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# Study relation between heavy metals in water and cultured fish at Abbassa fish farms, Al Sharkia, Egypt.

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## ABSTRACT

The present study aims to investigate some heavy metal concentrations in water and fish organs (liver, gills, muscles) of *O. niloticus*. Water samples were taken from the two different farms by a PVC tube column sampler at depth of half meter from the water surface during the period from December 2018 to May 2019 taken to lab. of central lab for Aquaculture Research (El-Abbasssa), Sharkia, Samples were collected from two different fish farms, Abbassa fish farms that located in Abbassa District, Central Laboratory for Aquaculture Research (CLAR) Abou Hammad, Sharkia, and the second sampling area is private fish farm in the way of Ismailia canal, Sharkia Governorate. In the 1$^{st}$ fish farm the mean metals concentration in the water of 1$^{st}$ fish farm decreased in the order: Fe > Mn > Zn >Cu > Cd > Pb, while in the 2$^{nd}$fish farm was Fe > Mn > Zn > Cd > Cu> Pb. All mean metals (Zn, Mn, Cu and Pb) concentrations in water were under the guiding lines set by (ECS, 1994). While Fe and Cd concentration their ratio exceeded the guiding lines. Fe concentration was 2.13 mg/L and 5.93 mg/L in both 1$^{st}$ and 2$^{nd}$ fish farm respectively and Cd concentration was 0.02 mg/L and 0.05 mg/L in both 1$^{st}$ and 2$^{nd}$ fish farm respectively. While Fe exceeded the guiding line value by 1.13 mg/L and 4.93 mg/L in both 1st and 2nd fish farm respectively, Cd also exceeded the guiding line value by 0.01 mg/L and 0.04 mg/L in both 1st and 2nd fish farm respectively.The mean metals concentrations in the fish muscle tissues exceed permissible limits in the 1st fish farm was (Cu) exceeded by 0.9 mg/g and exceeded by1.69 mg/g in 2nd fish farm and (Fe) exceeded only by11.96 mg/g in the 2nd fish farm.

**Key words**: Heavy metal pollution

## Introduction

Commercial aquaculture facilities require abundant clean water with oxygen, pH and nutrient levels at a suitable level to support the growth of farmed species **(Wallace, 1993)**. Variations beyond acceptable ranges for these water parameters lead to stress, impaired health by disrupting physiological functions as ionic regulation, liver and kidney functions **(Conte, 2004)** and mortality. Thus, optimal fish health is best achieved by rearing fish in a good environment, with good nutrition, and a minimum stress. The major benefit of farmed fish is that they provide a good and low-cost source of polyunsaturated fatty acids which can enhance cardiovascular health in humans. However, consumers have been surprised to find that several natural and man-made toxic substances are at higher concentrations in farmed than wild fish **(Cole, *et al*., 2009).** This situation is pronounced in Egypt, where Ministry of Irrigation prohibits the use of irrigation water in fish farms, and always recommends use of drainage water.

According to the Egyptian Law No. 124/1983, only brackish and marine water, and infertile land that is not suitable for agriculture, can be used in aquaculture. Water supply should be restricted to water from lakes and drains, and the use of fresh (i.e. irrigation) water is prohibited. Agricultural drainage waters containing high concentrations of different pesticides, fertilizers runoff and heavy metals **(Alne-na-ei, 2003; Khallaf, *et al*., 2003; Tayel, *et al*., 2007; Authman, 2008 and Authman, *et al*., 2008).** Heavy metal pollution is one of the greatest national health problems with referring to peoples eating fish foods, it requires special and intense effort at all levels; individual, groups, national, and international.

