The FAMACHA© System – an Aid in the Management of Haemonchosis in Small Ruminants

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Introduction

The FAMACHA© system is a technique used in small ruminants to assess the level of anemia resulting from infection with *Haemonchus contortus*, the barber's pole worm. The system allows a decision to be made with regard to anthelmintic treatment on an individual animal basis as opposed to treating all the animals in the herd or flock, and application of the method leads to a large reduction in anthelmintic use when compared with conventional drenching approaches. It is a method of 'targeted selective treatment' which refers to the identification and treatment of those individuals that truly require it while leaving the rest untreated (Besier, 2008). The system was developed in South Africa (Malan et al., 2001) to provide an alternative approach to the common practice of frequent drenching of sheep, which has been associated with the widespread emergence of anthelmintic resistance. The system has since been adopted for use worldwide, including in the United States, where anthelmintic resistance in small ruminants is common and widespread (Mortensen et al., 2003; Howell et al., 2008).

Haemonchus contortus is an abomasal parasite that follows a direct nematode life cycle. It is a voracious blood-sucker, and the main effect on the host is anemia, which can be evaluated clinically by examining the mucous membranes of the host. Named for its originator, the **FA**ffa **MA**lan **CHA**rt (FAMACHA©) system consists of a card with five color categories which is compared with the color of the conjunctival mucous membranes of the sheep or goat. The animal is classified into one of the five color categories, from 1 (non-anemic) to 5 (severely anemic). A decision to treat the animal or not is then made based on the FAMACHA© score, the age and production status of the animal, and general recommendations for the climatic region.

The use of a selective treatment strategy is founded on the concept that parasites are not equally distributed in host populations (Barger, 1985). Twenty to thirty per cent of the animals harbor most of the worms and are responsible for most of the eggs deposited in the feces on pasture. If this group of animals can be identified and treated, this will greatly reduce the daily pasture contamination. In the case of haemonchosis, FAMACHA© score has been shown to be negatively correlated with packed cell volume (higher score, lower packed cell volume) and positively correlated with fecal egg count (Kaplan et al., 2004). In practice, this means that the system may be used as an effective tool to identify those animals that are clinically most affected by the parasitism, or less 'resilient'. It should be noted, however, that the system has been validated in small ruminants for the control of *H. contortus* infection only.

Development and Validation of the FAMACHA© System

The first experiment, which led to the development of the actual FAMACHA© card, was conducted on a sheep farm near Badplaas, South Africa, in a climatic zone characterized by hot,

wet summers and mild winters (Malan et al., 2001). *Haemonchus contortus* was the predominant gastrointestinal parasite on the farm and the parasite population was highly resistant to multiple anthelmintics with only levamisole and morantel remaining effective. Furthermore, the sheep were maintained on irrigated pastures. Researchers, in collaboration with the producer, decided to test the possibility of grading the color of the ocular mucous membranes of the sheep as an indication of the extent to which animals were affected by *H. contortus* infection. From March to July 1991, routine drenching was stopped. Three hundred eighty-eight sheep were examined at weekly intervals and classified as red (subsequently designated FAMACHA© score 1), red-pink (2), pink (3), pink-white (4) or white (5). If the animal's mucous membranes were white or pink-white, or if the animal had submandibular edema ('bottle jaw'), its packed cell volume was determined, and if this was <15%, the sheep was treated with levamisole. In this manner, drenching was reduced by 90% compared with previous practices. Seventy per cent of the animals did not require drenching, 20% required one drench, 7% required two drenches, 2% required three drenches, and 1% required four drenches. The percentages of sheep requiring one or more drenches were higher in lactating and pregnant animals when compared with "dry" animals. Following this study, the chart itself was developed and tested further.

The first studies with the FAMACHA© system in goats were conducted in indigenous goats in South Africa (Vatta et al., 2001, 2002). Animals were scored with the card every 2-4 weeks during the late spring, summer, and early fall periods of 1998/1999 and 1999/2000, and blood samples for packed cell volume were collected. Goats were treated if scored as 4 or 5. Tests for sensitivity and specificity were applied to the data. Sensitivity is defined as the proportion of diseased individuals that test positive (Smith, 1995), or, in the case of the FAMACHA© system, the proportion of anemic animals (packed cell volume <19%) that are correctly identified as being anemic. Specificity is defined as the proportion of disease-free individuals that test negative, or, in the case of the FAMACHA© system, the proportion of non-anemic animals that are categorized as such. The data indicated that the sensitivity of the system was between 23.0% and 28.4%, and the specificity between 90.4% and 91.3%, when the packed cell volume cut-off for an anemic animal was considered to be <19%. However, when the animals scored as 3s, 4s, and 5s (as opposed to only 4s and 5s) were considered anemic and included in the analyses, the sensitivity improved to between 75.7% and 85.1%, but the specificity decreased to between 52.0% and 55.3%.

