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Effect of Some Environmental Impacts on Health Condition and Growth Performance of Cultured *Oreochromis niloticus* at Northern Delta, Egypt.

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ABSTRACT

The field study was done to study the effect of both water and soil quality on cultured *Oreochromis niloticus* (Nile tilapia) in the farms near Northern Delta Lakes. Six earthen ponds (about one Faddan each) were used in this experiment in three different locations; around Edco, Borollus and Manzala lakes. Three treatment-locations were tested in double replicates (2 ponds/lake); so six ponds were stocked with mono-sex males of tilapia (12000 fingerlings/pond with average initial bodyweight of 37±1 g). Growth performance, assessment of heavy metals residues, clinical, postmortem and laboratory examinations were done. The differences in the final weights (harvest) were significant and the lowest body weight came from farms around Lake Manzala and samples of water and soils suffered more from heavy metals pollution and parasitic diseases than fish from farms around Lake Edco and Lake Borollus. Regarding the clinical, postmortem and laboratory examinations; fish suffered from hepatitis, enlargement of the gallbladder, infested with metacercaria of Digenia and larval nematodes in all farms. From this study, overcoming pollution should be done seriously for producing fish fit for human consumption. The result from the study gave important information on the levels of the heavy metals in water and fish tissue .The concentrations of heavy metals in the water and fish tissue were under the permissible limits in Edko and Borollus lakes while in Lake Manzala the concentrations of heavy metals in the water and fish tissue were above the permissible limits. It is recommended that more attention must give to fish resources by the government to continuously reduce to the minimum level of lakes' pollution.

Keywords: Nile tilapia, Northern Delta, Heavy metals, Water, Soil.

INTRODUCTION

Water is a critical factor in the life of all living species. In fish culture, any features of water that affects all biological activities and fish management in one way or another; a water quality issue (Boyd, 2003). So, the overall status of any culture system is partly determined by its water quality (Alam and Al-Hafedh, 2006). Bad water quality stresses and terribly alters fish growth with consequently low production, profit and product quality. Moreover, decreases resistance to diseases (Iwama *et al*., 2000). Production is reduced when ponds contain pollutants that can hinder development, growth, reproduction or even cause mortalities to the cultured organisms. So, fish farmers are advised to manage water quality to provide a relatively clean and healthier environment that meets the physical, chemical and biological standards for both fish's normal health status and growth performance parameters (Elkareem *et al*., 2014).

The Egyptians northern Delta lakes are found costs of the Mediterranean sea at the Delta region that covers up to 6% of Egypt (the non-desert surface area). Lakes are a vital natural source for fish production in Egypt. Many years ago (early 90s), these lakes gave more than 40% of the country's total fish yield, but worth to mention, it decreased to 9.12% only (GAFRD, 2014) due to pollution. This forced locals to depend on aquaculture at these sights.

Pollution of ecosystems with heavy metals has seriously been a worldwide threat. Under certain predisposing factors fish may accumulate more than permissible limits of some metals from polluted ponds in their musculature (Mansour and Sidky, 2002). Some metals such as zinc and iron even though are essential in trace amounts for normal growth and development; however, others such as cadmium, lead and mercury are really harmful to many creatures even in very low concentrations. Heavy metals, especially mercury, have been reported as dangerous environmental pollutants. In addition to that, accumulate within the aquatic food chain risking not only animals but human health. On the other side, there are more chances for pathological changes in fish whenever prolonged exposure to pollutants occur. It was well known that metals are accumulated in some vital organs of fish and induced morphological, histological and biochemical changes in the body which may critically alter fish quality (Fadel and Gaber, 2007 and Khattaby *et al*., 2010).

More worthy to mention, pollution of the ecosystem by inorganic chemicals has been known to be dangerous for all water living organisms. The agricultural drainage water (waste water) polluted with pesticides, residues of fertilizers, discharges of industrial activities, runoffs as well as effluents of sewage alter water bodies and soil with huge quantities of inorganic anions and heavy metals (ECDG, 2002). Sources for metals include industrial, petroleum contamination and sewage disposal (Santos *et al*., 2005).

