

Aquaculture and Liver Fluke Parasites: Analyzing the Link Between Industry Growth and Parasite Spread

Haoyu Zhang

*Tianyi High School, Wuxi, China
haoyu7436@163.com*

Abstract. Recently, the fishery industry all over the world has been developing at a very fast rate, especially the soft-bodied animals. With the growing population of soft-bodied animals, the reproductive rate of *Fasciola hepatica* may increase significantly, and the incidence of infection and transmission of fascioliasis (a kind of zoonotic disease caused by *Fasciola hepatica*) will also increase significantly. This article will analyze the curve of fishery industry development around the world, combine the scholarly literature, and find out the relationship between the development of the fishery industry and the infection and spread of fascioliasis. According to the result, this article will give some advice to the fisheries sector and people about how to reduce the population and spread rate of *Fasciola hepatica* and take some preventive measures to protect themselves from fascioliasis. The analysis indicates that the rise of the aquatic products industry will intensify the reproduction, spread, and infection of liver flukes. People should frequently wash their hands, insist on eating cooked food, reduce the frequency of pets going out to forage, and limit the grazing areas for livestock in order to prevent infection with liver fluke disease.

Keywords: Zoonotic, *Fasciola hepatica*, Fishery industry, Preventive measures

1. Introduction

Fasciola hepatica is a kind of zoonotic parasite, which means that both humans and animals are infected with fascioliasis. In recent years, scientists have comprehensively studied all the information about *Fasciola hepatica* [1]. Ms. Yuan Ruixia also elaborated on the concept and life cycle of liver flukes in her doctoral application thesis. Additionally, she conducted research [2]. The Penicook Bush Loan of Edinburgh, the Pentlandz Science Park, the Moredon Institute, the Disease Control Center, and the British Agricultural Food and Biological Sciences Institute, through continuous drug testing, have discovered the resistance of liver fluke and the effective drugs that can inhibit and eliminate liver fluke [3]. Nevertheless, there is a paucity of studies or analyses examining the influence of the burgeoning aquatic product business on the reproduction and transmission of *Fasciola hepatica*. This article will examine the influence of the aquatic industry's development on the reproduction and spread of *Fasciola hepatica* infection. This analysis will examine the alterations in animal production within the global aquatic sector over the last ten years, with a specific focus on invertebrates. Simultaneously, it will examine the fluctuations in the incidence of fascioliasis within the same timeframe. This article will offer recommendations for individuals on mitigating the

proliferation, transmission, and prevention of *Fasciola hepatica* and infectious disorders. This article will furnish individuals and researchers with information on liver flukes, along with strategies for mitigating reproduction and prevention.

2. Background

According to the segmented graph on the world aquatic product industry output released by the United Nations Food and Agriculture Organization, the aquatic product industry has been growing year by year from 2015 to 2020(Figure 1). According to the survey conducted by the WHO and the statistics on the number of people infected with liver flukes released in 2015-2020, the number of infections has been increasing year by year. Therefore, it can be concluded that the development and increase in production of the world's aquatic products will intensify the reproduction, spread and infection of the liver fluke.

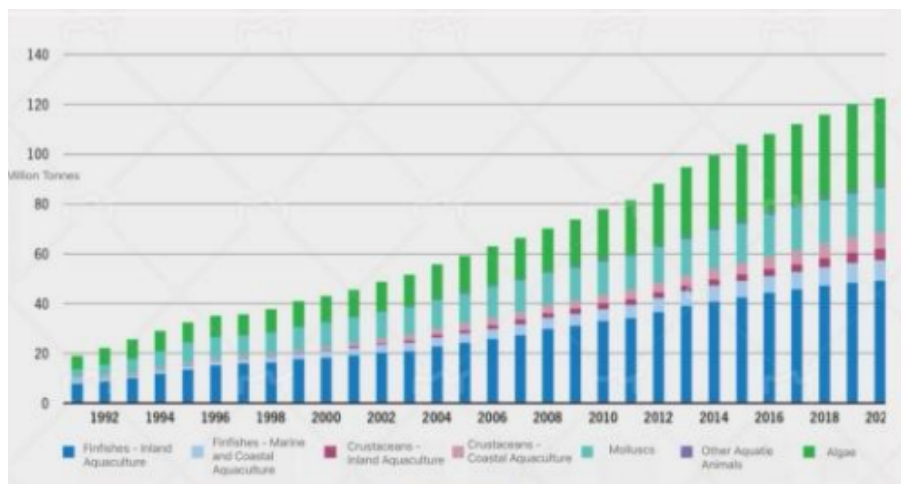


Figure 1. World aquaculture production from 1991 to 2020 [1]

