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Influence of different water resources on physical, chemical and heavy metals levels of El-Abbassa Fish Farms, El-Sharqia Governorate, Egypt

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ABSTRACT
In this study the influence of various water origin on physical, chemical and heavy metals levels of El-Abbassa fish farms, El-Sharqia governorate, Egypt during experiment period for five months from March till July 2018 were investigated. The first fish pond was irrigated from Ismailia Canal, which branched out from River Nile, while the second was supplied by agriculture drainage water. Physical, chemical and heavy metals levels of different water resources in different two fish ponds were monthly determined, also gonadosomatic index of the ovary of Nile tilapia was monthly determined. In addition, protein, cholesterol, carbohydrates and glycogen were determined at the end of experiment period. The results showed that, physical, chemical and heavy metal levels of different water resources in two fish ponds of El-Abbassa fish farms were differed significantly but not exceed the maximum permissible limits reported by ECS, 1994 and USEPA, 2006 so, quality analysis of ponds water, fish species and fish feeds during the breeding season must be performed continuously, accurately according to national and international standard specifications to ensure the success of the breeding process and to obtain the higher fish production, furthermore, the levels of pollutants must be continuously monitored in this important fish farms to improve the quality of the cultured fish species.

INTRODUCTION

Egyptian fish farms depends on different sources of water which have a different physical, chemical and biological properties that can be effects on the quality of the cultured fish and human health (Saeed, 2000; Pulatsu, *et al*., 2004 and Ali, 2007). Environmental pollution problem with heavy metals is one of the most serious problems worldwide. Agricultural drainage water contains more quantities of heavy metals, pesticide residues and inorganic materials as a result of human activity which is harmful to the environment (ECDG, 2002 and Ghannam, *et al*., 2014). Heavy metals are a toxic and harmful pollutants for aquatic environment and therefore it poses a very serious danger to human health and his life because they can bioaccumulate in fish tissues and they cannot be destroyed or degraded through biological degradation (Al-Kenawy and Aly, 2015). Heavy metals have a different effects on various fish organs and their tissues which contains a lowest heavy metals levels in comparison to liver, kidneys and gills, which contains higher levels due to bioaccumulation process (Barbara, and Malgorzata, 2006).

Heavy metals are transported to fish in aquatic environment through its gills and other exposed biomembranes by direct absorption from water (Matagi, *et al*., 1998). Biochemical composition of fish varied between species according to different seasons, while, fish protein consist of higher concentrations of easy to digest essential amino acids (Sreevalli and Sudha, 2014).

Previous studies by El-Nemaki, *et al*., (2008) recommended that, physical, chemical and microbiological quality analysis of both water, fish and fish feed must be continuously performed in fish farms, so that agricultural drainage water can be used for fish breeding. On the other hand, Al-Kenawy and Aly, (2015) evaluated heavy metal concentrations of some earthen fish ponds located at Abbassa, and found that, metals exceeded the maximum permissible limits in fish liver, while it was within the MPL in fish muscles according to (WHO, 1992). Emara, *et al*., (2015) found that, heavy metals concentrations of Nile tilapia tissues did not exceeded the standard limits in his study to compare between sewage and agriculture drainage water at Al-Abbassa and Shader Azzam. The same results were explained by Soltan, *et al*., (2016) whom found that, agriculture drainage water didn't contain higher concentrations of both heavy metals and pesticide residues, and thus, the quality of cultured Nile tilapia was within the standard limits and safe for human consumption. The effect of different water source on survival rate %, growth performance, feed utilization, fish yield, economic evaluation and production of Nile tilapia reared in earthen ponds were investigated by (Ghozlan, *et al*., 2017). Therefore, the aim of this work was to evaluate the influence of different water resources on physical, chemical and heavy metals levels of El-Abbassa fish farms, El-Sharqia governorate, Egypt during experiment period for five months from March till July 2018.

MATERIALS AND METHODS

Study area

Two fish ponds were used in the present study located at Al-Abbassa, El-Sharqia governorate, Egypt. The first pond received irrigation water from Ismailia canal while, the second used agriculture drainage water. The experimental commercial fish diets were consist of (49.50% soya 48; 24.50% rice bran; 15.20% corn; 4.00% wheat middling, 1.80% soya oil; 1.50% gelatin; 0.50% salt; 1.50% 1 minerals premix and 1.50% 2 vitamins premix).

