WAD_Mixed infection	RSG_control	WAD_control
0	18.20 ± 1.19^{a}	17.7 ± 0.36^{a}	18.38 ± 0.18^{a}	18.05 ± 1.85^{a}	19.23 ± 1.69^{a}	16.90 ± 0.65^{a}	19.75 ± 0.32^{a}	17.13 ± 0.24^{a}
1	18.80 ± 1.43^{ab}	18.00 ± 0.41^{ab}	17.95 ± 0.79^{ab}	17.25 ± 2.10^{ab}	17.93 ± 0.78^{ab}	17.00 ± 0.71^{b}	20.75 ± 0.78^{a}	17.38 ± 0.55^{ab}
3	18.500 ± 1.04^{ab}	17.50 ± 0.50^{b}	17.63 ± 0.49^{b}	14.83 ± 1.69^{c}	20.70 ± 0.64^{a}	16.25 ± 0.92^{bc}	18.50 ± 1.22^{ab}	16.35 ± 0.4^{bc}
5	18.33 ± 1.42^{ab}	17.65 ± 0.91^{ab}	18.20 ± 0.36^{ab}	14.00 ± 2.08^{c}	19.75 ± 1.19^{a}	16.38 ± 0.69^{bc}	19.20 ± 0.69^{ab}	17.13 ± 0.43^{ab}
7	15.97 ± 1.79^{ab}	15.80 ± 1.13^{ab}	16.83 ± 0.43^{ab}	13.77 ± 1.71^{b}	18.00 ± 1.50^{a}	15.68 ± 0.93^{ab}	19.00 ± 0.58^{a}	16.45 ± 0.25^{ab}
Total	18.02 ± 0.59^{bc}	17.33 ± 0.34^{cd}	17.80 ± 0.23^{c}	15.82 ± 0.87^{e}	19.24 ± 0.49^{ab}	16.44 ± 0.33^{de}	19.46 ± 0.30^{a}	16.89 ± 0.17^{cde}

Note: Mean±SE across a row with different superscripts are significantly different with a>b>c>d. Mean separation done with Duncan Multiple Range test

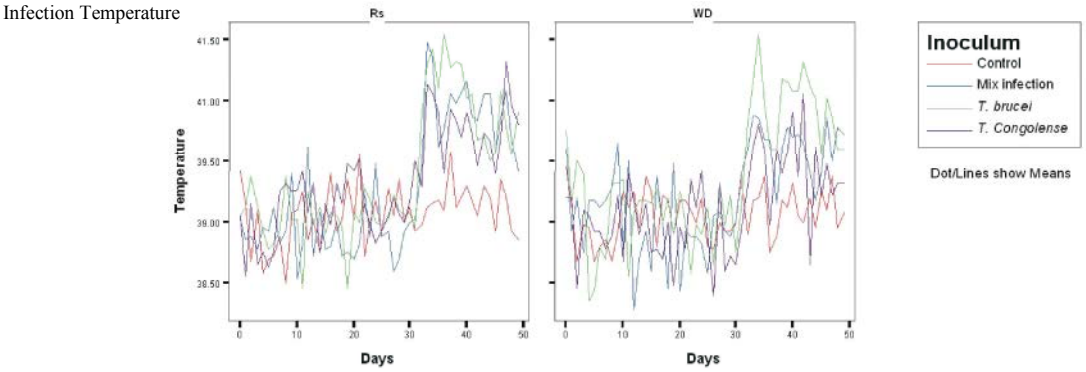

Fig. 1: Temperature (°C) of West African dwarf and Red Sokoto goats infected with T. *brucei* and *T. congolense*

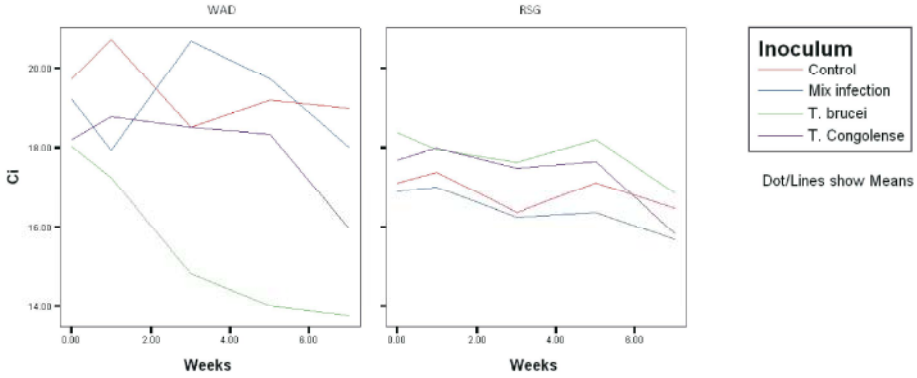

Fig. 2: Profiles of Scrotal Circumference of West African Dwarf and Red Sokoto Goats infected with *T. brucei* and *T. congolense*

to be the major conflicting factor [17]. But inflammation of testes called orchitis may arise from trauma or infections like those caused by trypanosomes, resulting in scrotum becoming painful, hot and oedematous while scrotal circumference changes and body temperature increases (8). Such inflammation of testes or scrotum being incited by the blood protozoan parasites also result in degeneration affecting testicular and scrotal cells as well as variation in size of scrotal circumference [3].

While testicular degeneration occurs in response to raised intra testicular temperature, some causes of the degeneration do not immediately manifest themselves in infertility [18]. But testicular degenerations accompanied by changes in scrotal circumference that was caused by trypanosome infection led to quick deterioration in sperm quality [13].

CONCLUSION

Temperature increased with trypanosome infection above that of uninfected controls. Scrotal circumference changed in trypanosome infection with general decrease relative to mean value of uninfected controls.

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