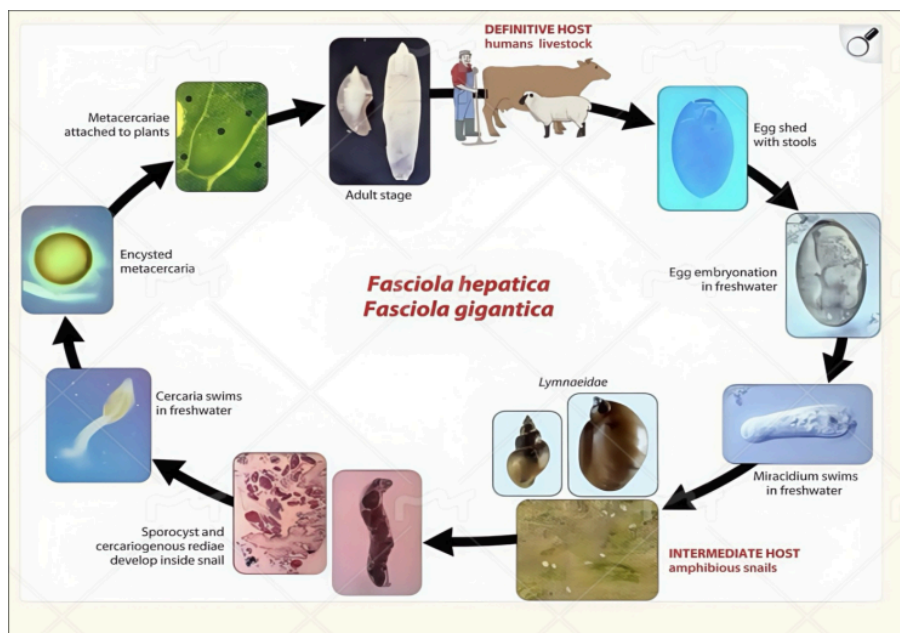


Figure 2. The life cycle of the liver fluke [2]

Fascioliasis is a plant-and waterborne zoonotic parasitic disease caused by two trematode species: (i) *Fasciola hepatica* in Europe, Asia, Africa, the Americas, and Oceania and (ii) *F. gigantica*, which is restricted to Africa and Asia. Fasciolid liver flukes infect mainly herbivores such as ruminants, equids, and camelids but also omnivorous mammals such as humans and swine and are transmitted by freshwater Lymnaeidae snail vectors [1]. According to the Departamento de Parasitologia, Facultad de Farmacia, Universidad de Valencia, Valencia, Spain, the life cycle of the liver fluke (Figure 2) is as follows: Adult worms lay eggs in the bile ducts of cattle, sheep, or humans, and these eggs are excreted in feces [2]. In a warm and humid environment, the eggs hatch (within 9–15 days), releasing miracidia. These miracidia invade the intermediate host, the freshwater snail, and develop through several stages—cercariae, metacercariae, and cercariae—over 4–7 weeks. The cercariae then escape from the snail and form cysts on aquatic plants (the infective larvae). When humans or animals ingest these contaminated aquatic plants or raw water, the cysts disintegrate in the duodenum. The larvae penetrate the intestinal wall, migrate to the liver, and develop into adults in the bile ducts (over about 3 months), thus completing the cycle.

3. Symptoms and modes of transmission

Infection with liver fluke disease can cause many symptoms. This condition generally progresses through two stages in healthy individuals. Following infection, patients typically present with fever, intense pain in the right upper quadrant of the abdomen, nausea, vomiting, rashes or measles, and hepatomegaly accompanied by tenderness. Blood tests typically reveal an elevated concentration of a particular subtype of white blood cells known as eosinophils. If the infection remains untreated and advances, it will proceed to the chronic stage.

At this point, the symptoms will persist for a longer period of time, and the infected person will often experience abdominal pain, yellowing of the skin and eyes (jaundice), and some symptoms such as diarrhea. Children, especially young children, will show more intense acute symptoms than adults, including higher body temperatures, convulsions, and liver swelling and pain. Chronic infections in children can seriously affect growth and nutritional status, leading to failure to gain weight normally, stunted development, and in severe cases, liver cirrhosis. Infants may experience symptoms such as significantly enlarged liver and spleen. Severe cases may lead to dehydration or dangerous conditions similar to widespread infections. Pregnant women face special risks. Inflammatory reactions during the acute phase may trigger uterine contractions, potentially resulting in miscarriage or premature birth.

Liver fluke spreads when infected animals like cows and sheep pass worm eggs in their poop. The eggs are excreted into freshwater reservoirs (e.g., ponds, irrigation ditches), undergoing embryonation to release motile miracidia. The miracidia then infect small water snails, where they grow into another stage called cercariae. Cercariae encyst as metacercariae on aquatic vegetation (e.g., watercress, lettuce) or remain free-floating in the water column. If people eat raw, contaminated plants or drink dirty water, the cysts open in the gut. The young worms then burrow through the intestine, move to the liver, and grow into adult worms. Therefore, humans can directly contract liver fluke disease from contaminated substances [4]. According to the research conducted by Gan Lian and Shi Jinyi on liver fluke, the eggs of the parasite are excreted from the bodies of patients, infected individuals, infected livestock and wild animals through feces. They enter water through various means and subsequently infect snails and fish and shrimp, developing into the infectious stage of cystic larvae. Eventually, they infect humans or animals. The main mode of human infection is by consuming raw or semi-raw freshwater fish and shrimp. It has been proven that the behavior of not washing hands after catching raw fish and shrimp and then eating them with

bare hands, as well as eating raw or semi-raw fish or shrimp, are risk factors for infection in the Shenzhen area [5]. Cooking food and boiling water kills the parasites.