Water samples

Water samples were monthly collected from each pond during March 2018 till July 2018 using PVC vertical water sampler from at least three spots in the pond between 9.00 am and 12.00 pm at a depth of 30 cm below the water surface and mixed together in a plastic container according to Boyd (1990). One liter of water samples at each pond was placed in polyethylene bottles previously washed with acid (0.01 N HNO_3) and rinsed by distilled water, then placed in a cooler at 4 °C and transferred to the lab for further analysis.

Fish gonad samples

Fish gonad samples of Nile tilapia (*Oreochromis niloticus)* were collected monthly from 15 fish samples and stored at -20^{o}C until analysis.

Analytical Methods

Chemical analysis of fish diet

Moisture, crude protein, fat, ash, fiber and calories were determined according to AOAC (1990).

Water analysis

Water temperature, TDS, TSS, dissolved oxygen, pH, ammonia (NH_3), nitrate (NO_3) and nitrite (NO_2) were determined according to (Boyd and Tucker, 1992). Fe, Cu, Zn, Pb and Cd concentrations of water samples were determined according to APHA (1998) using Atomic absorption spectrophotometer (Thermo 6600, thermo electron corporation, Cambridge, UK).

Fish gonad analysis

Total protein content was determined according to Lowry *et al.* Method (1951), while total glycogen by Dubois *et al.* Method (1956) and total cholesterol by Schoennerimer Method (Sperry and Webb, 1950). The values are expressed as mg/g wet weight of the testes.

Gonadosomatic index

Fish gonad was taken from 15 fishes per each water type. Gonadosomatic index was calculated as gonad percentage to the whole fish weight as the following equation:-

GSI = (Gonad weight (g) / Fish weight (g) × 100

Statistical analysis

Two-way ANOVA was employed to evaluate the variability of the concentration of each metal with respect to different seasons and farms, using the software CoStat ver. 6.4 (CoStat, CoHort software, USA). The analyzed data were expressed as mean ± standard diviation (SD). The inter-elemental relationships were performed through Pearson's correlation coefficient matrix. Significant differences are stated at $P<0.05$ (Bailey, 1981).

RESULTS AND DISCUSSION

The chemical composition of experimental commercial fish diet was as follows: 91.70% dry matter; 35% crude protein; 8.90% lipids; 5.80% ash; 6.0% fiber and 389.32 (Kcal/100 g) calories. The optimum protein level for tilapias which range between 20 and 40% crude protein (Wannigama, *et al*., 1985; Siddiqui, *et al*., 1988 and Ghozlan, *et al*., 2017).

Physical water quality parameters

Physical water quality parameters in fish ponds throughout the growing period (March-July 2018) are represented in Table 1.

Water temperature is the main environmental factor responsible for the growth, activity, safety of fish and other aquatic organisms (Boyd, 1990). Water temperature reached to highest values (34.10°C) during July 2018 in both irrigated and agriculture drainage ponds water. The monthly average values of water temperature recorded higher values (27.30±3.98) in irrigated water supply, while the lowest temperature monthly average (25.94±4.16) recoded in agriculture drainage water supply. The obtained results indicated that, water temperature values were suitable for fish culture in both types of water as reported by (Boyd, 1990; Broussard, 1985, Soltan, *et al*., 2016 and Ghozlan, *et al*., 2017) whom reported that, tilapia fish grow well in high water temperature and the optimal value was 24-30°C. They also, mention that water temperature reached its maximum values during August, however its minimum were observed during April and November.

The lowest values of total dissolved solids (233, 211, 259, 298 mg/l) were observed during March, April, May, June, July 2018, respectively, in irrigated water supply, while the higher values (455, 394, 563, 622, 475 mg/l) were recorded during March, April, May, June, July 2018, respectively, in agriculture drainage ponds water. The lower and higher monthly average of total dissolved solids were

(271.40±57.32 and 501.80±90.45 mg/l), in irrigated water supply and agriculture drainage ponds water, respectively. The highest monthly average (205.80±52.04 and 113±27.27 mg/l) of transparency were recorded in agriculture drainage ponds water and agriculture drainage water supply, respectively, while the lowest values (38.60±19.30 and 58±22.21 mg/l) were recorded in irrigated water supply and irrigated ponds water, respectively. TSS values were significantly increased during experiment period in irrigated water supply, while it showed fluctuation in the other three different water resources.

