



Giardia Infection in Recently Acclimatized Kalahari Red Goats in Nigeria

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SUMMARY

Prevalence of *Giardia duodenalis* in recently acquired and acclimatized Kalahari Red goats in Nigeria was determined using a commercially produced enzyme-linked immunosorbent assay (ELISA) kit. *Giardia duodenalis* coproantigens were detected in 46.9% of the faecal samples collected from 98 Kalahari Red goats. The highest (58.1%) and lowest rates (38.2%) were recorded in pre-weaned goat kids up to three months of age and adults goats over one year of age respectively. Infection was higher in females (56.8%) and diarrhoeic goats (75.0%) than males (38.9%) and non-diarrhoeic goats (45.7%) respectively. No significant difference ($p>0.05$) was observed in the infection rates among age categories, sexes and stool consistencies of the goats. The results of this study showed a high prevalence of *Giardia* infection in the Kalahari Red goat herd which may imply that they are susceptible to giardiasis if managed under conditions that may facilitate transmission from infected indigenous animals.

Key words: ELISA, *Giardia*, goat, Kalahari Red, Nigeria.

INTRODUCTION

Giardiasis is a common intestinal infection caused by single-celled flagellate protozoan, *Giardia duodenalis* (syn. *G. intestinalis* and *G. lamblia*) (Zhang *et al.*, 2012). Infection occurs in humans and a wide range of domestic and wild animals (Maikai *et al.*, 2012; Sima, 2012; Ibrahim *et al.*, 2013; Imran *et al.*, 2013; James *et al.*, 2013). It is a common cause of foodborne and waterborne gastroenteritis (Castro-Hermida *et al.*, 2007). *Giardia duodenalis* is a potent pathogen in goats and can be asymptomatic

or associated with severe diarrhoea, weight loss, lethargy, poor condition and mortality (Castro-Hermida *et al.*, 2007; Geurden *et al.*, 2010; Imran *et al.*, 2013). Severity of the disease depends on age of animal, nutritional status, management type and concomitant presence of other parasites such as *Cryptosporidium* and *Entamoeba* (Geurden *et al.*, 2010).

Molecular data have identified seven assemblages (A to G) within *G. duodenalis*. Assemblages A and B have the widest host

range that infect humans and a variety of domestic and wild animals (Zhang *et al.*, 2012). Assemblages C, D, E, F and G appear to be host specific for non-human species, however, they have been isolated in humans apart from assemblage G (Sprong *et al.*, 2009). The “hoofed livestock”-specific assemblage E is the most common genotype found in cattle, sheep, goats and pigs (Castro-Hermida *et al.*, 2007; Armson *et al.*, 2009) followed by assemblage A (Sprong *et al.*, 2009). This distribution of *Giardia duodenalis* assemblages therefore implies that livestock may potentially serve as sources of infection to humans (Minetti *et al.*, 2014).

The Kalahari Red goat, originating from southern Africa, is a medium to large framed lob-eared breed having highly pigmented smooth short hair coat (Kotze *et al.*, 2004; Snyman, 2014). Equipped with characteristics such as adaptation to arid and semi-arid savannah, good foraging abilities and excellent mothering abilities, it is regarded as a “minimum care/maximum profit” breed (Ramsey *et al.*, 2001; Kotze *et al.*, 2004).

The Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State acquired 60 of these goats from South Africa in September 2011 for the purpose of research and husbandry. This was also aimed at cross-breeding them with the Red Sokoto and West African Dwarf in order to improve the growth rate, body weight and milk production of these indigenous goat breeds (Bemji *et al.*, 2014).

Giardia infection has been reported in cattle and domestic fowl in Nigeria (Ibrahim *et al.*, 2013; James *et al.*, 2013; Agbolade *et al.*, 2014). There is however no available published report on the occurrence of *Giardia* infection in goats in Nigeria. Several studies have also revealed that newly acquired animals are highly susceptible to infection by prevalent microorganisms (Kashiwazaki *et al.*, 1998;

Lopez *et al.*, 2008; Mee, 2013). This study therefore aims to determine the prevalence of *Giardia* infection in Kalahari Red goats at a research institute in FUNAAB from which the infection status of indigenous animals in Ogun state can be inferred.

MATERIALS AND METHODS

Herd and Husbandry History

Sixty Kalahari Red goats were purchased from South Africa by the Federal University of Agriculture, Abeokuta, Ogun state in September 2011. They were quarantined and acclimatized for a period of 10 months during which routine treatment and prophylaxis with anthelmintic, antibiotic, anti-protozoan and acaricidal drugs were performed. They were intensively managed on the University’s Teaching and Research farm which placed them in close proximity to the indigenous breeds of cattle, sheep, goats and pigs which were semi-intensively managed on the farm. The Kalahari Red goats were thereafter relocated and intensively managed at a permanent site which is about 70 km from the University’s farm.

This study was conducted in November 2013 during which the herd size of the Kalahari Red goat was 125 and screening and treatment for various blood and gastrointestinal parasites were routinely performed.