Indeed, there are several predisposing factors that progress the disease occurrence and increase its prevalence including; stress resulted from overcrowding of intensive systems, bad handling of fish, bad hygienic conditions, low water and bad management, insufficient oxygen, unsuitable pH and temperature **(Simmons and Gibson, 2012).**

Heavy metals are inorganic chemicals that are non- biodegradable, cannot be metabolized and will not break down into harmless forms since they leave biological cycles very slowly. Elements such as cadmium, copper, lead and zinc are considered most dangerous in the ecotoxicological aspect **(Golovanova, 2008)**. Metal ions can be incorporated into food chains and concentrated in aquatic organisms to a level that affects their physiological state and causes drastic environmental impact on all organisms. Such health risk may over shadow the cardiovascular benefits from the consumption of certain farmed fish, Moreover, aquaculture products are sometimes banned due to rejection of export consignments.

In aquatic ecosystems, heavy metals have received considerable attention due to their toxicity, accumulation in biota **(Dural, *et al*., 2006)** and biomagnification in the food chain **(Erdogrul and Ates, 2006).** The main sources of heavy metal pollution are the sewage disposal, agriculture drainage water containing pesticides and fertilizers and industrial effluents **(Santos, *et al*., 2005 and Singh *et al*., 2007).** Heavy metals from natural and anthropogenic sources are continually released into aquatic ecosystems and accumulated in aquatic organisms especially fish which situated at the top of the food chain and can accumulate large amounts of heavy metals **(Yilmaz, *et al*., 2007).**

Fish are considered as one of the most susceptible aquatic organisms to toxic substances present in water **(Alibabić, *et al*., 2007)**, and the same time considered as the major part of the human diet due to high protein content, low saturated fat and sufficient omega fatty acids which are known to support good health therefore, various studies have been taken worldwide on the contamination of different fish species by heavy metals **(Sivaperumal, *et al*., 2007and Bhattacharya, *et al*., 2010).**

Heavy metals may accumulate in fish either through direct consumption of water or by uptake through epithelia like the gills, skin, and digestive tract **(Burger, *et al*., 2002)**. Eventually, dietary intake of these metals poses risk to human health as fish occupied a significant part of human diet **(Turkmen, *et al*., 2005)**. For these reasons, heavy metals load in fish has become an important worldwide concern, not only because of the threat to fish but also due to the health risks associated with fish consumption **(Begum, *et al*., 2013)**.

The heavy metal accumulation in farmed fish is limited to a number of studies comparing tissue metal concentrations between farmed and wild caught fish **(Calvi, *et al*., 2006; Yildiz, 2008 and Nawaz, *et al*., 2010).**

Fish are particularly vulnerable and heavily exposed to pollution because they cannot escape from the detrimental effects of pollutants as they are feeding and living in the aquatic environments **(Saleh and Marie, 2014).**

Accumulation of metals in various organs and tissues depends upon the way of exposure such as through diet or their elevated level in surrounding environment **(Nussey, 2000)**. Heavy metals exhibit different accumulation pattern in organs **(Nussey, 2000)**. Exchange of gases and absorption of heavy metals takes place from external aquatic to internal body environment through gills **(Wepener, *et al.* 2001)**.

Concentration of metals becomes toxic to the fish when its level exceeds the permissible level. This threshold limit not only varies from metal to metal but also from one species to another **(Mansour and Sidky, 2002).** Toxic effects of metals become more pronounced when various metabolic activities inside the body of organism fail to detoxify. Consumption of contaminated fish with heavy metals can result hazardous effects on human health **(Morais, *et al.* 2012).** Adverse effects of heavy metals may include serious threats like renal failure, liver damage, cardiovascular diseases and even death **(Rahman, *et al.* 2012).**

Heavy metals are non-biodegradable and persistent contaminants in the environment causing serious illness in fish, animals and human. Heavy metals after entering into aquatic environment accumulate in tissues and organs of fish that enter the food chain and elevate up to the highest level of consumers **(Akan, *et al*., 2009).**

It is also possible that environmental toxicants may increase the susceptibility of aquatic animals to various diseases by interfering with the normal functioning of their immune, reproductive and developmental processes **(Eissa, *et al*., 2013).**