4. Cases

Over the past decade, there have been numerous cases of infection with liver flukes. In 2021, a 35-year-old patient in Iran contracted a liver fluke infection [6]. In the same summer in Hawaii, a 58-year-old man contracted a liver fluke infection after consuming wild watercress [7]. In 2024, a child in India contracted acute liver fluke disease [8]. Most of the infected areas are located in the tropics and have relatively poor sanitary conditions. These typical cases demonstrate that wild aquatic plants can carry liver flukes. Therefore, improving hygiene conditions and enhancing environmental sanitation are of great significance.

5. Reasons

There are many reasons for the massive reproduction and spread of liver flukes. Firstly, overcrowded fish ponds provide an ideal environment for the reproduction of liver flukes. When too many fish or shellfish are crowded into a small space, their excrement accumulates, making the water murky and rich in nutrients. This contaminated water helps the parasite eggs and larvae survive for a longer time. The life cycle of the flukes depends on tiny water snails, and these snails multiply in these nutrient-rich waters. Intermediate host snails (e.g., *Galba truncatula*) ingest embryonated eggs, facilitating miracidium-to-sporocyst-to-cercariae metamorphosis. When the fish farm changes the water, these larvae will be washed into rivers or lakes, spreading the parasites to wild animals and even spreading to nearby other fish farms or river wetlands. Another major risk is selling infected fish or shellfish, especially soft-bodied animals like clams or snails, to the market. If people consume these uncooked or inadequately heated foods, the parasites will infect their livers, causing fever, pain, and long-term health damage. Even pets like dogs or cats, if captured and eaten by infected wild animals such as frogs or small mammals, can also get sick. When humans clean their pets' excrement, they may come into contact with contaminated feces and accidentally swallow parasite eggs. In 2010, Zhang Xianchang and colleagues utilized randomly selected water and snail samples from stratified fish ponds in Guangdong Province. A substantial quantity of feces was released into the fish ponds, resulting in a considerable infection rate of liver flukes among the snails in the ponds. The residents' inclination for raw food has resulted in a prevalent infection and dissemination of liver fluke illness in the region [9].

6. Suggestions

To reduce the massive reproduction and spread of liver flukes, the aquaculture industry should reduce the excessive density of organisms in the breeding ponds, especially those for soft-bodied mollusks. The farms mostly use scattered feeding to feed the animals, which is convenient but will rapidly increase the nutrient content in the water. Therefore, the breeding ponds of the farms need to be frequently replenished with water to maintain good water quality. However, discharging water containing a large number of liver flukes will lead to liver fluke contamination in a much larger area. Therefore, before discharging wastewater, it should be sterilized and disinfected first, such as through high-temperature sterilization before discharge. Then, control from the intermediate host is carried out. According to the 2020 literature "Drug resistance in liver flukes" in PMC, using fecal antigens can detect whether one is infected with liver flukes to determine the type of medication [3].

For example, using TCBZ can eliminate liver flukes at all stages. To mitigate the effects of liver fluke resistance on elimination efficacy, it is advisable to alternate the administration of chlorosulcon, nitrofluorphenazine, and albendazole for liver flukes that exhibit tolerance to TCBZ. To prevent liver flukes in humans, it is essential to manage animal excrement while wearing protective gloves and masks, and to wash hands and disinfect immediately after handling. Raw food can directly induce human infection with liver flukes. Consequently, it is imperative to ingest prepared meals. To avert liver fluke infections in cattle and pets, frequent deworming should be implemented, and grazing grounds should be restricted to minimize exposure to regions abundant in snails and characterized by poor water quality, such as marshy puddles. Pets may receive vaccinations for liver flukes.

7. Conclusion

The rapid development of the aquaculture industry, especially the development of the soft-bodied animal farming industry, has created favorable conditions for the massive reproduction of liver flukes, leading to the massive reproduction of liver flukes and the spread and infection of liver fluke disease. This study analyzed global fishery data and infection trends to determine the correlation between the growth of aquatic production and the increase in infection rates. However, these findings were limited by the lack of experimental verification and may have overlooked some natural environmental factors. Moreover, there are differences between regions, and the collection of cases of liver fluke infection is not yet sufficient to reveal some commonalities. The data in this article may affect others' understanding and research on liver flukes. To reduce the number of people infected with liver flukes and other similar parasites worldwide, the aquaculture industry should strictly control the number of soft-bodied animal farms, and frequently change water to maintain clean water quality. The livestock industry should limit grazing areas and regularly deworm livestock. Citizens can vaccinate their pets. Most importantly, eat cooked food, drink boiled water, pay attention to wearing protective equipment and hand-foot hygiene.

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