Small Ruminant Research 92 (2010) 120–125

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Parasitological examinations in sheep health management☆

M.A. Taylor

Food and Environment Research Agency (FERA), Sand Hutton, York YO41 1LZ, England, UK

ARTICLE INFO

Article history:
Available online 28 April 2010

Keywords:
Sheep
PGE
Anthelmintic resistance
Fluke
Coccidia
Ectoparasites
Diagnosis
Detection

ABSTRACT

Sheep are parasitised by a diverse range of internal and external parasites. The majority of adult helminths and many of the ectoparasites affecting sheep, are grossly visible to the naked eye due to their size. With internal parasites, however, observation and detection of adult stages is generally only possible on post-mortem examination of the appropriate organs and viscera. More often, the presence of parasites in the gastrointestinal tract, lungs and liver can be detected by parasitological examinations of appropriate samples, usually faeces, for the presence of their eggs, cysts or larval stages. This review focuses on the clinical and laboratory diagnostic approaches to a number of important parasitic diseases of sheep, in particular, parasitic gastroenteritis and the detection of species showing the presence of anthelmintic resistance, as well as other diseases, such as liver fluke and coccidiosis. The diagnosis of ectoparasite infections is generally much more straightforward, because of their size and location on the skin. However, misidentification can occur without appropriate experience in parasite identification. Accurate and correct diagnosis is fundamental to good parasite control, otherwise inappropriate or consequential, apparent treatment failures may occur.

1. Introduction

Sheep can be parasitised by a diverse range of parasites, with well over 150 species of internal and external parasites reported worldwide. For a comprehensive checklist of parasites of sheep see Taylor et al. (2007). The majority of helminths and many of the ectoparasites affecting sheep are grossly visible to the naked eye. With internal parasites, however, visual detection of adult stages is generally only possible on post-mortem inspection of the appropriate organs and viscera. The focus of the review will be on the clinical and para-clinical laboratory diagnostic approaches to the detection of parasitism in sheep, rather than on post-mortem parasitological examinations.

The most important endoparasitic disease seen in sheep, is parasitic gastroenteritis (PGE), which is caused by a range of gastrointestinal (GI) nematodes, as it has a significant cost for sheep farming (West et al., 2009). Given its importance, and the emergence of nematode species showing increasing levels of resistance to one or more of the available anthelmintic groups (Papadopoulos, 2008), a large part of this review will focus on the parasitological techniques used in detecting and identifying the presence of pathogenic worm burdens though faecal sampling, as well as on the methods employed to determine their resistance status to anthelmintics.

The diagnosis of other important endoparasitic diseases found in sheep will also be reviewed. These include fasciolosis caused by the liver fluke, *Fasciola hepatica*; coccidiosis and cryptosporidiosis, caused by protozoan parasites of the genus *Eimeria* and *Cryptoporidium*, respectively. Other internal parasitic infections seen in sheep are generally of lesser importance and will not be discussed further in this review. These include adult tapeworms (*Moniezia*); several intermediate stages (metacestodes) of

☆ This paper is part of the special issue entitled "Sheep diagnostic medicine", Guest-edited by G.C. Fthenakis, P.G. Gouletsou, V.S. Mavrogianni and I.A. Fragkou.

E-mail address: mike.taylor@fera.gsi.gov.uk.

0921-4488/$ – see front matter.
doi:10.1016/j.smallrumres.2010.04.012

tapeworms (*Echinococcus* spp., *Taenia* spp.); lungworms (*Dictyocaulus*, *Muellerius*, *Protostrongylus*, *Cystocaulus*) and 'nasal bots' (*Oestrus*).

The diagnosis of ectoparasitic infections is much more straightforward, because the parasites are usually easily visible to the naked eye. Misidentification can however, lead to inappropriate or apparent treatment failure. Important ectoparasitic diseases of sheep are 'sheep scab' (psoroptic mange, caused by the mite *Psoroptes ovis*, or sarcoptic mange, caused by the mite *Sarcoptes scabiei*) and blowfly strike, caused by larvae of flies (*Lucilia*, *Calliphora*, *Protophormia*). Lice infestations (*Bovicola*, *Linognathus*) are also of importance in many of sheep-rearing countries. Many tick species also infest sheep and are capable of transmitting a number of diseases to them, but will not be covered in this review.

