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# Abnormal Tissues Changes Made by Chlorine in the Gills of *Oreochromis niloticus* Fish

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#### **Abstract**

The study was conducted in the department of fisheries and wildlife science, Sudan University of science and technology aimed to find out the effects of chlorine as disinfection material in gills tissue of *Oreochromis niloticus*, fish samples were taken from fish hatchery and divided in to three groups, and they were acclimatized for two weeks during this time they were fed by commercial fish food after that they subjected to two dosages' of chlorine, the first group was subjected to 0.3 ppm, the second group was subjected to 0.5 ppm and the third was the control group without any additives, any dead fish during the experiment was dissected for general observation and their gills taken on 10% buffered neutral formalin and processed using the normal histological technique and examined under light microscope. Histological changes observed in the gills were severe congestion of blood vessels, edema of epithelial cells at the lamellae, Hyperplasia of mucous cells and fusion at lamellae and gills filaments damage were notice in the studied fish gills. In conclusion the histology of the fish gills provides information to evaluate the fish health status and to examine the toxic materials may attack fish in their natural habitats and environment. Also results reinforce the high potential of histopathological changes in increasing concentration of chlorine in water of fish.

#### **Keywords**

Chlorine, Histology, Gills, Hyperplasia, Oreochromis niloticus, Health, Toxicity, Environment

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#### 1. Introduction

Water contamination and effects of waterborne contaminant on aquatic life and Humans has become a strong concern over the last few decades. Untreated industrial, agricultural and domestic effluents are the most common causes of pollution since they usually contain mixtures of various pollutants they are hazardous to aquatic life [2, 8]. The gills in fish are a particularly sensitive organ they are responsible for respiration and maintaining the optimal osmotic pressure and acid-base balance of the body fluids. They play an essential role in excreting unnecessary and harmful metabolic products and in supporting food drainage [10], Chlorine (Cl<sub>2</sub>) and other chlorine compounds have been used as

disinfectants in water purification and wastewater treatment for many years because they are effective, relatively inexpensive, and remain active within systems for a considerable length of time [12]. The most common forms of chlorine found in water are HOCl, OCl<sup>-</sup>, NH<sub>2</sub>Cl and NHCl<sub>2</sub> [7]. It is also used as a gas (Cl<sub>2</sub>) or as salts of hypochlorous acid (HOCL), such as sodium hypochlorite (NaOCl) or calcium hypochlorite [Ca(OCl)<sub>2</sub>] [14]. Chlorine (Cl<sub>2</sub>), in gaseous form or as hypochlorite, is widely used for disinfection of water supplies and in aquaculture for sterilization of equipment's, tanks and standing water in drained ponds [15]. Chlorine also used to reduce levels of some coliform bacteria and some other pathogens in drinking water, thus it can also be used to reduce the levels and numbers of pathogens in water used for fish production [16].

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Chlorine may be toxic to fish at concentrations less than 0.05 mg/L. Residual chlorine in municipal water supplies is normally between 0.5 and 2.0 mg/L [15]. Toxicity varies with fish species, duration of exposure, temperature and other water quality conditions [14]. The consumption of chlorine in pond water is influenced by the concentration of suspended solids, oxidizable organic matter and inorganic compounds as well as dissolved oxygen [18, 4] and [1]. Gold fish, koi and carp are very susceptible to chlorine. Level of 4.0 ppm killed them within 8 hours of exposure [3]. Chlorine concentrations as low as 0.1-1.0 mg/L have been reported to cause significant mortality to shrimp and other aquatic organisms [6, 11]. Chloride is added to municipal water supplied to kill microorganisms and it's reacts with the natural organic matter or contaminants in surface waters and produces a complex mixture of disinfection by products (DBPs), some shown to be carcinogenic, mutagenic and or teratogenic in animal studies [9]. The aims of this study were to investigate the effects of short term expose of chlorine on the tissues of gills of Oreochromis niloticus fish.