Therefore, the present work studies the effect of some heavy metals pollutants in water and soils on cultured mono-sex males of tilapia in farms near Edco, Borollus and Manzala lakes.

MATERIALS AND METHODS

These field experiments were conducted during the summer season 2015 near Lake Edco (n = 13ponds), Lake Borollus (n = 20 pounds) and Lake Manzala (n = 20 ponds) for assessing the area for fish farming.

Six earthen ponds (about one Faddan each) were used in this experiment in three different locations around Edco, Borollus and Manzala lakes. Three treatment-locations were tested in double replicates (2 ponds/ lake); therefore, six ponds were stocked with mono-sex of *O. niloticus* (12000 fingerlings/ feddan with an average initial bodyweight of about 37±1 g). Thirty fish, soil and water samples from each pond around every single lake were taken every 2 weeks along the experimental period.

Sampling and methods of analysis:

Samples of both water and soil were collected from farms near studied locations, for evaluating the suitability of ponds for aquaculture.Water samples were collected (monthly during summer season 2015) from fish ponds , irrigation sources and drains near the three lakes for chemical analysis and the average data are presented in Table(1). Soil samples from the surface layer (0-30 cm) were collected at the end of the experiment from fish ponds , irrigation sources and drains near studied locations for chemical analysis. The soil samples were air dried grind, sieved through 1 mm sieve and saved for analysis. Moreover, measuring heavy metals residues, testing growth performance parameters and clinical examination of reared fish were done. Water samples were taken from different farms around the tested lakes by a PVC tube column sampler at depth of half meter from the water surface. The samples were mixed in a plastic bucket and a sample of 1 liter was placed in a polyethylene bottle, kept refrigerated and transferred cold to the laboratory of Soil and Water Research Institute and Sakha Aquaculture Research unit, (A.R.C); for Hydrogen ion concentration (pH) which was measured with pH meter (Model 25, Fisher Scientific). Total dissolved solids (TDS as g/l) were determined using a salinity-conductivity meter (model, YSI EC 300). Temperature and dissolved oxygen were measured by using a digital oxygen meter (Model YSI 55). The concentration of total hardness (mg/l as Ca CO3), total ammonia (NH4-N+NH3-N), unionized ammonia (NH3-N), nitrite (NO2-N) and nitrate (NO3-N) were measured by methods described in (Boyd and Tucker, 1992).

Water analysis:

Water samples were taken during the experiment from the different locations and chemically and physically analyzed for EC ,temperature, pH, soluble cations, nitrogen, trace elements(Iron , Zinc and manganese) and heavy metals(Copper, Cadmium and Lead) .

Total soluble salts (TSS) were measured as EC dSm-1 electrical conductivity apparatus in the saturated soil paste extract; pH, soluble ions and temperature were determined according to Page et al. (1982). nitrogen was determined by macro-Kjeldahl method. Micro-elements and heavy metals were determined using the Atomic Absorption Spectrophotometer (AAS model GBC A932 ver. 1.1).

Heavy metals in water samples were extracted with conc. HCl and preserved in a refrigerator till analysis for Fe, Zn, Mn, Cu, Cd and Pb, (Parker, 1972).

Soil analysis:

Soil samples were taken at the end of the experiment from the different locations and chemically analyzed for ECe and NPK, as well as some pollutant elements; Ni, Co and Pb.

Total soluble salts (TSS) were measured as ECe dSm-1 electrical conductivity apparatus in the saturated soil paste extract; soluble ions and organic matter were determined. Available micro-elements and heavy metals were extracted using diethyl triamine penta acetic acid (DTPA) according to Lindsay and Norvell (1978) and determined using the Atomic Absorption Spectrophotometer (AAS model GBC A932 ver. 1.1).

Fish samples and measurements:

Body measurements along the experimental period (6 months) were recorded within biweekly intervals.

