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Examination of heavy metals contamination in drain, farm water and Nile tilapia (*Oreochromis nilotius*) in EL-Fayoum Government, Egypt and use some methods for treatment

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ABSTRACT

This study was carried out at three different farms in EL-Fayoum Government and at three different drainages poured into it. The study included determination of some physical and chemical parameters of water and detection of five heavy metals (Zn, Cd, Pb, Fe and Cu) in Farm and drains water. The accumulation of these heavy metals in different fish organs (Gills, Skin, Muscles and Liver) in fish from different farms and fish from different drains, plant, sediment and diet also measured. The results showed that, Iron more accumulated than other in all three different drains and farms under study except accumulated of these heavy metals in *Nile Tilipia* fish blood results showed Zinc more accumulated than other. Water treatment by using low adsorbant (Eggplant and Pumpkin) to removal these heavy metals detected that, Pumpkin was good for treating Zn and Pb the maximum removal for Zn was 65% and for Pb the value was 50%. While Eggplant was good for treating Fe, Cd and Cu with maximum values (88%,78% and 77% respectively). Also the study included investigation of some biochemical blood parameters such as Urea, Creatinine, RBS, and T3,T4,TSH,GH and Cortisol hormones that showed a significant increase of levels Mean value ± S.D of RBS, a significant decrease of levels Mean value ± S.D of creatinine addition a significant increase of levels Mean value ± S.D of cortisol ,GH and T3 in both Locanda and EL-Bats farms when compared with EL Galini farm.

Keywords:
Nile tilapia, Heavy metals, Drain water, Fish farms, Eggplant, Pumpkin

1. Introduction

Drainage water is surface water—whether from an industrial or natural source—that has been extracted from an area that has a lot of water. Water from laterals is collected by main drains and sent to the outlet. Sub mains that diverge from the main drain are used to collect water (Dalrymple, 2015). Egypt gets its annual water supply from the Nile, rainfall on the Mediterranean coast, and deep groundwater, totalling about 57.7 billion cubic metres (BCM). Nonetheless, it is projected that 72.4 BCM of water are used by people, companies, and agriculture each year (Barnes, 2014). Most heavy metals are linked to sedimentary particles at the surface, although a small percentage dissolves in water and can spread extensively. Furthermore, wells, rivers, dams, and large ponds are efficient sources of water for fish farm ponds (Gabbadon and De Souza, 2008). The health of fish can serve as a valuable indicator of the overall health of an aquatic ecosystem, as they are highly responsive to environmental changes. Remarkably, harmful effects of pollution develop at the cellular or tissue level before discernible changes in fish behaviour or appearance (Abdel-Warith et al., 2011).

Blood parameters are essential for evaluating the structural and functional status of toxin-resistant fish. It appears that changes in the biochemical blood factors reflect changes brought on by different pollutants in the organism's metabolism and biochemical processes (Adhikari *et al*., 2004). Fish serum enzyme concentrations are commonly used as a health indicator for a variety of species. The analysis of certain blood components may be helpful in determining how stress affects the homeostasis of various animals, especially fish. As a result, situations that might be affecting manufacturing performance can be identified early on (Cnaani et al., 2004). It has been discovered that metal ions interact with food chains and become permanent in aquatic species to the extent that this affects the physiological state of the species. Since zinc, copper, and iron are trace amounts of an element that is necessary for the aquatic environment, they essentially have a biochemical role in the processes of life for all aquatic animals, particularly fish (Saeed and Shaker, 2008)

Pollution of the aquatic environment is a sign of approaching danger and could become a worldwide problem. Numerous industrial, commercial, and agricultural compounds that have several negative consequences are exposed to aquatic animals. As a result, numerous researchers have become interested in the issue of heavy metal residue in aquatic systems (Yacoub and Gad, 2012). The amount of heavy metal residue varies by species, age, sex, and other factors. Fish with high levels of metal accumulation accumulate in their liver and gills, while lower levels of metal accumulation occur in their muscles due to relatively low metabolic activity (Younis et al., 2002).

The primary drivers of residual activity in fish tissues include metal condensation, exposure duration, metal absorption, environmental parameters (temperature, pH, hardness, salinity, and water nuclear fuels), fish age, and eating habits. Heavy metals have varied degrees of affinity for entering fish tissues due to their tiny size, which can lead to the release of dangerous metals into the fish's muscles, gills, liver, and kidney. Of all the tissues mentioned, fish muscles usually contain the fewest metals. Many fish organs contain heavy metal residue, which frequently leads to functional issues as well as potential structural damage (Jezierska and Witeska, 2006).

Therefore, the objective of the current study was to monitor the impact of various drainage sources on fish farms in the Fayoum Governorate by gathering water and fish five heavy metals are measured in samples from farms (Fe, Cu, Zn, Cd and Pb). The accumulation of those metals in water, different fish organs and fish blood were examined. Addition to Moreover in addition, low cost adsorbent such as eggplant (*Solanum melongena*) and pumpkin (*Cucurbita pepo*) were used to treat heavy metals in the highly polluted drain. Moreover, identification of biochemical changes like glucose, urea, creatinine, cortisol hormone, growth hormone, and thyroid hormones was also studied.

2. Materials and methods

Collection of water and fish samples

Water samples (three bottles each one two litres from each drain and farm) collected from major three different drainages at EL-Fayoum Governorate (Dier El Berka, EL Wadi and EL Bats drains) and three different commercial farms that these drains poured into it (EL Gilani, Locanda and EL Bats farms, respectively) from middle site.

Fish samples (20 fish from each farm) Nile tilapia (*Oreochromis nilotius*) were collected from three different commercial farms (EL Gilani, Locanda and EL Bats) with size (170-230 g) and length (20-25 cm).

Pollution by heavy metals

The Soil and Water Laboratory, Faculty of Agriculture, Fayoum University used Atomic absorption (Perkin Elmer 3110 USA) with graphite atomizer HGA-600 method to assess the presence of heavy metals (Fe, Pb, Zn, Cu, and Cd) in water samples .

