

**Incidence, clinical appraisal and treatment of haemonchosis in small
ruminants of resource-poor areas in South Africa**

by

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When asked if he was never discouraged by the little fruit his efforts seemed to yield, the Master told the story of a snail that started to climb a cherry tree one cold, windy day in late spring.

The sparrows on a neighbouring tree had a good laugh at his expense. Then one flew over and said, *“Hey, blockhead, don’t you know there are no cherries on this tree?”*

The little fellow did not stop as he replied, *“Well, there will be when I get there.”*

Anthony de Mello, 1992

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Declaration

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Notwithstanding the inputs of the abovementioned people, whose particular assistance was critical to the execution of the study, and the assistance of those people thanked in the Acknowledgements, this study is original work of the candidate and has not been submitted in any form to another University.

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Abstract

A novel clinical assay for the assessment and subsequent treatment of *Haemonchus* infection in sheep to slow down the development of anthelmintic resistance – the FAMACHA[©] system – has been developed, tested and validated in South Africa. The system is based on a colour chart with five colour categories depicting varying degrees of anaemia that are compared with the colour of the conjunctival mucous membranes of sheep. The animal is then scored from severely anaemic (pale) through anaemic to non-anaemic (red) and those animals considered in danger of succumbing to the effects of haemonchosis are treated. This method was tested in the present study in goats and sheep farmed under resource-poor conditions in South Africa.

The diversity and predominance of nematode genera in goats and sheep at Rust de Winter, Gauteng Province, in goats at Impendle, KwaZulu-Natal Province, and in goats and sheep at Kraaipan, North-West Province, were determined by means of a longitudinal study of the nematode faecal egg counts (FECs) and differential third-stage larvae. The animals were bled for haematocrit determination, scored for pallor of ocular mucous membranes using the FAMACHA[©] method, and body condition scored. A longitudinal study of the pooled trematode FECs was conducted at the same time.

Lower haematocrit values were registered for the goats during periods of heavier *Haemonchus* infection, which periods occurred from December/January to March for Rust de Winter; from December to March/April for Impendle; and from November/December to February or April for Kraaipan. For the sheep, the periods of heavier *Haemonchus* infection occurred from October to March at Rust de Winter and from September/October to February or April at Kraaipan. There was agreement too between the lower haematocrits and paler mucous membranes scored according to the FAMACHA[©] method.

Analyses in goats performed during the summers of 1998/1999 and 1999/2000 show a test sensitivity of 76% and 85%, respectively, meaning that the system may be used to identify correctly 76% to 85% of those animals in need of treatment with an anthelmintic. However, the test specificity remains low at 52% to 55%. This means that a large proportion of those animals that would not require treatment would in fact be treated. On the other hand, when the use of the FAMACHA[©] system is compared with conventional dosing practices where all the animals are treated, using the FAMACHA[©] system would result in a large proportion of the animals being left untreated. The untreated animals are then able to deposit the eggs of anthelmintic-susceptible worms on the pasture, while the treated ones should pass very few ova, given an effective anthelmintic. This maintains a reservoir of susceptible larvae *in refugia*, and should slow down the development of anthelmintic resistance.

The use of the FAMACHA[©] system may be recommended as part of an integrated approach to worm control in the resource-poor areas studied and may have wide application in the tropics and subtropics of sub-Saharan Africa and elsewhere.

Seasonal variations in body condition were evident in the goats at Impendle with the animals showing lower body condition scores (BCS) from June to September. The sheep at Kraaipan showed lower BCS from July to December. The small ruminants at Rust de Winter did not show clear seasonal variations, although the goats at Rust de Winter showed lower BCS from mid-July to early December and the sheep from August to mid-February. Although body condition was maintained by the goats at Kraaipan, the scores remained low overall. The BCS for Rust de Winter where the animals were grazed on a private farm were generally higher than those of the other sites, where communal grazing is practised.

The amphistome FECs followed a seasonal pattern, with an increase in the counts during the warmer months of the year (September to April). The study seems to indicate a different pattern of infection in goats raised under resource-poor conditions in South Africa from that on commercial farms, where outbreaks of clinical paramphistomosis occur during autumn and winter.

