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Original Article

Histomorphometric analysis of gills in Nile tilapia (*Oreochromis niloticus*) exposed to different concentrations of ammonia

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Abstract

The rapid development of aquaculture resulted in modern methods such as intensive aquaculture or water circulation systems producing agricultural wastewater with high concentrations of nitrogen pollutants. However, these pollutants and urban, industrial, and agricultural wastewater are harmful to aquatic animals and increase damage in gills and energy loss. The present study aimed to evaluate the histomorphometry of the gills of Nile tilapia exposed to different ammonia concentrations. Juvenile *Oreochromis niloticus* were prepared and kept in the 100l aquariums for adaptation. After completing these steps, the test was conducted based on the increase in susceptibility of Nile tilapia on ammonia. Then, an acute toxicity test was performed in the experimental and control groups for 96 hours according to the standard instructions. For sub-lethal toxicity studies, 120 Nile tilapia were categorized into four groups, including three groups based on different percentages of (10, 20, and 30% LC50 96h) and a control group. The groups were exposed to ammonia for 14 days at a stable physicochemical conditions. Finally, histological analysis was carried out on fish gills. Then standard method of paraffin sections followed and tissue sections, 4-6µ thick were cut and stained with hematoxylin and eosin methods. The data obtained demonstrate that high concentrations of ammonia caused various gills tissue damage as hyperemia, filament swelling, increase in the number of chloride cells, necrosis and cell death, hyperplasia, hypertrophy and changes in behavior such as decreased appetite and mobility. The obtained data showed that an increase in ammonia level could cause irreversible damage to gill structure, and other tissues. Therefore, the habitats of these aquatic animals must be continuously monitored for ammonia levels.

Key words: Ammonia, Nile tilapia, Histomorphometric, Lethal concentration

Introduction

Aquatic animals play an important role in human food supply due to their easy reproduction (Dastan et al. 2017), consumption of relatively little energy, and potentials to produce more foods rich in vitamins, omega three fat, and phosphorus (Morovvati et al. 2017; Shalaby et al. 2021). Therefore, commercially, fish and seafood are among the most valuable protein sources to feed a growing world population. Tilapia is a genus of cichlid fishes endemic to freshwater habitats (Elbialy et al. 2021). Tilapia, native to Africa, has become the most popular farmed fish globally and one of the most traded seafood commodities (Luquet 2017). In addition to being delicious and cheap, this farmed fish is an ideal choice for human nutrition because it

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does not require the utmost care and eats fast-growing, inexpensive vegetables (Mei et al. 2020). It is the fourth most commonly consumed type of seafood in the United States due to its special characteristics (Espinosa et al. 2019). The tilapia belongs to the percidae family and has a rectangular body with small scales and a long dorsal fin with 23-31 thorns and radii. Most tilapias eat phytoplankton, but some prefer plants and use organic plants in areas where other breeding species feed on plankton. Tilapia species with short and coarse gill spines eat larger food particles. Tilapia's diet can contain large amounts of vegetable protein, lowering its production costs than other cultivars (Abdelghany 2020). Various diseases caused by toxins and pathogenic microorganisms may damage fish in the agricultural environment (Mohamed et al. 2021; Basir and peyghan. 2019). Ammonia is the most important toxic compound for farmed fish and combines nitrogen and hydrogen. This substance is mainly collected by moving air and water down in breeding ponds (Naderi et al. 2014; Sriyasak et al. 2015). Ammonia poisoning is a major cause of fish mortality on farms. The digestion of protein by fish leads to the production of ammonia, which is very toxic. Fish need to throw this waste into the water to remove it from their bodies (Yousefi et al. 2020; Jebur et al. 2019). Ammonia damages fish skin, gills, and other tissues (El-Shafai et al. 2004; Zeitoun et al. 2016; El-Greisy et al. 2016) and causes a variety of symptoms such as respiratory problems (rapid breathing of gills, shortness of breath, swallowing air from the water surface), irregular swimming, and sudden darting movement, skin bruising (bleeding) and excessive mucus production (dark spots on the skin), lethargy, loss of appetite, fish lying in bed, red streaks on the fins and body and red or purple gills (Ali et al. 2020; Mohamed et al. 2020). If the injury with ammonia poisoning continues, streaks or bloodstains appear on the body and fins. Internal damage also occurs in the brain, organs, and central nervous system. Eventually, bleeding (hemorrhage) occurs on the inner and outer surfaces of the fish, leading to death (Kim et al. 2019) (Kim et al. 2020). To date, very few studies have been conducted on the effects of different chemical elements on the tissues of tilapia species in Iran, which has resulted in conflicting results. The purpose of this study was to examine the histomorphometry of the gills of Nile tilapia (*Oreochromis niloticus*) exposed to different concentrations of ammonia to reduce the damage to this species and to prevent wastage of capital and workforce in breeding this species.