Nile Tilapia (*Oreochromis niloticus*) is a teleost fish with a worldwide distribution; therefore it is a good model for assessing the impacts of different environmental pollutants on aquatic ecosystems. A comparative study of five economically important taxa of tilapia showed that Nile Tilapia (*Oreochromis niloticus*) presents a God gifted strong immune system that maximizes their capability to tolerate biotic and abiotic types of stress **(Eissa, *et al*.,2012).**

Nile Tilipia *Oreochromis niloticus* fish adsorb soluble heavy metals causing accumulation in liver and muscles with highly significant quantities, thus showing caused toxicological effects **(Osman, *et al*., 2009).**

The heavy metals of the widest spread concern to human health are lead, mercury and cadmium **(Kris- Etherton, *et al*., 2003; Chen, *et al*., 2007 and Din, *et al*., 2008)**. It is thus evident that heavy metal toxicity is a subject that requires the attention of scientists and policy makers to increase public understanding of the severity of conditions caused by toxic elements and help at minimizing heavy metal related illnesses and deaths **(Achparaki, *et al*., 2012).** This has encouraged researchers worldwide to study heavy metals pollution in air, water, and foods to avoid their harmful effects and to determine their permissibility for human consumption.

Toxicity with heavy metals is due to disrupt the function of essential biological molecules such as protein, enzymes and DNA as metals lead to displacement of an essential metal cofactor of the enzyme and interaction of the metallic ions with DNA which proven to be carcinogenic to humans and animals **(Hodgson, 2011)**. In the body, heavy metals resist chemical and biological transformation and accumulated in the tissues including, liver, kidney and nerve to cause toxicity. Uptake of heavy metals through food chain in aquatic organisms may cause various pathological disorders like hypertension, sporadic fever, renal damage or cramps in human **(Gabriel, *et al*., 2006).** The growth, reproduction rate, mortality and physiological functions of fish has affected by toxic effect of heavy metals.

Heavy metals from natural and anthropogenic sources continuously enter the aquatic ecosystem where they pose a serious threat because of their toxicity, long time persistence, bioaccumulation, and biomagnifications in the food chain **(Karadede-Akin and Ünlü, 2007).** Toxicity with heavy metals is due to disrupt the function of essential biological molecules such as protein, enzymes and DNA as metals lead to displacement of an essential metal cofactor of the enzyme and interaction of the metallic ions with DNA which proven to be carcinogenic to humans and animals **(Hodgson, 2011).** In the body, heavy metal resists chemical and biological transformation and accumulated in the tissues including, liver, kidney and nerve to cause toxicity. Uptake of heavy metals through food chain in aquatic organisms may cause various pathological disorders like hypertension, sporadic fever, renal damage or cramps in human **(Gabriel, *et al*., 2006).** The growth, reproduction rate, mortality and physiological functions of fish has affected by toxic effect of heavy metals. Biomagnifications, sediments, contaminated water and contamination in food web is also cause of deposition of heavy metal in fishes **(Javed, 2005).** But still, there are some traces minerals which are very beneficial and nutritive to health **(Rehman, *et al*., 2013).** Harmful metal is characterized as that metal which shows extreme toxicological side effects at low levels. Heavy metals are categorized as: essential and non-essential heavy metals.

**Essential metals:**

Essential metals are (Cobalt, Chromium, Copper, Iron, Nickel, Zinc). The essential heavy metals play biochemical and physiological functions in plants and animals. They are important constituents of several key enzymes and play important roles in various oxidation-reduction reactions.

