Control of liver and rumen fluke in cattle

This document is part of the COWS Technical Manual which aims to provide a sound basis for advice to industry.

The manual also comprises chapters on Roundworms, lungworm, ectoparasites and integrated parasite control.

COWS
Control Of Worms Sustainably

COWS is an industry initiative promoting sustainable control strategies for parasites in cattle

With thanks to Professor Diana Williams, University of Liverpool for help and guidance in updating this COWS chapter

Section 1: Top tips for controlling liver fluke in cattle

IInformed and sound preparation will minimise liver fluke infection with positive effects on enterprise returns.

Identify Risk

1. The presence of sheep on pastures also grazed by cattle. Infected sheep will lead to the presence of metacercariae on pasture which are also infectious to cattle
2. Buying in animals. Bought-in animals may introduce fluke to previously clean pastures and can pose a serious risk for the introduction of flukicide-resistant parasites. This reinforces the need for effective quarantine procedures
3. Length of grazing season. The more time spent on grass, the higher the risk of infection, especially during the autumn when metacercariae numbers will peak

Treat Appropriately

Consider the 5 'R's for the effective use of flukicides:

1. Use the RIGHT flukicide
   - Flukicides belong to different classes, each of which are active against different developmental stages of fluke
   - Products should be chosen to target the specific stage of development that is most likely to occur, or is already identified as present on-farm
   - Other considerations, such as withdrawal periods and any known resistance issues should also be taken into account
   - Farmers should consult with the vet, Suitably Qualified Person (SQP), farm adviser or veterinary pharmacist for detailed advice on choosing the right product for specific on-farm problems
   - Only use products legally authorised for use against a particular parasite species or type of stock in the UK
2. Treat the RIGHT animal
   - There is nothing to be gained from treating animals that have never been exposed to metacercariae. However, if they are grazing 'flukey' pastures, any animal can be exposed to high levels of metacercariae
   - Effective treatment of animals at risk will reduce egg contamination onto pasture
   - There is little evidence that cattle develop immunity to liver fluke infection, so animals of all ages must be included in liver fluke control plans
3. Treat cattle at the RIGHT time
   - There is no 'one-size fits all' solution to liver fluke control. Treatment depends on assessing various factors including pasture-risk, animal type and time of year
4. Dose cattle at the RIGHT rate
   - In most situations, anthelmintics are administered at a specific dose rate (ml) according to the animal's live weight (kg). It is therefore important to:
     - Read the product label or Summary of Product Characteristics (SPC)
     - Ensure dosing equipment is well maintained, clean and calibrated
     - Weigh animals or use a weigh band to calculate the correct dose for each animal
5. Administer the treatment in the RIGHT way
   - Flukicides can be administered to cattle in different ways. These include injections, pour-on products and oral drenches
   - Always read the product label to ensure the selected product is administered in the correct way. Flukicides should not be mixed with any other products
6. Resistance to triclabendazole is increasingly prevalent in sheep. As the same parasite affects sheep and cattle, it is important to have an effective fluke control plan for cattle that reduces the risk of resistance spreading. If you suspect resistance, arrange a drench test, i.e. a Faecal Egg Count Reduction Test (FECRT), with the vet/SQP
7. Quarantine all incoming stock – sheep as well as cattle, from potential fluke areas for liver fluke as well as roundworms. This will take considerable planning but failure to do so could result in importing resistant liver fluke from another farm,

as well as losses and/or reduced performance in the animals. Refer to guidelines on the COWS/SCOPS website (www.cattleparasites.org.uk and www.scops.org.uk) and discuss with the vet/SQP

8. Be Prepared. Don't wait until the losses are mounting up. Act now to work with the vet or SQP to plan ahead in terms of management control options, treatments and monitoring that can be put in place

Section 2: Introduction to Liver fluke

The liver fluke (*Fasciola hepatica*) is a common and ubiquitous parasite affecting the health and welfare of cattle worldwide.