Materials and Methods

A total of 120 juveniles Nile tilapia (mean weight 35±1 g) were prepared and then transferred to the laboratory in a 500-liter tank for two weeks to adapt to environmental conditions. During acclimation, proper daily aeration was performed, and for 2% of the fish body weight by the plate, fish were fed with a commercial dry food (Bio mar, France). During the experimental period, the average temperature of the water was 27±1 °C, dissolved oxygen was 6.2 ±1 mg/L, and total hardness was 269 ±3 mg/L. Range finding test was performed on Nile tilapia to find lethal ammonia levels (Suliman et al. 2021). An acute toxicity test was carried out on tilapia fish for 96 hours according to standard instructions. Ammonia (Merck, Germany) was prepared as an ammonium chloride solution. Feeding of juveniles was stopped 24 hours before the acute toxicity test. All effective physicochemical parameters of water, including pH, dissolved oxygen, and temperature, were recorded daily. After determination of the lethal range, the final test for acute ammonia toxicity was performed. For this purpose, four treatments with control group specimens have been examined. The fish in each treatment were placed, and the solution was aerated 24 h before the test organisms were placed in the 15-liter aquarium. Dead fish were collected from the aquarium environment shortly after observation, and loss numbers were calculated and recorded 24, 48 , 72, and 96 hours later. The results of acute toxicity test data were analyzed using probit analysis with a 95% confidence level. For sublethal toxicity studies, fish were categorized into four experimental groups, three of which were selected based on different percentages of LC50 96h (10, 20, and 30%) and placed with a control group in three replication. The fish were exposed to ammonia for 14 days in 100-liter aquarium under controlled physicochemical conditions (Mazandarani et al.1395; Naji et al. 1388). Feed quantity was 2 percent of body weight per day. The remaining food was removed from the aquarium by exchanging water. Water containing the same amount of ammonia was drawn from the aquarium and was added to the aquarium to keep the ammonia concentration constant.

Histological Examination

At the end of the experiment, the fish were randomly caught and anesthetized with 0.5 g/l clove powder. Specimens prepared in 10% formalin buffer (Basir and Peyghan. 2016) were fixed and transferred in 70% alcohol for 24 hours. They were further processed through a series of graded ethanol's (70, 80, 90, 100% and 100%) and xylene. It should be noted that all these steps were performed by automated tissue processors (Leica ASP300 S, Germany) under the defined program (Suliman et al. 2021). The tissues were molded and then paraffinized by using Tissue-Tek, molded under the melting temperature of 56-58 ° C. Specimens were sectioned to 4 to 6-micron thick by using a microtome, and then they were placed on a slide and put in an oven at 60 ° C for 30 m for deparaffinization of paraffin-embedded sections (Pourkhadje et al. 2014). To stain the specimens, they were deparaffinized in xylene, rehydrated, and stained with hematoxylin and eosin. The slides, 10 slides from the gills, were examined by a light microscope attached to a Dinolit lens and a computer system equipped with DinoCapture software (Morovvati et al. 2012).

Results

Results showed no mortality rate during the adaptation period in different treatments under total ammonia sublethal level (0.9, 1.8, and 2.7 mg/L) and control treatment for two weeks. In microscopic studies of Nile tilapia fish exposed to different concentrations of ammonia, especially in high concentrations and in the last days of the experiment, some symptoms of ammonia poisoning were observed, including decreased appetite, decreased mobility, nervous conditions, and swallowing air from the water surface, acceleration in respiration and opening and closing of the gill operculum. The gills were severely hyperemic, and the accumulation of mucus was noticeable in all parts. Bleeding on the outer surface, and accumulation of mucus on the surface of the fish's body were also quite obvious. The results of microscopic studies of fish gills exposed to different concentrations of ammonia compared to control fish showed changes and lesions in gill tissue. Tissue changes such as hyperemia and hemorrhage, hyperplasia and adhesion of lamellae, hypertrophy, filament swelling, detachment of lamella epithelium, and increase in chloride cell count and cell necrosis were also observed. Overall, the severity of these complications increased significantly from low- to high-concentration treatment ($p<0.05$) (Figures 1 and 2).