**Nonessential:**

Nonessential are (Arsenic, Cadmium, Mercury, Lead) **(Umer, *et al*., 2017).** Although heavy metals are considered as the oldest known toxins harmful to humans, heavy metal toxicity remains a very general subject due to the variety of symptoms caused by heavy metal poisoning. Lead (Pb), Mercury (Hg) and Cadmium (Cd) are some of the most commonly found metals associated with several adverse effects to humans due to their accumulation in the human body caused through any dietary products especially fish **(Achparaki, *et al*., 2012).** Lead, due to its vast use for industrial purposes is a very dangerous toxic element that can induce oxidative stress to human tissues and DNA. Mercury is easily absorbed by the human body and is extremely harmful for all groups of people, especially women of reproductive age and children as it affects the fetus and the normal development of young individuals. Cadmium is easily accumulated by plants and animals and reaches humans through the food chain affecting many organs and causing serious illnesses. It is thus evident that heavy metal toxicity is a subject that requires the attention of scientists and policy makers to increase public understanding of the severity of conditions caused by toxic elements and help at minimizing heavy metal related illnesses and deaths **(Achparaki, *et al*., 2012).** Heavy metals may accumulate in fish either through direct consumption of water or by uptake through epithelia like the gills, skin, and digestive tract **(Burger, *et al*., 2002).** Eventually, dietary intake of these metals poses risk to human health as fish occupied a significant part of human diet **(Turkmen, *et al*., 2005)**. For these reasons, heavy metals load in fish has become an important worldwide concern, not only because of the threat to fish but also due to the health risks associated with fish consumption **(Begum, *et al*., 2013).**

The prevalence of renal failure and liver cirrhosis in human was markedly increased in the last few years, which could be linked with heavy metal pollution in Egypt **(Salem, *et al*., 2000 and Kamel and El-Minshawy, 2010).**

Heavy metals contamination is a serious problem in the aquatic environment. Some of them are very important, having biological roles for aquatic organisms, and called essential heavy metals. In contrast, other heavy metals are considered harmful even at low concentrations. The toxic levels of heavy metals may be of agricultural, industrial and mining activities. This will cause water pollution and changes in the physicochemical characteristics of the aquatic environment. This pollution has deleterious toxic effects on fish and raises concerns over its potential impact on human health. The most common heavy metals are arsenic, chromium, lead and mercury, which affect human health and are considered systemic toxicants. These metals induce organ damage even at low levels of exposure and according to the US Environmental protection agency and international agency for research on cancer, they classified as carcinogens. For all the above reasons, this review was written to contribute to heavy metals' role in the environment, toxic mechanism and toxic effects on fish. **(AL-Taee *et al*., 2020).**

Cadmium (Cd) compounds are classified as human carcinogens by several regulatory agencies. The International Agency for Research on Cancer **(IARC, 1993)** and the US National Toxicology Program have concluded that there is adequate evidence that cadmium is a human carcinogen. This designation as a human carcinogen is based primarily on repeated findings of an association between occupational Cadmium exposure and lung cancer, as well as on very strong rodent data showing the pulmonary system as a target site **(IARC, 1993)**Thus, the lung is the most definitively established site of human carcinogenesis from cadmium exposure. Other target tissues of cadmium carcinogenesis in animals include injection sites, adrenals, testes, and the hemopoietic system **(IARC, 1993; Waalkes and Berthan, 1995 and Waalkes *et al.*, 1996)**. In some studies, occupational or environmental cadmium exposure has also been associated with development of cancers of the prostate, kidney, liver, hematopoietic system and stomach **(Waalkes and Berthan, 1995 and Waalkes *et al.*, 1996)**. Carcinogenic metals including arsenic, cadmium, chromium, and nickel have all been associated with DNA damage through base pair mutation, deletion, or oxygen radical attack on DNA **(Landolph, 1994)**. Animal studies have demonstrated reproductive and teratogenic effects. Small epidemiologic studies have noted an inverse relationship between cadmium in cord blood, maternal blood or maternal urine and birth weight, and length at birth **(Nishijo *et al.*, 2004 and Zhang *et al.*, 2004).**

