International Journal of Global Science Research ISSN: 2348-8344 (Online)
Vol. 11, Issue. 2, October 2024, pp. 2466-2477 DOI: https://doi.org/10.26540/ijgsr.v11.i2.2024.282
Available Online at www.ijgsr.com

Review Paper

Prevalence, diagnosis and management of fasciolosis in livestock

Sajana Rai
Livestock Service Office, Bharatpur, Chitwan, Nepal
Email: raisajana2079@gmail.com

Received: 13/09/2024
Revised: 20/09/2024
Accepted: 28/09/2024

Abstract: *Fasciola gigantica* and *F. hepatica* are two types of liver flukes that cause fasciolosis in domestic animals such as pigs, sheep, goats and cattle. The disease is very common and can drastically lower fertility, milk production and weight gain. This review investigates the fascioliasis prevalence, economic loss, diagnosis and management. Fascioliasis can arise due host, parasite and environment. More precise and direct identification of Fasciola hepatica antigens in fecal samples is now possible because to the introduction of copro-antigen detection assays. Early diagnosis is possible using an indirect enzyme linked immunosorbent assay (IEA). Drugs namely Albendazole, Oxyclozanide and Triclabendazole are frequently used for the control of this disease. Vaccination is not commonly employed because of an incompatible immunological response. Managing pastures to include making the environment unfriendly to the intermediate host (snail) is one efficient way to lower infection rates.

Keywords: Fascioliasis, Snails, Cirrhosis.

Introduction:

Numerous bacterial, fungal, viral and parasitic diseases affect domestic livestock and lower animal productivity and efficiency. Fasciolosis, sometimes called liver rot, distomatosis and fascioliasis are brought on by trematodes, specifically the common liver flukes *Fasciola hepatica* and *Fasciola gigantica*. Although distributed practically everywhere in the world, the F. hepatica species is mostly found in temperate zones, whereas the F. gigantica species is found mostly in tropical regions (Andrews, 1999). According to Khan *et al.* (2009), both species are spread among livestock by the Lymnaeidae family of snails, which can cause both acute and chronic infections and blood loss. Mature flukes reside in the bile ducts, while young flukes, extremely infrequently, reside in the liver's parenchyma. They have a laurel leaf-like appearance and are essentially flat. The adults have a dirty gray to brownish appearance and measure 18–30 mm in length and 4–13 mm in width. The intermediate host, a snail that primarily inhabits water, is needed for the eggs, which are expelled through feces. Before attaching themselves as cysts to the ground plants, the parasites go through several phases in snails. During grazing, the host takes it up from there. The young fluke emerges once the host's gastrointestinal tract dissolves the cyst wall. It enters the

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liver through the intestines and penetrates there. Regardless of location, ruminant Fasciola infestations result in significant loss and pose a major risk to the socioeconomics of cattle husbandry in terms of milk and meat production and human health. There are several potential contributing elements, including the host, parasite and environment, to the development of fascioliasis (Maqbool *et al.*, 2002). Numerous studies have documented that important risk factors for bovine fasciolosis include animal characteristics such sex, age, and breed, livestock management, climate and area elevation (Jaja *et al*., 2017; El-Tahawy *et al.*, 2017). Goats (2.35%–15%), cattle (10.79%), buffaloes (10.79%), and sheep (2.78%–8.98%) have all been reported to have varied percentages of fasciolosis infection in India (Garg *et al.*, 2009). Fasciolosis is more common in Boss taurus, or the Friesian breed, than in Boss indicus (Castelino and Preston, 1979) and Friesian Holsteins are 2.63 times more likely to have it than Friesians or Holsteins (El-Tahawy *et al.*, 2017). According to Bhusal *et al.*, (2020), improved/cross breeds have a greater prevalence of fasciolosis (15.75%) than indigenous breeds (12.5%). Simbwa *et al.* (2014) found 25.5% in local and 54.8% in exotic, which is consistent with this result. Younger calves had a greater infection rate, according to studies by Nath *et al.* (2016) and Bista *et al.* (2018). This could be explained by the fact that, compared to heifers and adult animals raised for food, calves have a lower immune system to ward against diseases. Fasciolosis in cattle results in anemia, hypoproteinemia, bottle jaw condition, reduced body weight, decreased rectal temperature and ruminal motility, decreased serum Cu, Fe, and Mg, increased heart and respiration rates, and more. In chronic cases, the disease also causes reduced production (Siddiki *et al.*, 2010). There are several methods available for the diagnosis of fasciolosis through immunological and molecular techniques. However, faecal testing methods for egg identification are considered the gold standard for diagnosing trematode infections such as fasciolosis (Esteban *et al.*, 2014).