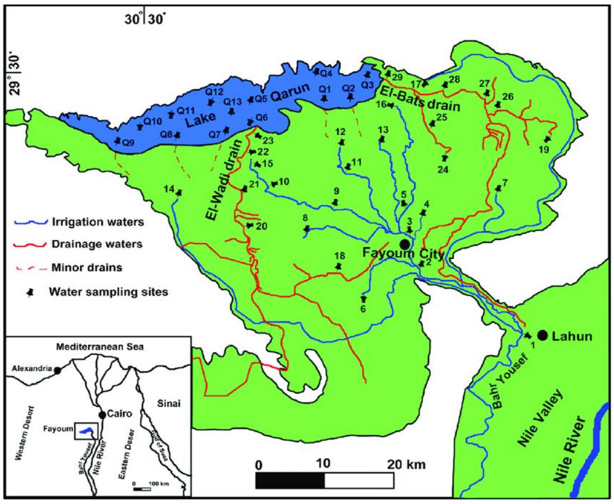


Fig. 1 Location map of the Fayoum area, showing the sampling sites (Abdel Wahed, 2015)

Handling of water drainage

To clean the water, samples were taken from the middle site's EL-Bats drain using two adsorbent vegetables: *Cucurbita pepo* and *Solanum melongena.*

Pumpkin (Cucurbita pepo) preparation

A pumpkin is a round, smooth-skinned, slightly ribbed variety of the squash plant, most frequently Cucurbita pepo. Its color ranges from deep yellow to orange. Pumpkins are readily available in nearby markets. Sun-drying the seeds takes two to three days. Using a pestle and mortar, the dried seeds are ground into a fine powder (Deepthi et al., 2017). In order to activate the coagulant capabilities of the seed and generate a solution, 0.5 g/l of powdered pulverized seed material was formed into a paste using a small amount of water combined in a small amount of water and agitated for one minute.

Preparation of eggplant peel adsorbent

After being gathered from the neighbourhood market, the aubergine (the chemical constituents of eggplant (*S. melongena* L.) mainly contain flavonoids, multiple alkaloids (including amides and glycoalkaloids), phenolic acids, and steroids (Gürbüz et al., 2018) was ready to be treated for heavy metals. After removing the outer peel, the waste peel was submerged for 24 hours in a 0.01 M HCl solution to get rid of any remaining contaminants. The leftover aubergine peel was treated with HCl, then cleaned with distilled water and left in a 1.0 M NaOH solution for 48 hours (Min et al., 2004). After that, it was cleaned with D.W. and dried in a drying oven for 30 hours at 60°C. After the dried adsorbents were ground in a grinding machine and sieved through a standard mesh size of 200 mm, 4 g/l of the powder was employed as the dosage for the experiment, with an ideal duration of 110 minutes.

Blood analysis

Fish that had not been given anaesthesia had their caudal veins sampled for blood; one to three milliliters of blood were extracted from each fish and placed in a sterile centrifuge tube. After that, serum was separated using a centrifuge running at 3000 r.p.m. (1006 g (RCF) for 15 minutes in order to estimate the concentration of glucose in the serum using Trinder's (1969) method.

According to Tunn et al. (1990), serum cortisol was created evaluated (1990). Serum T4 was prepared in accordance with Chopra (1972), while serum T3 was assessed in accordance with Wild's (1994) instructions. Furthermore, growth hormone (GH) in plasma was measured in accordance with Baum et al. (1998) using an ELISA Kit. Analytical Toxicology Laboratory Services received samples for heavy metals analysis in blood, and the analysis was completed in accordance with the procedures of Gajek et al. (2013) by Inductively Coupled Plasma Mass Spectrometry (ICP-MS

Accumulation of heavy metals in different fish organs

Fish samples were moved into beakers and kept overnight in a drying oven with a temperature set at 105°C. Fish specimens were subjected to representative weight samples (10 g fresh muscles, 3 g liver, 10 g gills, and 3 g skin). The samples were broken down using Goldberg's (1963) recommended protocol .

Statistical analysis

The data were analyzed by one-way ANOVA and significant differences were determined by Duncan Waller Multiple Range Test at 5% level using SPSS Statistical Package Program (SPSS, 2008) 17, released version.3.

3. Results

Heavy metals concentrations in three different water drainages before treatment.

Zn concentrations in water taken from the Dyer El-Berka drain were substantially greater than those in samples taken from the El-Wadi and El-Bats drains, as shown in Table (1). In comparison to samples from El-Wadi and Dyer El-Berka drainage, the amounts of Cu and Cd in water obtained from El-Bats drain were much greater. In contrast to Dyer El-Berka drain samples, the mean value of Pb in water collected from El-Bats and Dyer El-Berka drains was greater than that of El-Wadi drain samples. The mean value of Fe was also higher in the water collected from these two drains.

Table 1. Heavy metals concentrations in the three drainages water before treatment.

Heavy metals		Drainage		
		Dier El- Berka	El-Wadi	El-Bats
Zinc (µg/l)	Range Means ± SD	300 - 305 300 ± 3.5	200 - 205 200 ± 0.0 $^{\# p = 0.02}$	200 - 205 200 ± 3.5 $^{\#p = 0.001, * p = 0.02}$
Copper (µg/l)	Range Means ± SD	60 - 65 60 ± 3.5	80 - 85 80 ± 3.5 $^{\#p = 0.03}$	130 -135 130 ± 3.5 $^{\#p = 0.003, * p = 0.01}$
Iron (µg/l)	Range Means ± SD	1500 - 1510 1500 ±7.0	3000 - 3010 3000 ± 7.0 $^{\#p = 0.002}$	3000 - 3010 3000 ± 7.0 $^{\#p = 0.002, * p = 0.5}$
Lead (µg/l)	Range Means ± SD	40 - 45 40 ± 3.5	30 - 35 30 ± 3.5 $^{\#p = 0.11}$	40 - 45 40 ± 3.5 $^{\#p = 1.0, * p = 0.10}$
Cadmium (µg/l)	Range Means ± SD	7 - 8 7 ± 0.3	4 -5 4.6 ± 0.3 $^{\#p = 0.02}$	9-10 9 ± 0.3 $^{\#p = 0.02, * p = 0.01}$

p > 0.05 is non-significant, p ≤ 0.05 is significant, #P-value: when different groups compared with Dier El-Berka drain, *P-value: - when different groups compared with El-Wadi drain.

Heavy metals concentrations in three different farm water

Table (2) reveals that the water samples from El-Galini farm had substantially higher Zn concentrations than the ones from Locanda and El-Bats farms. Water samples from El-Bats farm had far greater concentrations of Cu and Fe than samples from El-Galini and Locanda farms. There were no appreciable variations in the mean Pb content of the water obtained from El-Bats farm compared to samples from El-Galini and Locanda farms. However, there were no appreciable variations in the higher mean value of Cd found in the water taken from the El-Galini farm.