Condition factor (K) was calculated by using the following equation:

$$K\ \% = \text{weight (g)} / (\text{length, cm})^3 100$$

Specific Growth Rate was calculated according to Jauncey and Rose (1982) by using the following equation:

$$SGR\ \%/d = (LnW2 - LnW1/t)\ 100$$

Biochemical examinations of blood serum and musculature:

At the end of the fattening period, blood samples were taken from the caudal vein for serological analysis in the form of a pool sample from each location. Serum was obtained by centrifugation of blood at 3000 rpm for 15 min then frozen deeply for further biochemical analyses (Brezonik *et al*., 1991). Fish samples were kept frozen in an ice box until transported to the laboratory for examining musculature by the method described in the Association of Official Analytical Chemists (AOAC, 1990). Atomic Absorption Spectrophotometer (Model Thermo Electron Corporation, S. Series AA Spectrometer with Gravities furnace, UK,) instrument was used to detect the heavy metals in mg/l for water and µg/g. dry wt. for sediment samples and fish organs.

- Fish inspection:

Clinical inspection of fish was done similar to the methods described by Noga (1996) to record any changes away from the apparently healthy features (either externally or internally) of fish.

-Postmortem inspection (PM):

PM was done to inspect internal organs of fish according to Stoskopf (1993). The abdominal wall was dissected and removed. The internal organs and body cavities were exposed and clinically examined for both abnormal signs and or presence of parasitism.

-Parasites identification:

The identification of the detected parasites depended on the morphological characteristics of isolated species according to Lom and Dykova (1992).

-Histopathological findings:

Samples of infested fish musculature with cysts were fixed immediately in 10% neutral buffered formalin for two days. Then dehydrated in ascending grades of ethanol, soaked in paraffin wax, tiny cut at 4-5 micron thickness and finally stained with Haematoxlin and Eosin (H and E), more or less as done by Bullock (1978).

-Statistical analysis:

Analysis of gathered data was carried out by running the computer program (SAS, 1996). Differences within means were tested for significance according to Duncan's multiple range test (1955).

RESULTS AND DISCUSSION

Water physico-chemical properties and heavy metals content:

Results of the present study are illustrated in Table 1. Generally, averages of water temperature were compatible for tilapia growth (Lai and Lam, 1997). Dissolved oxygen readings were almost within tilapia tolerance level, more or less to what AIT, (1986) recommended. The pH values and the average values of Secchi disk readings were suitable with those recorded by Boyd (1998).

Mean concentration of free ammonia (NH_3) was some what accepted for tilapia, in one way or another as those mentioned by Diana and Lin (1998). Also the readings of nitrite seemed to be constant among locations (Ayas *et al.*, 2012). The values of the total alkalinity matched those mentioned by Reddy and DeLaune (2008). These results showed that all parameters of water quality were almost within suitable ranges mentioned by Boyd (1979).

Water quality criteria might differ from one pond to another within the same farm, even having the same surface area and water depth. This may be due to farm management, nutrition and eutrification methods, aeration, fish species and stocking rate (Abdel-Hakim *et al.*, 2000).

Table, (1): Some water quality parameters in different farms during the experimental period

Parameters	Edco	Borollus	Manzala
Temperature(C°)	26.94±0.10a	28.32±0.14b	29.16±0.12c
DO (mg/l)	3.89±0.016a	4.22±0.022b	3.79±0.010c
pH	8.15±0.02a	7.44±0.02b	7.09±0.03c
Salinity (g/l)	2.49±0.011a	2.18.±0.009b	3.02±0.016c
NO_3 (mg/l)	0.69±0.011a	0.54±0.007b	0.46±0.009c
NH_2 (mg/l)	0.66±0.006a	0.39±0.005b	0.41±0.006c
NH_3 (mg/l)	0.053±0.006a	0.047±0.006	0.070±0.007c
Total hardness (mg/l)	2099±5.13a	1842±3.17b	2328±8.22c
Secchi disck (cm)	21.09±0.62b	20.42±0.86c	19.78±0.94a
SAR	3.59±0.60	3.67±0.73	16.7±0.82
Na+Cations (meq/l)	8.5±0.94	10.70±0.91	89.00±1.23
K+Cations (meq/l)	0.20±0.18	0.26±0.23	1.5±0.21
Ca++Cations (meq/l)	5.20±0.47	8.00±0.79	24.25±1.03
Mg++Cations (meq/l)	6.00±1.06	9.00±1.14	32.54±2.11

a, b, c: Means with the same letter in each row are not significantly different (P≥0.05).
DO: dissolved oxygen, SAR: sodium adsorption ratio

