

Physiology and Biochemical Properties of Fish Mucus Particular Emphasizes as a Body Defense System

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Abstract

Nile tilapia belongs to the family Cyprinidae. All fishes are at risk of pathogenic and other microbes, because fishes are contain by environment which is rich in microorganisms. Fish exist in environment of water which is useful because mucus is produce from the body of fish and protect against the large number of microbes which are present in the water. Usually the body of fish is protected by the layer of mucus and the mucus contain many kinds of biological constituent in the outer layer, these are the mucus cells, the club cells and the epithelial cells. The fish immune system is very important. The fish mucus having several unwilling defiance parameter which are immunoglobulin's, pathogen peptide and harmonize factors that provide both physical and machinal protection. Important part of the fish mucous defense system is immunological defense that is present in mucus of fish's skin, helping as a physiological and structural barrier against outside risks. Genetic makeup and evolutionary lineage determine the innate immune system of pathogens that are modified through time, pathogenic association and environmental factors.

Keywords: Mucus, Skin, Defense system, Fish, Pathogenic strains.

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INTRODUCTION

Nile tilapia (*Oreochromis niloticus*) fish is mostly one of the illustrious fish species in Bangladesh, Nevertheless, as compare to other civilized fish species market value of Nile tilapia is in the order of higher. This high bazaar value is suitable to its characteristics quality such as good quality flavor, yummy taste, meat quality and the fresh nature. In Bangladesh, fish species is very legendary for its delicious taste and nature in the people of middle to rich. The way of wrapping the Nile tilapia fillet well be high and it as well as suitable to them [1].

Nile tilapia belongs to the family Cyprinidae. It is native to Pakistan and is establish throughout the streams and in geologically occurring waters, along with fish tanks and fish ponds. Nile tilapia (*Oreochromis niloticus*) is more significant in Indian most important (IMC) and it is normally used in polyculture method. *Nile tilapia* is the ordinary indweller of arctic and midway India and it is currently available in in Bangladesh River, Myanmar and Pakistan. Now a day it is present in common other countries for example Japan, Nepal, China, and Sri

Lanka it is also present in other river of Africa. Nile tilapia is more as compared to other fish such as mrigala (*Cirrhinus mrigala*) and catla[2].

Naturally protective layer are also cover the body of fish gills and digestive tract. Fish is slimy due to prance of mucus layer. Mucus provides indirectness because it has big amount of water inside along with the occurrence of gel-forming molecules which have high molecular weight. Usually the body of fish is protected by the layer of mucus and the mucus contain many kinds of biological constituent in the outer layer, these are the mucus cells, the club cells and the epithelial cells. Mucus is composed by gel like oily, sticky and having the mixture of different ions, enzyme and water [3, 4].

The fish mucus have the constant association among their aquatic environment and it perform as obstacle in opponent of mechanical, chemical agents and this layer is also a wall of next biological catching agents. The mucus layer of the fish, for example, plays various biological tasks. Mucus provides safety from injury throughout excavate and epidemic raises in

damage medicinal help in intra-species program and insulate production in different type of fish species [5].

The mechanical limitations of the fish outer layer disrupt the access of pathogens into the body. Respiratory tract, digestive tract and genitourinary systems are covered with mucus layer. This layer has the purpose of capturing unfamiliar pathogens outside the body. The mucus layer of fish body called major protective layer. Mucus cell cover the mucus and in fish it function as attack against microorganism, chemical, biological and physical, partially permeable and natural wall. Furthermore, the fish mucus as well as natural resistant against the pathogen and enzyme. The Fish mucus also has some resistance compounds such as

immunoglobulin's, lecithin, interferon, agglutinin, calmodulin, lysozymes, proteolytic enzymes and antimicrobial peptides [6].

The fish immune system is very important. This protective system contains 3 layers, the cellular machinery, the humeral part and the epithelial obstacle. The important barrier of sickness in fish is the mucosal and epithelial barrier of the digestive, skin and gill region, which is persistently absorbed in the media. The fish mucus having several unwilling defiance parameter which are immunoglobulin's, pathogen peptide and harmonize factors that provide both physical and machinal protection [7].

