Theriogenology 86 (2016) 667–673

Contents lists available at ScienceDirect

Theriogenology

journal homepage: www.theriojournal.com

Semen characteristics and reaction time of Yankasa rams experimentally infected with *Trypanosoma evansi* infection

Francis Abidemi Ogundele [a,*], Oluyinka Oluseyi Okubanjo [a], Olagunju Joseph. Ajanusi [a], Samuel Tanko Fadason [b]

[a] Department of Veterinary Parasitology and Entomology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria
[b] Department of Veterinary Medicine, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria

ARTICLE INFO

Article history:
Received 18 June 2015
Received in revised form 7 December 2015
Accepted 22 February 2016

Keywords:
Trypanosoma evansi
Yankasa rams
Semen characteristics
Reaction time
Reproduction

ABSTRACT

Trypanosomosis is a serious, often fatal disease of domestic animals and humans, and a major constraint to livestock productivity and agricultural development in areas of Africa, Latin America, the Middle East, and Asia. It is caused by hemoflagelate protozoan of the genus *Trypanosoma*. Several species of *Trypanosoma* such as *Trypanosoma congolense, Trypanosoma vivax, Trypanosoma brucei,* and *Trypanosoma evansi* are known to infect domestic animals. *Trypanosoma evansi* is one of the most widespread pathogenic trypanosomes in the world causing disease known as "Surra" in animals. The effects of experimental *T evansi* infection on some aspects of reproduction in Yankasa rams were investigated over a 108-day period. Rams in the infected group A ($n = 7$) were each inoculated with 1×10^6 trypanosomes in 1 mL of donor blood via the jugular vein, whereas the control group B ($n = 5$) were administered 1 mL of normal saline. Semen volume, gross motility, live and/or dead sperm ratio, sperm morphologic abnormalities, and concentration as well as reaction time of infected and control rams were evaluated on a weekly basis. The results showed a nonsignificant ($P > 0.05$) decrease in semen volume and a significant ($P < 0.05$) decrease in concentration compared to the control rams. Reaction time showed considerable significant ($P < 0.05$) increase from preinfection values 26.7 ± 4.54 to 94.7 ± 7.54 seconds compared to control 32.9 ± 2.64 to 33.4 ± 4.78 seconds. Furthermore, semen gross motility for infected rams differed significantly ($P < 0.05$) from those of the control. There was a significant surge ($P < 0.05$) in the total sperm morphologic abnormalities in the infected rams to $90.75 \pm 2.73\%$ by week 20 (14 weeks after infection), compared to preinfection value of $20.9 \pm 0.52\%$. The outcome of this study suggests that infection with *T evansi* in Yankasa rams has far reaching severe effects on their reproductive performance.

1. Introduction

Trypanosomosis is a serious, often fatal disease of domestic animals and humans, and a major constraint to livestock productivity and agricultural development in areas of Africa, Latin America, the Middle East, and Asia [1,2]. It is caused by hemoflagellate protozoan of the genus *Trypanosoma* [3]. Several species such as *Trypanosoma congolense, Trypanosoma evansi, Trypanosoma vivax,* and *Trypanosoma brucei* are known to infect domestic animals. *Trypanosoma evansi* is undoubtedly one of the most widespread pathogenic trypanosomes in the world [4], infecting a variety of both wild and domestic animals including camels, equines, buffalos, cattle, deer, dogs, sheep, and goats [5,6]. This success is attributed to it transmissibility by biting flies [4]. Surra is a disease caused by *T evansi* and is

* Corresponding author. Tel.: +2348035284134.
E-mail address: francisoguns@gmail.com (F.A. Ogundele).

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http://dx.doi.org/10.1016/j.theriogenology.2016.02.018

of great economic importance in Africa [5,7]. It is primarily transmitted mechanically by biting flies like *Tabanus, Stomoxys, Hematopota*, *Lyperosia,* and *Chrysops* [8] and vampire bats (*Desmodus rotundus*) [9,10]. Transmission is enhanced when animals congregate or are closely herded and when they have high number of parasites in their blood, thus, enabling fast spread of parasites by biting flies.