Lead (Pb) adverse effects in children and the adult population; In children, these studies have shown an association between blood level poisoning and diminished intelligence, lower intelligence quotient-IQ, delayed or impaired neurobehavioral development, decreased hearing acuity, speech and language handicaps, growth retardation, poor attention span, and antisocial and diligent behaviors **(U.S. EPA, 2002; Kaul *et al.*, 1999; Litvak *et al.*, 1998 and Amodio-Cocchieri *et al.*, 1996)**. In the adult population, reproductive effects, such as decreased sperm count in men and spontaneous abortions in women have been associated with high lead exposure **(Hertz- Picciotto, 2000 and Apostoli *et al.*, 1998).** Acute exposure to lead induces brain damage, kidney damage, and gastrointestinal diseases, while chronic exposure may cause adverse effects on the blood, central nervous system, blood pressure, kidneys, and vitamin D metabolism **(ATSDR, 1992; ATSDR, 1999; Flora *et al.*, 2006; Kaul *et al.*, 1999; Litvak *et al.*, 1998; Amodio-Cocchieri *et al.*,1996; Hertz-Picciotto , 2000 and Apostoli *et al.*,1998).**

## MATERIALS AND METHODS

**Studying area:**

Samples collected from two different fish farms, Abbassa fish farms that located in Abbassa District, Abou Hammad, Sharkiya. The other is private fish farm in the way of Ismailia canal, Sharkiya Governorate.

Water Supply: Agricultural drainage waters. The source of water from the Ismailia canal by way of the El Wadi El Quadim supply canal. The Ismailia canal originates from the Nile River.

**Sampling**

Water samples, One liter of water samples from taken from each of the two different farms irrigated with agricultural drainage water by a PVC tube column sampler at depth of half meter from the water surface during the period from December 2018 to May 2019. Hydrogen ion concentration (pH) was measured with pH meter (Model 25, Fisher Scientific), Salinity was determined using a salinity-conductivity meter (model, YSI EC 300). **(APHA 1985)**, Total ammonia.Temperature and Dissolved oxygen was measured by using a digital oxygen meter (Model YSI 55). Total ammonia was measured by methods described in **(Boyd and Tucker 1992).** Metals concentrations in water (mg/l) were measured after digestion with HNO3 and HCl according to **(EPA 1992)**. Analysis for Fe, Zn, Cu, Cd and Pb then measured using Atomic Absorption Spectrophotometer (Model Thermo Electron Corporation, S. Series AA spectrometer with Gravities Furnace, UK) **(A.O.A.C., 1990)**.

Fish samples were collected from the same two studied areas during the same period of water sampling. A number of 9 naturally diseased *O. niloticus* fish from each fish farm, with atotal numbers of 18 fish randomly of different stages and different weights with average 75 ± 5 gm body weight and length 13 ± 2 cm. were obtained alive in taken to lab. of central lab for Aquaculture Research (El-Abbasssa), Sharkia, during the period from December 2018 to May 2019.

## Results and Discussion

Contamination of water with heavy metals will likely modify the biochemical and physiological parameters of fish and hence will magnitude the severity of bacterial infection **(Vinodhini and Narayanan, 2009).**

In both gills and liver of fish in both studied area 1st and 2nd fish farms all mean metals concentrations exceeded permissible limits set by **FAO/WHO (1999).** The accumulation of heavy metals was in liver with high values than gills and muscle tissues, this result matches with **(Nussey, 2000)** who reported that gills, liver and kidneys accumulate heavy metals in higher concentration in comparison to muscles **(Wepener, *et al*., 2001)** reported that muscles exhibit lowest levels of metals accumulation among different organs, liver accumulates higher concentrations of metals and has been used widely to investigate the process of bioaccumulation.

Water supply used in aquaculture is not from fresh water (i.e. irrigation) because it is prohibited According to the Egyptian Law No. 124/1983. Heavy metal pollution is one of the greatest national health problems with referring to peoples eating fish foods, it requires special and intense effort at all levels; individual, groups, national, and international.

All mean metals (Zn, Mn, Cu and Pb) concentrations in water were under the guiding lines except Fe and Cu concentration. Fe concentration was 2.13 mg/L and 5.93 mg/L in both 1st and 2nd fish farm respectively and Cd concentration was 0.02 mg/L and 0.05 mg/L in both 1st and 2nd fish farm respectively. While Fe exceeded the guiding line value by 1.13 mg/L and 4.93 mg/L in both 1st and 2nd fish farm respectively, Cd also exceeded the guiding line value by 0.01 mg/L and 0.04 mg/L in both 1st and 2nd fish farm respectively.