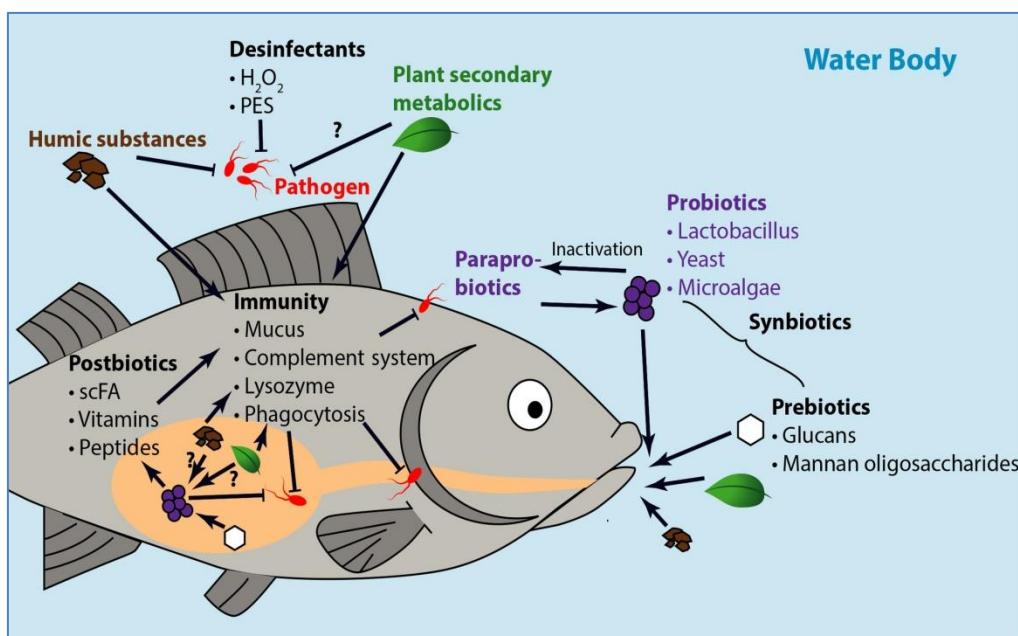


Fig-1: Shows the structure of fish mucus with biochemical functions

Humoral parameter is called cell receptors. These are matching systems, which are well refined in fish; contain traditional pathways, alternative, and lecithin. Cell breakdown occur when these 3 pathways are finish in membrane hit complex, and phagocytosis improved by the procedure of microorganisms opsonisation and adaptive defiant reaction occur by this usual pathway. In the serum of fish, the natural activity of hemolytic that is interconnected to substitute complement pathways are typically high. Several fish sera show strong lysozyme activity, which is an essential bactericidal enzyme [8].

Some other necessary parameter of local humoral defense consists of lectins such as mannose binding lectin (MBL) and it proceed as bacterial agglutinins. There are also tumors in fish that attack cytotoxic cells that are non-specific in nature. And these cells act just like mammals as natural killer cells. For different medical purposes, fish mucus or skin are used and might be representing as good source of naturally active compounds. Mucus layer of fish act as a

biological boundary between fish and their aqueous surrounds, this mucus layer comprise dissimilar epidermal cells [9, 10].

In the field of medicine science, there is only challenge to save from pathogens due to high and spread antibiotic resistant. Therefore, in order to recognized and overcome such matters, novel and numerous antimicrobial studies were done. Captivatingly, more likely agents are current which have been revealed to illustrate the dissimilar categories of microorganism activity and one of the most developed or effective things appeared from these fish mucus. For mechanical protection, lubricant functions together with decreasing body resistance in water and thus helping in swimming, there is a layer of mucus on the outer body of fish that performs all these functions [10, 11].

Role of Fish Mucus

As a notice, presumptive molecules are responsible for antimicrobial activities earlier studies

indicate that fish mucus contains a diversity of biologically active compounds such as proteolytic enzymes, apolipoproteins, antimicrobial peptides, lectins, proteins and flavoenzymes that are expressed principally in order to give the fish with instant protection beside potential pathogens. Interestingly, many previous studies have shown that fish skin mucus has cytotoxic effects as in human cancer cells [12-14].

Fish skin comparison with human skin displayed that both continuously challenged by potentially catching agents in their habitats (water vs air/land). SO different skin phenotypes processes various life patterns in different habitats, fish and human skin jointed these protective and defense functions that are evolutionary preserved. Versus environmental predators and xenobiotics fish produce slimy and slippery substance known as mucus which works as outer defensive barrier. In response to

physical, biological and chemical stressors, a large number of protective molecules and skin production of glandular secretions are produced .All these things produced secretions which is called as glandular secretions [15].

