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HYGIENIC WATER QUALITY IN FRESH WATER AQUACULTURES IN ASSIUT AND EL-MINIA GOVERNORATES

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ABSTRACT

Water is one of essential compounds for all forms of plants and animals. It is the most effective dissolving agent, and adsorbs or suspends many different compounds. Water quality in fish pond is influenced by pond management practices such as fertilization strategy and supplemental feeding. Three hundred and forty water samples were collected from five aquacultures in Assiut and Al-Minia Governorates in winter and summer seasons. Twenty samples from each aquaculture as well as 20 samples from Bahr-Yousef were examined. The samples subjected to an estimation of some water quality parameters (water temperature, pH, total hardness, chloride, total dissolved solids, calcium ions concentration and electrical conductivity). The results revealed that in open system, closed system, Bahr-Yousef in winter and summer seasons, respectively as the following: Temperature (17.8, 18.5-19.6, 18.8) & (29, 28-28.3, 29.2); pH (8, 7.6-8.3, 7.7) & (8, 7.9-8.7, 8); chloride (mg/l)(16, 16.8-317, 20.6) & (12, 19-283.1, 13); total dissolved solids (mg/l)(237, 217-1341.1, 181.6) & (158, 208.6-1146.7, 191.4); total hardness (mg/l)(124, 118-457.3, 114) & (78, 104-402.7, 82.4); calcium (95.6, 99.4-417.7, 97) & (95.6, 84.2-354.7, 66); electric conductivity (µs/cm) (0.4, 0.3-2.1, 0.3) and (0.3,0.3-1.8,0.3). We can conclude that water quality parameters showed significant positive correlations with each other except for temperature which showed no significance with any of the estimated parameters.

INTRODUCTION

Multiple factors including season, physical and chemical properties of water play a significant role in metal accumulation in fish (Hayat *et al*., 2007). The aquatic environment is considered the main factor controlling the state of health and disease in both cultured and wild fish (Samir & Shaker, 2008). Monitoring of water quality in cultured fish operations is important in protecting both fish and human health (Indah *et al*., 2008).

American Public Health Association (APHA, 2005) found that temperature was a critical water quality parameter, since it directly influences the amount of dissolved oxygen that was available to aquatic organisms. Bujar *et al.* (2008) concluded that water temperature was an important physical parameter to aquatic ecosystems as not only affect on quality of the water but also deports as catalyst, tappet or activist, stimulant, controller or as killer of life for some aquatic organisms. Shuhaimi-Othman *et al*. (2009) approved that water physical-chemical parameters such as temperature and pH have significant correlation with metals concentration in the water. Osman & Werner (2010) reported that pH is a measure of hydrogen ions

concentration in the water which indicates the acidity or alkalinity of that water. Natural fresh waters have a pH as 6 and 8. The pH of the water was important because it affects the solubility and availability of nutrients, and how they can be utilized by aquatic organisms.

Total Water hardness (TH) and pH are of key importance in the bioaccumulation of heavy metals in freshwater fish and other aquatic organisms as accumulation of heavy metals in fish tend to be increased as these parameters decreased (Arellano *et al*., 2000 & Adhikari *et al*., 2006). Phyllis *et al.* (2007) showed that Total Dissolved Solids (TDS) causing toxicity through increasing in salinity, changes in the ionic composition of the water and toxicity of individual ions. Increases in salinity causes shifts in biotic communities, limit biodiversity, exclude less-tolerant species and cause acute or chronic effects at specific life stages.

Yalcin & Sevinc (1993) recorded that chloride ions was an indicator of pollution and 20 mg/l was accepted as the beginning value of pollution in natural waters. Amaal (2005) showed that the low chloride values were recorded in hot period where the high values were recorded in cold season (16.07-29.54 mg/l in River Nile). They added that chloride concentrations possessed a good positive relationship with most anions and cations which evaluated in the examined water samples. Bujar *et al.* (2008) showed that chlorides have constituted the almost of anions of natural water which may come as pollution cross sanitary and industrial waters.

Metal uptake and toxicity in freshwater fish are influenced by calcium concentration in addition to other factors as pH and alkalinity of the water (Alabaster & Lioyd, 1980). Pascoe *et al.* (1986) approved that low Ca concentration increased permeability and toxicity of cadmium to rainbow trout. Spry & Wiener (1991) found that Ca levels in water affect heavy metals uptake and accumulation, and low Ca in water increases the permeability of biological membranes such as gills. Amaal (2005) found that Ca concentration in River Nile was low in the hot season as 20.26 to 31.17 mg/l and high in the cold seasons as 26.05 to 36.07 mg/l. This may be attributed to the decrease in the solubility of CaCO3 as the temperature increase. This was achieved by a negative correlation existed between calcium and water temperature during autumn and summer seasons. Adam *et al.* (2011) reported that the physicochemical factors influencing the bioavailability of manganese to fish and invertebrates were calcium, magnesium and pH.