In order to prevent fascioliasis from developing, medication is essential since afflicted animals excrete eggs. Several anthelmintics are effective in destroying parasites at different stages of their life cycle (Boray, 1986). Due to resistance resulting from the indiscriminate use of anthelmentics, the disease has not been totally eradicated (Boray, 1990). Certain older drug combinations work quite well against both immature and mature flukes (Boray, 1994). As a broad spectrum anthelmintic that is also active against helminth in the gastrointestinal system, which can negatively impact milk production (Charlier *et al.*, 2007), Albendazole is the most commonly used medication in dairy herds infected with F. hepatica (Mezo *et al.*, 2008). Drugs like Triclabendazole, which are effective against all stages of the parasite, should result in a bigger improvement in milk yield as Oxyclozanide is the only medication that works against adult flukes older than 14 weeks (Boray, 1986; Richards *et al.*, 1990). Pasture management and rotational pasture are important for controlling of snail, the host of liver flukes. The objective of this review study was to explore the useful information regarding the prevalence, diagnosis and management of Fasciolus in cattle to prevent economic loss in farms

Milk reduction and economic loss

Fascioliasis, caused by *Fasciola hepatica* or *Fasciola gigantica*, can significantly impact on milk production in cattle, leading to economic losses for dairy farmers. The parasite primarily affects the liver and bile ducts, leading to various

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Available Online at www.ijgsr.com

physiological disturbances that ultimately reduce milk yield. Charlier *et al.* (2007), Khan *et al.* (2009), Mezo *et al.* (2011), Charlier *et al.*, (2012) found that milk yield in cattle was reduced due to liver fluke infection. Howell *et al.* (2015) showed a reduction of 15% in milk yield due to liver fluke infection. Fluke infection had a significant effect on the content of butterfat and milk protein (Köstenberger *et al.,* 2017; Charlier *et al.*, 2007; Khan *et al.*, 2009). About 6% reduction in milk production was noted in herds due to F. hepatica by Köstenberger *et al.* (2017) Howell *et al.* (2015) found that in a situation with high incidence and high-yielding dairy herds, there was 15% drop. However, a reduction of 18–32% has also been seen in herds with low productivity. According to Mehmood *et al*. (2017), the livestock industry loses USD 3.2 billion annually due to liver infections caused by Fasciola spp. worldwide. In a Chinese study of sheep, the total prevalence of these helminths was estimated to be 28.5%; the higher prevalence indicated that better management methods were required (Wang *et al.*, 2006). The various effects of fasciolosis on livestock production is given in Table 1.

Table 1. Effect of fasciolosis on livestock production

Category of cattle	Parameter	Impact	References
Dairy cattle	Milk yield	Decrease of 2 kg/cow/day	Skuce and Zadoks, 2013).
		15% milk reduction in UK herds Decrease of 0.7 -1.5 kg/cow/day in European herds	Howell *et al.*, 2015
	Milk quality	Decreased butterfat content	Schweizer et al 2005
Beef cattle	Growth rate	10-15% reduction in daily liveweight gains	Schweizer et al 2005

Table adapted from Colston and Mearns (2023).

Prevalence and epidemiology

Otto Muller made the first detection of liver fluke cercariae from a pond in 1773 (Andrews, 1999). The habitat where snails typically inhabit is the edges of ditches, marshlands, and stagnant ponds (Ulmer, 1971; Saladin, 1979). This may be the cause of the higher occurrence of fascioliasis in animals that bathe in stagnant water. The prevalence of fascioliasis is greatly influenced by climatic conditions. (Rangel-Ruiz *et al.*, 1999). According to Maqbool *et al.*(1994, 2002), Siddiqui and Shah (1984), Chaudhry and Niaz (1984), Masud and Majid (1984) and Sahar (1996), both F. hepatica and F. gargantuan are common in Pakistan. A highly dangerous liver parasitosis called fascioliasis, which affects human and animal species worldwide, is spread by freshwater lymnaeid snails. The disease is caused by trematode species of the genus Fasciola. In turn, the presence and population dynamics of a particular intermediate host species are linked to the presence of suitable mater bodies and to appropriate climate characteristics that facilitate fluke development.