Role of Antimicrobial Peptides in fish defense system

Lastingly fish are bordered by the water organisms and further pathogens, so evidently it is required a particular defense system. Existence of enzymes, lytic agent and immunoglobulins complete the microorganism's neutralization when they hit. On skin bacterial infections and fish skin immunity a large number of experiments and research have been done but, insufficient information obtained on fish skin mucus role as first line of protection against different pathogens [16-19].

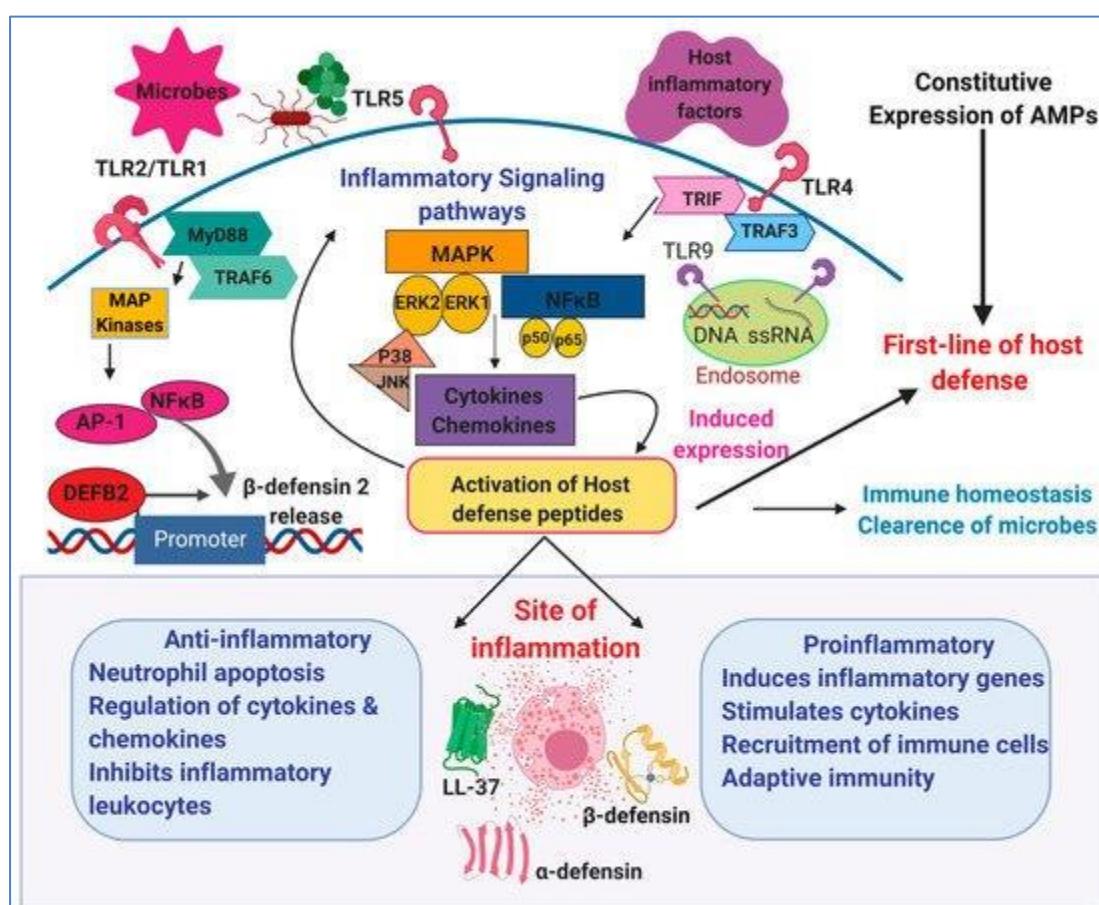


Fig-2: Shows the role of Antimicrobial Peptides in fish defense system

For studying progressive begin of human make it to antimicrobial struggle system, kin mucus offers unique opportunities for this purpose, such as antimicrobial peptides in fish (AMPs) has been conserved in the improved vertebrate skin. A specific and aware study on fish resistance skin structure has increased the condition that little of different antimicrobial activity Fish mucus may be preferred for use in outlook clinical dermatology. The first line of the

defense system is antimicrobial peptides. As disturbed with pathogens of fish having the immune mechanisms of fish consist of macrophages, antimicrobial peptides that, just like humans. It is generate by intra-mesenchymal support cells and epithelium and logically stirring killer cells [20].