On the other side, the concentrations of heavy metals in water were found to vary from one area to another (Table 2). All metals were of higher concentrations at Lake Manzala. While, Lake Borollus came second in accumulation of the tested metals. Lake Edco was the less polluted one. This may be attributed to the vegetation of the aquatic and higher plants. As they adsorb metals from water and soil. Unfortunately, these levels were higher than the permissible limits recommended for tilapia culture (Khallaf *et al.* 1998). This is because of disposing huge amounts of raw sewage, agricultural and industrial wastewater discharged into fisheries (Abdel-Moati and El-Sammak, 1997). The presence of Cd and Pb in water can be attributed to the discharge of industrial and agricultural wastes. As well as from leaded petrol from fishing boats and dust which holds a huge amount of lead from the ignition of petrol in automobiles (Mason, 2002). Moreover, Banat *et al.* (1998) wrote that higher levels of Pb often found in ecosystems near highways and large cities due to high gasoline combustion.

Table, (2): Heavy metals concentration (ppm)* in water sources during the experimental period

Sample	Cd	Pb	Cu	Mn	Zn	Fe
Edco main irrigating canal	ND	0.004	0.13	0.33	0.18	0.85
Edco ponds	0.002	0.012	0.19	0.58	0.22	1.16
Edco drainage canal	0.004	0.028	0.25	0.77	0.28	1.21
Borollus main irrigating canal	0.002	0.030	0.12	0.71	0.18	1.000
Borollus ponds	0.003	0.044	0.10	0.62	0.14	1.37
Borolus drainage canal	0.006	0.069	0.18	0.90	0.30	2.400
Manzala main irrigating canal	0.020	0.120	0.22	0.96	0.34	1.82
Manzala ponds	0.031	0.180	0.28	1.32	0.39	2.50
Manzala drainage canal	0.045	0.280	0.36	2.20	0.58	5.36
Permissible limits	0.01	0.05	1.0	0.05	1.0	1.0

ND: not detected.
***: Permissible limits according to USEPA (1986).**

Beliles (1979) wrote that, the main source for manganese in air and water could be from iron and steel industries. More added, diesel fuel combustion in the transportation means. So, motor boats which are distributed in lakes could be a reason for elevating the Pb and Mn in fish farms near these lakes. The increased Zn concentration in water samples may be due the leaching amounts of zinc from coating layers of boats welded by active zinc.

It is noticed that the concentrations of metals in the present study are less than those usually found in the scientific literature regarding the studied area, except for both Cu and Pb near Manzala seemed to exceed those recorded by Elghobashy *et al*. (2001).

Soil heavy metals content:

Results obtained from soil analysis (Table 3) are much greater than permissible limits (Persaud *et al*. 1990). It differed between locations around different lakes especially in farms near Manzala. This can be attributed to the industrial and agricultural discharges. In addition to that, from spilling leaded petroleum from small fishing boats which are abundantly moving around in Lake Edco and Lake Borollus. More over, dust may hold huge amounts of lead from ignition of petroleum byproducts in vehicles increasing Pb content (Abdel-Moati and El-Sammak, 1997).

Presence of heavy metals in mud around northern delta lakes is affected by water input, variation of soil type and its characteristics. The areas near drains suffered highest pollution levels. This came close to the findings of Franc *et al*. (2005) . The concentration of heavy metals in mud increased as the amount of organic mater increased to (Tsai *et al*., 2003).

Table, (3): Soil available heavy metals (ppm) at the end of the experiment.

