Review Article

Potential of Lemna sp. in Aquaculture: An Overview of Flavonoids for Boosting the Immune System in Fish

ABSTRACT

Aims: Diseases that attack fish can potentially cause large losses such as increased fish mortality and decreased water quality which in turn can result in a decrease in the selling price of fish. Disease control through prevention (preventive) can be done by providing adequate feed in maximum quantity and quality, controlling water quality, and providing immunostimulants. L*emna* sp. is known to have several bioactive compounds and polysaccharide macromolecules that can function as immunomodulators to influence non-specific immune responses to increase the body's resistance to pathogens.

Keywords: Flavonoid, Immune System, Lemna sp., Fish

1. INTRODUCTION

The disease is one of the factors that can inhibit fish farming, especially bacterial diseases. Apart from being a nuisance, this disease is generally caused by other organisms, feed, and environmental conditions that do not support fish survival. Fish diseases are divided into two, namely infectious diseases (bacteria, viruses, parasites, and fungi) and non-communicable diseases (stress, tumors, nutritional disorders, and feed trauma) [1].

Fish that are attacked by disease can be characterized by a decrease in the ability of fish to maintain normal physiological functions [2]. Therefore, an effort is needed to overcome the spread of disease in fish. Prevention is a preventive measure that can be carried out by providing adequate feed and providing immunostimulants [3]. Management of fish health by utilizing natural ingredients is an effective solution to dealing with sick fish. The use of natural ingredients is an alternative treatment that is cheap, effective, and natural [4].

Lemna sp. is known to have several bioactive compounds and polysaccharide macromolecules that can function as immunomodulators to influence non-specific immune responses to increase the body's resistance to pathogens [5]. *Lemna* sp. contains vitamin E, carotenoids, and flavonoids which can be used as a source of antioxidants. has the potential to increase the body's resistance to fish because it contains carotenoids and antioxidant activity which is quite high [6]. In addition, *Lemna* sp. has immunomodulatory properties, namely the ability to increase phagocytosis.

Therefore, with the existence of disease problems in fish, it is necessary to use safe alternative materials to control fish diseases using natural ingredients. Availability of Lemna sp. The abundance of fish can be used as an effort to utilize natural ingredients and increase growth and the immune system in fish.

2. FLAVONOID COMPOUNDS

Flavonoids are closely related to antioxidants because they have the ability to break down free radicals [7]. Further studies have shown that flavonoids also stimulate internal antioxidant enzymes, suppress enzymes related to the formation of free radicals, and bind metals [8].

Flavonoids are very effective antioxidants. Flavonoids also have the potential to stimulate the immune system, induce protective enzymes in the liver, or block damage to genetic material [9]. There is ample evidence showing that free radicals cause oxidative damage to lipids. Plant flavonoids may also reduce the risk of thrombosis by inhibiting platelet aggregation and adhesion. Flavonoids can inhibit enzymes involved in the oxidation of polyunsaturated fatty acids. Flavonoids inhibit platelet aggregation by mediating other enzyme systems. Its antioxidant properties directly participate in its antithrombotic action [10].

3. FISH IMMUNITY SYSTEM

The immune system in fish is an immune system that involves self-defense mechanisms against foreign particles, especially disease-causing pathogens. If there is an infection of microorganisms in the fish's body by pathogens from types of bacteria, viruses, and parasites/fungi that enter the body, the fish or shrimp will respond with the body's defense system [11].

The immune system in fish is known to consist of an innate defense system or an innate/natural defense system that is non-specific and a specific immune system or an adaptive response [12]. It is said to be non-specific because it does not only respond to certain (non-specific) types of pathogens. This immune system has existed since birth/hatch, so it is said to be natural. The non-specific immune system in fish, for example, is physical (skin, mucus, scales), humoral (lysozyme, stomach acid, lactoferrin, complement, interferon), and cellular (phagocytes, NK cells) [13].

