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Prevalence of Lymphocystis disease virus (LCDV) in freshwater fish.

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ABSTRACT

Lymphocystis disease, caused by the lymphocystis disease virus (LCDV) is a serious issue in aquaculture, affecting many marine and freshwater fish species worldwide. This disease is distinct by wart-like growths on the skin and fins of fish. Although it usually doesn't cause high mortality, it significantly impacts the industry by reducing fish marketability increasing the risk of secondary infections and slowing growth rates. The growths can also impair fish health, especially if they prevent vital areas like the gills, affecting swimming and breathing. LCDV disrupt with normal cell processes, leading to the formation of these growths. To manage the disease effectively, it's important to use prevention strategies including new immunomodulators and vaccines, and to direct environmental pollutants that impact fish health. By understanding these factors and applying comprehensive management practices, we can reduce the disease's impact and improve the sustainability of aquaculture.

Introduction

The LCDV is the type of DNA virus which belong to the *Iridoviridae* family [1]. LCDV has impacted over 140 species of both marine and freshwater fish across the globe. This includes flounder (*Paralichthys olivaceus*), a species crucial to the economies of countries like Japan, Korea and China. The disease has led a significant financial loses in these regions [2] [3]. Lymphocystis disease (LCD) is a long lasting but self-limiting condition that impact a variety of teleost fish species around the world. Lymphocystis disease is caused by a virus called as lymphocystis disease virus. This illness is characterized by the appearance of white, wart like growths on the skin and fins of fish [4]. Some of these nodules covered areas rich in chromatophores, which appeared gray to reddish. The nodules ranged in diameter from 0.2 to 2 cm [5]. While mortality is rare, LCD can cause economic losses due to non-marketability, secondary infections and reduced growth rate of fish. LCDV is a double standard DNA virus with an icosahedral structure measuring up to 350nm in diameter. It has a wide host range of marine and freshwater species[6]. LCDV primarily infects fibroblasts, that are plentiful in the skin's connective tissue. As a result, LCDV mainly affects the skin, often leads to the development of Lymphocystis nodules[7].

Symptoms:

The main signs of lymphocystis in fish is the appearance of small to medium-sized, uneven, wart-like lumps on the fins, skin or gills. These lumps usually shift in color from cream to gray though they can differ in color, particularly when they occur in pigmented areas. They can form over a few days and can persist for weeks. For instance, African cichlids and clownfish often display lymphocystis nodules on their fins and bodies. In some cases, lymphocystis can lead to "pop-eye" (exophthalmia), where the eye bulges out due to pressure from lymphocystis masses pushing against it. Despite these nodules, fish with lymphocystis typically do not show changes in behavior changes compared to healthy fish. However, if a fish has a lot of nodules or if they cover a significant portion of its gills, it can impact its ability to swim or respiration properly [8].

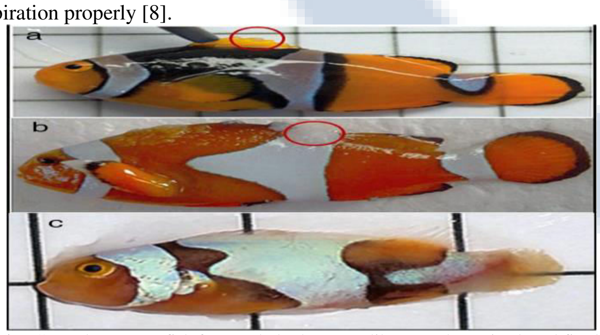

Fig. 1: LCDV shows: (A) fish from Takalar has wart-like growths on its dorsal fin.(b) A fish from Ambon is covered in widespread warts.(c) A fish from Takalar is severely affected by fin rot and has lesions on its tail fin.[9]

Life cycle

In fish, lymphocystis disease is primarily caused by the lymphocystis disease virus (LCDV). This virus results in the development of distinctive nodules on the fish's skin and fins. Research into this condition is limited, but microarray experiments have provided valuable awareness. These studies found that LCDV infection inhibits both cells apoptosis and division in the ventral fins of flounder, leading to the development of lymphocystis cells through cell fusion. The microarray results presented valuable changes in genes involved in cell cycle regulation, indicating that LCDV infection led to a halt cell cycle. A crucial factor in lymphocystis cell formation is the control of apoptosis. Particularly, the research identified a down-regulation of several major apoptosis related genes, such as of caspase-3, caspase-6 precursor (*casp6*) and caspase-8. This inhibition of apoptosis is considered a major play a role to the development of lymphocystis in infected flounders [10].