In fish, contact with pathogens and injure activates the manufacture and free of antimicrobial

peptides certain definitive skin cells that demolished pathogens during membrane breakdown, RNA/DNA/protein inhibition, direct pathogens killing, and opsonization. In fish and humans, the principle of this whole process of synthesizes and release AMPs is the same. These receptor-independent mechanisms decrease pathogens' chances or possibility of creating resistance to peptides [21].

The fish skin mucus is used to solve skin anti-infection defense and to study potential future and clinical applications in dermatology studies. Because fish skin provides physical, chemical and mechanical barriers to inter-individual communication through metabolism by using visual signals such as pigments, maintain osmotic balance and sensory functions. There is no epidermal barrier of dead cells based on keratin, which is characteristic of humans in most fish. That may support in the microorganism entry. In addition, the fish mucosal surface of waterborne microorganism is an excellent (nutrient-rich and stable) environment and the best target for colonization. For scheming the growth of microbes on the exposed surfaces of fish and also in tissues, reproductive success, growth and fitness are essential or important [22-24].

Specially, after wounding, fish skin needs to have immunological properties and some structural changes to prevent from infections when the skin of fish is vulnerable to proteolytic attack. To explain the immunological challenges that is faced by the fish, in human medical policy it may be stated that formation principle of skin of fish showed similarities to the oral cavity of human. A chief challenge of fish is how to save from "pan-body mucosal ailment". Fish epidermal cells perform as a boundary between environment and fish. To control the spring of mucus and serve to maintain on the outer covering of the fish, they contain micro bridges that are high actin-rich structure performs all these functions in fish [25].

Recent and further studies, well identified and showed that there are a lot of AMPs in the mucus fish which are significantly rising as antibiotic for human to cure diseases specially skin disease. For example, against human pathogenic fungi, hybrid striped bass was defined to exhibit strong antifungal activity. Similarly, against the fibrosarcoma cells of human only few fish AMPs (epinecidin-1) are also used as strong antitumor agents that inhibited the cell proliferation and decreased the movement of the cells of tumor from one to another place[26, 27].

Some other differential cells are present beneath and in between this surface layer such as mucus goblet cells of stratum spinosum which provide the mucus. In fish these goblet cells are alike to mammalian

goblet cells in structure that produced mucus which consists of acid (sulfated and carboxylated), neutral, disulfides, glycoconjugates and some other components, that are constantly assembled in the way of external epidermal region. Then they create the mucus greatly valuable protection [28].

This type of protection shield contains most of known fish AMPs and it is formed by supplementation of AMP-independent substances that are anti-infection in nature containing cathepsin B, transferring, alkaline phosphatase, lysozyme, C-reactive proteins and complement. In all the kingdoms of life, important constituents of innate immune system are AMPs. Cationic alpha helical AMPs having cecropins that contains amino acids from 35 to 39 in length. Cecropins have cationic (positive) charge that give them attraction and consequent binding to the comparably negatively charged membrane of bacteria. The AMPs multitasked action provides them the benefit above conventional antibiotics [29, 30].

Propagation of bacterial strains that are resistant to antimicrobial agents are become little possible because of the variation of one or more bacterial macromolecule which is necessary for complete resistance. There are few examples of bacteria which are mainly resistant to positively charged AMPs. Numerous other AMPs, contains pleurocidin and b-defensins which are been immunolocalized in mucus layer of integument epithelium. Furthermore AMPs in epithelial tissues and skin of perciform fishes, known as piscidins which are formed in the mast cells, mast cell is the tissue granulocytes population also present in some other vertebrates [31].

Biochemical properties of Skin as body defense

And In fish, the response is depend on the secreted products, for example AMPs and cytokines which contains the epithelial cells activities, mast cells, complement factor of wide range, Toll-like receptors and skin-associated macrophages in comparison with mammals. About the immune reserves, in case of T-cells receptors and immunoglobulins, fish seems to insufficiency of large variety of immunoglobulins which mammals have, but still they can increase the specific response. When once goblet cells discharge mucus from the skin of fish, then these cells is not capable to produce and release the mucus second time. Therefore, there is a permanent turnover of goblet cells of external layer of epidermis. The physicochemical character mucus from the skin of fish, are tenacious by the occurrence of bioactive compounds and the epidermal movement of inflammatory cells and its secretions, that may damage the proliferation and establishment of copepods, monogenean helminthes, ectoparasitic bacteria and ciliates [32].