Cadmium is easily accumulated by plants and animals and reaches humans through the food chain affecting many organs and causing serious illnesses. It is thus evident that heavy metal toxicity is a subject that requires the attention of scientists and policy makers to increase public understanding of the severity of conditions caused by toxic elements and help at minimizing heavy metal related illnesses and deaths **(Achparaki, *et al*., 2012).** Cadmium (Cd) is toxic at low concentrations, non biodegradable, non-essential heavy metals and has no role in biological processes in living organisms. Thus, even in low concentration, it could be harmful to fish **(Badr, *et al*., 2014).** But for Iron (Fe) according to **(WHO, 2011)** indicate No health-based guideline value is proposed for iron because it is not of health concern at levels found in natural water (0.5-50.0 mg/l).

Fe in muscle tissues exceeded the permissible limits by11.96 µg/g in the 2nd fish farm, that matches with results of **(Saeed, 2013)** who recorded that Fe annual mean (61.94, for *O. niloticus* collected from Lake Edku, Egypt, and much lower than that reported by **(Emara, *et al.*, 2015)** who showed no significant ($P<0.05$) variation between the two farms, where it was (97.47 & 94.99 µg/g dw) at Al-abbassa & Shader Azzam respectively.

The mean metals concentrations in the fish muscle tissues exceed permissible limits in the 1st fish farm was (Cu) exceeded by 0.9 µg/g and exceeded by1.69 µg/g in 2nd fish farm and (Fe) exceeded by11.96 µg/g in the 2nd fish farm, that matches with **(Abdel-Khalek, 2015)** who reported a higher Cu mean value of 11.9 µg/g dry wt. Copper (Cu) annual mean concentration (4.31 & 7.26 µg/g dw at Al-abbassa & Shader Azzam fish farms, respectively) in fish muscles showed very high significant ($P<0.05$) difference between the two farms.

In both gills and liver of fish in both studied area 1st and 2nd fish farm all mean metals concentrations exceeded permissible limits set by **FAO/ WHO, (1999).**

Fish living in the wild as well as under cultured system are susceptible to wide diverse of bacterial pathogens. Potentially harmful substances as heavy metals are often released into the aquatic environment **(Austin, 1999).** Heavy metals are pollutants produced by industries and mining which can be dangerous to humans and animals even in very small quantities **(WHO, 2002).**

Lower levels of discharge may result in an accumulation of the pollutants in aquatic organisms. Tilapia aquaculture industry is of increasing importance in Egypt and the fastest growing sector in Egypt and all over the world. Water pollution with immunotoxic pollutants constitutes one of the most important stressors leading to adverse effects on fish health **(Mousa, *et al*., 2009).** Fish are held in aquaculture pens, live in an environment where they are constantly exposed to various stress factors such as handling, crowding, and infection, besides the exposure to pollutants and physiological changes that may lead to immune depression and outbreaks of infections. Water pollution stresses the cultured fish and increases susceptibility to infectious diseases, leading to high mortalities **(Austin and Austin, 2007).** Bacterial fish pathogens are the most important constraints facing development and sustainability of aquaculture **(Woo and Bruno, 1999).**

Table (1): The averages of some water physiochemical parameters in the two regions of the studied fish farms.

| Parameter | 1st fish farm | 2nd fish farm |
|---|---|---|
| | Mean ± SE | Mean ± SE |
| Temperature(°C) | 28.27$^{a}$±0.27 | 29.37$^{a}$±0.19 |
| DO (mg/l) | 5.68$^{b}$±0.22 | 6.37$^{a}$±0.31 |
| pH | 8.24$^{b}$±0.06 | 8.79$^{a}$±0.09 |
| Salinity | 0.32$^{b}$±0.08 | 1.78$^{a}$±0.12 |
| ammonia | 0.15$^{b}$±0.05 | 0.26$^{a}$±0.07 |

a, b : Values having different script a and b at the same row are significantly differentp ≤ 0.05