Table 2. Heavy metals concentrations in three different farms water

Heavy metals		El-Galini farm	Locanda farm	El-Bats farm
Zinc (µg/l)	Range Means ± SD	420 - 425 420 ± 3.5	170 -175 170 ± 3.5 $^{\# p = 0.001}$	140 -144 140 ± 2.8 $^{\# p = < 0.001, * p < 0.001}$
Copper (µg/l)	Range Means ± SD	97 - 98 97 ± 0.07	96-98 96 ± 1.4 $^{\# p = 0.8}$	137-139 137 ± 1.4 $^{\# p = 0.01, * p = 0.001}$
Iron (µg/l)	Range Means ± SD	1400 - 1410 1405 ± 7.0	1100 -1110 1100 ± 7.0 $^{\# p < 0.001}$	1800 -1810 1800 ± 7.0 $^{\# p < 0.001, * p = 0.01}$
Lead (µg/l)	Range Means ± SD	20 - 24 24 ± 0.7	20 - 20 20 ± 0.3 $^{\# p = 0.5}$	30 –35 30 ± 0.3 $^{\# p = 0.08, * p = 0.1}$
Cadmium (µg/l)	Range Means ± SD	8 - 9 9 ± 2.8	6 -7 6 ± 0.0 $^{\# p = 0.09}$	7-8 7 ± 3.5 $^{\# p = 0.1, * p = 0.11}$

P-value when different groups compared with El-Galini farm * *P*-value when different groups compared with Locanda farm. p>0.05 is non- significant - p≤0.05 is significant - S.D ± standard deviation.

Compression of heavy metals concentrations in El-Bats drainage water before and after treatment (µg/l) by pumpkin and Eggplant.

The results of the compression between the two heavy metal removal methods were mean ± SD in (Table 3), which proved that pumpkin was effective at treating zinc and lead (the maximum removal for zinc was 65% and the value for lead was 50%). It was found that egg plants were effective in treating Fe, Cd, and Cu to maximum values of 88%, 78%, and 77%, respectively.

Table 3. Compression of heavy metals concentrations in El-Bats drainage water before and after treatment by pumpkin and eggplant.

Heavy metals		Before treatment	After treatment by pumpkin			After treatment by eggplant		
			Treat 1	*p*-value	percent of removal %	Treat 2	*p*-value	percent of removal %
Zinc (µg/l)	Range Means ± SD	200 - 205 200 ± 3.5	70 - 75 70 ± 3.5	0.02	65	150 - 154 150 ± 2.8	0.01	25
Copper (µg/l)	Range Means ± SD	130 - 135 130 ± 3.5	50 - 54 50 ± 2.8	0.001	62	31 - 34 31 ± 2.1	0.001	77
Iron (µg/l)	Range Means ± SD	3000 - 3010 3000 ± 7.0	700 - 720 700 ± 14.1	0.001	77	354 - 355 355 ± 0.7	<0.001	88
Lead (µg/l)	Range Means ± SD	40 - 45 40 ± 3.5	20 - 24 20 ± 2.8	0.08	50	30 - 34 30 ± 2.8	0.03	25
Cadmium (µg/l)	Range Means ± SD	9 -10 9 ± 0.3	3-5 3 ± 1.4	0.01	67	2 - 3 2 ± 0.7	0.09	78

$p > 0.05$ is non- significant – $p \leq 0.05$ is significant, S.D; standard deviation.

Measurements of Nile tilipia growth in three different farms

When compared to fish from El-Galini and El-Bats farms, fish from Locanda farm exhibited higher body weight, body highest, stomach weight, and food index. On the other hand, fish taken from El-Bats farm had greater mean values of liver weight and hepato-stomach index (Table 4).

Table 4. Measurements of Nile tilapia fish growth in three different farms.

Measurements of Nile tilapia		EL-Galini Farm	Locanda Farm	EL-Bats Farm
Fish body weight (g)	Range Means ± SD	159.44 -182.43 170.9 ±16.2	304.4 -329.6 317.0 ± 17.8 # p = 0.02	206.6 - 236.8 221.7 ± 21.3 # p = 0.1, *p = 0.04
Total length (cm)	Range Means ± SD	19.8 - 21.03 20.4 ± 0.83	24.0 - 24.09 24.0 ± 0.28 # p = 0.11	20.6 - 22.0 21.3 ± 0.98 # p = 0.4, *p = 0.1
Measured length (cm)	Range Means ± SD	15.8 - 16.6 16.2 ± 0.55	18.82 - 18.86 18.84 ± 0.02 # p = 0.9	16.9 - 17.12 16.7 ± 0.5 # p = 0.4, , *p = 0.11
Body highest (cm)	Range Means ± SD	6.65 - 6.82 6.69 ± 0.18	8.60 - 8.80 8.7 ± 0.14# p = 0.01	7.5 - 8.03 7.7 ± 0.37 # p = 0.11, *p = 0.14
Liver weight (g)	Range Means ± SD	0.58 - 1.34 0.96 ± 0.53	5.0 - 5.08 5.04 ± 0.05 # p = 0.5	6.9 - 7.26 7.08 ± 0.25# p = 0.02, *p = 0.05
Stomach weight (g)	Range Means ± SD	2.44 - 3.85 3.14 ± 0.99	14.80 - 15.08 14.94 ± 0.19# p = 0.03	6.90 - 7.26 3.92 ± 1.5 # p = 0.6, *p = 0.05
Condition index (g/cm^3)	Range Means ± SD	1.99 - 2.02 2.00 ± 0.02	2.10 - 2.30 2.2 ± 0.14 # p = 0.2	1.83 - 2.4 2.23 ± 0.4# p = 0.7, *p = 0.8
Hepato - stomach index (%)	Range Means ± SD	0.69 - 0.92 0.81 ± 0.16	1.02 - 2.04 1.83 ± 0.29 # p = 0.07	3.33 - 3.38 3.35 ± 0.03 # p = 0.02, *p = 0.08
Food	Range Means ± SD	3.0 - 3.61 3.31 ± 0.10	5.61- 5.83 5.62 ± 0.16 # p = 0.003	1.3-1.80 1.32 ± 0.12 # p = 0.008, *p < 0.001

P-value when different groups compared with El-Galini farm. * *P*-value when different groups compared with Locanda farm. P >0.05 is non- significant - p≤0.05 is significant, Condition index (g/cm^3) = (wet weight)/(total lenght^3)×100 Hepato-stomach index (%) = (liver weight)/ (body weight)×100 Food index (%) = (weight of gut)/ (gutted weight)×100

Biochemical parameter levels of fish blood in three different farms

In both Locanda and El-Bats farms when compared to El-Galini farm) when compared to Locanda farm, there was a substantial rise in levels of Mean value of RBS.*Random blood sugar) Additionally, levels of Mean value ±S.D of creatinine significantly decreased in both the Locanda and El-Bats farms as compared to the El-Galini farm, On the other hand, there was a significant increase) in El-Bats farm when compared to El-Galini farm and a significant drop when compared to Locanda farm for levels mean value of urea.as showed in Figure (2).