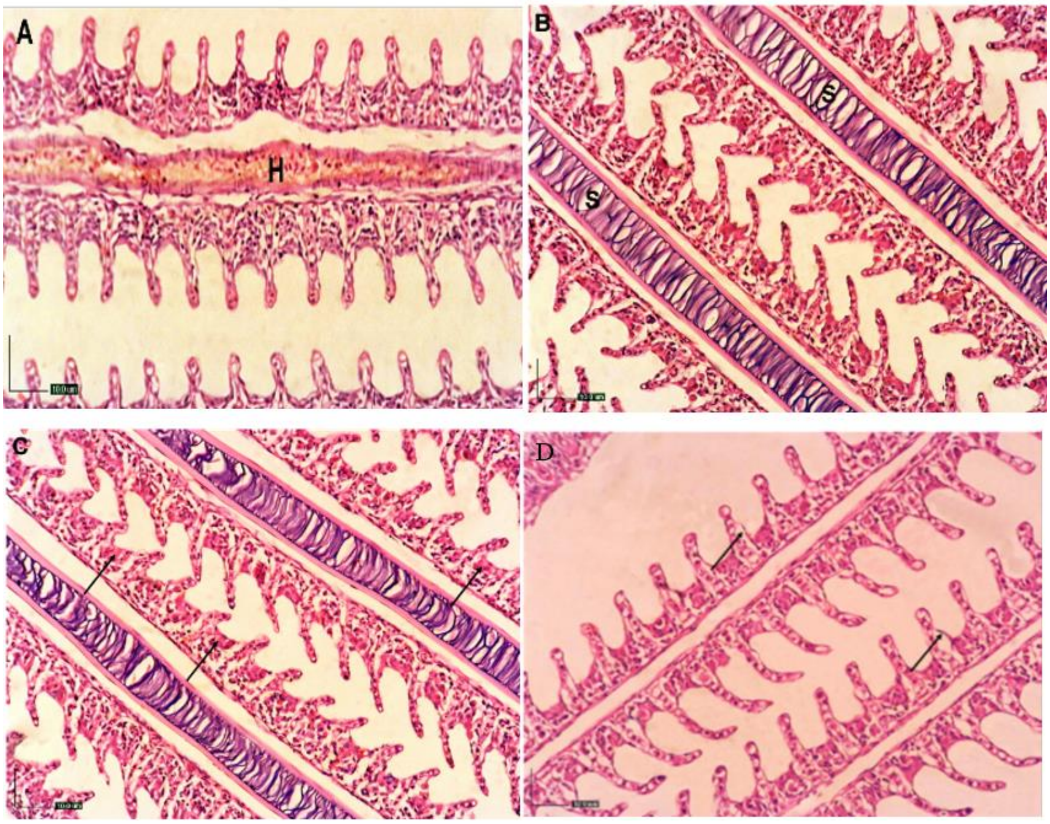

Figure 1: Gills tissue micrograph of Nile tilapia in experimental groups (H&E, x40). A) Hyperemia (H) in ammonia-affected groups 0.9 mg/L for two weeks; B) Filament swelling (S) in ammonia-affected groups 1.8 mg/L over two weeks C); Increase in the number of chloride cells (arrows) in ammonia-affected groups 2.7 mg/L, D); Peeling of the epithelium (arrows) in the groups affected by ammonia 0.9 mg/L in two weeks.