Sample	Cd	Pb	Cu	Mn	Zn	Fe
Edco main irrigating canal	ND	0.35	1.42	15.20	1.60	22.10
Edco ponds	ND	0.64	2.54	33.50	3.50	52.30
Edco drainage canal	ND	0.81	4.00	50.50	5.10	80.10
Borollus main irrigating canal	ND	1.10	3.40	44.21	4.02	83.20
Borollus ponds	ND	1.32	4.00	52.20	4.82	99.60
Borollus drainage canal	ND	1.40	4.40	60.44	6.24	110.92
Manzala main irrigating canal	ND	0.68	2.44	40.00	4.00	100.46
Manzala ponds	ND	1.20	4.40	68.00	5.70	124.00
Manzala drainage canal	ND	1.50	5.60	82.60	6.40	143.12
Permissible limits*	0.00	0.31	0.16	4.6	1.2	-

ND: not detected.
***:permissible limits according to USEPA (1986).**

More added, pollutants concentration in mud accumulated more with decreasing the particle size of it. Soil absorbs different ions from waters penetrating through it. This ability is lowest for carbonate-sandy fractions of soils (brackish area) and more sound in clayey organic matter rich mud. Therefore, elevated metal concentrations near lakes' mud probably reflects the prolonged deposition of these metals through atmospheric deposition and surface water runoff into these areas. On the other side, water metals probably reflects shorter exposure.

concentration of serum heavy metals:

As shown in table 4, heavy metal concentrations in fish were proportionally related to the heavy metals content of both water and mud in the three tested areas. Irrespective of whether the metal is essential or not, the accumulation levels were significantly more provoked than ever premised. Metal uptake by fish is a double phase process. The first step involves initial fast adsorption or binding to surface, followed by a slower movement intra cellular. In epithelial tissues the following next step is; a rate limiting matter in trans epithelial kinetics of metals. Metals entry inside cell structure may be rushed by either diffusion of the metal along the cell membrane or moved by a protein carrier (Brezonik *et al.,* 1991).

More processes for understanding metal uptake includes the speciation of the metals in the medium before reaching gill epithelia. It is well agreed that metal concentration in fish is almost dose and time dependent. More factors include; salinity, temperature, interacting agents and metabolic activities of concerned tissues. This issue was more studied by Mansour and Sidky (2002).

Table, (4): Concentrations of heavy metals in ppm (Fe, Cu, Ni, Cd, Pb and Zn) in tilapia serum reared in ponds near different lakes

Parameters	Edco	Borollus	Manzala
Fe	46.19±0.004b	14.49±0.003c	59.61±0.004a
ZN	16.63±0.002b	3.68±0.002c	24.08±0.004a
Cu	2.18±0.003b	1.39±0.003c	12.16±0.006a
Mn	1.22±0.003b	0.11±0.001c	5.19±0.003a
Cd	0.19±0.001b	0.011±0.004c	1.79±0.003a
Pb	0.42±0.002b	0.012±0.002c	1.91±0.003a

a, b, c: Means with the same letter in each row are not significantly different (P≥0.05).

- concentration of heavy metals in the musculature of fish:

The metal concentrations in tilapia are correlated with metal content of water around all tested lake areas, (Table 5). It came in the following order: Fe >Cu >Mn >Cd > Pb > Zn. This may be attributed to the presence of these metals in the surrounding environment by the same order. Detail relationship between heavy metals concentrations in musculature and the water source is more emphasized by Ibrahim and El-Naggar (2006).

Table, (5): Heavy metals concentrations of; (mg / kg dry weight, ppm) Fe, Cu, Ni, Cd, Pb and Zn in musculature of tilapia reared around the three lakes.

Parameters	*Permissible limits	Edco	Borollus	Manzala
Fe	43	59.19±0.008b	19.98±0.008c	214.13±0.008a
ZN	60	29.52±0.006b	8.22±0.006c	177.09±0.006a
Cu	3	2.61±0.005b	1.56±0.005c	45.23±0.005a
Mn	2.0 – 9.0	1.70±0.006b	0.22±0.006c	19.92±0.00a
Cd	0.1**	0.21±0.006b	0.011±0.006c	9.45±0.006a
Pb	0.214	0.47±0.006b	0.013±0.006c	8.41±0.006a

Permissible limits according to FAO/WHO (1999). **µg/g.
a ‹b, c: Means with the same letter in each row are not significantly different (P≥0.05).

These values are near those recorded by Karakoc and Dincer (2003) concerning Zn accumulation, Karakoc (1999) regarding Cu. While Dallinger and Kautzky (1985) mentioned closer records for the others.

