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Fish Skin Mucus and Its Importance in Fish and Humans

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The fish skin mucus contains innate immune components, secreted by goblet cells that provide the primary defense against various pathogenic microbes and act as a barrier between the fish and its immediate host. The main purposes of fish skin mucus include capturing and eliminating microorganisms. Additionally, a number of substances are found in mucus that support innate immunity, including antimicrobial peptides (AMPs), lysozymes, lectins, and proteases. The study of fish mucus is also expanding rapidly with the advent of high throughput technologies that allow concurrent examination of multiple genes and molecules, resulting in a better comprehension of the elements of fish mucus and its purposes. According to most studies, the mucus of fish skin has antibacterial properties that protect the fish from diseases. Due to these antibacterial properties, fish skin mucus is now being used in human medicine as a cheap drug to combat a variety of pathogens and treat clinical diseases. Seeing all this, today's article is based on fish skin mucus and its importance in fish and humans.

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1. INTRODUCTION

Large-scale fish farming industries are more vulnerable to diseases brought by various pathogens. To protect themselves from various pathogenic diseases, fishes have several specialized and sophisticated defense mechanisms, such as the skin mucus, which serves as the first line of physiological defense against pathogens [1]. A reliable chemical or physical barrier against invasive infection is provided by the skin mucus of the fish. A slimy, smooth film known as mucus covers epithelial surfaces in fish. Three different types of cells – goblet cells, sacral cells, and club cells – secrete it. All external surfaces as well as the surface of the gills are covered with goblet cells, which also contain glycoproteins and form mucus granules. Club cells secrete mainly proteinaceous elements, while succiniform cells mix their secretion with that of goblet cells. For fish, mucus is an important component. It varies greatly between species in terms of stickiness, wideness, and glycoprotein (mucin) concentration, which also serves as a proxy for the main mucus components. High molecular weight glycoproteins called mucins give mucus its viscoelastic and rheological properties. Composition of fish mucus and its rheological properties are vital for the maintenance of mucus functions [2,3]. Mucus surfaces are dynamic matrices and their composition varies among fish species and with endogenous (sex and developmental stage) and exogenous factors (stress, water temperature, pH and infections) [4]. The skin mucosa of fish has different components such as proteins, carbohydrates, lipids, metabolites [5,6]. Lysozyme, glycosaminoglycans, immunoglobulins, complement, carbonic anhydrase, lectins, and calmodulin are additional substances present in fish mucus [7]. However, species, sex, developmental stage, and environmental factors all significantly affect the makeup of fish skin mucins. In recent years, there has been great interest in the ability of fish skin mucus to combat various diseases. According to Fuochi et al. [8], the antibacterial properties of mucus make them a promising option for the formulation of new commercially available drugs as well as new therapies to treat human diseases [9]. According to a recent study, it may be possible to create a new sunscreen using the slime produced by some coral reef fish. Protein fibers found in hagfish slime could be used to create novel textiles and materials. Fish slime bacteria make compounds that may be useful in treating human diseases.

2. ROLE OF FISH SKIN MUCUS IN FISH AND HUMANS

a. Fish skin mucus protects fish from harmful viruses right away.
b. On human cancer cells, fish skin mucus has a similar cytotoxic effect [10].
c. Fish skin mucus aids in human wound healing.
d. Fish mucus may be useful for the formulation of topical dermatological remedies.
e. To combat the critical issue of antibiotic resistance, it can be used as an alternative to antibiotics.

1. Intraspecific and interspecific chemical communication
2. Prevention of abrasion
3. Defense against heavy metal toxicity and environmental contaminants
4. Parental nourishing
5. Virus and pathogen defense
6. Improves swimming performance by reducing water resistance [21]

Fig. 1. Functions of fish skin mucus

Table 1. Antibacterial activity of fish skin mucus against bacterial pathogens

Sr. No	Name of fish species	Antibacterial substances	Bacterial strains that are inhibited	References
1.	*Siganusfuscescens,* and *S. guttatus*	Acidic Glycoprotein	Numerous Gram-negative bacteria	Nagashima et al. [11]
2.	*Hippoglossushippoglossus* L.	Antimicrobial Peptide	Numerous Gram-positive, and Gram-negative bacteria	Birkemo et al. [12]
3.	*Sebastesschlegeli*	Antimicrobial Protein	*Aeromonashydrophila, A. salmonicida*, and *Photobacteriumdamselae* spp.	Kitani et al. [13]
4.	*Pelteobagrusfulvidraco*	Antimicrobial Peptide	*Bacillus subtilis, Staphylococcus aureus, Candida albicans, and Escherichia coli*	Su, [14]
5.	*Mastacembelusarmatus*	Protein	*Salmonella typhi, Escherichia coli, Staphylococcus aureus, Vibrio cholera, Klebsiellapneumoniae*, and *Yersinia ruckeri* are examples of human pathogens. *Aeromonashydrophila, A. formican, A. liquefaciens,* and *Pseudomonas aeruginosa* are examples of fish pathogens.	Uthayakumaret al. [15]
6.	*Barbonymusschwanenfeldii*	Glycoprotein	Gram-positive bacteria like *Staphylococcus aureus,* and *Bacillus cereus* Gram-negative bacteria, such as *Escherichia coli*, and *Shigellaboydii*	Subhashiniet al. [16]
7.	*Hypophthalmicthysnobilis*	Protein	*Aeromonashydrophila, Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, Staphylococcus epidermidis, and Klebsiellapneumoniae*	Tyor and Kumari, [17]
8.	*Oncorhynchusmykiss*	Alkaline Phosphatase	*Aeromonashydrophila* and *Yersinia ruckerii*	Taee et al. [18]
9.	*Hypophthalmichthysnobilis, Ctenopharyngodonidella,* and *Cyprinuscarpio*	Protein	*Aeromonashydrophila, Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, Staphylococcus epidermidis, and Klebsiellapneumoniae*	Kumari et al. [19]
10.	*Anabas testudines*	Proteases, andLysozyme	*Salmonella choleraesuis, Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa, and Serratiamarcencen S381*	Al-rasheed et al. [20]

3. CONCLUSION

The preceding summary highlights the important role of fish skin mucus in preventing infection in both fish and humans. Mucus contains a large number of physiologically active substances that participate in a wide range of biological processes. Some of these compounds have generated interest as possible therapeutic development candidates. Fish epidermal mucus may play a role as an antibiotic in the treatment of bacterial diseases in both humans and fish. The use of antibacterial substances found in the epidermal mucus of fish could help tackle the global problem of antibiotic resistance, which is threatening to disrupt health care and improve life expectancy. The ability of mucus to kill bacteria appears to be a promising option for creating new substances that are beneficial to the industry as well as new pharmacological drugs to cure infections in humans. In addition to its importance for the health and welfare of aquaculture, mucus from specific fish species may be a future source of new antimicrobial drugs for uses related to human health.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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