Sample collection

Faecal samples were collected from 98 randomly selected Kalahari Red goats. The sample size was determined using the EpiInfo version 7 software using a population size of 125, prevalence rate of 50.0% and 95% confidence interval. The goats were grouped into pre-weaned (up to 3 months), post-weaned (>3 months to 1 year) and adult (>1 year) age categories. Stool samples were collected directly from the rectum of each goat. When rectal sampling was not possible, such as in neonates, freshly voided faeces were collected by the

use of wooden tongue depressors which were used to scoop up the superficial layer of faeces without contacting the floor. The faeces were then dropped into individual universal sample bottles and labelled appropriately. The stool samples were then transported to the laboratory in cold packs, where they were catalogued, processed and analyzed. The stool samples were analyzed immediately and stored (if analysis was delayed) at a temperature of 4°C until they were processed.

Detection of *Giardia duodenalis* antigens by ELISA

The detection of *Giardia duodenalis* coproantigens in the samples was done using a commercially available ELISA kit for faecal samples (RIDASCREEN® *Giardia duodenalis*; R-Biopharm AG, Germany). The procedure was carried out according to manufacturer's instructions.

The optical densities (OD) of the samples were read at 450nm using a microtitre plate reader (BIOTEX; Model: ELx800, Biotex Instruments, USA). Samples were analyzed using the manufacturer's cut-off calculations in the instruction manual. The cut-off was calculated as shown below:

$$\text{Cut-off} = \text{Extinction of the negative control} + 0.15$$

Samples were considered positive if their extinction is more than 10% above the calculated cut off but considered negative if their extinction was more than 10% below the calculated cut-off. Samples were however considered as equivocal and repeated if their extinction was within the range 10% above to 10% below the cut-off.

Statistical analysis

Data was collated and analyzed with Statistical Package for Social Sciences (SPSS) version 17 on Windows. Chi-square test was used to compare the differences in occurrence of *Giardia duodenalis* coproantigens between the age categories,

sexes and stool consistencies of Kalahari Red goats at 5% level of significance.

RESULT

The mean \pm SEM of haemagglutination inhibition (HI) titres of group A, B, C and D measured at weeks zero, 3, 6, 9, 10 and 11 respectively (table 1).

The maternally-derived antibody (MDA) measured on day 1 of the experiment showed uniform mean antibody titres with no statistical difference. The mean Ab titres of the chickens in groups A, B, C and D at 3 weeks of age were 8.13 ± 0.24 , 8.53 ± 0.23 , 7.93 ± 0.34 and 4.16 ± 0.55 respectively. There was no significant difference of the mean Ab titres among chickens of groups A, B and C, while that of chickens in group D was significantly lowered at week 3 post primary vaccination. At 6 weeks of age, there were mean antibody titres of 9.39 ± 0.13 , 8.96 ± 0.25 , 6.41 ± 0.37 and 3.50 ± 0.41 of the chickens in groups A, B, C and D, respectively. The higher HI titres were found in chicken of groups A and B, which differ significantly with the chickens of group C and D. The same pattern of HI titres differences were observed at week 9. The mean antibody titres of the chickens at 10 week of age following challenge with the virus were 4.68 ± 0.74 , 4.00 ± 0.57 , 5.20 ± 0.72 and 5.72 ± 0.43 for groups A, B, C and D, respectively. Likewise the mean HI titres of the birds among the groups at 11 week of age depict similar values to that of week 10. Three days post challenge some chickens begin to show clinical signs particularly in unvaccinated control group. The clinical signs manifested were: Somnolence (15/20), ruffled feathers (17/20), listlessness (15/20), diarrhoea (10/20), reduced feed and water intake, depression (13/20), swollen head (1/20), coughing and sneezing, rales (4/20), sitting on the hock (13/20), recumbence (7/20), leg paralysis (4/20), dropped wing (3/20), torticollis (5/20), star gazing (3/20)

Table I: Prevalence of *Giardia duodenalis* coproantigens in Kalahari Red goats in FUNAAB, Ogun state, Nigeria

Parameters		No. infected/sampled	Prevalence (%)	p-value
	Pre-weaned kids	18/31	58.1	0.313
	Post-weaned kids	15/33	45.5	
Age categories	Pre-weaned kids	18/31	58.1	0.110
	Adults	13/34	38.2	
	Post-weaned kids	15/33	45.5	0.549
	Adults	13/34	38.2	
Sexes	Females	25/44	56.8	0.077
	Males	21/54	38.9	
Stool consistency	Diarrhoeic	3/4	75.0	0.251
	Non-Diarrhoeic	43/94	45.7	

and in coordination (2/20). The gross lesions observed on dead chickens following post-mortem examination were congested skeletal muscles (10/15), congested liver (9/20), congested heart (5/20), congested spleen (12/20), congested kidneys (8/20), congested lungs (13/20), haemorrhagic trachea (15/20), haemorrhages in the proventriculus (15/20), haemorrhages in the duodenum (12/20) with button ulcers (4/20), haemorrhages in the jejunum (9/20), haemorrhages in the jejunum (10/20) with button ulcers (4/20), enlarged and haemorrhagic caecal tonsils (12/20), haemorrhagic caeca (8/20). The gross lesions for the chicken in group C, were congested skeletal muscles and haemorrhages in the proventriculus, duodenum and caecal tonsils. The morbidity, mortality and protective rates of the treatment and control groups are summarised in table II. There were zero percent morbidity and mortality rates, while 100 % protective efficacy was observed in chickens of groups A. there is 4 % morbidity rate recorded for the chickens in group B