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Table 2. Prevalence of fasciolosis in cattle

Category	n	Percentage	Country	Year	References
Breed					
Small East African Zebu	131	67.52	Uganda	2016	Opio *et al.*, 2021
Ankole	11	50	Uganda	2016	Opio *et al.*, 2021
White Fulani	460	20.9	Nigeria	2022-2023	Banwo *et al.*, 2023
Sokoto Gudali	84	23.8	Nigeria	2022-2024	Banwo *et al.*, 2023
Red Bororo	88	13.6	Nigeria	2022-2025	Banwo *et al.*, 2023
Sex					
Female	110	68.75	Uganda	2016	Opio *et al.*, 2021
	508	21.3	Nigeria	2022-2023	Banwo *et al.*, 2023
	515	72.33	Peru	2020	Diaz-Quevedo *et al.*, 2021
Male	32	57.14	Uganda	2016	Opio *et al.*, 2021
	197	27.67	Peru	2020	Diaz-Quevedo *et al.*, 2021
	132	15.2	Nigeria	2022-2023	Banwo *et al.*, 2023
Age of animal at slaughter, years					
0–3.5	32	43.24	Uganda	2016	Opio *et al.*, 2021
4–5	98	78.4	Uganda	2016	Opio *et al.*, 2021
6–10	12	70.58	Uganda	2016	Opio *et al.*, 2021
1-1.5	59	8.29	Peru	2020	Diaz-Quevedo *et al.*, 2021
1.5-2.5	124	17.42	Peru	2020	Diaz-Quevedo *et al.*, 2021
>2.5	529	74.3	Peru	2020	Diaz-Quevedo *et al.*, 2021
Season					
Wet (April – November)	408	26.5	Nigeria	2022-2023	Banwo *et al.*, 2023
Dry (December – March)	232	8.6	Nigeria	2022-2024	Banwo *et al.*, 2023

n = Number of sampled cattle. This Table is adapted from Opio *et al.*, (2021), Banwo *et al.* (2023) and Diaz-Quevedo *et al.* (2021).

These factors determine the distribution of fascioliasis in space (latitudinal, longitudinal, and altitudinal) as well as time (seasonal and yearly). The prevalence of fasciolosis depends on breed, sex, age of animal and season. The prevalence of fasciolosis in cattle is given in Table 2.

Diagnosis

Early and accurate diagnosis of fascioliasis is crucial for effective

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management. Fecal examination is the most commonly used method for diagnosing fascioliasis. It involves the microscopic detection of Fasciola eggs in the feces of infected cattle. Eggs are dense and settle at the bottom of the solution, making it easier to detect. Fecal Eggs Count (FEC) test is a simple, non-invasive method. However, depending on the host species, the parasite can only be detected during the chronic phase (8–10 weeks after infection). Furthermore, the age of the host, the fecal characteristics, the rate of egg shedding, and the parasite burden can all affect the test's sensitivity (Sargison and Scott, 2011; Paras *et al*., 2018). Enzyme-Linked Immunosorbent Assay (ELISA) method detects specific antibodies against Fasciola antigens in the blood or milk of cattle. ELISA is highly sensitive and can be used to detect early infections before eggs appear in the feces. Early detection of fasciolosis is possible with the use of the indirect-enzyme immune-linked immunosorbent assay (IEA). Indirect-ELISA is the first method for detecting F. hepatica antibodies, and it can be used three to six weeks after infection, during the juvenile worms' liver migration phase (Marin, 1992). When used with milk samples, the MM3-SERO ELISA is a highly specific and sensitive test for the sero-diagnosis of cattle fasciolosis. When applied to bulk samples, it is a highly effective technique for determining the within-herd prevalence of infection (Mezo *et al.*, 2009, 2010). Because of their great sensitivity and ability to analyze several sera samples, immune-enzymatic techniques such as indirect ELISA have been proven to be highly suited for the diagnosis of fasciolosis. Early infection detection has been successfully achieved using these antibody-based approaches (Oldham, 1985; Hillyer and Soler de Galanes, 1991; Poitou *et al.*, 1993; Paz *et al.*, 1998). F. hepatica antigens are available to the immune system during the migratory phase of infection and they can be found using serologic probes such as the sandwich-enzyme-linked immunosorbent assay (SEA) (Langley and Hillyer, 1989). The immune system has less access to antigen once the parasite has established itself in the bile ducts, thus samples of feces or bile must be used for detection. It has been shown that the majority of pathogenic damage occurs during the fluke's migration through the liver parenchyma and peritoneal cavity prior to its establishment in the bile ducts. Utilizing early diagnostic methods is crucial to minimizing significant losses in cattle. Polymerase Chain Reaction (PCR) detects the DNA of Fasciola species in feces, blood, or tissues. Single-step duplex PCR test allow for quick and precise identification of fasciolosis (Le *et al.*, 2012).