The clinical signs of Surra in domestic animals are nonspecific and may likely be confused with other diseases [11,12]. The clinical signs seem to vary among hosts depending on the virulence of the isolate, the susceptibility of the hosts, and the presence of concurrent infections, stress, malnutrition, or adverse climatic conditions [13]. The most common signs among infected animals include progressive anemia, intermittent fever, poor body condition, weakness, anorexia, edema, lymphadenopathy, nervous signs, low reproduction, and death [3,12,14]. In horses and camels, the disease is usually fatal [15]. In small ruminants, the disease is usually chronic, but acute cases may also occur with high mortality. In experimental infection of Yankasa sheep, Audu et al. [16] described two distinct forms of the disease namely, acute form occurring within 4 to 14 days after infection in which the animals died within 2 weeks and chronic form with a longer duration of 43 to 59 days after infection. In addition, abortion, infertility, testicular enlargement, diarrhea, coughing, and ocular lesions have been reported in goats [17–19]. Trypanosomosis has direct impact on livestock productivity, reducing meat and milk take, calving rate, and lambing and kidding rates in sheep and goat livestock management [20]. Trypanosomosis has been shown to cause a wide range of reproductive disorders in animals by their ability to cause pathologic effects on endocrine glands and gonads, with consequent disruptions in the secretions and plasma concentration of hormones necessary for normal reproductive process in both sexes [6]. In male animals, delayed puberty, loss of libido, severe degenerative changes of the genitalia manifested by production of very poor quality semen, or even cessation of semen production are some of the reproductive disorders resulting from Trypanosomosis [6,21,22]. Increased scrotal diameters, scrotal inflammation, testicular degeneration, periorchitis, epididymitis, abnormal spermatogenesis, and preputial hemorrhages have all been reported in rabbits infected with *T brucei* [23]. Massive scrotal enlargement, severe testicular and epididymal degeneration, and deteriorated semen characteristics have been reported in bucks and rams infected with *T vivax* [24–27]. Similarly, *T vivax* infection was reported to have caused testicular and epididymal degeneration and poor semen quality in the bovine [28]. Deteriorated semen characteristics were reported in West African short horn bulls resulting from *T congolense* infection [29,30]. Previous investigations [21,31] in Zebu bulls infected with *T vivax* and *T congolense* showed abnormalities, including progressive elongation of ejaculation time and poor semen quality such as oligospermia, aspermia, poor motility, 70% dead ratio, and 100% morphologic abnormalities. The Yankasa sheep is indigenous to the guinea savannah region of Nigeria and considered the most numerous of the four Nigerian breeds, it also serves as a repository of saved money for local household owners. The role of Trypanosomosis in limiting livestock production and its economic impact on the livestock industry are widely recognized [2]. However, there is paucity of information on the effect of *T evansi* infection on reproduction in indigenous Yankasa rams. This study is therefore designed to investigate the effect of experimental *T evansi* infection on reaction time, the time from onset of stimulation to ejaculation and semen characteristics in Yankasa rams.

2. Materials and methods

2.1. Experimental animals

Twelve matured, apparently healthy, and sexually intact (unneutered with both testicles fully descended)Yankasa rams of approximately 2 years of age were bought from local open markets in Zaria, Local Government Area of Kaduna State, Nigeria.

2.2. Housing and feeding

The experimental animals were kept in clean fly proof pens provided by the Department of Veterinary Parasitology and Entomology, Faculty of Veterinary Medicine, Ahmadu Bello University Zaria, Nigeria. The rams were screened for helminthes infections as well as hemo and ectoparasites, after which they were treated using ivermectin (Ivomec) at 200 μg per kg body weight subcutaneously and Albendazole at 7.5 mg per kg body weight per os (orally) and repeated 2 weeks later. This gave a period of six-weeks interval between last treatment and commencement of study. The rams were fed on hay, maize offal and concentrates, and multimineral salt lick, and water was provided ad libitum.

2.3. Trypanosoma evansi isolate

A field strain of *T evansi* was obtained from the pooled blood of camels at slaughter in Kano abattoir in Kano state, Northwestern Nigeria and inoculated into white albino rats. Patency was detected in the rats after 31 days, and from thence, the parasite was maintained with three passages in laboratory rats until inoculation into experimental rams. The rats were bled into a flat bottom flask containing EDTA at 1 mg/kg, and the pooled blood was diluted with phosphate buffered saline glucose for inoculation into experimental rams [32,33].

2.4. Experimental design

The rams were conditioned for a period of 8 weeks during which they were treated for any underlying infection, introduced to handlers, and to the electro-ejaculator for habituation. Animals that responded poorly were removed from the group before the commencement of study. The rams were allotted into two groups A and B consisting of seven and five rams for the infected and control groups, respectively. The infected group A ($n = 7$) rams were inoculated with 1×10^6 *T evansi* trypomastigotes in 1 mL of donors (laboratory rats) blood [33,34] via the jugular vein as quantified by Patena [35] and allowed to run