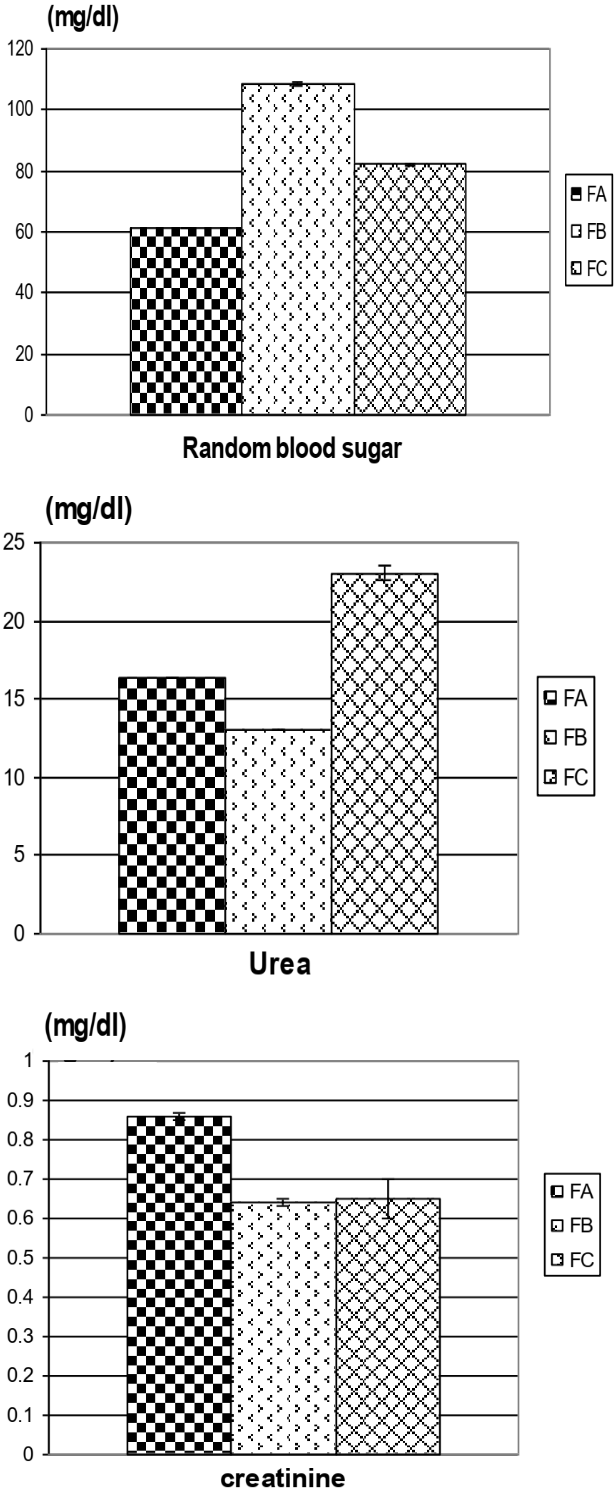


Fig. 2. Random blood sugar and kidney functions levels in blood fish of three different farms. Data represented by Mean ± SE. FA: -El- Gilani farm, FB: -lLocanda farm, FC: -EL-Bats farm, RBS: -Random Blood sugar.

Hormone parameters levels in Nile *tilipia* fish blood of three different farms

According to Fig. 3, there was a substantial increase in cortisol levels at Locanda farm but a significant drop at El-Bats farm- when compared to Locanda farm. likewiseLikewise, there was a significant difference between the El-Bats and El Galini farms, but not between the mean value values of the GH levels in the Locanda farm.