Phases of Fascioliasis

Animals with acute fasciolosis cannot exhibit any overt signs of the disease. Some animals may get jaundiced and exhibit stomach ache. Usually, blood loss from liver hemorrhage is the cause of death. When the immature fluke burrows through the liver, it causes a hemorrhage. Depending on the quantity and stage of flukes in the liver, fasciolosis is typically categorized as acute, subacute, and chronic; however, there is a significant overlap. Numerous migratory larvae are linked to acute disease, which frequently causes sudden death from acute and severe hemorrhage. On the other hand, chronic fasciolosis is characterized by anemia, hypoalbuminemia, and weight loss.

The Acute Phase (Acute Fascioliasis):

The acute phase is also known as the migratory, invasive, hepatic, parenchymal, or larval stages. After passing through the intestinal wall, peritoneal cavity, liver capsule, and hepatic tissue, immature larval flukes finally reach the bile ducts. The acute phase, which can last up to three or four months, ends when the larvae arrive and mature in the bile ducts. Larval migration, especially through the liver, can result in internal bleeding, inflammation, local or systemic toxic/allergic reactions, and tissue death. Coughing, dyspnea, and urticaria are symptoms of infection. This stage could be lethal for sheep with massive parasite inoculum.

Subacute Phase (Subacute fasciolosis)

Jaundice, some ill thrift, and anemia are the hallmarks of subacute fasciolosis. The significant tissue damage caused by the burrowing fluke results in liver damage and bleeding. Death within 8–10 weeks, severe anemia, and liver failure are the results.

The Chronic Phase (Chronic Fascioliasis)

The adult phase and biliary phase are other terms for the chronic phase. The bile ducts are where the juvenile larvae enter the chronic phase, where they develop into adult flukes and begin to lay eggs. The bile ducts allow the eggs to go through the intestines and eventually into the excrement. In this stage, the patient may experience no symptoms for several months, years, or even forever. Routine blood tests may only reveal peripheral eosinophilia, which is usually less noticeable than during the acute phase. Some experts differentiate an asymptomatic latent period from a symptomatic obstructive phase, which only occurs in a tiny percentage of patients. If any symptoms are present, they can be more distinct or focused, or they might resemble those of the acute phase. These symptoms include cholecystitis and gallstones, pancreatitis (also see below related ectopic infection), and sporadic clinical signs of cholangitis and biliary blockage. Liver fibrosis may occur.

Prevention

In areas where Fasciola infection occurs, people can prevent infection by avoiding raw watercress and other freshwater plants, particularly those from grazing zones, which are areas where cattle graze. Avoiding places with inadequate sanitation is crucial since they may have contaminated water and food. Preventing fasciolosis, caused by the liver fluke *Fasciola hepatica*, in cattle involves several key strategies. Cattle should be avoided to graze on wet, marshy pastures where fluke larvae thrive. Pastures should be rotated to reduce the likelihood of infection. Drainage should be improved in pasture to reduce moisture. Fence around wet areas should be made to prevent cattle access. Regular monitoring to find out the signs of infection and regular test for fluke eggs in feces is needed. Snail population should be controlled because they serve as intermediate hosts for liver flukes. This involves the reducing moisture and using molluscicides if necessary. Maintenance of good health of cattle through proper nutrition and management practices is necessary as healthy animals are better able to withstand infections.