Evidence from various sources suggests the prevalence for infection has increased considerably in recent years for a variety of reasons including:

- Climate change
- Changing farming practice
- Increased farm animal movements

There are now severe triclabendazole resistance problems in 'flukey' areas and evidence of problems in lower risk areas. Closantel resistance has been reported outside the UK.

Fluke can modulate the host's immune system. This affects diagnosis of bovine tuberculosis and susceptibility to other pathogens such as *E.coli* 0157, *Clostridia* and *Salmonella* Dublin.

Control of fluke in cattle requires a thorough understanding of the biology of the parasite, its life cycle and epidemiology and the control options available for each individual farm.

Disease

The disease caused by *F. hepatica* is known as fasciolosis. Cattle typically develop chronic disease and classically show loss of weight and condition and may become anaemic. Sometimes cattle develop diarrhoea, but whether this a direct consequence of fluke infection or due to other reasons, such as co-infection with *Salmonella* Dublin, is not clear.

Severity of disease depends on the number of parasites present in the animal. Livestock become infected by ingesting the infective stage, the metacercaria, which contaminates grass and other vegetation. These hatch in the small intestine and migrate across the gut wall directly into the liver.

The juvenile flukes migrate through the liver tissue, feeding and growing until they reach the bile ducts.

Figure 1: Liver showing fluke damage

Signs of fasciolosis

- Weight loss
- Poor weight gain
- Reduced milk yield

The migrating flukes cause liver damage, destruction of tissue and haemorrhage. In sheep, this causes acute disease and commonly death of animals. However, acute disease is seen rarely in cattle in the UK.

Once the fluke reach the bile ducts, they mature into adult egg-laying parasites.

The spines on the surface of the flukes damage the bile duct walls as they move and the adults feed on blood. This causes biliary hyperplasia, calcification of the bile ducts and enlargement of the gall bladder. The greater the number of fluke present, the more severe the liver damage and the more serious the disease.

Cattle infected with lower fluke numbers rarely show overt clinical signs, but sub-clinical effects become apparent. In dairy cattle, this manifests as reduced milk yield, changes in milk quality and can also affect fertility.

In younger stock, sub-clinical infection may result in reduced feed conversion ratios, poor growth and reduced carcase value, including liver condemnation (Figure 1). Whilst these effects on health may be subtle, the economic impact can be considerable.

Section 3: The parasite

Liver fluke biology

Liver fluke are trematodes and have a very different life cycle from nematodes.

Other trematodes include:

- The paramphistomes, including rumen fluke (see Section 7)
- *Dicrocoelium dendriticum*, the lancet fluke

Mature liver fluke are large, leaf-shaped flatworms; 3cm to 5cm long and 1cm wide (Figure 2).

They are hermaphrodite and each parasite has both male and female sex organs. They feed by secreting and excreting enzymes which break down blood and tissue.

Liver fluke parasitise a range of animals. Sheep and cattle are the main hosts in the UK, but deer, hares and rabbits can also be infected.

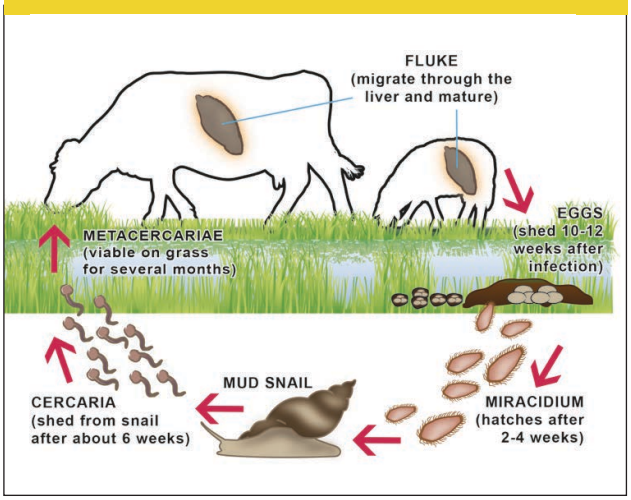
Liver fluke can also cause disease in llamas, alpacas, reindeer, donkeys, horses and buffalo.