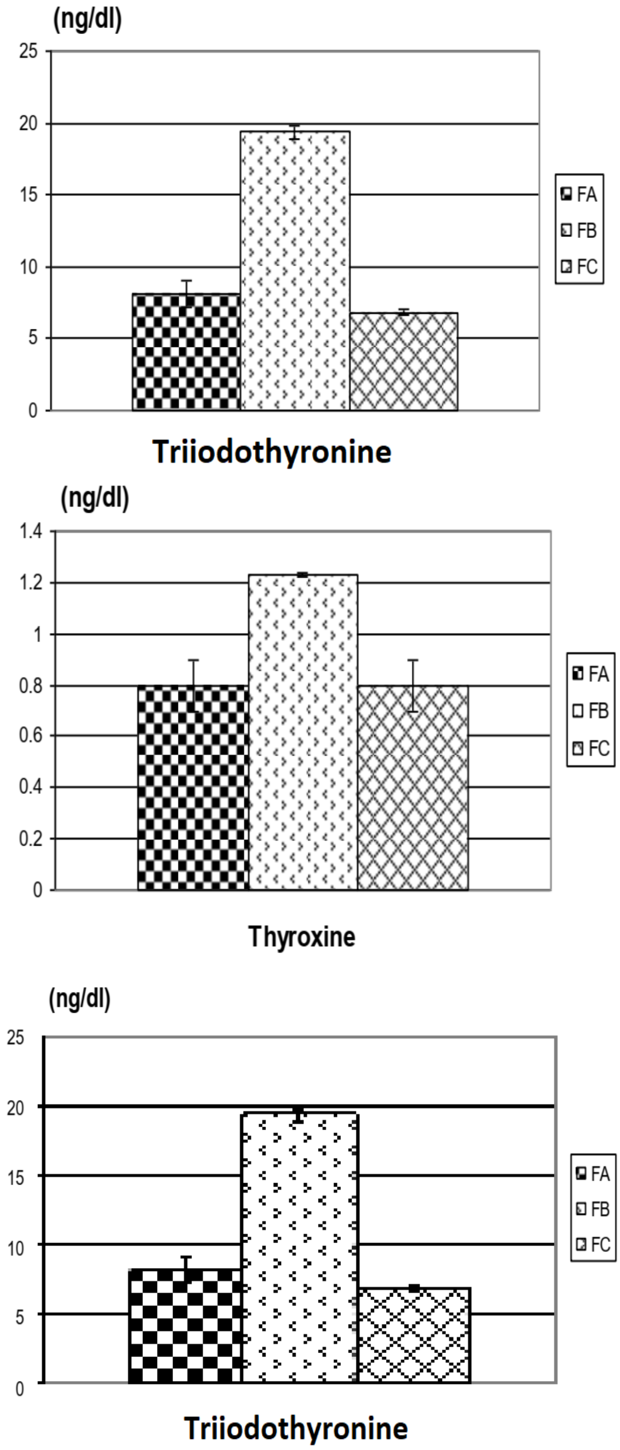


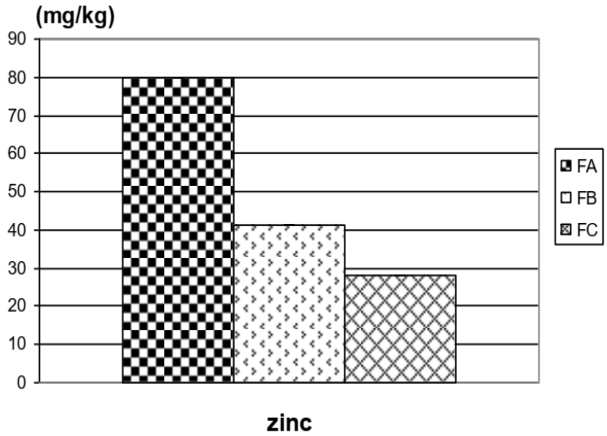
Fig. 3. Hormone parameters levels in Nile *tilipia* fish blood of three different farms. Data represented by Mean ± SE. FA: -El- Gilani farm, FC: EL-Bats Farm, FB: -locanda farm, T4: -Thyroxin, T3: -Triiodothyronine

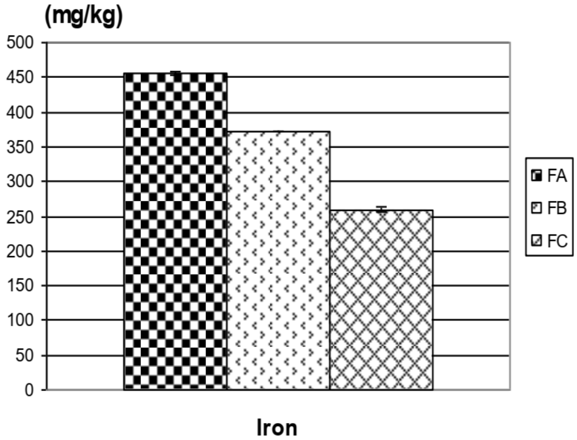
However, El-Bats farm displayed a non-significant rise when compared to El-Galini farm, whereas levels of mean value of T3 showed a substantial increase when compared to Locanda farm. Furthermore, when comparing the mean value of T4 in the Locanda and El-Bats farms to the El-Galini farm, there were non-significant.

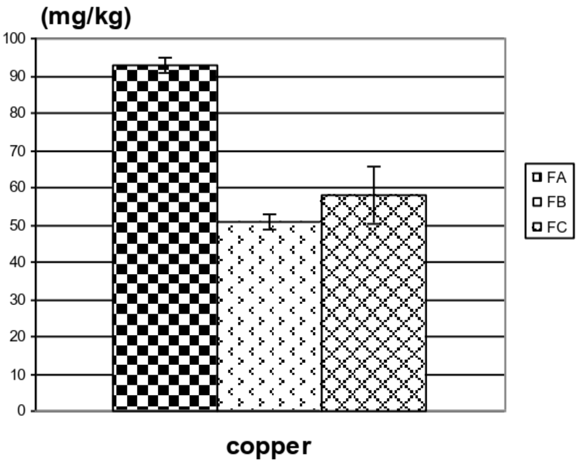
Comparison between concentrations of heavy metals in different organs in fish of three different farms.

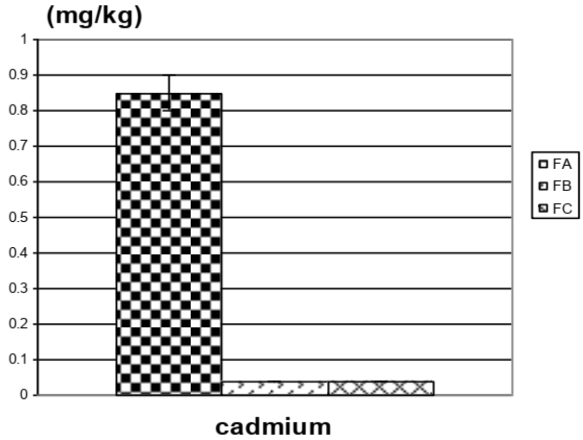
Accumulation of some heavy metal concentrations in fish liver of three different farms

According to our findings, the levels of Zn, Cu, Fe, and Cd all significantly decreased in both the Locanda and compared to the El-Galini farm However, there was a substantial rise in Pb levels in both the Locanda and El-Bats farms, compared to the El-Galini farm. All of the studied heavy metals varied in their levels of contamination across the three separate farms, as follows: In the El-Galini farm, but in the following order: Fe, Cu, Zn, Pb, and Cd in both Locanda and El-Bats farms (Fig. 4).









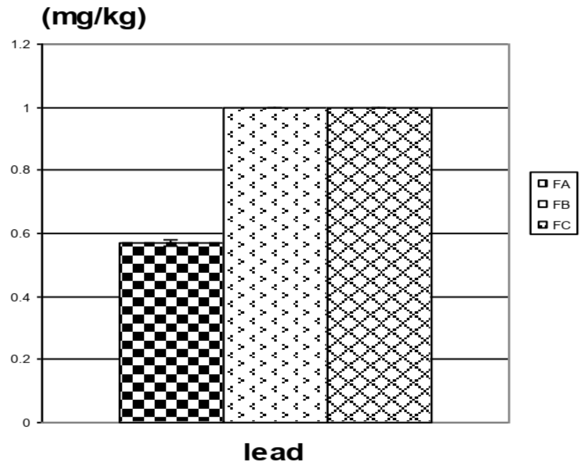


Fig. 4. Accumulation of some heavy metals' concentrations in fish liver of three different farms represented by mean ± SE. FA: -El- Gilani farm, FB: -locanda farm, FC: -EL-Bats farm

Accumulation of some heavy metals in fish muscles organ of three different farms.

