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REVIEW ARTICLE **OPEN ACCESS**

An examination of the effects of changing water quality on the histological characteristics of fresh water fish

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ABSTRACT
Freshwater fish play a significant role in the aquatic ecology, but changes in water quality can have a negative impact on their survival and development. The objective of this review study is to examine how altering water quality may affect freshwater fish's histological future. The review discusses the histological alterations brought on by alterations in water quality in fish, the mechanisms underlying these alterations, and any potential long-term implications on fish populations.
Keywords;*- Fish, Histopathology ,water quality, pollutants*

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INTRODUCTION

Many species, particularly freshwater fish, which are crucial to preserving the biological balance of these systems, depend on freshwater habitats for their survival. However, a variety of human activities, including as industrial pollution, agricultural runoff, and climate change, pose a threat to freshwater ecosystems and can have a substantial impact on the water quality in these systems.

Growing concern exists on how altering water quality can affect the histopathological future of freshwater fish. Changes in the histology of freshwater fish may be a symptom of health problems and may have a big impact on the survival of these species. Histology is the study of the microscopic structure of tissues and organs. Therefore, for successful management and protection of freshwater ecosystems, it is essential to comprehend how changing water quality affects the histology of freshwater fish.

This paper aims to provide a comprehensive analysis of the existing research on the impact of changing water quality on the histological future of freshwater fish. We will examine the various factors that can impact the histology of freshwater fish, including heavy metals, pH, pesticides, and water temperature. By exploring the current state of knowledge on this topic, this paper aims to provide insights into the potential implications of changing water quality for the health and survival of freshwater fish and highlight the importance of effective management strategies to protect these species and the ecosystems they inhabit.

METHODS

This review paper is based on a systematic review of existing literature on the impact of changing water quality on the histological future of freshwater fish. The literature search was conducted using electronic databases such as PubMed, Science Direct, and Google Scholar. The keywords used for the search were "freshwater fish," "water quality," "histology," "physiology," and "pathology." The search was limited to articles published in the last ten years to ensure that the review covered the most recent research in the field.

Results

The impact of changing water quality on the histological future of freshwater fish is an area of growing concern due to the potential impact on both the health of the fish and the ecosystems they inhabit. This literature review aims to explore the existing research on this topic and provide an analysis of the key findings.

Heavy metals are among the most significant pollutants affecting freshwater fish. Studies have shown that heavy metals can accumulate in the tissues of fish and cause a range of negative effects on their health, including histological changes. Agah et al. (2013) found that fish species from the Caspian Sea had accumulated high levels of heavy metals, and these metals were present in the gills, liver, and muscle tissues. The authors also conducted a human health risk assessment and found that consuming fish from the Caspian Sea could pose a risk to human health due to the high levels of heavy metals present.[1]

The pH of water is another important factor that can impact the histology of freshwater fish. Gomes et al. (2017) investigated the impact of pH on the gill structure and ion regulation of the Nile tilapia, Oreochromis niloticus. The authors found that exposure to low pH caused significant histological changes in the gills, including hyperplasia, fusion of lamellae, and epithelial lifting. These changes can reduce the ability of fish to regulate their ion balance, which can ultimately lead to death.[2]

Pesticides and other chemical contaminants can also impact the histology of freshwater fish. Kavitha and Vasanthi (2016) exposed common carp (*Cyprinus carpio*) to a sublethal concentration of the pesticide chlorpyrifos and found significant histopathological changes in the gill, liver, and muscle tissues. The authors observed damage to the gill filaments, liver cells, and muscle fibers, indicating that exposure to pesticides can cause severe tissue damage in fish.[3]

Water temperature is another critical factor that can impact the histology of freshwater fish. Lu and Liu (2014) investigated the effects of water temperature on the gills of three tropical air-breathing fish and found that high water temperatures can cause histological changes, including hypertrophy of the gill filaments and an increase in the density of mucous cells. These changes can reduce the respiratory efficiency of the gills, which can ultimately impact the health of the fish.[4]

According to a study by Hedayati et al. (2020), water pollution has a significant impact on the histology of freshwater fish. The researchers found that exposure to water pollutants caused histological changes in the liver and gills of fish, leading to reduced function and potentially fatal health problems.[5]

Similarly, a study by Al-Harbi and Uddin (2018) found that exposure to polluted water led to the accumulation of heavy metals in the tissues of fish, which can cause damage to organs and lead to long-term health problems. The study also found that exposure to polluted water can lead to changes in fish behavior, such as reduced swimming speed and feeding activity.[6]

Another study by Tarkan et al. (2017) analyzed the impact of water quality on the histology of European catfish. The researchers found that exposure to water pollutants led to changes in the liver, kidney, and gills of the fish. These changes included tissue damage, inflammation, and cell death, which can have long-term impacts on fish health and survival.[7]

Furthermore, a study by Rahman et al. (2016) analyzed the impact of water pollution on the histology of rainbow trout. The researchers found that exposure to pollutants caused histological changes in the liver and gills of the fish, leading to reduced function and potential health problems.[8]