Table 1: Physical quality parameters of water during experimental period (March-July 2018).

Parameters	March	April	May	June	July	MA±SD*
Temperature						
Irrigated water supply	22.30	25.60	27.20	28.20	33.20	27.30±3.98
Agriculture drainage water supply	19.80	24.40	26.20	28.80	30.50	25.94±4.16
Irrigated ponds water	22.70	23.90	26.10	28.80	34.10	27.12±4.54
Agriculture drainage ponds water	20.60	24.40	26.60	28.90	34.10	26.92±5.05
TDS (mg/l)						
Irrigated water supply	233.00	211.00	259.00	298.00	356.00	271.40±57.32
Agriculture drainage water supply	341.00	412.00	377.00	398.00	451.00	395.00±40.84
Irrigated ponds water	241.00	239.00	283.00	344.00	348.00	291.00±53.21
Agriculture drainage ponds water	455.00	394.00	563.00	622.00	475.00	501.80±90.45
TSS (mg/l)						
Irrigated water supply	21.00	23.00	42.00	38.00	69.00	38.60±19.30
Agriculture drainage water supply	121.00	126.00	67.00	113.00	138.00	113.00±27.27
Irrigated ponds water	48.00	45.00	34.00	78.00	85.00	58.00±22.21
Agriculture drainage ponds water	165.00	211.00	276.00	231.00	146.00	205.80±52.04
pH value						
Irrigated water supply	7.70	7.30	8.20	8.20	8.60	8.00±0.50
Agriculture drainage water supply	7.80	8.90	7.70	8.40	7.30	8.02±0.63
Irrigated ponds water	7.20	7.20	8.20	7.00	8.40	7.60±0.65
Agriculture drainage ponds water	7.90	8.20	8.80	7.90	8.60	8.28±0.41

**** Monthly average (MA) ± standard deviation (SD)***

The monthly average (±SD) of pH values were (8.00±0.50, 8.02±0.63, 7.60±0.65 and 8.28±0.41) for irrigated water supply, agriculture drainage water supply, irrigated ponds water and agriculture drainage ponds water, respectively. The pH values were fluctuated during the five months of experiment period in all water supply. The present results agree with (Boyd, 1990, Saeed, 2000, Ali, 2007 and El-Nemaki, *et al*., 2008). On the other hand, Johnson (1986) recommended the range (6.5 to 9.0) of pH for almost freshwater fish species. The higher pH values in agriculture drainage water could be due to their higher rates of phytoplankton which contains high values of phosphorus and nitrogen in comparison with irrigation water (El-Nemaki, *et al*., 2008) or may be due to algal blooms (Padmavathi and Prasad, 2007).

Chemical water quality parameters

Chemical quality parameters of water during experimental period (March-July 2018) are shown in Table (2). Dissolved oxygen is one of the most important environmental factors which considered a limiting factor for success or failure in intensive culture and depends on water temperature, fish biomass and rate of water exchange. An excellent aquaculture attribute of tilapia is their tolerance to low dissolved oxygen concentration (Simon, *et al*., 2011 and Hute, 1972). Soltan, *et al*., (2016) reported that, 5 mg/l and above of DO is the appropriate and preferred concentration for most fish species.

Table 2: Chemical quality parameters of water during experimental period (March-July 2018).

Parameters	March	April	May	June	July	MA±SD*
DO (mg/l)						
Irrigated water supply	5.50	6.60	7.70	6.90	7.20	6.78±0.82
Agriculture drainage water supply	4.40	4.90	6.60	5.70	4.40	5.20±0.95
Irrigated ponds water	5.50	6.40	6.80	7.70	6.90	6.66±0.80
Agriculture drainage ponds water	5.80	6.50	5.80	6.70	6.40	6.24±0.42
NH_3 (mg/l)						
Irrigated water supply	0.06	0.13	0.09	0.11	0.14	0.11±0.03
Agriculture drainage water supply	0.47	0.62	0.71	0.35	0.52	0.53±0.14
Irrigated ponds water	0.12	0.18	0.04	0.18	0.19	0.14±0.06
Agriculture drainage ponds water	0.50	0.29	0.58	0.34	0.56	0.45±0.13
NO_2 (mg/l)						
Irrigated water supply	0.12	0.20	0.17	0.15	0.13	0.15±0.03
Agriculture drainage water supply	0.31	0.21	0.41	0.22	0.29	0.29±0.08
Irrigated ponds water	0.16	0.32	0.22	0.11	0.14	0.19±0.08
Agriculture drainage ponds water	0.42	0.57	0.64	0.66	0.26	0.51±0.17
NO_3 (mg/l)						
Irrigated water supply	1.40	1.50	1.90	1.20	1.30	1.46±0.27
Agriculture drainage water supply	1.60	4.40	3.90	4.30	3.90	3.62±1.15
Irrigated ponds water	1.50	1.80	1.20	2.10	1.10	1.54±0.42
Agriculture drainage ponds water	1.90	1.60	1.40	2.70	2.00	1.92±0.50