The World Health Organisation considers *F. hepatica* to be an important threat to human health in some developing countries.

Figure 2: A mature liver fluke

Sinclair Stammers, Micromacro

Figure 3: Liver fluke life cycle



Life cycle

Liver fluke have a complex life cycle involving an intermediate host, the mud snail *Galba truncatula*. This snail species plays an essential part of the life cycle (Figure 3).

Adult fluke can produce hundreds of eggs each day and these are passed out in the dung of infected hosts. They can take up to one month to develop, depending on external temperature. If it is summer and it is warm, development is rapid. Little development occurs in winter when temperatures fall below 10°C.

When the egg has developed, it hatches and the microscopic miracidium is released. The miracidium only lives for a few hours and requires water to swim through to reach the snail.

Once it finds a suitable snail, it burrows through the snail's foot and into the body cavity. Here the fluke grows and multiplies. This takes about six weeks and again is dependent on temperature – the warmer the weather, the faster the development.

The next stage of the fluke – the cercaria, is then released from the snail. A snail infected with a single miracidium can produce more than 600 cercariae, as there is amplification of the parasites in the snail.

Cercariae swim through water and reach grass and vegetation around the habitat were the snails live. Here they form infective cysts called metacercariae. These can remain viable on pasture for several months, depending on the weather.

When eaten by a grazing animal, the cysts are swallowed, hatch and burrow through the gut and into the liver.

It takes about eight weeks for flukes to complete their migration through the liver and reach the bile ducts. Eggs can be detected in the dung about 10 to 12 weeks after infection.

Section 4: Environment and epidemiology

Environment

For liver fluke to be found in animals on a farm, mud snails must also be present.

These live in mud around the edges of ponds, streams, rivers and hoof prints or tractor ruts in muddy fields. They tend not to be found in areas that are shady or heavily poached. They prefer slow moving water with a neutral pH. They also need calcium and other minerals for good shell growth.

Snails reproduce rapidly in warm, wet summers. Warm temperatures increase development of the fluke as well. Both the snails and the fluke need water, so wet summers with high rainfall increase the risk of fluke infection.

Historically in the UK development of fluke stages outside the host occurs from May to October. However, the trend towards earlier springs and milder winters is increasing the length of the transmission season. The effects of this can be cumulative over a number of years.

UK winter months are generally too cold for liver fluke to develop. Snails go into hibernation and stages of the parasite in the snail at the start of winter also stop developing.

Eggs can survive on pasture over winter and when the weather warms up in spring, the eggs develop, snails come out of hibernation and the parasite life cycle resumes.

Metacercariae can also survive on pasture over winter and stock turned out in spring are at risk from (normally) low levels of infection.

High risk conditions

- Wet muddy areas
- Warm summer weather
- High summer rainfall

Peak risk periods

- Stock infected late summer/autumn
- Disease seen late autumn/winter
- Risk lower after very dry summers

Epidemiology

Fasciolosis is a seasonal disease, with a peak of infective cysts on pasture in late summer/autumn leading to disease in cattle over winter.

Liver fluke can only develop in the environment and the snail at temperatures >10°C, and the snail requires temperatures of >10°C to reproduce. Hence, most development occurs from May to October in the UK and, if conditions are ideal over the summer, large numbers of metacercariae are released from snails onto pasture from late August to October. This leads to disease associated with the adult flukes in bile ducts, normally in late winter to early spring and can occur in housed cattle if they have not been treated with an appropriate flukicide after housing.

When the weather is less favourable, for example after a dry summer, snail and fluke development is slower. This results in fewer cysts on the pasture in the autumn and their release is more gradual. Cattle become infected and although they may not develop clinical disease, there may be sub-clinical effects on productivity.

Whilst there is a peak in the number of infective cysts on pasture in late summer/early autumn, low numbers of infective cysts can be present on pasture all year, including over winter. This is because cysts can survive on pasture for several months when conditions are neither too dry nor too hot. Infected snails that have hibernated over winter can release low numbers of metacercariae onto pasture when they come out of hibernation in spring.