A study by Wong et al. (2018) examined the histological changes in the gills of common carp (Cyprinus carpio) exposed to different levels of ammonia in water. The results showed that exposure to high levels of ammonia led to histological changes in the gills, including epithelial hyperplasia, fusion of secondary lamellae, and swelling of pillar cells. The study concluded that exposure to high levels of ammonia can significantly impact the histology of the gills in freshwater fish.[9]

Another study by Rana et al. (2019) examined the impact of water quality on the histological changes in the liver of freshwater fish. The study focused on the impact of heavy metal contamination on the liver tissue of catfish (Clarias gariepinus) and showed that exposure to heavy metals can cause histological changes in the liver, including cellular degeneration, fibrosis, and necrosis. The study concluded that heavy metal contamination in water can have a significant impact on the histological future of freshwater fish.[10]

A study by Pan et al. (2020) examined the impact of water temperature on the histology of the kidney in freshwater fish. The study focused on the impact of high water temperatures on the histology of the kidney in zebrafish (Danio rerio) and showed that exposure to high water temperatures can lead to histological changes in the kidney, including glomerular hypertrophy and tubular atrophy. The study concluded that changes in water temperature can significantly impact the histological future of freshwater fish.[11]

One study by Akhter et al. (2020) investigated the effects of water pollution on the liver and kidney tissues of Labeo rohita, a freshwater fish species. The researchers found that exposure to polluted water led to significant changes in the histology of these organs. The liver tissue showed signs of necrosis and degeneration, while the kidney tissue exhibited vacuolization and congestion.[12]

Similarly, a study by Rahman et al. (2020) analyzed the histological effects of water pollution on the gills of Oreochromis niloticus, another freshwater fish species. The researchers found that exposure to

polluted water led to changes in the gill tissue, including hyperplasia, fusion of secondary lamellae, and edema.[13]

Another study by Linton et al. (2021) investigated the effects of water quality on the histology of the liver, spleen, and kidney tissues of Oncorhynchus mykiss, a freshwater fish species. The researchers found that exposure to low-quality water led to changes in the histology of these organs, including hepatocyte vacuolation and necrosis in the liver, and lymphocyte depletion in the spleen.[14]

A study by Magesh et al. (2017) examined the impact of water quality on the histological structure of the gill, liver, and kidney of the freshwater fish, Cyprinus carpio. The study found that exposure to poor water quality led to histological changes in these organs, such as epithelial lifting, hyperplasia, and hypertrophy. The study concluded that water quality significantly impacted the histological structure of freshwater fish organs.[15]

Another study by Ahmad et al. (2021) analyzed the histological changes in the liver and gill of the freshwater fish, Labeo rohita, exposed to sublethal concentrations of heavy metals. The study found that exposure to heavy metals led to various histological changes, such as tissue damage, inflammation, and necrosis. The study concluded that heavy metal contamination in water bodies could have severe consequences on the histological structure of freshwater fish organs.[16]

In a study by Zaki et al. (2019), the histological changes in the gill and liver of the freshwater fish, Oreochromis niloticus, due to exposure to pesticides were analyzed. The study found that exposure to pesticides led to histological changes such as epithelial lifting, congestion, and necrosis. The study concluded that pesticide contamination in water bodies could negatively impact the histological structure of freshwater fish organs.[17]

In a study conducted by Nwani et al. (2010), histological changes were observed in the gills, liver, and kidney of Clarias gariepinus exposed to water polluted with lead and cadmium. The authors found that the fish exposed to polluted water had significant histological alterations, including hemorrhages, necrosis, and cellular infiltration. [18] Similarly, in a study by Kumar et al. (2017), it was observed that fish exposed to wastewater from a nearby textile mill had histological changes in their gills, liver, and kidney. The fish showed hyperplasia, hypertrophy, and necrosis in their gills, as well as severe degeneration in their liver and kidney.[19]

Water quality also affects the immune system of fish. In a study by Varela et al. (2014), it was observed that rainbow trout exposed to water contaminated with heavy metals had histological changes in their spleen, which is an important organ of the immune system. The fish showed a decrease in the number of lymphocytes, which are cells responsible for the immune response.[20]

Furthermore, water quality can also affect the reproductive system of fish. In a study by Muangkeow et al. (2019), it was observed that Nile tilapia exposed to water polluted with heavy metals had histological changes in their ovaries and testes. The fish showed significant degeneration in their ovaries and testes, which could potentially affect their reproductive success.[21]

CONCLUSION

This literature review examines the impact of changing water quality on the histological future of freshwater fish. Heavy metals, pH, pesticides, water temperature, and pollutants have been found to have significant effects on the histology of freshwater fish. The accumulation of heavy metals can cause tissue damage and health problems, while exposure to low pH levels can reduce the ability of fish to regulate their ion balance. Exposure to pollutants can lead to changes in fish behavior and severe tissue damage, such as damage to gill filaments, liver cells, and muscle fibers. Changes in water temperature can reduce the respiratory efficiency of the gills and lead to histological changes in the kidney. Overall, water pollution can have a significant impact on the histological feature of freshwater fish, leading to reduced function, potential health problems, and long-term impacts on fish health and survival.

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