**** Monthly average (MA) ± standard deviation (SD)***

The higher monthly average of dissolved oxygen were (6.78±0.82 and 6.66±0.80 mg/l) in both irrigated water supply and irrigated ponds water, respectively, while lowest values of DO (5.20±0.95 and 6.24±0.42 mg/l) were recorded in agriculture drainage water supply and agriculture drainage ponds water. The obtained results indicated that, DO was suitable for aquaculture, and this agree with (Boyd, 1990 Abdel-Tawwab, *et al*., 2007 and Ali, 2007; El-Nemaki, *et al*., 2008). The higher value of dissolved oxygen in water may be due to the increase of photosynthetic process as a results of the presence of great amounts of phytoplankton (El-Nemaki, *et al*., 2008).

Generally the levels of ammonia in water ponds remained below levels (1 mg/l to 2 mg/l) which would cause chronic toxicity problems for fish species and it depends on pH value, where at higher pH, free toxic ammonia is released to critical levels. Tilapia fish is more tolerant to elevated levels of ammonia than more other sensitive species, while some tilapia have been shown to acclimate to higher levels of ammonia after chronic exposure to low levels (Barry and Robert, 1979; Boyd, 1990 and Johnson, 1986). Agriculture drainage water supply and ponds water showed the higher monthly values of ammonia which recorded (0.53±0.14 and 0.45±0.13 mg/l), respectively. The lower monthly values of ammonia (0.11±0.03 and 0.14±0.06 mg/l) were recorded in irrigated water supply and irrigated ponds water, respectively. Our results agree with (El-Nemaki, *et al*., 2008 and Ghozlan, *et al*., 2017) whom mention that, the fluctuations of ammonia reached the highest values of 0.13 mg/l during August.

The lowest monthly values of nitrite (0.15±0.03 and 0.19±0.08 mg/l) were recorded in irrigated water supply and irrigated ponds water, respectively, while both of agriculture drainage ponds water and agriculture drainage water supply showed the highest monthly values of nitrite which recorded (0.51±0.17 and 0.29±0.08 mg/l), respectively. The lowest monthly values of nitrate (1.46±0.27 and 1.54±0.42 mg/l) were recorded in irrigated water supply and irrigated ponds water, respectively, while both of agriculture drainage ponds water and agriculture drainage water supply showed the highest monthly values of nitrate which recorded (3.62±1.15 and 1.92±0.50 mg/l), respectively. The higher levels of nitrate in agriculture drainage ponds water may be due to the higher values of nitrate which found in agriculture drainage water in comparison of irrigation ponds water, and this led to increase the values of ammonia which nitrified to nitrate due the high values of Do (Boyd, 1990, Gross *et al*., 2000 and El-Nemaki, *et al*., 2008).