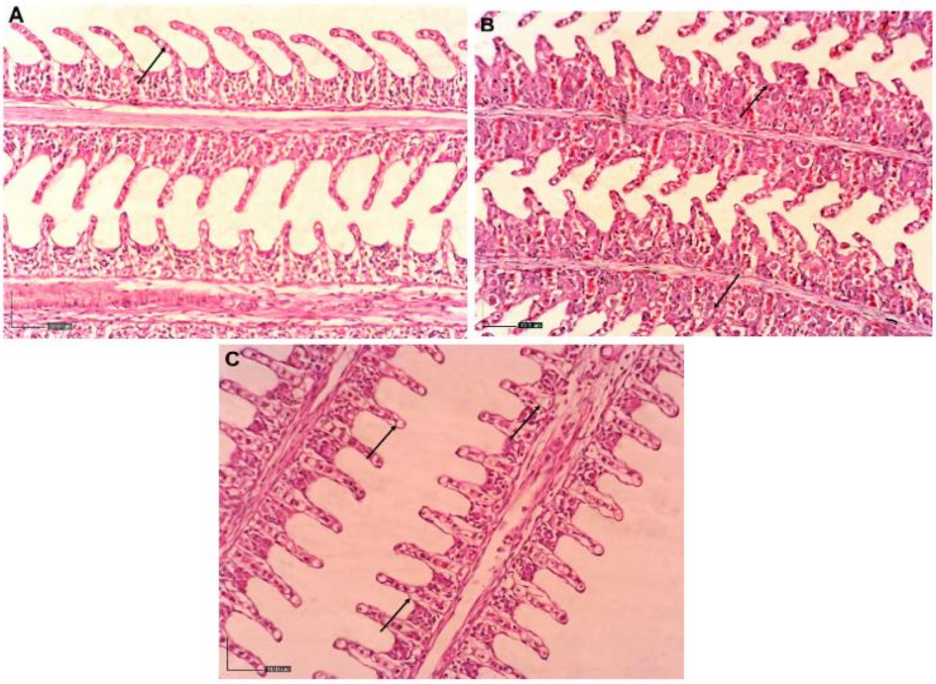

Figure 2: Gills tissue micrograph of Nile tilapia gills in experimental groups (H&E, x40). A) necrosis and cell death (arrows) in ammonia-affected groups 0.9 mg/L over two weeks, B); Hyperplasia Cellular (arrows) in ammonia-affected groups 1.8 mg/L for two weeks C); Cellular hypertrophy (arrows) in ammonia-affected groups 2.7 mg/L for two weeks.

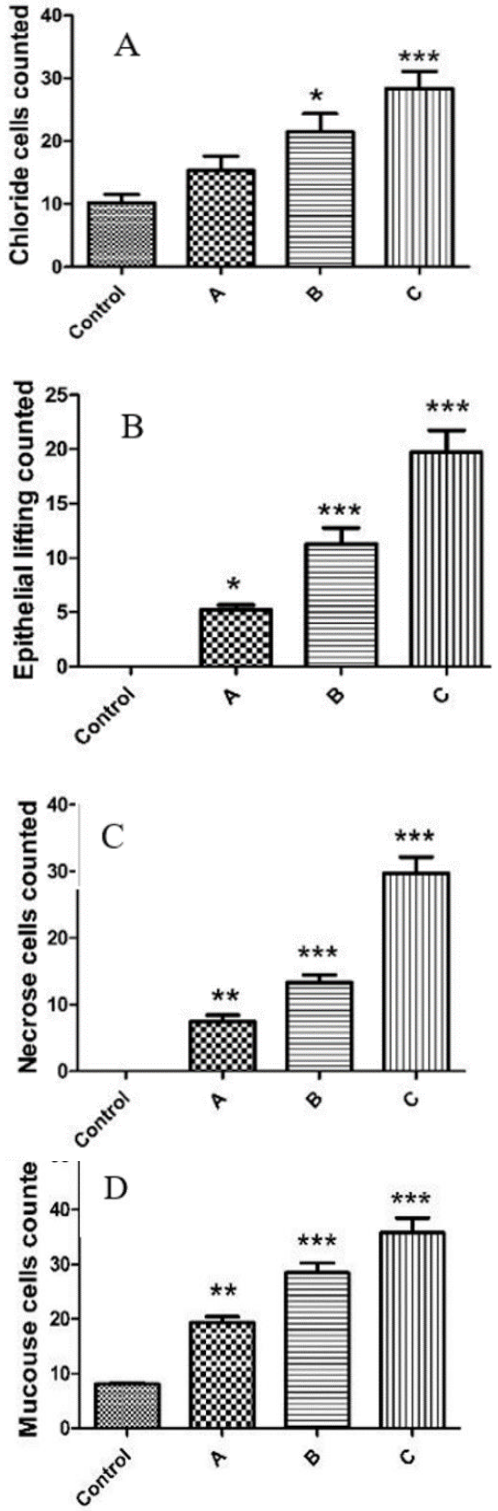

Figure 3: According to the figures: Graph A: Increase in the number of chloride cells, Graph B: Increase in the number of epithelial protrusions, Graph C: Increase in the number of necrotic cells, Graph D: Increase in mucosal cells in the gill of the Nile tilapia ammonia-affected groups, 0.9 mg/L (A), 1.8 mg/L (B), and 2.7 mg/L (Different symptoms indicate a significant difference in level of $p<0.05$).