Keywords: Anthelmintic resistance; Body condition scores; Clinical assay; Eye colour chart; Faecal nematode and trematode egg counts; FAMACHA[®]; Goats; Haematocrit; *Haemonchus* spp.; Sheep

Opsomming

‘n Nuwe kliniese toets — die FAMACHA[®]-sisteem — vir die ondersoek en daaropvolgende behandeling van *Haemonchus*-besmetting in skape is in Suid-Afrika ontwikkel, getoets en geldig verklaar om die ontwikkeling van wurmmiddelweerstand te vertraag. Die sisteem is gebaseer op ‘n kleurkaart met vyf kleur kategorieë wat uiteenlopende grade van bloedarmoede uitbeeld en met die kleur van die oogslymvliese van skape vergelyk word. Die dier word as ernstig bloedarmoedig (bleek) tot bloedarmoedig tot nie-bloedarmoedig (rooi) aangewys en in dié gevalle waar dit verwag word dat die diere aan hemonchose sal vrek, word behandeling toegepas. Dié metode is in hierdie ondersoek getoets in bokke en skape waarmee daar onder hulpbron-bepaalde omstandighede in Suid-Afrika geboer word.

Die verskeidenheid en belang van nematodegenera in bokke en skape by Rust de Winter, Gauteng Provinsie, in bokke by Impendle, KwaZulu-Natal Provinsie, en in bokke en skape by Kraaipan, Noordwes Provinsie, is bepaal deur middel van ‘n longitudinale studie van miseiertellings (METs) van nematodes en onderskeiding van derde-stadium larfies. Die diere is gebloeï om die hematokrit te bepaal, die kleur van hulle oogslymvliese is aangewys deur middel van die FAMACHA[®]-metode, en die diere se kondisie is bepaal. ‘n Longitudinale studie van die gepoelde METs van trematodes is terselfdertyd uitgevoer.

Laer hematokritwaardes van bokke is gedurende die periode van swaarder *Haemonchus*-besmetting aangeteken. Dié periodes was van Desember/Januarie tot Maart by Rust de Winter; van Desember tot Maart/April by Impendle; en van November/Desember tot Februarie of April by

Kraaipan. In skape was die periodes van swaarder *Haemonchus*-besmetting van Oktober tot Maart by Rust de Winter en van September/Oktober tot Februarie of April by Kraaipan. Die periodes van bleker oogslymvliese wat aangeteken is volgens die FAMACHA[®]-metode het ook met die laer hematokritte ooreengestem.

Verwerkings wat vir die data van die bokke vir die somers van 1998/1999 en 1999/2000 gedoen is, het onderskeidelik 'n toetssensitiwiteit van 76% en 85% getoon, wat beteken dat die sisteem gebruik mag word om 76% tot 85% van dié diere wat behandeling met 'n wurmmiddel nodig het, korrek te identifiseer. Die toetsspesifisiteit het egter laag gebly en was 52% tot 55%. Dit beteken dat 'n groot deel van dié diere wat nie behandeling nodig het nie, wel behandel sal word. Wanneer die FAMACHA[®]-sisteem egter met die gewone doseerpraktyke vergelyk word, sal die gebruik van die FAMACHA[®]-sisteem tot volg hê dat 'n groot gedeelte van die diere nie behandel sal word nie. Die onbehandelde diere kan daarna die eiers van wurmmiddelvatbare wurms op die weiding uitskei, terwyl die behandelde diere baie min eiers sal uitskei, mits die wurmmiddel effektief is. Dit handhaaf 'n reserwe van vatbare larfies *in refugia*, en behoort die ontwikkeling van wurmmiddelweerstand te vertraag.

Die gebruik van die FAMACHA[®]-sisteem mag as deel van 'n geïntegreerde benadering tot wurmbeheer in die hulpbron-beperkte gebiede wat bestudeer is, aanbeveel word en mag wye toepassing in die tropiese en subtropiese gebiede van Afrika besuide die Sahara en elders hê.