In Locanda and El-Bats farms when compared to El-Galini farm, there was a significant drop of levels mean value of Zn and Fe, when compared to Locanda farm. Additionally, compared to El-Galini farm, there was no statistically significant difference in the levels of mean value of Cu in the Locanda and El-Bats farms. However, Cd and Pb were not found in the muscular organs of the fish in the three farms under investigation. All of the studied heavy metals varied in their levels of contamination across the three separate farms, as follows: -Fe>Cu>Zn. (Fig. 5).

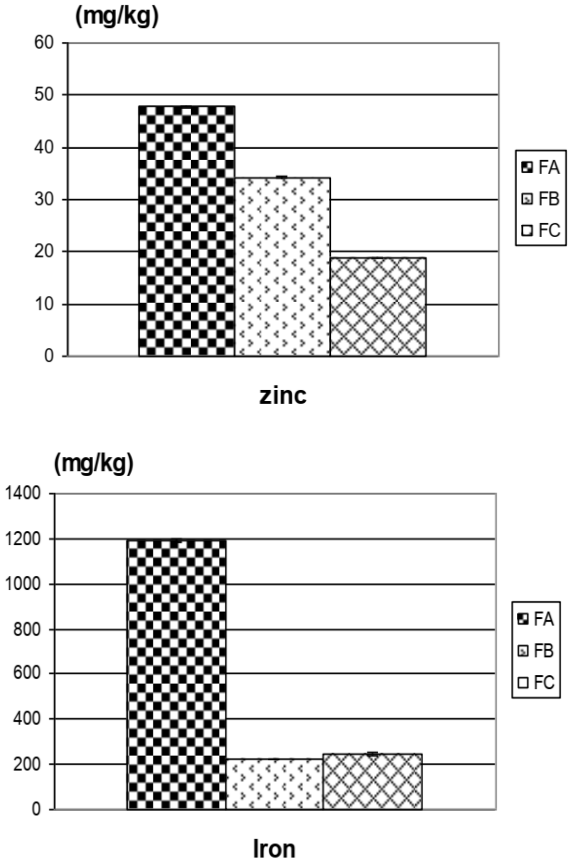
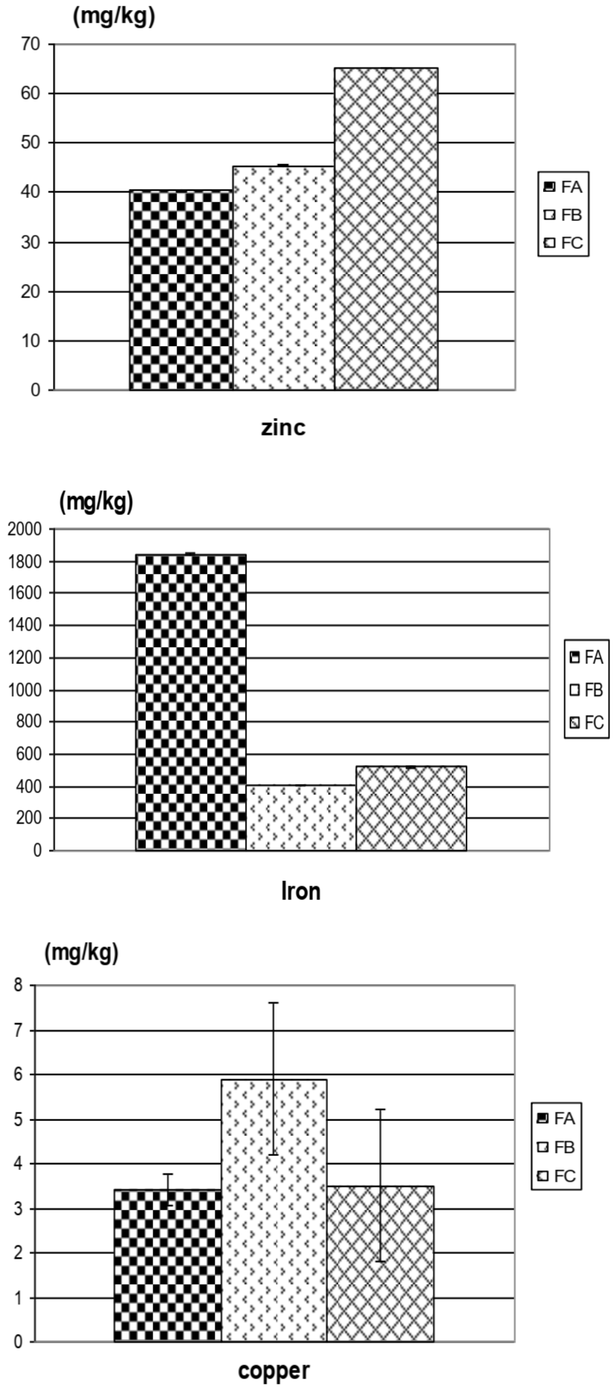


Fig. 5. Accumulation of some heavy metals in fish muscles organ of three different farms. Data represented by Mean ± SE. FA: -El- Gilani farm, FB: -Locanda farm, FC: -EL-Bats farm

Accumulation of some heavy metals in fish gills of three different farms

Fig. 7 it was shown that levels of means value of Zn and Pb had significantly increased in both Locanda and El-Bats farms. However, a non-significant variation in levels means value of Cu in both Locanda and El-Bats farms when compared with El-Galini farm and Cd was recorded high levels means value in El-Bats farm compared with Locanda farm were obtained farms El-Galini and Locanda. All of the studied heavy metals varied in their levels of contamination across the three separate farms, as follows: Fe > Zn > Cu > Pb > Cd that recorded in Fig. (6).