Discussion

In recent years, tilapia has become the second most important fish in aquaculture after carp worldwide (Šilovs 2018). By region, asia accounts for over 70% of world tilapia production (Mo et al. 2018). Diseases affecting aquatic animals, especially farmed fish, are among the most significant causes of human and capital loss in the region, increasing the risk of cultivating these organisms (Mercante et al. 2018; Abdi et al. 2011). Ammonia is a toxic compound with many toxic effects and destroys the gill tissue and skin of aquatic animals. It is increased by the excretion of fish in aquaculture water, leading to the extinction of this species (Mo et al. 2018). Ammonia in aqueous media can be detected in both ionized and non-ionized types, while the latter is highly toxic because it penetrates the epithelium of aquatic organisms (Kim et al. 2017). In this study, histomorphometry of the gills of Nile tilapia exposed to different ammonia concentrations was examined for the first time in Iran. The results showed that increased ammonia concentrations lead to tissue damage such as gill damage, paleness, various tissue damage, and changes in behavior such as decreased appetite, decreased mobility, nervous conditions, swallowing air from the water surface, acceleration in respiration, and opening and closing the gill cover eventually resulted in death in aquatic animals. Banihashemi (2013) reported similar features and symptoms in histopathological effects of ammonia gills of *Acipenser persicus*. The results of microscopic studies of fish gills exposed to different concentrations of ammonia compared to control fish showed changes and lesions in gill tissue. Tissue changes such as hyperemia and hemorrhage, hyperplasia and adhesion of lamellae, hypertrophy, filament swelling, detachment of lamella epithelium, and increase in chloride cell count and cell necrosis were also observed. Similar histopathological changes and complications were reported by other substances in similar cases on other aquatic animals (Elbialy et al. 2021; Jebur and El-Demerdash. 2019; Naji et al. 2009). Overall, the severity of these complications increased significantly from low to high concentration treatment and showed a significant difference compared to specimens in the control group. Banihashemi et al (2013). examined and determined the lethal concentration of ammonia and its effect on the histopathological status of gills, kidneys, and liver of ozone fish. Their results showed that it is possible when the gills are exposed to ammonia, hyperemia, hyperplasia, secondary lamellar adhesion, primary lamellar swelling, hemorrhage, and cell necrosis. Besides, complications such as hyperemia, bile aggregation, cellular necrosis, and cell atrophy were observed in the liver, and all complications such as hyperemia, interstitial tissue degeneration, cellular necrosis, Bowman's dilatation, and hemosiderin were observed in the treatments. In general, the most relevant injuries have been observed in the gills of these fish (Banihashemi et al. 2013; Magouz et al. 2021). Shalaby et al (2021). examined the lethal concentration and behavioral changes in acute ammonia and nitrite poisoning in Common carp. They found that adding ammonia and nitrite to the studied concentration increased the mortality rate of fish exponentially. The present study is another example of studies proving necrotic changes in the gills and tissues of fish due to ammonia poisoning, which can lead to death if the duration is increased. In a study investigated the effect of oral menthol extract on the growth of Nile tilapia and showed that ammonia increases cortisol and glucose levels as well as oxidative stress in this aquatic species, which is consistent with the findings of the present study (Yilmaz et al. 2020; Mo et al. 2018). Mercante et al. (2018) also confirmed the increase in tissue problems due to the increase in the exposure time of fish to aquatic ammonia and showed that this exposure could lead to increased complications of gills, cortisol level and oxidative stress leading to death in aquatic animals (Termeh Yusefi et al. 2018), and it was in line with the results of the present study.

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Conflict of interest

We need to declare no conflict of interest.

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References

Abdelghany, A. (2020). Food and feeding habits of Nile tilapia from the Nile River at Cairo, Egypt. Fish Farming Technology, P: 447-54.

Abdi, R.; Pourkhadje, M.R.; Zolgharnein, H.; Hosseinzadeh Sahafi, H. and Morovvati, H. (2011). Effect of salinity on mitochondria of chloride cells in gill of juvenile's grouper (*Epinephelus coioides*). Journal of Animal Environment, 2(4): 37-42.