**Table (2): The average of heavy metals concentration (mg/L) in water samples collected from the two regions.**

| Parameter | 1st fish farm | 2nd fish farm | GV |
|---|---|---|---|
| | Mean ± SE | Mean ± SE | |
| Fe | 2.13$^{b}$±0.11 | 5.93$^{a}$±0.14 | 1 |
| Zn | 0.09$^{a}$±0.003 | 0.18$^{a}$±0.07 | 5 |
| Mn | 0.17$^{a}$±0.004 | 0.23$^{a}$±0.005 | 0.5 |
| Cu | 0.03$^{a}$±0.001 | 0.04$^{a}$±0.001 | 0.4 |
| Cd | 0.02$^{a}$±0.001 | 0.05$^{a}$±0.002 | 0.01 |
| Pb | 0.006$^{a}$±0.002 | ND$^{b}$±0.0 | 0.05 |

ND: Not detectable, Guideline values (mg/l) according to (ECS, 1994).

Table (3): The average of heavy metals concentration (mg/g dry wt.) in tissues of tilapia fish collected from the two farms.

| Metals | Essential metals | | | | | | | | Heavy metals | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fe | | Zn | | Mn | | Cu | | Cd | | Pb | |
| Tissues | 1$^{st}$ fish farm | 2$^{nd}$ fish farm | 1$^{st}$ fish farm | 2$^{nd}$ fish farm | 1$^{st}$ fish farm | 2$^{nd}$ fish farm | 1$^{st}$ fish farm | 2$^{nd}$ fish farm | 1$^{st}$ fish farm | 2$^{nd}$ fish farm | 1$^{st}$ fish farm | 2$^{nd}$ fish farm |
| Muscle | 31.43$^{b}$ ±5.22 | 54.96$^{a}$± 26.2 | 21.57$^{a}$ ±2.12 | 32.76$^{a}$ ±8.5 | 1.35$^{b}$±0.03 | 3.46$^{a}$ ±0.05 | 3.90$^{a}$± 0.22 | 4.69$^{a}$± 0.32 | 0.04$^{a}$± 0.001 | 0.07$^{a}$± 0.001 | ND$^{a}$ ±0.0 | ND$^{a}$ ±0.0 |
| Gills | 149.5$^{b}$ ±11.37 | 178.6$^{a}$± 22.8 | 99.56$^{a}$ ±13.4 | 113.4$^{a}$ ±20.4 | 22.56$^{b}$± 5.8 | 37.18$^{a}$±6.3 | 7.28$^{b}$± 0.78 | 10.96$^{a}$ ±0.56 | 0.17$^{a}$± 0.03 | 0.23$^{a}$± 0.02 | ND$^{a}$ ±0.0 | ND$^{a}$ ±0.0 |
| Liver | 199.61$^{a}$ ±22.5 | 203.4$^{a}$± 34.9 | 109.8$^{b}$ ±18.9 | 128.5$^{a}$ ±17.6 | 6.07$^{a}$±1.2 | 7.18$^{a}$ ±2.4 | 6.07$^{b}$± 0.56 | 8.56$^{a}$± 0.47 | 0.38$^{a}$± 0.02 | 0.45$^{a}$± 0.03 | ND$^{a}$ ±0.0 | ND$^{a}$ ±0.0 |
| PL* (mg/d) | 43.0 | | 60.0 | | 2.0 – 9.0 | | 3.0 | | 0.1 | | 0.214 | |

ND: Not detectable. *PL: Permissible limits (wet wt.) according to FAO/WHO (1999).

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# دراسة العلاقه بين المعادن الثقيله في المياه و الاسماك المستزرعه في مزارع الاسماك بالعباسه

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## الملخص العربى

تربية الأحياء المائية لاتزال واحده من أسرع قطاعات إنتاج الأغذية نموا، ومن المقرر أن تلعب دورا رئيسيا فى تلبية الطلب المتزايد على المنتجات السمكية التى تعتبر من أرخص مصادرالبروتين فى مزارع العباسه التى هى واحده من أهم مزارع الأسماك فى مصر.