Cattle grazing contaminated pasture, even early in the season, are at risk of infection. This may not lead to clinical disease, but these animals pass eggs in their dung, which go on to infect snails, perpetuating the situation. When winters are mild, fewer snails perish and more will be present in spring, ready to become infected as eggs develop and hatch.

There is little evidence that cattle develop immunity to fluke infection. Infection can be picked up at any time and animals can be repeatedly infected.

Survival of metacercariae

It is thought that metacercariae can survive on pasture for a year or more, but a proportion will die off over that time.

Experimental studies suggest that 10% of metacercariae survive for one year at temperatures of 2–5°C. Their survival depends on moisture and moderate temperatures. Metacercariae will not survive for more than six weeks at 25°C, but can survive for eight weeks at temperatures of -2°C.

It has been estimated that 50% of metacercariae will survive a normal UK winter. Heat and drought will kill metacercariae.

Studies at the University of Liverpool suggest that metacercariae do not survive in silage produced under anaerobic conditions. There is no information about their survival in haylage and in hay it is unclear.

One study conducted in 1927, suggested that metacercariae survived for eight months in hay that had been harvested in rainy weather, with a relative humidity of >90% and that was stored at low temperatures.

Another study showed that when metacercariae were placed in hay, they survived for two to three months when stored at low temperatures. It is not clear if metacercariae will survive in hay produced under normal farm conditions.

Freshly cut grass should be regarded as a potential source of infection if harvested from fluke-contaminated pasture.

Section 5: Diagnosis

Diagnosis is important to establish if liver fluke is the cause of disease or production loss.

Abattoir reports are useful in establishing if liver fluke are present on the farm. Other herd tests, such as bulk tank tests and composite faecal egg count tests, should be regarded as the first step in investigating the presence of fluke. They are also useful monitoring tools if it is necessary to implement a control programme.

For individual cattle three diagnostic tests are used widely:

1. Faecal egg counts (FEC). FEC lack sensitivity, particularly in cattle and can only detect patent infection. Diagnostic sensitivity ranges from 30–70%, depending on the amount of faeces sampled. Increasing the amount of faeces analysed to more than 30g per animal, can increase sensitivity to 90% (Figure 4)
2. An Enzyme-linked Immunosorbent Assay (ELISA) that detects antibody in serum and milk samples can detect early, pre-patent infection, from two to four weeks after infection. However, serum antibodies are known to persist for four to ten weeks after treatment, so a positive ELISA result does not prove that an infection is actually present – rather that the cow has exposed to the parasite. The sensitivity of most antibody-detection ELISAs is high – ranging from 86–100%, with specificities ranging from 83–96%

Figure 4:

3. A copro-antigen detection ELISA for use on faecal samples is commercially available in the UK. In sheep this test is useful for detecting infection slightly earlier, before eggs are detected in faeces

In individual animals, liver enzymes, gamma-glutamyl transferase (ɣ-GT) and glutamate dehydrogenase (GLDH), may be raised, but this is not pathognomic.

Diagnostic test

- Antibody detection via blood or milk samples
- Checking dung samples
- Copro-antigen ELISA

Dairy herds

Bulk tank ELISAs are used routinely to establish the presence of infection within the herd. They indicate high, moderate, low or no infection and can be done three or four times a year to monitor levels of infection and efficacy of control programmes. Several milk testing laboratories have the capacity to test routinely for liver fluke.

Dairy and beef herds

Composite faecal egg counts can be informative. Normally at least 5g of dung are required from each of ten animals and a single sedimentation assay carried out. This reduces the cost of diagnosis but can only provide information about whether the parasite is present within the herd and to prompt further investigation.

All the caveats about individual egg counts apply to composite egg counts. Bear in mind that fluke egg shedding can be intermittent and the absence of eggs does not necessarily mean that animals are fluke-free. They may be harbouring immature liver fluke, which are too young to lay eggs.