Ali, A.; Moustafa, Y.T. and El-Said, S. (2020). Evaluating the influence of different water sources on water quality, survival and growth rates of Nile tilapia (*Oreochomis niloticus*) larvae in tilapia hatcheries. Egyptian Journal for Aquaculture, 10(1): 45-64.

Banihashemi, E.; Khara, H.; Pajand, Z. and Rahanandeh, M. (2013). Histopathological effects of ammonia on gills, liver and kidney of Acipenser persicus. Comparative Pathobiology, 983-992.

Basir, Z. and Peyghan, R. (2016). The process of kidney gradual changes in, *Tenualosa ilisha* during migration from sea to the river. Journal of Persian Gulf, 7(26): 47-56.

Basir, Z. and Peyghan, R. (2019). Immunohistochemical and ultrastructural study of the effect of different salinities on gill chloride cells of *Cyprinus Carpio*. Iran Fisheries Science Journal, 28(5): 131-141.

Dastan, V.; Abdi, R.; Movahedinia, A. and Salari-Aliabadi, MA. (2017). Study of gill and kidney tissue changes in *Tenualosa ilisha* during migration from sea to the Karun and Bahmanshir rivers. Iranian Scientific Fisheries Journal, 25(4): 53-62.

Elbialy, Z.I.; Salah, A.S.; Elsheshtawy, A.; Rizk, M.; Abualreesh, M.H. and Abdel-Daim, M.M. (2021). Exploring the multimodal role of yucca schidigera extract in protection against chronic ammonia exposure targeting: Growth, metabolic, stress and inflammatory responses in nile tilapia (*Oreochromis niloticus*). Animals, 11(7): 2072.

El-Greisy, Z.A.E-B. and Ahmed, N.A.M. (2016). Effect of prolonged ammonia toxicity on fertilized eggs, hatchability and size of newly hatched larvae of Nile tilapia, *Oreochromis niloticus*. The Egyptian Journal of Aquatic Research, 42(2): 215-22.

El-Shafai, S.A.; El-Gohary, F.A.; Nasr, F.A.; Van der Steen, N.P. and Gijzen, H.J. (2004).Chronic ammonia toxicity to duckweed-fed tilapia (*Oreochromis niloticus*). Aquaculture, 232(1-4): 117-27.

Espinosa-Chaurand, D.; Aparicio-Simón, B.; Cortés-Sánchez, A.D.J.; Garza-Torres, R.; García-Morales, R. and Maeda-Martínez, A.N. (2019). The productive assessment of two tilapia nilotica (*Oreochromis niloticus*) commercial strains in Sinaloa Mexico. Latin american journal of aquatic research, 47(3): 440-8.

Jebur, A. and El-Demerdash, F. (2019). Hexavalent chromium toxicity induced biochemical perturbation in Tilapia nilotica: role of Phoenix. IOP Conference Series: Earth and Environmental Science, IOP Publishing.

Kim, J.H.; Cho, J.H.; Kim, S.R. and Hur, Y.B. (2020). Toxic effects of waterborne ammonia exposure on hematological parameters, oxidative stress and stress indicators of juvenile hybrid grouper, *Epinephelus lanceolatus*, *Epinephelus fuscoguttatus*. Environmental Toxicology and Pharmacology, 80: 103453.

Kim, J.H.; Kang, Y.J.; Kim, K.I.; Kim, S.K. and Kim, J.H. (2019). Toxic effects of nitrogenous compounds (ammonia, nitrite, and nitrate) on acute toxicity and antioxidant responses of juvenile olive flounder, Paralichthys olivaceus. Environmental toxicology and pharmacology, 67: 73-78.

Kim, J.H.; Park, H.J.; Hwang, I.K.; Han, J.M.; Kim, D.H.; Oh, C.W.; lee, J.S. and Kang, J.C. (2017). Toxic effects of juvenile sablefish, Anoplopoma fimbria by ammonia exposure at different water temperature. Environmental toxicology and pharmacology, 54: 169-176.

Luquet, P. (2017). Tilapia, Oreochromis spp. Handbook of nutrient requirements of finfish: CRC Press, P: 169-180.