The non-specific defense systems in fish generally sweep adaptive responses, activate and determine the nature of adaptive responses and cooperate in maintaining homeostasis. The specific immune system is a mechanism of cooperation and interaction between phagocytes and lymphocytes. The emergence of a specific response starts from the work of phagocytic cells or macrophages or also called Antigen Presenting Cells (APC). This APC will then introduce it to specific immune cells, namely T cells and B cells. The adaptive or specific immune defense system will function properly when induced by exposure to pathogens or products derived from pathogens (for example LPS and vaccines). This specific defense system only reacts to certain antigens [14].

Fish have been known to rely more on the mechanisms of their non-specific/natural/innate immune system than on their specific immune system [15]. Non-specific defense is a very important body defense system in the fish immune system. In fish, the new immune response is fully formed when the fish are adults. Juvenile fish do not have a perfect specific immune response and rely on non-specific cell responses to defend against microbial infection. Non-specific defense is the main defense in fry and juvenile fish [16]. According to Buchmann (2014), immunostimulants are substances or drugs that can restore the disturbed immune system by stimulating and improving immune system function. Administration of immunostimulants can be administered through injection, feed (oral), and immersion [17].

4. THE POTENTIAL OF LEMNA SP AS FISH FEED

Lemna sp. (duckweed) is a type of aquatic plant that can be found growing in ponds, lakes, and reservoirs. The ability of this plant is to grow quickly and develop well in various climates. Lemna sp. become one of the aquatic plants that have not been utilized because it has no selling value and does not compete with human needs [18].

According to Solomon and Okomoda (2012), Lemna as a feed ingredient has better content than most other vegetable proteins and is more similar to animal protein. Protein content ranges from 10-45%, fiber 7-14%, carbohydrates 35%, fat 3-7%, and the content of vitamins and minerals is quite high. The protein content of dry duckweed is 25.2 – 36.5 % and the protein concentrate ranges from 37.5 – 44.7 %.

Lemna sp. as a source of protein contributes to maintaining the availability of feed to support aquaculture activities. Fresh lemna as a source of feed from nature is very suitable to be used as feed for herbivorous fish. Herbivorous fish are fish that eat plants (vegetables). Herbivorous fish are generally easy to accept additional food or artificial feed. Some examples of herbivorous fish are tilapia, grass carp, milkfish, nilem, and tawes [19].

5. EFFECT OF LEMNA SP. FOR IMMUNITY RESPONSE

Lemna sp. is a small aquatic plant that has a high nutritional content. The ability of this plant is to grow quickly and develop well in various climates. Lemna sp. known as weeds in waters tend to be difficult to control growth. This aquatic plant is one of the aquatic plants that has not been utilized because it has no selling value and does not compete with human needs [18].

The ability of this easily cultivated aquatic plant is capable of producing secondary metabolites such as a wide variety of flavonoids including luteolin and apigenin which can be used as antioxidant compounds [20]. Flavonoids can function as antioxidants, immunomodulators, and anti-inflammatory agents, while several other substances are thought to increase fish immunity, namely vaccines, immunostimulants, probiotics, and antioxidants. The active compounds are mainly flavonoids, carotenoids, and amino acids of plant extracts including extracts from Lemna sp. able to play a role in stimulating leukocytes as a non-specific defense so that it functions as an immunostimulant [6].

Lemna sp. is a medicinal plant that does not have severe side effects. Recent studies have revealed various pharmacological effects of duckweed. L. Minor has antibacterial activity against gram-negative bacilli (Pseudomonas fluorescence, Shi gella fexneri, Escherichia coli, and Salmonella typhi) and gram-positive bacteria (Bacillus subtilis), and can be an alternative antibacterial for the treatment of various diseases. Flavonoids in Lemna sp. may contribute metabolites to antioxidant activity. In particular, the flavonoids in L. minor have been reported to have an immunosuppressive effect by reducing free hemoglobin levels and antibody production in human whole blood samples infected with ovalbumin antigen [10].

6. CONCLUSION

This review discusses the content of Lemna and the use of Lemna as an additive in fish feed to increase the body's resistance of fish.

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