Other factors should be taken into account when diagnosing infection including herd history, time of year and weather conditions over the summer months. The National Animal Disease Information Service (NADIS) provides useful monthly updates on fluke risk for regions of Great Britain. However, it is important to recognise that risk will vary between individual farms within an area, depending on the farm environment and management practices.

Section 6: Control

Control of fasciolosis depends on the type of farm, the history of the herd and should involve both management and chemical treatment options.

Infection pressure will depend on prevailing weather conditions and varies year to year.

Each programme should be tailored to a particular farm, designed in consultation with the vet, considering grazing and treatment plans for the whole year. It is important to:

- Establish if fluke infection is present
- Identify 'flukey' pastures, for example those with marshy/muddy areas which provide ideal snail habitat
- Design a programme for the whole farm, taking into consideration all stock, regardless of age and species

Most programmes will require the use of flukicides to prevent disease and reduce contamination of pasture with eggs, plus grazing strategies to avoid having heavily contaminated pasture, particularly in the autumn.

There is a range of products available for use in cattle, but care must be taken to select the right product for the specific purpose required, to dose animals according to the product information leaflet and to observe meat and milk withdrawal periods.

Triclabendazole is the only product effective against very early immature fluke that are two weeks and older through to adults. It is used extensively to control liver fluke in sheep and a result, triclabendazole resistance has been reported in many parts of the UK. It is important to remember that the same parasite affects cattle and sheep. Triclabendazole resistance to liver fluke has been reported in cattle in the UK.

It is vital that the triclabendazole resistance status is established for each individual farm before a control programme is developed. A Faecal Egg Count Reduction Test (FECRT) can be used, especially on farms where there are also sheep.

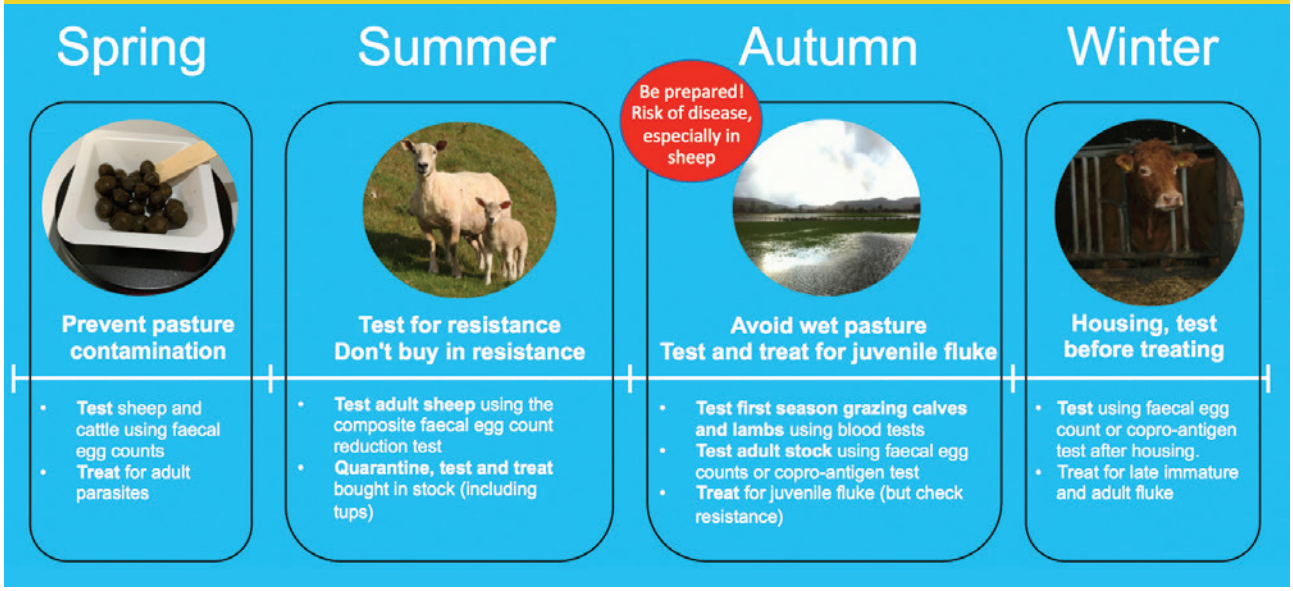
If parasites on a farm are demonstrated to be susceptible to triclabendazole, products containing this active ingredient can be included in the control programme.