Spry & Wiener (1991) confirmed that electrical conductivity (EC) is closely related to Ca content of water, so in low conductivity waters, heavy metals are more easily incorporated into fish via respiration than in high conductivity waters. They attributed that to Ca ions, where water with low Ca content increases the permeability of gills. Ravindrak *et al*. (2003) found that Delhi downstream was polluted as indicated by high total hardness, sulphates, electrical conductivity and TDS. Bujar *et al*. (2008) defined conductivity of water as it expresses the capacity of aqua system to conduct the current. This depended on the presence of ions, their concentration and water temperature. So the aim of this study is to investigate the hygienic quality of water Tilapia fish aquacultures in Assiut and Al-Minia governorates.

MATERIALS AND METHODS

Area of Study: (1) **Assiut Governorate [Two Tilapia fish aquacultures were subjected to the examination. The first in El-Waledyeah region close to an electric power station and the second**

found in the petroleum company. (2) Al-Minia Governorate [Three aquacultures are found in Samalout city, El-Saleba village where they all receive their water supply from Bahr-Yousef canal. Bahr-Yousef is a branch from Al-Ibrahemiea canal which is a direct branch from the River Nile].

I- Materials

Water Samples

One hundred and twenty water samples were collected from the five aquacultures in Assiut and Al-Minia Governorates in winter and summer seasons. Twenty water samples from each aquaculture as well as 20 samples were collected from Bahr-Yousef which is the water source supply of the examined fish farms at Al-Minia Governorate. Each water sample was collected at 20 cm depth in 1 liter plastic bottle previously soaked over a night in 5% Nitric acid and rinsed with de-ionized water before use (Laxen & Harrison 1981). For representative water samples collection, each fish farm was imaginary divided into 10 equal sites where the plastic bottles were used for water collection from each site. Plastic bottles were directly immersed into water stream at the sites near to the farm edges but in case the sampling points far from direct approach boat was used for reaching theses points. Collected water samples were named, labeled, refrigerated, and transferred to the laboratory for further analysis.

II- Methods

[A] Estimation of water parameters:

1- Water temperature was estimated at the same time of sampling directly in the fish farm by using Chemical thermometer 25 cm long with a range from 0-50 °C.

2- Water pH by using pH meter Engineered system Design Model 60.

3- Chloride by using ION Chromatography Dionex. DX 500.

4- Ca ions level estimated by Computerized Spectro-photometer Jasco V. 630.

5- TDS estimated by titremetric method.

6- EC by Conductivity meter/pH meter (HI 9835- Italy).

7- TH by Lovibond Microprocessor Multidirect Photometer.

Total dissolved Solids, electrical conductivity, chloride, and calcium concentrations were estimated in National Research Center, Consulting and Analysis unit-Domain of waste water and Environmental Studies, Dokki-Cairo, Egypt

[B] Statistical analysis

Data entry and data analysis were done using SPSS version 16 (Statistical Package for Social Science). Data were presented as, mean and standard error. Mann-Whitney test was used to compare quantitative variables between groups. Spearman correlation wad done to measure correlation between quantitative variables. P-value considered statistically significant when $P < 0.05$ (Snedecor *et al*., 1989).

Table 1: **Water quality parameters in examined sites in Assiut and Al-Minia governorates in winter and summer seasons (Mean ± SE).**