تم أخذ عينات من المياه لكل من المزرعتين واللتان تستمدان مياههما من مياه صرف زراعى وذلك بواسطه أنبوبه PVC تحت عمق نصف متر من سطح الماء. وتم قياس درجة الحراره الأكسجين المذاب بإستخدام جهاز قياس نسبة الأكسجين ،وكذلك جهاز لقياس pH , والملوحه وتركيز المعادن الطبيعية والثقيلة فى المياه وذلك بعد عملية الهضم بالأحماض عالية التركيز مثل حمض الهيدروكلوريك وحمض النيتريك.

تم سحب واحد لتر من مياه كل مزرعة من المزرعتين المحددتين للدراسه كلا على حدا أحداهما و هى مزرعة من مزارع العباسة أبو حماد شرقية و الأخرى وهى مزرعة خاصة على طريق ترعة الإسماعيليه محافظة الشرقية .وتم فحص ١٨ سمكة من أسماك البلطى النيلى بأوزان مختلفة تم تجميعها من المزرعتين ٩فى نفس الفترة التى تم اخد عينات المياه فيها , ٩سمكات من الأولى و٩ سمكات من الأخرى وتم نقلهم إلى معمل صحة الأسماك ورعايتها بالمعمل المركزى لبحوث الثروة السمكية بالعباسه محافظة الشرقية فى الفترة مابين ديسمبر٢٠١٨ إلى مايو٢٠١٩.

فى المزرعه الأولى كان تركيزنسبة المعادن فى المياه تقل فى الترتيب كالآتى Fe>Mn>Zn>Cd>Cu. بينما فى المزرعه الثانية فكان كالآتى Fe>Mn>Zn>Cu>Cd>Pb. حيث أن تركيز كلا من الحديد والزنك والمنجنيز والنحاس والكادميوم فى مياه المزرعه الأولى أكثرمن المزرعه الثانيه. بينما الرصاص Pb كان بتركيز قليل جدا فى المزرعه الأولى ولم يحدد له أى تركيز فى مياه المزرعه الثانيه؛ ولكن كل تركيزات المعادن فى كلا من تحليلات المياه للمزرعتين الأولى والثانيه هم تحت النسب المسموح بها والمحددة من قبل المعايير المصريه الكيميائيه الخاصة بمياه الرى لسنه (١٩٩٤). بينما تركيز الكادميوم يتخطى النسب المحدده بمقدار ٠,٠١و ٠,٠٤ ميللى جرام /لتر فى كلا من المزرعتين الأولى والثانية بالتوالى , والحديد أيضا يزيد عن النسبة المسموح بها بمقدار ١,١٣و ٤,٩٣ ميللى جرام/لتر.

تم قياس تركيزات المعادن فى عينات السمك من نفس المزارع التى جمعت منها عينات لتحليل المياه وتكون العينات من أجزاء اللحم والخياشيم والكبد.

تركيزات المعادن فى خياشيم وكبد السمك لكلا من المنطقتين تتخطى النسب المسموح بها المحدده من قبل منظمة الفاو ومنظمة الصحه العالمي لسنة (١٩٩٩). ماعدا الرصاص الذى لم يتحدد أى نسبه له فى الخياشيم أو الكبد أو اللحم وكان تركيزات تلك المعادن فى الكبد أكثر من الخياشيم واللحم.
يزيد تركيزالنحاس فى أنسجة اللحم بمقدار ٠,٩ ميللى جرام/جرام فى المزرعة الأولى وبمقدار ١,٦٩ ميللى جرام/جرام فى المزرعة الثانيه؛ بينما يزيد تركيز الحديد فى أنسجة اللحم أيضا بمقدار ١١,٩٦ ميللى جرام/جرام فى المزرعة الثانية فقط.