Fish skin mucus and its importance in fish and humans

Abstract:

The primary line of defense against infection is fish skin mucus, which is a crucial component of the innate immune system. The main purposes of fish skin mucus include capturing and eliminating microorganisms. Additionally, a number of substances are found in mucus that supports 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.

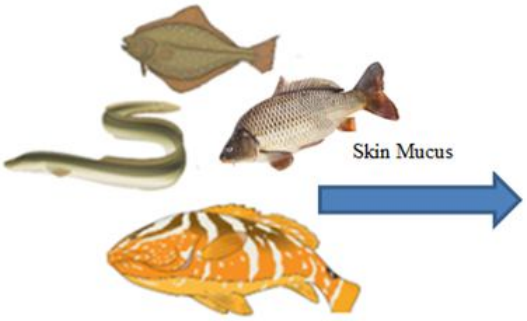
Keywords: Pathogen, antimicrobial, innate immunity, fish skin mucus

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 (Wang *et al.*, 2011). 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. Lysozyme, glycosaminoglycans, immunoglobulins, complement, carbonic anhydrase, lectins, and calmodulin are additional substances present in fish mucus (Shepherd, 1994). 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.*, (2017), 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 (Pethkar and Lokhande, 2017). 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.

Fig 1: Functions of fish skin mucus



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

Role of Fish skin mucus in fish and humans:

- Fish skin mucus shields fish from harmful viruses right away.
- On human cancer cells, fish skin mucus has a similar cytotoxic effect (Kwak *et al.*, 2015).
- Fish skin mucus aids in human wound healing.
- Fish mucus may be useful for the formulation of topical dermatological remedies.
- To combat the critical issue of antibiotic resistance, it can be used as an alternative to antibiotics.
- Compared to freshwater fish, marine fish offer better antibacterial capabilities against several human infections (Tiralongo *et al.*, 2020).
- In comparison to frequently used antibiotics, fish skin mucus is more effective at combating a variety of human and fish illnesses.
- Fish skin mucus is a strong candidate to provide new antimicrobial chemicals for human health due to its significant and well-known antibacterial activity.

Table1. Antibacterial activity of fish skin mucus against bacterial pathogens

Sr. No	Name of fish species	Antibacterial substances	Bacterial strains that are inhibited	References

1.	*Siganus fuscescens,* and *S. guttatus*	Acidic Glycoprotein	Numerous Gram-negative bacteria	Nagashima *et al.* (2001)
2.	*Hippoglossus hippoglossus* L.	Antimicrobial Peptide	Numerous Gram-positive, and Gram-negative bacteria	Birkemo *et al.* (2003)
3.	*Sebastes schlegeli*	Antimicrobial Protein	*Aeromonas hydrophila, A. salmonicida,* and *Photobacterium damselae* spp.	Kitani *et al.* (2007)
4.	*Pelteobagrus fulvidraco*	Antimicrobial Peptide	*Bacillus subtilis, Staphylococcus aureus, Candida albicans, and Escherichia coli*	Su, (2011)
5.	*Mastacembelus armatus*	Protein	*Salmonella typhi, Escherichia coli, Staphylococcus aureus, Vibrio cholera, Klebsiella pneumoniae,* and *Yersinia ruckeri* are examples of human pathogens. *Aeromonas hydrophila, A. formican, A. liquefaciens,* and *Pseudomonas aeruginosa* are examples of fish pathogens.	Uthayakumar *et al.* (2012)
6.	*Barbonymus schwanenfeldii*	Glycoprotein	Gram-positive bacteria like *Staphylococcus aureus,* and *Bacillus cereus* Gram-negative bacteria, such as *Escherichia coli*, and *Shigella boydii*	Subhashini *et al.* (2013)
7.	*Hypophthalmicthys nobilis*	Protein	*Aeromonas hydrophila, Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, Staphylococcus epidermidis, and Klebsiella pneumoniae*	Tyor and Kumari, (2016)
8.	*Oncorhynchus mykiss*	Alkaline Phosphatase	*Aeromonas hydrophila* and *Yersinia ruckerii*	Taee *et al.* (2017)
9.	*Hypophthalmichthys nobilis, Ctenopharyngodon idella,* and *Cyprinus carpio*	Protein	*Aeromonas hydrophila, Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, Staphylococcus epidermidis, and Klebsiella*	Kumari *et al.* (2019)

			pneumoniae	
10.	*Anabas testudines*	Proteases, and Lysozyme	*Salmonella choleraesuis, Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa, and Serratia marcencen S381*	Al-rasheed *et al.* (2020)

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.

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