DISCUSSION

Several reports are available in Nigeria on Giardiasis in humans (Biu *et al.*, 2009; Akinbo *et al.*, 2010; Molloy *et al.*, 2010; Inabo *et al.*, 2011; Ayinmode *et al.*, 2012; Maikai *et al.*, 2012; Pam *et al.*, 2013) while there are fewer reports on the infection in animals (Ibrahim *et al.*, 2013; James *et al.*, 2013; Agbolade *et al.*, 2014) and in most of these studies, microscopic techniques were utilized. To the best of our knowledge, this is the first study that detected *Giardia* coproantigens in goats in Nigeria.

Our observation of an increase in size of the Kalahari Red goat herd implies that the goats were successfully acclimatized and managed thus corroborating the report of Harriet (2012) that successful acclimatization and management of animals results to high fecundity, low morbidity and mortality rates. An unpublished preliminary study that was conducted during the quarantine period of the Kalahari goats utilized microscopic techniques and revealed infection and infestation by roundworms, *Eimeria* spp., *Cryptosporidium* spp., *Babesia* spp., *Trypanosoma* spp., *Anaplasma* spp., *Rhipicephalus* and

Linognathus spp.. Subsequently, anthelmintic, anti-protozoan and acaricidal treatment and prophylaxis were routinely performed.

The overall prevalence, 46.9%, of *Giardia duodenalis* coproantigens in Kalahari Red goats observed in this study was higher than previous reports of 19.5% of cattle in Niger state (James *et al.*, 2013), 25.0% of slaughtered cattle in Sokoto state (Ibrahim *et al.*, 2013) and 14.5% of domestic fowls in Ogun state (Agbolade *et al.*, 2014). Similarly, it was higher than the range of 10.0% and 42.0% prevalence in goats reported in several countries (Castro-Hermida *et al.*, 2007; Minetti *et al.*, 2014; Radavelli *et al.*, 2014; Sudre *et al.*, 2014; Tzanidakis *et al.*, 2014). This observation may be associated with the intensive system employed in managing the Kalahari Red goats which has been reported to encourage transmission and high prevalence of *Giardia* in such herd (Minetti *et al.*, 2014). It may also suggest that *Giardia* infection may occur in the indigenous animal species managed on the University's farm.

Detection of *Giardia* coproantigens in these acclimatized Kalahari Red goats implies that they can be infected with *Giardia* and may serve as reservoir of infection to indigenous ruminants. The infection may originate from South Africa where the goats were purchased and/or from contact with feed, water or handlers possibly contaminated with infective cysts shed by indigenous ruminants bred on the farm which usually graze in proximity to the pen provided for the Kalahari Red goats.

The high infection rate recorded in pre-weaned goat kids in this study corroborates reports of Minetti *et al.* (2014), Sudre *et al.* (2014) and Tzanidakis *et al.* (2014) but contrasts the report of Castro-Hermida *et al.* (2007). This may be associated with the under-developed immune system of this age group and the shedding of higher amounts of *Giardia* cysts in their faeces in contrast to

the adult goats (Sudre *et al.*, 2014). Infected adult goats may, however, serve as carriers and source of infection for their young ones. This may be the case in the Kalahari Red goat herd since they, irrespective of their age, are housed together.

The higher rate recorded in females was similar to previous submissions of Ibrahim *et al.* (2013). This observation has been attributed to changes in the immunoreactivity of female domestic ruminants during late pregnancy, parturition and lactation (Reynolds and Griffin, 1990; Castro-Hermida *et al.*, 2005).

Occurrence of *Giardia* infection in both diarrhoeic and non-diarrhoeic Kalahari Red goats observed in this study corroborates reports of Castro-Hermida *et al.* (2007) and Minetti *et al.* (2014). This suggests that the diarrhoea in Giardiasis may be due to co-infections with other enteropathogens and therefore implies that both clinically ill and asymptomatic Kalahari Red goats should be screened and treated for *Giardia* infection.

This study therefore indicates that acclimatized Kalahari Red goats have a high risk of *Giardia* infection thereby necessitating regularly screening and treatment. Furthermore, these goats can also serve as sources of infection to various animals and humans in Ogun state. These imply that *Giardia* infection may occur in animals reared on the University's farm and Ogun state which therefore emphasizes the importance of prevalence studies of *Giardia* infection in domestic and wild animals in various parts of Nigeria.

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