Dosing around housing in autumn is a useful control option for beef cattle. The choice of product will depend on the triclabendazole resistance status, the infection pressure of the year and the meat withdrawal times.

Control of fluke in dairy cattle is more difficult with few treatment options available.

See Parasiticide resistance in the 'COWS Integrated

Figure 5: The Liverpool Fluke Plan



Parasite Control' chapter for more information.

Flukicides have no persistent activity and allowing cattle onto fluke-infected pasture after treatment re-exposes them to risk of infection.

If cattle are housed after treatment, there is a very low risk of picking up new infection until they are turned out again. If cattle are turned back out after treatment, use tactics such as moving them to low-risk areas or fencing off risky areas.

If cattle remain on highly contaminated pasture, monitoring for infection is essential, as further treatments may be needed.

Many flukicidal medicines are sold in combination with medicines used to treat roundworms as well as fluke. It is important to use these only when both parasites need to be targeted, for example at housing.

Treatments that target all stages of fluke, that is triclabendazole, and hypobiosed/arrested nematode larvae, should be given two weeks after housing for optimum fluke control.

Treatment of milking cattle is problematic. Two products are licenced for use in milking herds; albendazole and oxyclozanide, which have withdrawal periods of 60–72 hours and 108 hours, respectively.

Fasinex 240 can be used at drying off, but not within 48 days of calving and milk for human consumption may only be taken from 48 hours after calving. Should a cow calve earlier than 48 days after treatment, milk for human consumption may only

Table 1: Summary of different flukicidal products licenced for use in cattle*

Active Ingredient	Administration Route	Stage of liver fluke killed
Triclabendazole	Oral	2 weeks onwards
	Pour-on	6–8 weeks onwards
Closantel	S/c** injection or pour-on	7 weeks onwards
Nitroxynil	S/c** injection	8 weeks onwards
Clorsulon	S/c** injection	Adults only
Oxyclozanide	Oral	Adults only
Albendazole	Oral	Adults only

*Note: This information was correct when this document was updated (December 2019). Current data sheets must always be checked before treatment. **Sub-cutaneous.

Use the product most suitable for the time of year and management of the cattle involved. See the COWS Flukicide Product Table (December 2019) at www.cattleparasites.org.uk for all products available.

be taken from 50 days after the last treatment was administered.

Liver fluke take approximately 10–12 weeks to mature, following ingestion of infective stages and not all flukicides are effective against all immature stages. It is important to choose an appropriate product and to administer it at the correct dosage and at the most suitable time, according to the life cycle of the parasite.

The COWS group strongly advises farmers to discuss product choice with their vet or SQP as part of their Herd Health Plan. (Figure 5: The Liverpool Fluke Plan).

The choice of drug will be influenced not only by the risk of infection, but also by its meat/milk withdrawal period, the risks posed by other parasites and the ease of administration.

Table 1 summarises the main treatment options in relation to when they are best used post-housing.

Quarantine treatments

Bringing in cattle or sheep from markets, other farms or common grazing can introduce fluke, including those that are resistant to triclabendazole.

If there are no snails on the farm, the life cycle cannot be completed and there is no risk. However, since the *Galba truncatula* is found throughout the UK, unless established otherwise, it is better to assume that every farm has suitable snail habitat.

The aim of quarantine treatments is to minimise the risk of introducing resistant liver fluke onto the farm and importantly, to avoid contamination of pastures.

Quarantine measures should be applied to all incoming livestock. This includes those purchased or hired from other herds and flocks, including bulls and rams, and cattle and sheep that have been grazing on other farms or common grazing, including tack sheep.