Heavy metals concentrations of water

Generally, agriculture drainage water ponds and supply showed the higher monthly average values of Fe (395.20±44.26 and 323.20±42.77 µg/l), Cu (35.70±15.61 and 32.56±6.88 µg/l), Zn (104.60±32.16 and 60.02±17.24 µg/l) and Cd (1.40±0.38 and 1.04±0.51 µg/l), respectively, while irrigated ponds water and irrigated water supply recorded the lowest monthly average values of Fe (131.60±9.15 and 192.20±44.13 µg/l), Cu (14.32±2.10 and 15.74±4.14 µg/l), Zn (35.60±9.39 and 36.86±12.90 µg/l) and Cd (0.06±0.01 and 0.09±0.06 µg/l), respectively. On the other hand, the most heavy metals reached to its maximum values during April and July (Table 3). The obtained results indicated that, higher heavy metals levels were observed in agriculture drainage water compared with irrigated water. These results agree with (Saeed, 2000 and El-Nemaki, *et al*., 2008) whom stated that, usually agriculture drainage water contains widely heavy metals levels than irrigation water. The results illustrated that, heavy metals were not exceeded the maximum permissible levels which reported by (ECS, 1994 and USEPA, 2006) whom stated that, the maximum permissible levels of heavy metals in water as follows: Fe (1 mg/l), Cu (1 and 0.013 mg/l), Zn (5 and 0.12 mg/l), Cd (0.01 and 0.0025 mg/l) and Pb (0.05 and 0.0025 mg/l), respectively.

Table 3: Heavy metals concentrations (µg/l) of water during experimental period (March-July 2018).

Parameters	March	April	May	June	July	MA±SD*
Fe						
Irrigated water supply	115.00	198.00	219.00	208.00	221.00	192.20±44.13
Agriculture drainage water supply	322.00	432.00	412.00	423.00	387.00	395.20±44.26
Irrigated ponds water	134.00	141.00	139.00	121.00	123.00	131.60±9.15
Agriculture drainage ponds water	298.00	342.00	312.00	277.00	387.00	323.20±42.77
Cu						
Irrigated water supply	13.60	17.40	12.40	12.70	15.50	14.32±2.10
Agriculture drainage water supply	23.70	41.10	27.90	36.40	33.70	32.56±6.88
Irrigated ponds water	13.80	21.50	18.70	12.30	12.40	15.74±4.14
Agriculture drainage ponds water	25.80	16.80	56.60	34.60	44.70	35.70±15.61
Zn						
Irrigated water supply	44.20	21.30	32.90	43.80	35.80	35.60±9.39
Agriculture drainage water supply	96.00	64.00	143.00	131.00	89.00	104.60±32.16
Irrigated ponds water	54.50	44.60	31.10	21.20	32.90	36.86±12.90
Agriculture drainage ponds water	54.70	87.90	43.80	49.80	63.90	60.02±17.24
Pb						
Irrigated water supply	11.40	11.60	16.60	21.60	31.80	18.60±8.49
Agriculture drainage water supply	22.80	39.70	21.50	28.50	32.70	29.04±7.47
Irrigated ponds water	16.60	17.50	19.90	12.30	14.50	16.16±2.90
Agriculture drainage ponds water	16.70	13.70	21.70	15.50	12.20	15.96±3.64
Cd						
Irrigated water supply	0.02	0.09	0.12	0.06	0.17	0.09±0.06
Agriculture drainage water supply	1.90	1.20	0.90	1.60	1.40	1.40±0.38
Irrigated ponds water	0.08	0.05	0.06	0.04	0.06	0.06±0.01
Agriculture drainage ponds water	0.60	0.60	1.30	0.90	1.80	1.04±0.51

**** Monthly average (MA) ± standard deviation (SD)***

Biochemical composition of fish gonad

The mean values (±SD) of protein, cholesterol, carbohydrates and glycogen of both fresh water ponds fish and agriculture drainage ponds fish were (2.26±0.39 and

1.90±0.38 mg/g), (346.67±132.46 and 456±88.26 mg/g), (1.35±0.37 and 1.29±0.92 mg/g) and (1.30±0.61 and 1.91±0.18 mg/g), respectively (Table 4). Gonadosomatic index is the ratio of the fish gonad weight to body weight and it is particularly helpful in identifying days and seasons of spawning, as the testes of gravid fish swiftly increase in size just prior to breeding season and this index is helpful for better management of freshwater fisheries and prevention of fish capture in breeding season to conserve the diversity of fish (Sreevalli and Sudha, 2012). GSI index of Nile tilapia gonad during experimental period (March-July 2018) are represented in (Table 5).

Table 4: Biochemical composition of Nile tilapia fish gonad (Mean ± SD)

Water resources	**Protein (mg/g)**	**Cholesterol (mg/g)**	**Carbohydrates (mg/g)**	**Glycogen (mg/g)**
Fresh water pond	2.26±0.39*	346.67±132.46	1.35±0.37	1.30±0.61
Drainage water pond	1.90±0.38	456±88.26	1.29±0.92	1.91±0.18

***** *Standard deviation***

Table 5: Gonadsomatic index of Nile tilapia fish gonad during experimental period (March-July 2018).