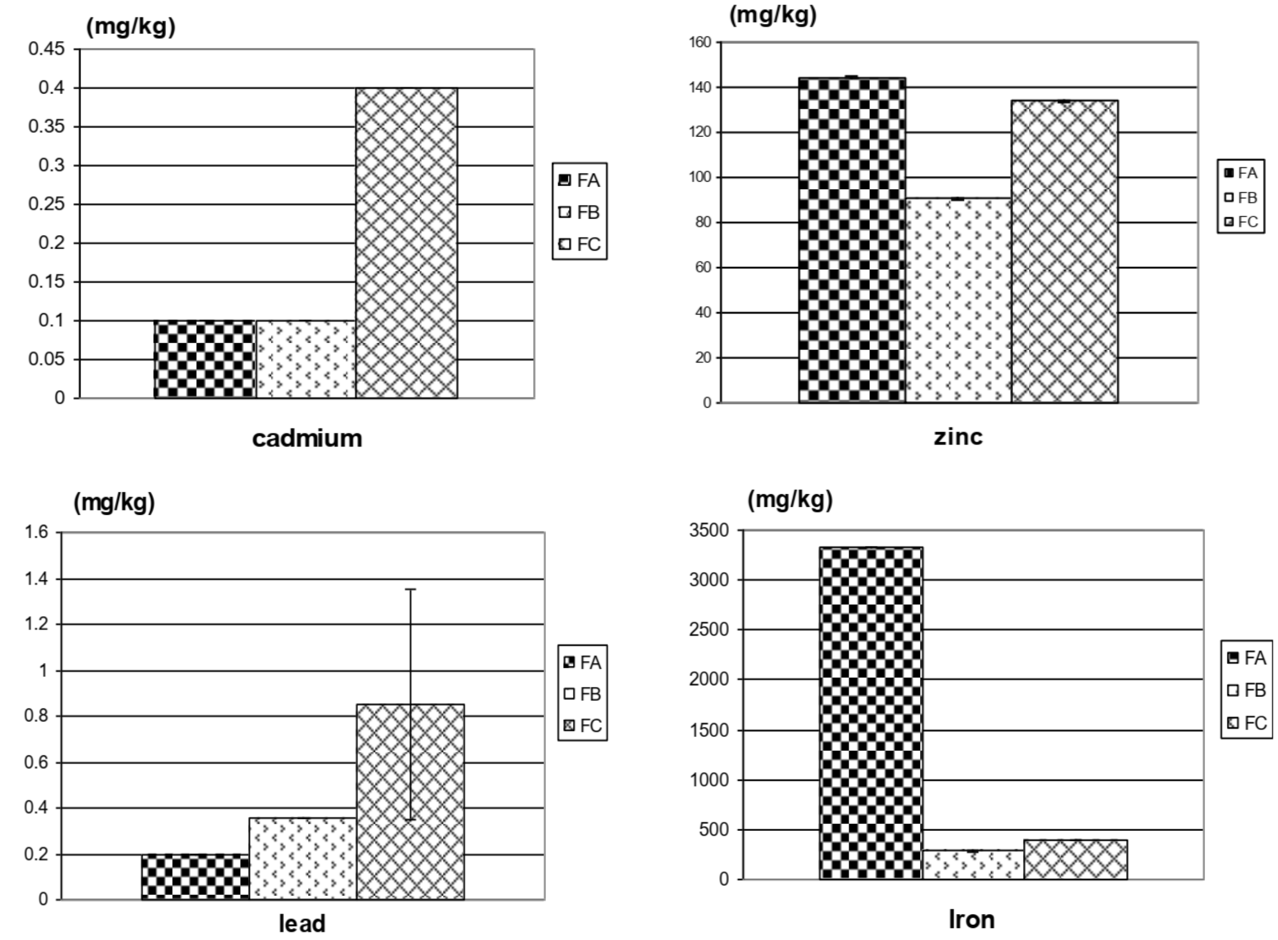


Fig. 6. Accumulation of some heavy metals in fish gills of three different farms represented by mean ± SE. FA: -El- Gilani farm, FB: -locanda farm, FC: -EL-Bats farm.

Accumulation of some heavy metals in fish skin of three different farms

The mean values of zinc and iron in the Locanda farm significantly decreased, but there was no statistically significant difference between the mean values of copper in the Locanda and El-Bats farms. With the exception of the El-Bats farm, where levels were identified, none of the three farms under investigation had Cd or Pb in the fish's skin organs. Because of the streptococci bacteria, it has been observed that fish with larger gallbladders than those at El-Galini Farm had pop eyes (exophthalmia), darkening, loss of appetite, enlarged gallbladders, brown or black patches in the liver, and many fish die in this pond. All heavy metals under study showed variation in contamination incontamination in all three different farms in following order:-Fe>Zn>Cu.

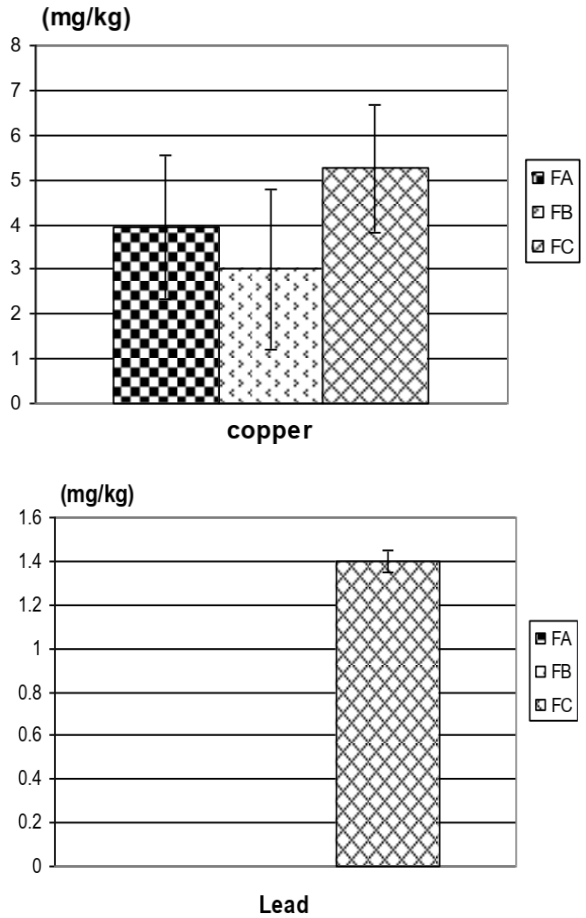


Fig. 7. Accumulation of some heavy metals in fish gills of three different farms represented by mean ± SE. FA: -El- Gilani farm, FB: -locanda farm, FC: -EL-Bats farm.