Magouz, F.I.; Mahmoud, S.A.; El-Morsy, R.A.; Paray, B.A.; Soliman, A.A.; Zaineldin, A.I. and Mahmoud, A.O. (2021). Dietary menthol essential oil enhanced the growth performance, digestive enzyme activity, immune-related genes, and resistance against acute ammonia exposure in Nile tilapia (*Oreochromis niloticus*). Aquaculture, 530: 735944.

Mazandarani, M.; Soodagar, M. and Kalangi Miandreh, H. (1395). Short-term exposure to lethal concentrations (high levels) of non-ionized ammonia in Caspian word fish (*Rutilus caspicus*). Development of aquaculture (biological sciences), 10(2): 119-126.

Mei, F.; Liu, J.; Wu, J.; Duan, Z.; Chen, M. and Meng, K. (2020). Collagen peptides isolated from salmo salar and tilapia nilotica skin accelerate wound healing by altering cutaneous microbiome colonization via upregulated NOD2 and BD14. Journal of agricultural and food chemistry, 68 (6): 1621-1633

Mercante, C.T.; David, G.S.; Rodrigues, C.J.; do Carmo, C.F. and da Silva, R.J. (2018). Potential toxic effect of ammonia in reservoirs with Tilapia culture in cages. International Journal of Fisheries and Aquatic Studies, 6(5): 256-61.

Mo, W.Y.; Man, Y.B. and Wong, M.H. (2018). Use of food waste, fish waste and food processing waste for China's aquaculture industry: Needs and challenge. Science of the Total Environment, 613: 635-43.

Mohamed, M.; Abdi, R.; Ronagh, M.T.; Salari - Aliabadi, M.A. and Basir, Z. (2020). Comparative histomorphometry of dorsal, ventral and lateral skin in macroscopy, microscopy and free scale fish. Iranian Veterinary Journal, 16(2): 47-53.

Mohamed, M.; Abdi, R.; Ronagh, M.T.; Salari-Aliabadi, M.A. and Basir, Z. (2021). Comparative histomorphology of epidermis of head and caudal peduncle in *Otolithes ruber*, *Huso huso* and *Pangasius hypophthalmus* fish. Iranian Journal of Aquatic Animal Health, 7(1): 10-20.

Morovvati, H.; Abdi, R. and Shamsi, M.M. (2017). Effect of different salinity concentration on gill of benni Barbus sharpeyi. Journal of Veterinary Research, 72(2).

Morovvati, H.; Zolgharnein, H.; Noori Moghahi, M.H.; Abdi, R. and Ghazilou, A. (2012). Alterations to chloride cells of the secondary lamella and gill branches of spotted scat (*Scatophagus argus* L.) in different salinities. Journal of Veterinary Research, 67(2): 109-17.

Naderi, S.; Abdi, R.; Navabi, M.B. and Movahedinia, A. (2014). Distribution Pattern of Main Mucus Secretory Cells in Different Parts of Epiderm in Epinephelus coioides. International Journal of Scientific Engineering and Technology, 3(5): 630-3.

Naji, T.; Khara, H.; Rostami Bashman, M. and Nasiri Perman, A. (1388). Evaluation of the effect of ammonia toxicity on liver tissue of common carp (*Cyprinus carpio*). Environmental science and technology, 11 (1 (Series 40)) .

Naji, T.; Khara, H.; Rostami, M. and Nasiri, A. (2009). The effect of toxic ammonia on liver tissue of common carp (*Cyprinus carpio*). Journal of Environmental Science and Technology, (1): 131-48.

Pourkhadje, M.; Abdi, R.; Zolgharnein, H.; Hoseinzade Sahafi, H. and Morovvati, H. (2014). Effects of different salinity on number and area of chloride cells in gill of juvenile grouper (*Epinephelus coioides*).Iranian Fisheries Science Research Institute, 23(2): 1-10.

Shalaby, A.; Khames, M.; Fathy, A.; Gharieb, A. and Abdel-Hamid, E. (2021). The Impact of Zeolite on Ammonia Toxicity, Growth Performance and Physiological Status of the Nile Tilapia (*Oreochromius niloticus*). Egyptian Journal of Aquatic Biology and Fisheries, 25(1): 643-63.

Šilovs, M. (2018). Fish processing by-products exploitation and innovative fish-based food production. Research for Rural Development, 2: 210-5.

Sriyasak, P.; Chitmanat, C.; Whangchai, N.; Promya, J. and Lebel, L. (2015). Effect of water de-stratification on dissolved oxygen and ammonia in tilapia ponds in Northern Thailand. International Aquatic Research, 7(4): 287-99.