Control

For the treatment of F. *hepatica* infections, Triclabendazole (TCBZ) is now the medicine of choice due to its great activity against both juvenile and adult flukes (Boray *et al.*, 1983; Fairweather, 2005). The establishment of populations of F. hepatica that are resistant to TCBZ is endangering the continuous use of the drug (Fairweather, 2005, 2009). The different doses of flukicides used for control of liver flukes in cattle is given in Table 3. Increasing the drug's bioavailability and active lifetime through pharmacokinetic manipulation is one possible technique to combat resistance and ultimately increase its efficacy. Co-treatment with inhibitors

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that target the flarin mono-oxygenase (FMO) and cytochrome P450 (CyP450) enzyme pathways can impact the metabolism of benzimidazble-type medicines, such as TCBZ (Lanusse *et al.*, 1992, 1995; Mckellar *et al.*, 2002; Merino *et al.*, 2003; Virkel *et al.*, 2009). This could result in an improvement of the bioavailability of the active metabolisms. The bioavailability of the active metabolisms may enhance as a result. The effectiveness of the medicine has been shown to increase with higher bioavailability (Benchaoui and Mckellar, 1996; Lopez-Garcia *et al.*, 1998; Sanchez-Bruni *et al.*, 2005). Lymnaeid snail fecundity can be decreased or sterilized by rediae of F. *hepatica* (Boray, 1964; Hodasi, 1972) and F. *gigantica* (Wilson and Dennison, 1980) by gonad damage. Early infection stages of F. *hepatica* in L. *truncatula* (Kendall, 1950) and F. gigantea in L. *natalensis* (Madsen and Monrad, 1981) inhibit snail growth. However, F. hepatica may enhance growth rate later on (Gold, 1980).

The snails die when they have severe F. hepatica infections (Boray, 1964). According to Lie *et al.* (1966), trematode rediae of one species can eat the sporocysts of another species. F. gigantica is eradicated from snails by the rediae of E. audyi (Hoa *et al.*, 1970). According to Estuningsih (1991), E. revolutum prevents super infection and eradicates current F. gigantea infections. Although there hasn't been much of an influence on the disease overall, there have been some notable results with biological management of schistosomiasis in the field, especially with competitor snails and trematode antagonists (Combes, 1982; Madsen, 1990).Cattle develop resistance to F. hepatica infections on their own, and part or all of this resistance may result from calcification and fibrosis in the bile duct as well as fibrosis of the liver parenchyma (Boray, 1967; Ross, 1967; Doyle, 1973; Kendall *et al.*, 1978). While treating fasciolisis with anthelmintics is effective, it is costly and not a long-term solution, and there have been reports of drug-resistant strains (Overend and Bowen, 1995).

Table 3. Doses of flukicides against liver fluke parasites in cattle

Active	Dose (ml)	Use in dairy cattle
Triclabendazole 100 mg oral	6 ml/50 kg body weight	Within 45 days following calving, it is not recommended for use. It is allowed to consume milk 47 days following the previous treatment.
Albendazole 100 mg oral	10 ml/kg body weight	Withdrawal period 5 days
Oxyclozanide 3.4% w/v	10 ml /kg body weight	Withdrawal period 7 days for milk and 14 days for meat

(Source: BAHL, 2019)

Vaccines would need to be just as affordable in developed countries as flukicides. Although vaccines in developing nations would need to be reasonably priced, they would have the benefit of having efficacy that would not depend on the infection levels of other animals in the neighborhood. The Lymnaeid Crustaceans, amphibians, birds, rodents, and reptiles are among the predators that can harm snails with thin shells and no operculum.

Pasture management

The main advantage of pasture management strategies is the decrease in F.

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hepatica egg contamination of the pastures. To achieve this, divide the pastures on a farm into zones that are infested with snails and those that are not. The liver fluke pre-patent period lasts at least 8 weeks; hence animals can graze on pastures with snail habitats for a maximum of 8 weeks before being moved to pasture without snails if it is believed that fluke eggs would be present in the feces (Knubben-Schweizer *et al.*, 2010). An efficient flukicide was sprayed on cattle before they were placed on grass with snail habitats to prevent the spread of infection.

Conclusion: *Fasciola hepatica* and *Fasciola gigantica* are the parasites that cause fasciolosis, a prevalent disease that affects cattle and other ruminants. This disease cause milk and meat reduction in cattle and other ruminants, thus substantial economic loss to farmers. Fasciolosis can be diagnosed using a variety of techniques, from simpler and more widely applicable ones (fecal examination) to immunological or biomolecular-based approaches that enable an earlier and more precise diagnosis. The control of host (snail) in pasture is an effective practice for controlling this disease. Triclabendazole, Oxyclozanide and Albendazole should be used for the control of livestock fascioliasis. The application of flukicides revealed the issue caused by resistance development, which has prompted the creation of new treatment plans and even the pursuit of alternative management practices.

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