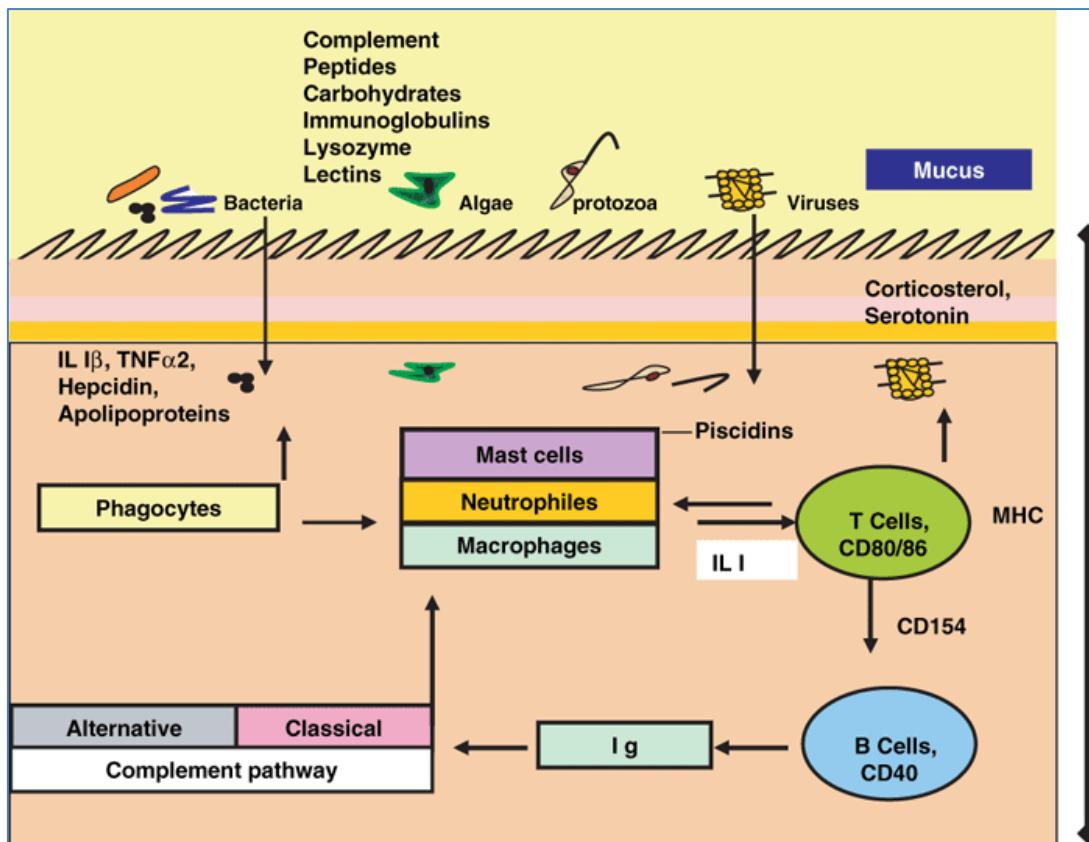


Fig-3: Shows the Biochemical properties of skin of fish

The nature of cathelin domains are highly conserved which are been used to seek out for cathelicidins in fish species other than the humans. Many cathelicidins have been recognized in the fish [33-35]. Protease elastase is utilized to activate and processed the cathelicidins that is the main cleaving stimulant in mammals collectively with kallikreins. Cathelicidins with b-defensins combinably are the major part that are present in arctic char skin and zebrafish that is regulated by 24 hours after bacterial and viral challenges [36, 37].

In fish the outer mucus's layer was examined as drag decreasing polymers. To compare the velocity profile of the rainbow trout (*Salmo gairdneri*) and it's wax models figure without and with water dynamically silky surfaces exposed that the secretion of integumental mucus can importantly decrease the momentum rate transfer throughout its boundary layer [38, 39]. The demand for effective and new analysis or medication of bacterial diseases remains with the constant development of bacterial pathogens of antibiotic resistant strains in both health care and agriculture environments [40].

CONCLUSION

Immunological defense system of vertebrate contains both mucosal and systematic immune compartments, but immune system of the mucosal membrane is important because this system saved the body from first pathogens encounter. To build up tools

of health management to provide a finfish growing aquaculture industry, a defense mechanism for fish arises for that purpose. In fish, Novel vaccination procedure assisted by increased in knowledge of fish mucosal resistant system the inherit system present in the vertebrates and invertebrates is a very old evolutionary system.

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