2. Gastrointestinal parasitism (parasitic gastroenteritis)

Diagnosis of PGE is generally based on clinical signs, seasonal occurrence of disease and, where possible, supported by post-mortem examination and worm burden enumeration. Most species of nematodes affecting the digestive tract cause diarrhoea. In contrast, acute haemonchosis (*Haemonchus contortus*) is characterised by anaemia, variable degrees of oedema (submandibular oedema and ascites are the forms more easily recognized), lethargy, dark coloured faeces and sudden death (Taylor et al., 2007). Diarrhoea is not generally a feature. Pallor of the mucous membranes is striking and can be assessed by inspection of the conjunctivae using the *FAMACHA*© assessment system (Kaplan et al., 2004; Bath and van Wyk, 2009), rather than the oral mucosa or skin where differentiation from a normal appearance is difficult. Faecal Occult Blood (FOB) testing as a means of predicting the severity of *H. contortus* infections has also been used (Colditz and LeJambre, 2008). This utilises a dipstick type of approach and uses the fact that blood can be detected in host faeces, as a result of worm feeding activity before there is a significant rise in faecal egg counts (FEC). A fluorescent microscopy technique for the differentiation of *H. contortus* eggs from other species, using the lectin binding characteristics of nematode eggs has also been reported (Colditz et al., 2002). The laboratory-based technique uses a fluoroscein isothiocyanate (FITC)-labelled peanut agglutinin (PNA) lectin. Lectin binding exhibits a genus specific pattern, with *Haemonchus* spp. staining strongly positive with PNA.

Faecal consistency and appearance also provide clues regarding possible species identity and presence. Pelleted faecal samples with moderate to high FEC are generally indicative of *H. contortus* infections. Dark, foul-smelling, diarrhoeic faeces are rather suggestive of *Trichostrongylus* infections. Faecal egg counts are a useful aid to diagnosis, although faecal cultures are necessary for generic identification of larvae and are described in more detail below.

2.1. Monitoring of faecal egg counts

Monitoring of faecal egg counts (FEC) can be undertaken in a suitably equipped and trained veterinary practice or via a commercial laboratory. An on-farm approach is also available in some countries using the FECPAK system (McCoy et al., 2005).

2.1.1. Collection of faeces

Sheep may be sampled individually or as a group, to determine a mean FEC. Fresh dung samples should be collected either from the pasture or alternatively directly from the rectum. At least ten sheep in a group should be sampled. The wide variation in FEC between sheep grazing together in the same field means that random sampling effects have a significant impact on the confidence limits surrounding the estimate of the group mean FEC. Samples should be fresh when collected and kept cool (not frozen) in an airtight container or plastic bag, before delivery to the laboratory within 48 h. If faeces are too old, some eggs will have hatched and the reported egg count will be an underestimate (Abbott et al., 2004, 2007).

2.1.2. Faecal egg counts (FEC)

Described FEC or coproscopic methods are either qualitative or quantitative. Qualitative methods provide information on the species present, whereas quantitative methods provide an indication of the levels of infections. Both have their own importance in determining the health status of a flock and determining appropriate treatments and control measures. Examination of faeces for helminth eggs may vary from a simple direct smear to more complex methods involving centrifugation and the use of flotation fluids (MAFF, 1986).

Flotation methods involve separating the eggs from faecal debris using a variety of flotation solutions with specific gravities, such that worm eggs float to the surface of the suspension. Nematode and cestode eggs float in a liquid with a specific gravity between 1.10 and 1.20; trematode eggs, which are much heavier, require a specific gravity of 1.30–1.35. The flotation solutions used for nematode and cestode ova are mainly based on sodium chloride (NaCl) or sometimes magnesium sulphate ($MgSO_4$). A saturated solution of these is prepared and stored for a few days and the specific gravity checked prior to usage. The standard quantitative technique and the one most widely used is the McMaster method (Gordon and Mc Whitlock, 1939; Whitlock, 1948), of which there are various modifications reported in the literature. Reported methods differ in the weight of faeces examined, in the flotation solution used (chemical salt, level of saturation and volume), in the flotation time, in the presence or absence of a centrifugation step, in the design and number of McMaster counting chambers, in the counting method and multiplication factors employed and in whether any correction factors are used to allow for faecal consistency (Dunn and Keymer, 1986; MAFF, 1986; Cringoli et al., 2004). Quantitative FEC results are normally expressed as egg per gram (epg) of faeces. Problems can however, occur when analysing and comparing the results obtained by different laboratories on the same samples. Therefore, there is a need to provide some degree of standardisation of the numerous modifications of the McMaster method (Cringoli et al., 2004; Coles et al., 2006), particularly where these are used in the determination of the presence of anthelmintic resistance by using