## 2. Materials and Methods

#### 2.1. Fish Samples and the Experiment

Adult freshwater fish *Oreochromis niloticus*, were obtained from the Hatchery of the Department of fisheries and wildlife science, Sudan University of science and Technology. (30) Fish samples of both sexes were used in average weight (90-120) g. they were placed in large tanks with aerated tap water (tested for chlorine using chlorine kits) and fed with commercially pellets. Fish were acclimatized for two weeks and check daily for temperature using an ordinary centigrade measuring thermometer and water pH using portable digital pH meter. Chlorine was added as a powder in two dosages all of them are in two replicates: The first group was 0.3 ppm, the second group was 0.5 ppm and the third was the control group. Any dead fish was dissected for its gills.

#### 2.2. Histopathological Examination

In the laboratory, the second right gill arch was removed, fixed in 10% formalin for 24 h and then decalcified in 10% nitric acid, dehydrated in increasing concentrations of alcohols, cleared in xylene, impregnated and embedded in paraffin. Five µm thick sections were stained with hematoxylin and eosin for histological description and examined under light microscope.

#### 2.3. Statistical Analysis

All data were compared using one-way analysis of variance (ANOVA) followed by LSD test. All the tests were regarded statistically significant when p < 0.05.

## 3. Results

**Table 1.** Shows the occurrence of main types of histopathological changes detected in *Oreochromis niloticus* gills exposed to chlorine.

Abnormalities	% of infected fish	
	0.3 ppm	0.5 ppm
Severe congestion of blood vessels	90%	92%
Edema of epithelial cells at the of lamellae	90%	98%
Hyperplasia of mucous cells and fusion at lamellae	88%	90%
Gills filaments damage	90%	96%

Sections through the gills of *Oreochromis niloticus* showing control fish gills Figure 1 severe congestion of blood vessels Figure 2, Edema of epithelial cells at the of lamellae Figure 3 Hyperplasia of mucous cells and fusion at lamellae Figure 4 and Gills filaments damage Figure 5.

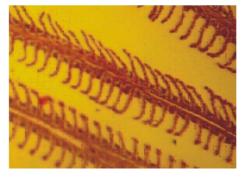


Figure 1. The control fish gills (400 × magnification).



Figure 2. Severe congestion of blood vessels (100× magnification).

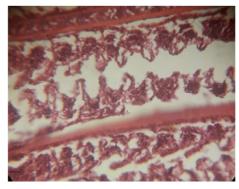


Figure 3. Edema of epithelial cells at the lamellae (400× magnification).

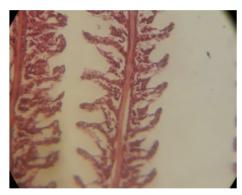


Figure 4. Hyperplasia of mucous cells and fusion at lamellae (400× magnification).



Figure 5. Gills filaments damage (400× magnification).

# 4. Discussion

Chlorine toxicity can present as acute to subacute mortality associated to a newly setup tanks or when fresh tap water is used for water change [10].

Results of the structure of gills of *Oreochromis niloticus* were reported to other teleost species by [13]. as the comparisons with other studies where the chronic exposure to contaminants were investigated. According to [19]. severe congestion and Edema of epithelial cells found in individuals from Lake Park and Lake Cedeteg and they are considered as moderate severity according to the classification of [5]. Oedema of the gills lamellae is often found as a result of exposure to toxic substances such as, pesticides, as well as the effect of water acidification [21, 17]. Hyperplasia of mucous cells and fusion at lamellae may occur as a tissue response to the presence of pollutants diluted in water, increasing the distance between the blood capillary and lamellae surface duo to pollutants uptake. [13] And [20].

## 5. Conclusion

The data in the current work showed that according to the histological analysis, chlorine as disinfection in water is more impacted in fish gills tissues this is supported by the number of abnormalities found differently in the studied species.

In addition the results reinforce the high potential of

histopathological changes in increasing concentration of chlorine in water of fish.

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