4. Discussion

Given that heavy metals are poisonous and dangerous to plant and animal life, they disrupt the normal biological balance in the aquatic environment, making them a major problem. According to Bhattacharya et al. (2008), residue is the net build-up of chemicals from water in an aquatic organism as a result of increased intake and slow elimination. The current analysis revealed that the heavy metal values in three separate drains varied somewhat. The heavy metals were found in the following sequence in each of the three different drains, according to the results: Fe > Zn > Cu > Pb > Cd. Furthermore, relative variance was observed in the heavy metal readings for Fe, Zn, Cu, Pb, and Cd across all three farms, which is in line with the results of the study previously cited by Adham et al. (2002) who studied contamination of heavy metals (Fe, Cu, Zn, Cd and others) at Maryut lake in difference stations. Furthermore, the current discovery aligns with the research conducted by Ali and Abdel-Satar (2005), who examined the presence of heavy metals (Fe, Mn, Zn, Cu, Pb, and Cd) in the water of various fish farms located in El-Fayoum (Goda1, 2; El-shoura and shalakany). Furthermore, Zaghloul (2008), Abdel-Satar et al. (2010), and Gohar et al. (2018) investigated heavy metal pollution in water samples from the El-Bats and El-Wadi drainage canals, including Fe, Zn, Cu, Pb, and Cd. Additionally, it has been observed that in 2015, there was a noticeable increase in the number of "Z" farms. It is important to note that Abd El-Atti et al. (2018) found elevated levels of lead and cadmium in water taken from Qarun and Burullus Lakes. Pb and Cd levels in Lake Qarun were significantly lower than those in Burullus Lake. Water needs to be purified completely since heavy metals, in particular, negatively impact fish life. Thus, the current study concentrated on treating drainage water entering fish farms by using simple and low-cost treatment techniques, like treating eggplant (*S. melongena*) and pumpkin (*C. pepo*). The percentage fluctuation in heavy metal contents in the El-Bats drainage between before and after treatment with pumpkin was evident. The data obtained clearly show that the elimination of the various heavy metals occurs in the following order: Fe> Cd> Zn> Cu>Pb. The maximum removal was 77% for Fe, and the minimum was 50% for Pb. It is clear from obtained results that, the order of removal of the different heavy metals were arranged as follows: Fe> Cd> Cu> Zn and Pb (Zn and Pb had equal removal percentage).

Under the influence of aubergine treatment, the highest removal of Fe was 88%, and the minimum removal of Zn and Pb was 25%. Pumpkin was effective at treating zinc and lead; the maximum removal values for zinc and lead were 65% and 50%, respectively, according to compression between the two heavy metal removal procedures. Eggplant shown efficacy in treating Fe, Cd, and Cu, with highest values of 88%, 78%, and 77%, respectively. The results shown above are in line with those of Samuel et al. (2016), who found that pumpkin was an excellent adsorbent for lowering the concentrations of Cu (II) and Ni (II) ions. Moreover, it was shown by Karimi et al. (2018) and Deepthi et al. (2017) that pumpkin seeds, which are naturally occurring coagulants, may remove copper from water. However, Karimi et al. (2018) found that lead removal from wastewater was successfully achieved when processed aubergine peel was utilised as an adsorbent for Pb from aqueous solution. Serum biochemical constituent level measurements are useful in the identification and diagnosis of fish metabolic abnormalities and diseases (Ferrari et al., 2007). The current study identified disparities in biological parameter values between the El-Galini farm under inquiry and the Locanda and El-Bats farms. Both farms showed a significant rise in biological parameter values, indicating disrupted metabolism of carbohydrates. The accelerated breakdown of glycogen in the liver and muscles through glycogenesis may be attributed to the action of adrenocortical and catecholamine hormones, as well as a decrease in insulin secretion (Gad, 1999). This finding aligns with research carried out by Adham et al. (2002). on the amount of glucose in Nile tilapia at Maryut Lake and Osman et al. (2018) on the amount of glucose in the blood serum of the Nile tilapia increased in Aswan, Kena, Assiut, BeniSuef, Damietta and Rosetta. In the present study, showed that the blood levels of all the hormones under investigation were significantly higher in the Nile tilapia from Locanda farm than in those from El-Galini and El-Bats farms, respectively. The values of the hormone parameter level (T3, T4, GH, and) varied amongst the fish from three distinct farms. As a result, the current findings covered the presence of heavy metal residues in the blood of Nile tilapia from three distinct farms, including Fe, Cu, Zn, Cd, and Pb. Additionally, it showed that the blood of Nile tilapia fish varies in its levels of heavy metals, which are found in fish from El-Galini and Locanda farms in the following order: Zn> Fe> Cu. However, in the fish of El-Bats Farm, the order was Zn> Cu> Fe and not detectable for Pb and Cd in Locanda and El-Gilini fish farms, residue of heavy metals; varied between species, ages, sex and organs; liver and gills have metabolic activity in which high levels of metals were found. Nevertheless, muscles showed low metabolic activity where less level of heavy metals were found (Younis et al., 2015). Residue of heavy metals in different organs, such as liver, gills, muscles and skin discussed in the present study showed that, all heavy metals under study showed variation in residue in all three different farms. The order was Fe> Cu> Zn and Cd>Pb in the Nile tilapia fish liver organ, but in fish muscles the order was Fe> Zn> Cu with no detectable Pb or Cd. While, in gills, the order was Fe > Zn> Cu>Pb> Cd. On the other hand, the residue of heavy metals in fish skin of three different farm was in the following order: Fe> Zn> Cu, and no detectable Pb or Cd was spotted except in fish skin of El-Bats Pb due to the existence of streptococci bacteria. This result is similar to those of Yacoub et al. (2008), Ghannam et al. (2014) and Talab et al. (2014). The previous authors found that, the order of heavy metals was Fe> Zn> Cu > Cd >Pb in liver, gills, muscles and intestine organs of Nile tilapia (*O. niloticus* L.) living in fish farm in El-Fayoum Province that coincides with the results of Talab et al. (2016) and Abd El-Atti et al. (2018).

Conclusion

The current study investigated the effects of different drains on fish farms by measuring the levels of different heavy metals in water and fish collected from drains and farms. The Nile tilapia was used as a biomarker of heavy metal pollution, detecting the accumulation of heavy metals in different fish organs and blood. Pumpkin and aubergine were found to be effective low adsorbents for treating Zn and Pb, whereas aubergine was found to be effective for treating Fe, Cd, and Cu when heavy metals were removed from water. This study also looked at how glucose levels, liver, kidney, and thyroid hormone functioned in relation to the effects of heavy metals on fish biochemistry. The results consistently emphasised that heavy metal pollution, encompassing lead, zinc, iron, and copper and cadmium in water of drainage and fish farms is very hazardous to aquatic life and fish culture.

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