Growth parameters:

Both growth and survival rates that control production are affected by some biological factors; as heredity and fish welfare, including water and food quality, energy richness of ration and stocking rate. This interpretation came some what near the studies of both El-Sayed (1999) and Ashagrie *et al*., (2008). Good growth rate in all farms may be as a result of natural food abundance (planktons) in these farms.

Table, (6): The effect of water source on some growth parameters of Nile tilapia.

Parameters	Edco	Borollus	Manzala
Initial weight, g/fish	31.56±0.89a	32.30±0.89a	31.49±0.89a
Final weight, g/fish	313.22±2.67a	309.85±2.67b	278.19±2.67c
Initial length, cm	15.06±0.90a	14.80±0.90a	14.99±0.90a
Final length, cm	28.93±1.09b	27.14±1.09a	26.69±1.09c
Initial K	1.72±0.39b	1.71±0.39a	1.73±0.39b
Final K	0.98±0.11b	0.99±0.11b	0.96±0.11a
DWG, g/fish	1.80±0.29a	1.62±0.29b	1.49±0.29c
SGR, %/d	1.41±0.32a	1.42±0.32ab	1.37±0.32b

a, b, c: Means with the same letter in each row are not significantly different (P≥0.05).

This growth rate is somewhat as Mc Donald (1985) reached for *Oreochromis aureus* nourished on the blue greenish algae (*Anabaena* species.) when compared with the control. Moreover, Tefei *et al*. (2000) mentioned that tilapia was found to be essentially a phytoplankton eating fish in Lake Chamo; the blue greenish algae contributed more than half of the total ingested food. Appropriate feeding can stimulate early productivity for aquaculture (Kamal and Agouz, 2006).

The Condition factor, (K) of fish is an ideal measurement of relative musculature to bony growth. As well as the differing growth responses of these tissues to ration treatment may be reflected by changes in (K), (Soltan *et al*., 2006). It is abundantly assumed to show not only condition of fish such as health, reproductive state and growth but also features of the environment such as the quality of habitat (fish welfare), water quality (source of water) and availability of preys (carnivores), (Liao *et al*. 1995).

Elkareem *et al*. (2014) recorded that the average condition factor of tilapia was about 1.23 g/cm^3 and around 1.22 g/cm^3 in treated wastewater and White Nile, respectively. These were some what above 1.0 indicating healthier tilapia (Barnham and Baxter, 1998). On the other side, they were less than those noticed by Nwabueze (2013) for cat fish which may be due to species difference. While, King (1995) attributed differences in fish condition factor to food amount, adaptation with the environment and gonadal maturity.

Table 6 also shows the effect of water quality criteria on daily weight gain (DWG) of tilapia. Statistical analysis illustrated that the studied water parameters significantly changed the DWG of fish. Mentioning the specific growth rate, analysis of variance indicated that the studied water sources were significantly influencing the SGR of fish during the period of study.

Clinical, postmortem, parasitological examinations, identification of the isolated parasites and histopathological findings:

Some cultured fish from farms around the studied lakes showed external mucus secretions (excessive sliminess), enlarged head to total body shape; indicating emaciation, eye cataract, abdominal distention and some fish gathered near water inlets (gasping atmospheric oxygen) with decreased feed intake (poor appetence) and loss of equilibrium (lethargy) (Figure 1). More clinical signs included inflammation of the vent (Figure 2). This may be due to poor water quality as a result of water pollution with insecticides, turbidity, too shallow water and high water temperature (Noga, 1996). Moreover, postmortem examination showed distended and enlarged gall bladder due to hepatitis as a result of prolonged exposure to heavy metals (Figure 3). In addition to that, the intestine was enlarged, swollen because of Nematode infestation (Figure 4) (Lom and Dykova, 1992). On the other side, histopathological alterations showed encysted metacercarae of Digenia embedded in between the muscle bundles (Figure 5). Musculature was surrounded by slight edema and fibrosis with infiltration of melano-macro phages and loss of cell architecture (Figure 6). These results in one way or another nearly met those noticed by Bassiony (2002).

Figure 1: Fish showing excessive mucus (sliminess) of the skin, large head, exophthalmia, abdominal distention.

Figure 2: Fish suffering inflammation of the vent.

Figure 3: Distended gall bladder due to hepatitis.