Water resources	**March**	**April**	**May**	**June**	**July**	**(MA±SD*)**
Fresh water pond	2.61	4.10	4.80	5.82	5.12	4.49±1.22
Drainage water pond	2.11	2.80	4.21	4.60	4.22	3.59±1.07

Monthly average± Standard deviation

The mean values of gonadsomatic index of Nile tilapia fish gonad of both freshwater pond and drainage water pond were (4.49±1.22 and 3.59±1.07), respectively. Similar results were reported by (El-Nemaki, *et al*., 2008) whom mentioned that, GSI index of Nile tilapia was (0.162 ±0.02) grown in agriculture drainage ponds water and this conclusion may be due to perfection of the physical and chemical water quality parameters.

Relationship between physicochemical parameters and heavy metals levels

Correlation coefficient matrix was determined to explain the relationship between various physicochemical analysis and heavy metal levels of different sources of water. Different noticeable significant correlations were reported between different quantitative variables and it was presented in (Table 6).

Table 6: Correlation coefficient matrix between physicochemical parameters and heavy metals levels of different water resources

	WT	TDS	TSS	pH	DO	NH_3	NO_2	NO_3	Fe	Cu	Zn	Pb	Cd
WT	1												
TDS	-0.413	1											
TSS	-0.315	0.994	1										
pH	-0.215	0.766	0.746	1									
DO	0.994	-0.493	-0.396	-0.315	1								
NH_3	-0.840	0.838	0.773	0.619	-0.887	1							
NO_2	-0.256	0.985	0.998	0.745	-0.340	0.734	1						
NO_3	-0.996	0.380	0.277	0.244	-0.992	0.823	0.219	1					
Fe	-0.839	0.745	0.666	0.710	-0.892	0.960	0.624	0.849	1				
Cu	-0.666	0.953	0.913	0.727	-0.733	0.964	0.887	0.643	0.901	1			
Zn	-0.987	0.519	0.423	0.371	-0.998	0.901	0.367	0.987	0.917	0.754	1		
Pb	-0.904	0.068	-0.044	0.111	-0.884	0.594	-0.104	0.935	0.697	0.366	0.879	1	
Cd	-0.865	0.797	0.724	0.631	-0.911	0.995	0.682	0.857	0.982	0.942	0.928	0.657	1

Water temperature was negatively correlated with all physicochemical parameters and heavy metals except dissolved oxygen showed positive correlation (r=0.994). On the same way, dissolved oxygen showed negative correlation with all physicochemical parameters and heavy metals.

CONCLUSION

Physical, chemical and heavy metal levels of different water resources of two fish ponds were differed significantly but not exceed the permissible limits, so complete analysis of water and fish before and on a periodical basis during fish growing seasons must be performed continuously to assure good quality of water and fish production, furthermore, the levels of pollutants and GSI must be continuously monitored in this important fish farms to improve the quality of the produced fish species.

REFERENCES

Abdel-Tawwab, M.; Abdelghany, A. E. and Ahmad, M. H. (2007). Effect of diet supplementation on water quality, phytoplankton community structure, and the growth of Nile tilapia, *Oreochromis niloticus* (L.), common carp *Cyprinus carpio* L., and silver carp, *Hypophthalmichthys molitrix* V. poly-cultured in fertilized earthen ponds. J. Appl. Aquac., 19. 1: 1-24.

Ali, A. N. (2007). Ecological study on some water characteristics used in fish farms and their relation to fish productivity. Ph. D. Thesis. Al-Azhar Unive. Fac Sci. Chemistry dept. Egypt.

Al-Kenawy, D. A. and Aly, N. A. F. (2015). Levels of some heavy metals in muscles and liver of freshwater farmed fish at abbassa. Abbassa Int. J. Aqua., 8 (1) 20-35.

AOAC (1990). Association of Official Analytical Chemists. Official Methods of Analysis. 13th Ed. Washington DC, USA.

APHA (American Public Health Association), (1998). Standard Methods for the Examination of Water and Wastewater. 20th Edition. APHA, Washington, D.C.