Step 1 – House

Keep newly arrived cattle inside, yarded or on snail-free pasture away from other livestock, until quarantine treatments have been completed, the animals have been tested and results show they are free of infection. This will reduce the risk of introducing resistant fluke onto the farm.

Step 2 – Treat

It is safest to assume that brought-in animals are infected with resistant liver fluke. Where new animals can be housed or kept on snail-free pastures, treatment can be delayed until the fluke are sufficiently mature to be killed by the chosen product. If cattle are treated immediately, they may need a second treatment to kill any fluke that were too young to be killed by the first treatment.

Step 3 – Test

Do not turn animals out onto pasture that might be harbouring snails until they are free from infection. This means checking dung for fluke eggs post-treatment to check all fluke have been killed.

Use the product most suitable for the time of year and management of the cattle involved. See the COWS Flukicide Product Table (December 2019) at www.cattleparasites.org.uk for all products available. Alternatively, the copro-antigen test offered by a number of different diagnostic labs can indicate if treatment has been successful. It is recommended that dung samples are checked six weeks after treatment to ensure no fluke has survived. If cattle are positive, it could indicate the need for re-treatment to remove parasites that have matured since the first treatment.

Information on individual products is available in the NOAH Compendium of Data Sheets for Animal Medicines at www.noahcompendium.co.uk or from the product manufacturer.

Always check the latest product data sheet and/or product label before advising on or administering products.

Section 7: Rumen fluke

Rumen fluke (*Calicophoron daubneyi*) is a type of paramphistome and has worldwide distribution. It is considered to be an important parasite in a number of ruminant species, particularly in tropical and sub-tropical areas.

They are 0.5–1cm long and resemble pink, fleshy maggots on the surface of the rumen and reticulum (Figure 6).

Rumen fluke have been found increasingly in British and Irish livestock over the past ten years.

Epidemiology

For decades it has been assumed that the principal rumen fluke species infecting British and Irish livestock is *Paramphistomum cervi*, which has a wildlife reservoir in deer and is known to favour aquatic snails as their intermediate host.

However, using DNA analysis of rumen fluke specimens from homebred sheep and cattle, has shown the major species now affecting both species in the UK is *Calicophoron daubneyi*. This species uses *Galba truncatula* as its intermediate host, the same mud snail used by liver fluke.

Diagnosis

Rumen fluke are diagnosed through the presence of rumen fluke eggs in dung samples or rumen fluke parasites in the intestine or rumen at post-mortem.

Dung samples are processed in exactly the same way as for liver fluke diagnosis ie, sedimentation in water.

Their eggs also look similar, although rumen fluke eggs are more variable in shape and are clear, as opposed to the golden colour of liver fluke eggs.

Disease

Generally, mature rumen fluke are not thought to cause clinical disease. Where disease has been reported, it has invariably involved large numbers of immature rumen fluke in the intestine, usually in the duodenum, and typically found in youngstock.

This results in severe enteritis characterised by ill-thrift and profuse, fetid diarrhoea. In severe cases it has proved fatal in both cattle and sheep.

Figure 6: Adult rumen fluke on the surface of a bovine rumen

Whilst the clinical importance of rumen fluke is under debate, these parasites are significant from a diagnostic perspective.

Liver fluke and rumen fluke are often found as co-infections and because their eggs are similar, this could lead to mis-diagnosis and/or mis-interpretation of treatment outcome.

A differential diagnosis is important because there are only a few flukicides than can kill rumen fluke. Treatment of livestock for rumen fluke in the absence of confirmed clinical signs, is not recommended.

Treatment

Only one flukicide, oxyclozanide, has reported activity against adult and immature rumen fluke. However, none of the commercial flukicides containing oxyclozanide, either on its own or in combination with levamisole, have a specific label claim for rumen fluke.

Consequently, SQPs cannot prescribe oxyclozanide for rumen fluke and farmers should seek advice from a vet.

Oxyclozanide is a medicine that kills liver fluke in its own right but is only capable of killing adult liver fluke. Using it on its own at certain times of the year may leave stock, especially sheep, unprotected against acute liver fluke infections.