Figure 4: Intestine enlarged, swollen and suffered Nematode infestation.

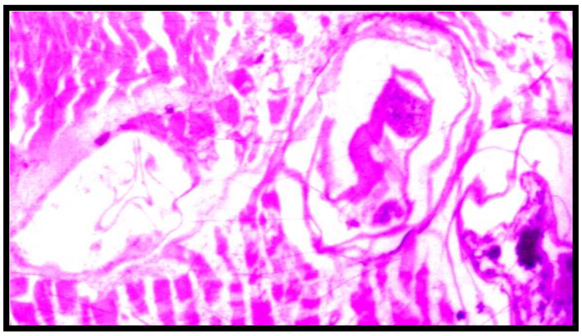

Figure 5: Musculature of *O. niloticus* showing cysts of Digenia surrounded by melanomacrophages (H&E stain X 200).

Figure 6: Encysted metacercarae surrounded by slight edema and fibrosis of musculature.

Chemical composition:

Proximate analysis shows significant (P≤0.001) effects in the three lakes. As described in Table 7, Edco Lake reflected the highest values of crude protein content of fish body, while Borollus Lake showed the highest values of fat and ash. The changes in chemical composition during development and in response to different factors are the result of differential growth of tissues. The main tissues involved in the whole-body growth are bones, musculature and adipose tissues. The relative development of these tissues is very important for the conformation of fish and thus its yield in processing (Soltan *et al*., 1999).

Table 7: Least-square means and standard errors of the different locations affecting the chemical composition (% DM basis) of whole fish body of Nile tilapia

Parameters	Edco	Borollus	Manzala
Moisture	62.30±0.08a	61.90±0.08a	62.40±0.08a
Protein	61.80±0.09a	58.40±0.09c	60.20±0.09b
Fat	20.10±0.06c	22.40±0.06a	21.50±0.06b
Ash	18.10±0.05b	19.20±0.05a	18.30±0.05b

a, b and c: Means with the same letter in each row are not significantly different (P≥0.05).

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تأثير بعض العوامل البيئية على معدلات النمو والحالة الصحية لأسماك البلطى النيلي المستزرع قرب ثلاث بحيرات فى منطقة شمال الدلتا - مصر

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تم اجراء هذا البحث لدراسة بعض العوامل البيئية التى لها علاقة بجودة المياه والتربة على أسماك البلطى النيلى المستزرعة فى مزارع بالقرب من بحيرات شمال الدلتا. تم استخدام ستة أحواض مساحة كل حوض حوالى فدان وذلك فى ثلاثة مواقع (بحيرة ادكو –بحيرة البرلس- بحيرة المنزلة) حيث استخدم ثلاث مواقع ولكل موقع مكررتين، وفى الستة احواض تم تسكين أسماك بلطى نيلى وحيد الجنس بمعدل ١٢٠٠٠ اصبعية للحوض بوزن أولى متوسط ٣٧ جم/ سمكة، وتم أخذ مجموعة من القياسات الهامة مثل معدلات النمو والمتبقى من بعض العناصر الثقيلة وبعض الصفات المرضية وبعض القياسات المعملية. وكان من أهم النتائج التى توصل اليها البحث هو أن الاختلاف فى معدلات الوزن النهائى والنمو كانت معنوية بين المواقع الثلاثة، إذ كان هناك انخفاض فى الأوزان النهائية وبطء فى معدلات النمو فى المزارع بمنطقة المنزلة عن الموقعين الآخرين، بالإضافة لاحتواء عينات المياه والرواسب على كميات كبيرة من العناصر الثقيلة والطفيليات المرضية الخارجية وذلك بالمقارنة بالمزارع بمنطقة بحيرة ادكو والبرلس. كما أظهرت الفحوص الاكلينيكية وجود التهاب بالمرارة والكبد وظهور بعض الطفيليات كالديدان الأسطوانية وحويصلات الديدان ثنائية العائل بسبب التلوث الملحوظ داخل تللك المزارع . من هذه الدراسة يمكن ان ننصح بمواجهة مشكلة التلوث بجدية لإنتاج أسماك صالحة للاستهلاك الآدمى.