Bailey, N. T. (1981). Statistical Methods in Biology. 2nd ed. Biological Science Texts.

Barbara, J. and Malgorzata, W. (2006). The metal uptake and accumulation in fish living in polluted waters. Soil and Water Pollution Monitoring Protection and Remediation, 69: 107-114.

Barry, D.R. and Robert, R.S. (1979). Acclimation to Ammonia by Tilapia aurea. Transactions of the American Fisheries Society 108 (4): 383-388.

Boyd, C. E. (1990). Water Quality in ponds for aquaculture. Agriculture Experiment Station, Auburn Univ., Alabama, U.S.A: 482.

Boyd, C.E. and Tucker, C.S. (1992). Water Quality and Pond Soil Analyses for Aquaculture. Alabama Agricultural Experiment Station, Auburn University, Alabama, pp.183.

Broussard, M.J.R. (1985). The basic biology of tilapia. Pioc. Texas Fish Farming. Conf, Texas A and M Univrsity, Collage Station, USA, pp. 0402.

Dubois, M.; Gilles, K.A.; Hamilton, J.K.; Rebers, P.A. and Smity, F. (1956). Colorimetric method for determination of sugars and related substances. Analytical Chemistry, 28:350-356.

ECDG, 2002. European Commission DG ENV. E3 Project ENV. E.3/ETU/0058. Heavy Metals in Waste, Final Report.

Egyptian Chemical Standards (ECS), (1994). Protection of the Nile River and Water Stream from pollution, Ministry of Irrigation, Cairo, Egypt, Law No 4.

El-Nemaki, F.A.; Ali, N.A.; Zeinhom, M.M. and Radwan, O.A. (2008). Impacts of different water resources on the ecological parameters and the quality of tilapia production at El-Abbassa fish farms in Egypt. 8th International Symposium on Tilapia in Aquaculture, 491-512.

Emara, M. M.; Rabie, S.; Farag, A.; Dawah, A. and Mohammad, F. (2015). Assessment of Heavy Metals Concentration in Water and Edible Tissues of Nile Tilapia (*Oreochromis niloticus*) from two Fish Farms Irrigated with Different Water Sources, Egypt. Int. J. Environ., 4 (1): 108-115.

Ghannam, H. E.; Talab, A. S.; Gaber S. E. and Jahin, H. S. (2014). Assessment of heavy metals distribution in some freshwater fish organs using inductively coupled plasma optical emission spectrometry (ICP-OES). Eco. Env. Cons. 20 (3): 859-870.

Ghozlan, A.; Zaki, M.; Gaber, M. and Nour, A. (2017). Effect of Different Water Sources on Survival Rate (%) Growth Performance, Feed Utilization, Fish Yield, and Economic Evaluation on Nile Tilapia (*Oreochromis niloticus*) Monosex Reared in Earthen Ponds. Oceanogr Fish. J. 4(4): 1-7.

Gross, A.; Boyd, C. E. and Wood, C. W. (2000). Nitrogen transformations and balance in channel catfish ponds. Aquac. Eng. 24: 1-14.

Hute, M. (1972). Textbook of fish culture breeding and cultivation of fish. Published by Edition Ch. De, Wyngaert, Brussels, 1970. Fertilization and season in two Central American Countries. Aquaculture 90: 279.

Johnson, S.K. (1986). Ground water: Its quality characteristics aquaculture. Proc. Texas fish farming conf., Texas A&M University, USA.

Lowry, O. H.; Rosebrough, N. J.; Farr, A. L. and Randall, R. J. (1951). Protein measurement with the Folin phenol reagent. J Biol Chem. 193: 265-275.

Matagi, S. V.; Swai, D. and Mugabe, R. (1998). A review of heavy metal removal mechanisms in wetlands. Afr. J. Trop. Hydrobiol. Fish., 8: 23-35.

Padmavathi, P. and Prasad, M. K. D. (2007). Studies on algal bloom disasters in carp culture ponds. Braz. J. Morphol. Sci, 24(2): 32-43. Pesticide manual (2005): Version 3-1, thirteenth edition.

Pulatsu, S.; Rad, F.; Koksal, G.; Aydm, F.; Benli, A. C. K. and Topcu, A. (2004). The Impact of Rainbow Trout Farm Effluents on Water Quality of Karasu Stream, Turkey. Turkish J. fisheries and aquatic Sci. 4: 09-15.