The FAMACHA© system was subsequently validated in the United States by members of the American Consortium for Small Ruminant Parasite Control. Kaplan et al. (2004) determined the sensitivity of the system was 92.2% for sheep and 93.9% for goats when animals with packed cell volumes ≤19% and FAMACHA© scores of 3, 4, and 5 were considered anemic. The corresponding values for specificity were 59.2% and 35.5%. This was based on data from Arkansas, Georgia, Louisiana, Florida, and the Virgin Islands, and the scoring was done by scientists. However, Burke et al. (2007), applying the same cut-offs, found that the values for sensitivity in the hands of producers in Georgia, Louisiana, Florida, and Puerto Rico were 59.2% and 66.3% for sheep and goats, respectively. The specificities were 68.8% and 64.5%, respectively. Mahieu et al. (2007) determined a sensitivity of 63.4% and a specificity of 71.3% for goats in Guadeloupe, French West Indies, when the scoring was done jointly by two technicians.

The FAMACHA© system has been further tested and/or adopted in several other countries, including Brazil (sheep: Molento et al., 2009; sheep and goats: Sotomaior et al., 2012; goats: Vilela et al., 2012), Morocco (sheep: Ouzir et al., 2011), Kenya (goats: Ejlertsen et al., 2006), Italy (sheep: Di Loria et al., 2009; Cringoli et al., 2009), and Switzerland (goats: Scheurle et al., 2010).

Recommendations for Use

Recommendations were developed for the use of the FAMACHA© system in the southern United States (Kaplan et al., 2004). Briefly, these include the following:

- Examine the animals at least every 2-3 weeks at the beginning of the expected period of *Haemonchus* challenge in climates where a seasonal incidence of infection occurs.
- During critical periods, examine the animals on a weekly basis.
- In adult animals, treat the 4s and 5s, but ensure that the flock or herd is in good body condition and good overall health.
- Specifically identify and treat animals that are unthrifty, anorexic, lagging behind the flock or herd, or have submandibular edema.
- If the flock or herd is not in good body condition and good overall health, treat the 3s as well.
- In lambs, kids, and periparturient animals, always treat the 3s.
- If ≥5-10% of the animals are anemic (4s and 5s), treat the 3s, 4s, and 5s, and change the pasture, if possible.
- Also treat the 3s when scores shift, indicating the outbreak of disease, for example, when a rapid downward trend in the 1s is seen, and there is a reciprocal increase in the 2s and 3s.

The recommendations that concern good husbandry, such as identifying unthrifty animals, are important because, while the FAMACHA© system has relatively good sensitivity in sheep and goats, there is a small possibility that anemic animals may be missed. The system must, therefore, be used in conjunction with other parasite control and good husbandry measures, including good grazing management, especially where non-*Haemonchus* infections occur. Currently, the system is increasingly being used within integrated parasite control programs (see, for example, Vatta et al., 2007; Miller et al., 2011; Spickett et al., 2012).

Advantages and Concluding Remarks

Use of a selective drenching approach will lead to reductions in anthelmintic treatment when compared with conventional drenching practices, and should slow down the development of anthelmintic resistance. This reduction in drenching was dramatically demonstrated in the Badplaas study (Malan et al., 2001). In the study by Mahieu et al. (2007), only 37.3% of the does scored according to FAMACHA© system required treatment. There were 0.57 doses administered per doe in the FAMACHA© group compared with 3 doses per doe in the controls.

Producers should be aware, however, that the benefits of reduced drenching may be somewhat offset by potential production losses. Van Wyk (2008) reported some production losses in two of three trials; in one of these, the losses were approximately 4.85 lb (2.2 kg) per sheep. On

many farms, however, sparing use of remaining effective anthelmintic groups remains the only manner in which anthelmintic resistance may be managed into the future.

The FAMACHA© system may be used to identify animals that repeatedly require treatment, to enable culling of those animals. Heritability of FAMACHA © scores has been shown to be relatively good (Riley and Van Wyk, 2009), and Burke and Miller (2008) were able to identify a superior sire for parasite resistance/resilience through the use of FAMACHA© scores.

The FAMACHA© system also has the potential to be used, following validation, as a diagnostic tool for anemia in other livestock species. It has been tested in camelids (Williamson et al., 2009) infected with *H. contortus*, as well as in cattle infected with trypanosomes (Grace et al., 2007).

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