Seisoenale variasies in liggaamskondisie is vir die bokke by Impendle aangeteken en die diere het laer liggaamskondisietellings (LKTs) van Junie tot September getoon. Die skape van Kraaipan het laer LKTs van Julie tot Desember getoon. Die klein herkouers van Rust de Winter het nie duidelike seisoenale variasies gewys nie, alhoewel die bokke by Rust de Winter laer LKTs van middel Julie tot vroeg in Desember en die skape van Augustus tot middel-Februarie getoon het. Alhoewel die bokke by Kraaipan liggaamskondisie behou het, het die tellings oor die algemeen laag gebly. Die LKTs vir Rust

de Winter waar die diere op 'n privaat plaas gewei het, was oor die algemeen hoër as dié van die ander plekke, waar die weiding gemeenskaplik gebruik word.

Die amfistoom METs het 'n seisoenale patroon gevolg, met 'n vermeerdering in die tellings gedurende die warm maande van die jaar (September tot April). Dit skyn dat die studie 'n verskillende patroon van infeksie aandui in die bokke waarmee daar onder hulpbron-bepaalde omstandighede geboer word, in teenstelling met die situasie op kommersiële plase waar uitbreke van kliniese paramfistomose gedurende die herfs en winter voorkom.

Sleutelwoorde: Bokke; FAMACHA[®]; *Haemonchus* spp.; Hematokrit; Kliniese toets; Liggaamskondisietellings; Misiertellings van nematodes en trematodes; Oog kleurkaart; Skape; Wurmmiddelweerstand

Introduction

Small ruminants play an important role in the local economies of many resource-poor communities in South Africa. However, little is known about the prevalence and effects of diseases in such animals in South Africa. The importance of internal parasites as causes of mortality and poor production is, however, recognized in commercial sheep farming in this country. In the summer rainfall area, haemonchosis is the most important helminth infection in sheep. As such it is necessary to examine its role in the resource-poor farming sector with the aim of developing worm management strategies for these areas.

With the worldwide emergence of anthelmintic resistance in sheep and goats, the testing and application of worm control strategies which reduce the use of anthelmintics is critical. One such strategy, the FAMACHA[®] system, was developed for use in sheep. The method is based on the principle that anaemic animals may be identified by examining the colour of the conjunctival ocular mucous membranes and these animals may be treated with an anthelmintic. A large proportion of the flock is left untreated and the number of treatments administered is considerably reduced.

Aims

The aims of the present study were thus :

- to conduct a longitudinal study of the helminth infections of goats and sheep raised by resource-poor farmers in the summer rainfall area of South Africa;
- to determine the effect of worm infection on the eye colour, haematocrit and body condition of the small ruminants; and
- to apply and evaluate the use of the FAMACHA[®] system in goats.

This dissertation consists of eight chapters which have been written following the format of *Veterinary Parasitology*. Chapter 1 gives the background to the study and includes a literature review. Chapter 2 describes the general materials and methods used. Chapters 3, 4, 5 and 6 describe the results for the goats studied while Chapter 7 gives the results for the sheep.

Chapter 3 discusses the sensitivity and specificity of the FAMACHA[®] assay in goats. It also gives the results of faecal egg count reduction (FECR) tests carried out in this species.

Chapter 4 gives the proportional nematode faecal egg counts (FECs) of the various strongyle worm genera found in the goats. This chapter also describes the results of the microhaematocrit determinations and provides a summary of the eye colour scores.

Chapter 5 describes the body condition scores (BCS) for the goats in relation to their FECs.

The results of the trematode FECs for the goats are given in Chapter 6.

Chapter 7 records the strongyle FECs, the microhaematocrit results, the FAMACHA[®] scores, the BCS and the trematode FECs for the sheep. The results of the FECR test conducted in the sheep at Kraaipan are also reported here.

Chapter 8 concludes the dissertation and provides suggestions for the application of the FAMACHA[®] system elsewhere in Africa.