Saeed, M. S. (2000). A study on factors affecting fish production from certain fish farms in the delta. M. Sc. Thesis. Ins. Environmental studies and Research. Ain Shams Univ. Egypt.

Siddiqui, A. Q.; Howlader, M. S. and Adam, A. A. (1988). Effects of dietary protein levels on growth, feed conversion and protein utilization in fry and young Nile tilapia, *Oreochromis niloticus*. Aquacult. Mag., 70(1): 63-73.

Simon, L.; Eren, T. and Jeanne, N. (2011). Freshwater conservation planning: the case for systematic approaches. Freshwater Biol., 56 (1) 6-20.

Soltan M.; Hassaan, M.; Abaas, F. and Khattaby, A. (2016). Agricultural Drainage Water as a Source of Water for Fish Farming in Egypt. Ecol. Evol.. Biol. 1(3): 68-75.

Sperry, W.M. and Webb, M. (1950). A revision of the Schoennerimer sperry method for cholesterol determination. J. Biol. Chem., 187:97.

Sreevalli, N. and Sudha, H. R. (2014). Total protein, glycogen and cholesterol content in the ovary and liver during post spawning and resting season of Mystus vittatus (Bloch). Current Biotica 7(4): 321-325.

Sreevalli, N. and Sudha, H.R. (2012). Seasonal Variation and Effect of Salinity on the Total Protein, Glycogen and Cholesterol Content in the Testes of *Mystus vittatus* (Bloch.).Current Biotica, 6(2): 227-236.

USEPA, (2006). National Recommended Water Quality Criteria. United States Environmental Protection Agency. Office of Water, Office of Science and Technology.

Wannigama, N.D.; Weerakoon, D.E.M. and Muthukumarana, G. (1985). Cage culture of *Sarotherodon niloticus* in Sri Lanka: effect of stocking density and dietary crude protein levels on growth, in Finfish Nutrition in Asia, Methodological Approaches to Research and Development, Cho, Y.; Cowey, C.B. and Watanabe, T., Eds., Ottawa, Ont., IDRC-233e, 1985, 113.

WHO (1992). Cadmium. Environmental Health Criteria, vol. 134. Geneva: World Health Organization.

ARABIC SUMMARY

تأثير مصادر المياه المختلفة على الخصائص الفيزيائية والكيميائية ومستوى العناصر الثقيلة فى مزارع أسماك العباسة بمحافظة الشرقية بمصر

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يهدف البحث إلى تقدير الخصائص الفيزيائية والكيميائية ومستوى العناصر الثقيلة فى مياه مزرعتين مختلفتين فى مصدر المياه فى مزارع أسماك العباسة بمحافظة الشرقية بمصر وذلك لمدة خمسة أشهر (من مارس-يوليو ٢٠١٨) حيث أن المزرعة الأولى تستخدم المياه العذبة من ترعة الإسماعيلية المتفرعة من نهر النيل، بينما تستخدم المزرعة الثانية مياه الصرف الزراعى. تم إجراء التحليلات الفيزيائية والكيميائية ومستوى العناصر الثقيلة فى عينات المياه شهريا، وكذلك دليل الأعضاء التناسلية فى أسماك البلطى النيلى شهريا. كما تم تقدير البروتين والكوليسترول والكربوهيدرات والجليكوجين فى مبايض أسماك البلطى النيلى مرة واحدة فقط فى نهاية التجربة.

أظهرت النتائج وجود إختلاف معنوى فى الخصائص الفيزيائية والكيميائية والعناصر الثقيلة لموارد المياه المختلفة في حوضى الأسماك بمزارع أسماك العباسة ولكنها لم تتجاوز الحدود القصوى المسموح بها ، لذلك فإن تحليل جودة مياه الأحواض وأنواع الأسماك والأعلاف السمكية خلال موسم التكاثر يجب أن يتم بشكل مستمر وبدقة عالية بما يتوافق مع المواصفات القياسية المحلية والدولية لضمان نجاح التربية والحصول على أعلى إنتاج من الأسماك ، وعلاوة على ذلك ، يجب مراقبة مستويات الملوثات بشكل مستمر في هذه المزارع السمكية الهامة لتحسين جودة أنواع الأسماك المنتجة.