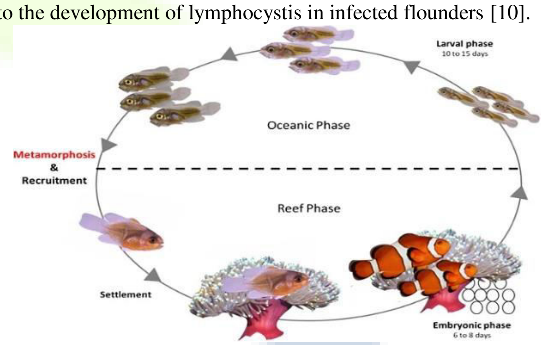

Fig. 2: Life cycle of clownfish. [11]

Effect of LCDV on fish and human health

Dietary intake effects immune systems both directly through the nutrients it provides and indirectly by affecting the gut microbiota. This microbiota is essential for stimulating and regulating different immune cells [12]. Fish and its components have several beneficial effects on immune health[13]. Omega-3 polyunsaturated fatty acids (ω3-PUFA) are a type of fat that are present in very small concentrations in most land-based animals and plants. However, they are espically rich in fish and seafood. Among the fish that have the highest levels of omega-3 fatty acids are salmon (both wild or farmed), herring, mackerel, sardines, tilefish, albacore tuna, pollock, halibut and trout [14] [15].

LCDV Transmission to fish

Lymphocystis disease, led to the lymphocystis disease virus is prevalent among a wide range of teleost fish species around the world. This infection causes the formation of unsightly, benign nodules on the fish, Which can led to substantial financial losses in the aquaculture industry [7].

Prevention and treatment

The study aimed to evaluate the long-term effects of enhancing methods for preventing and treating fish diseases using both natural and synthetic immunomodulators and vaccines in aquaculture. Fish farming faces numerous threats in the aquatic environment, including pesticides (likes organochlorine insecticides and organophosphorus herbicides), aromatic hydrocarbons, pentachlorophenol, heavy metals and chemotherapeutics agents, all of these substances are extremely toxic to fish. Biodegradation in aquatic ecosystems continuously processes these toxic substances, making them available to fish and impacting the immune systems. The health of fish immune systems can represent the quality of their environment. Innate immunity is vital for protecting fish from pathogens and other threats. Using immunomodulation techniques is crucial for strengthening these natural defenses, improving disease prevention and managing treatment in controlled aquaculture settings[16]. In terms of vaccines, there are Several options for managing and preventing *Iridoviridae* infections in fish. Two commercially available vaccines target these infections: one vaccine targets Red Sea bream

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iridoviral disease, while other targets general iridoviruses infections. These include a formalin-killed vaccine and AQUAVAC® IridoV [17].

Conclusion:

Lymphocystis disease led to the lymphocystis disease virus (LCDV), is a major concern for fish populations in both freshwater and marine environments worldwide. This condition leads to the formation of unsightly nodules on the fish, which can cause substantial economic losses for the aquaculture industry. Research shows that LCDV disrupts normal cell death and division processes, causing lymphocystis nodules in fish by lowering the activity of crucial apoptosis-related genes. While the disease is generally non-lethal, it can affect fish and human health by impairing growth and marketability. Effective management of LCDV involves understanding its transmission and impact, with various vaccines and immunomodulatory treatments available to mitigate its effects. Ongoing research into natural and synthetic methods for disease prevention and treatment remains crucial for maintaining fish health and ensuring the sustainability of aquaculture practices.

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