Suliman, E.A.M.; Osman, H.A. and Al-Deghayem, W.A.A. (2021). Hstopathological changes induced by ectoparasites on gills and skin of *Oreochromis niloticus* (Burchell 1822) in fish ponds. Journal of Applied Biology & Biotechnology, 9(1): 68-74.

Termeh Yusefi, A.; Khara, H. and Ahmadnezhad, M. (2018). Evaluation of the effects of ammonia-induced stress on hematologic, stress factors and gill histology of Banded Cichlid (*Heros severus*). Journal of Animal Research (Iranian Journal of Biology), 31(2): 130-44.

Yilmaz, E. (2020). Effect of dietary carob (Ceratonia siliqua) syrup on blood parameters, gene expression responses and ammonia resistance in tilapia (*Oreochromis niloticus*). Aquaculture Research, 51(5): 1903-12.

Yousefi, M.; Vatnikov, Y.A.; Kulikov, E.V.; Plushikov, V.G.; Drukovsky, S.G. and Hoseinifar, S.H. (2020). The protective effects of dietary garlic on common carp (*Cyprinus carpio*) exposed to ambient ammonia toxicity. Aquaculture, 526: 735400.

Zeitoun, M.M.; EL-Azrak, K.; Zaki, M.A.; Nemat-Allah, B.R. and Mehana, E.S.E. (2016). Effects of ammonia toxicity on growth performance, cortisol, glucose and hematological response of Nile Tilapia (*Oreochromis niloticus*). Aceh Journal of Animal Science, 1(1): 21-8.

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چکیده

توسعه‌ی سریع آبزی‌پروری منجر به روش‌های مدرنی مانند آبزی‌پروری فشرده یا سیستم‌های گردش آب برای تولید فاضلاب کشاورزی با غلظت بالایی از آلاینده‌های نیتروژن شد. اما این آلاینده‌ها و پساب‌های شهری، صنعتی و کشاورزی برای آبزیان مضر بوده و باعث افزایش آسیب در آبشش‌ها و اتلاف انرژی می‌شود. مطالعه‌ی حاضر با هدف بررسی هیستومورفومتری آبشش‌های ماهی تیلاپیا نیل در معرض غلظت‌های مختلف آمونیاک انجام شد. ماهیان جوان پس از تهیه و برای سازگاری در آکواریوم‌های صد لیتری نگهداری شدند. پس از انجام این مراحل، آزمایش بر اساس افزایش حساسیت ماهی تیلاپیا نیل به آمونیاک انجام شد. سپس تست سمیت حاد طبق دستورالعمل استاندارد به مدت ۹۶ ساعت انجام گرفت. برای مطالعات سمیت زیر کشنده، ۱۲۰ ماهی تیلاپیا نیل به چهار گروه، شامل سه گروه بر اساس درصدهای مختلف (۱۰، ۲۰، و ۳۰ درصد LC50 96h) و یک گروه کنترل دسته‌بندی شدند. گروه‌ها به مدت ۱۴ روز در شرایط فیزیکوشیمیایی پایدار در معرض آمونیاک قرار گرفتند. در نهایت، تجزیه و تحلیل بافت‌شناسی بر روی آبشش ماهی انجام شد. سپس روش استاندارد مقاطع پارافینی و برش‌های بافتی به ضخامت ۶-۴ میکرون برش داده شد و با روش‌های (E&H) رنگ‌آمیزی شد. داده‌های به دست آمده نشان می‌دهد که غلظت‌های بالای آمونیاک باعث آسیب‌های مختلف بافت آبشش مانند پرخونی، تورم رشته، افزایش تعداد سلول‌های کلرید، نکروز و مرگ سلولی، هیپرپلازی، هیپرتروفی و تغییرات رفتاری مانند کاهش اشتها و تحرک می‌شود. داده‌های به دست آمده نشان داد که افزایش سطح آمونیاک می‌تواند آسیب‌های جبران‌ناپذیری به ساختارهای آبشش و سایر بافت‌های مربوط به آن وارد کند. بنابراین، زیستگاه این آبزیان باید به طور مداوم از نظر سطح آمونیاک کنترل شود.

کلمات کلیدی: آمونیاک، تیلاپیای نیل، هیستومورفومتری، غلظت کشنده

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