Seasons	Water Parameters	Assiut		Al-Minia	
		Open (Farm 4)	**Closed (Farm 5)**	**Closed (Farm 1.2.3)**	**Bahr Yousef (Source)**
Winter	Temp	17.8 ± 0.1	19.6 ± 0.3	18.5 ± 0.3	18.8 ± 0.2
	pH	8.0 ± 0.1	7.6 ± 0.1	8.3 ± 0.1	7.7 ± 0.1
	Cl	16.0 ± 0.6	16.8 ± 0.6	317.0 ± 39.4	20.6 ± 2.6
	TDS	237.0 ± 2.4	217.2± 11.8	1341.1 ± 129.1	181.6 ± 5.4
	TH	124.0 ± 5.4	118.0 ± 7.7	457.3 ± 36.9	114.0 ± 13.6
	Ca	95.6 ± 3.3	99.4 ± 6.0	417.7 ± 35.3	97.0 ± 13.1
	EC	0.4 ± 0.0	0.3 ± 0.0	2.1 ± 0.2	0.3 ± 0.0
Summer	Temp	29.0 ± 0.3	28.0 ± 0.2	28.3 ± 0.4	29.2 ± 0.5
	pH	8.0 ± 0.0	7.9 ± 0.1	8.7 ± 0.1	8.0 ± 0.0
	Cl	12.0 ± 1.7	19.0 ± 2.2	283.1 ± 40.7	13.0 ± 1.3
	TDS	158.0 ± 24.3	208.6 ± 2.9	1146.7 ± 118.2	191.4 ± 5.3
	TH	78.0 ± 8.5	104.0 ± 7.8	402.7 ± 34.5	82.4 ± 13.2
	Ca	59.6 ± 7.5	84.2 ± 6.7	354.7 ± 32.4	66.0 ± 11.0
	EC	0.3 ± 0.0	0.3 ± 0.0	1.8 ± 0.2	0.3 ± 0.0

Temp = Temperature (˚C), TH= Total hardness (mg/l), TDS= Total Dissolved Solids (mg/l) Cl = Chloride mg/l & Ca= Calcium ions (mg/l), EC= Electrical Conductivity (µs/cm)

Table 2: **Water quality parameters in different fish farms in winter and summer (mean ± SE).**

Season		Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Bahr Yousef (Source)
Winter	**Temp**	**19.0±0.4**	**18.3±0.3**	**18.2±0.2**	**17.8±0.1**	**19.6±0.3**	**18.8±0.2**
	pH	**8.8±0.1**	**8.7±0.1**	**7.4±0.0**	**8.0±0.1**	**7.6±0.1**	**7.7±0.1**
	TH	**488±14**	**680±14**	**204±7**	**124±5**	**118±8**	**114±14**
	TDS	**1525±22**	**2083±9**	**414±11**	**237±3**	**217±12**	**181.6±5.4**
	Cl	**404±3**	**522±4**	**25.0±2.1**	**16.0±0.6**	**16.8±0.6**	**20.6±2.6**
	Ca	**448±13**	**629±14**	**175±9**	**96±3**	**99±6**	**97±13**
	EC	**2.38±0.04**	**3.25±0.01**	**0.65±0.02**	**0.37±0.0**	**0.34±0.02**	**0.28±0.01**
Summer	**Temp**	**28.5±0.1**	**27.5±0.2**	**28.8±0.3**	**29.0±0.3**	**28.0±0.2**	**29.2±0.5**
	pH	**9.2±0.0**	**9.0±0.1**	**8.0±0.1**	**8.0±0.0**	**7.9±0.1**	**8.0±0.0**
	TH	**508±46**	**484±41**	**216±44**	**78±9**	**104±8**	**82±13**
	TDS	**1527±158**	**1375±122**	**537±178**	**158±24**	**208±3**	**191±5**
	Cl	**371.2±75.5**	**364.0±47.5**	**114.0±57.7**	**12.0±1.7**	**19.0±2.2**	**13.0±1.3**
	Ca	**457.6±42.2**	**429.8±38.8**	**175.4±38.4**	**59.6±7.5**	**84.2±6.7**	**66.0±11.0**
	EC	**2.38±0.25**	**2.14±0.19**	**0.84±0.28**	**0.25±0.04**	**0.30±0.00**	**0.30±0.01**

Temp = Temperature (˚C), TH=Total hardness (mg/l), TDS= Total Dissolved Solids (mg/l) Cl = Chloride mg/l & Ca= Calcium ions (mg/l), EC= Electrical Conductivity (µs/cm)

Table 3: **Statistical correlations between different water quality parameters.**

Parameter		TH	Cl	TDS	EC	Ca	pH
Cl	r-value	**0.963**					
	P-value	**0.000***					
TDS	r-value	**0.985**	**0.968**				
	P-value	**0.000***	**0.000***				
EC	r-value	**0.985**	**0.968**	**1.000**			
	P-value	**0.000***	**0.000***	**0.000***			
Ca	r-value	**0.998**	**0.961**	**0.986**	**0.986**		
	P-value	**0.000***	**0.000***	**0.000***	**0.000***		
pH	r-value	**0.748**	**0.752**	**0.761**	**0.761**	**0.744**	
	P-value	**0.000***	**0.000***	**0.000***	**0.000***	**0.000***	
Temp	r-value	-0.099	-0.023	0.055	0.055	-0.114	0.268
	P-value	0.760	0.943	0.865	0.865	0.723	0.400

Fig. 1: **Temperature in different fish farms and Bahr Yousef canal in winter and summer.**

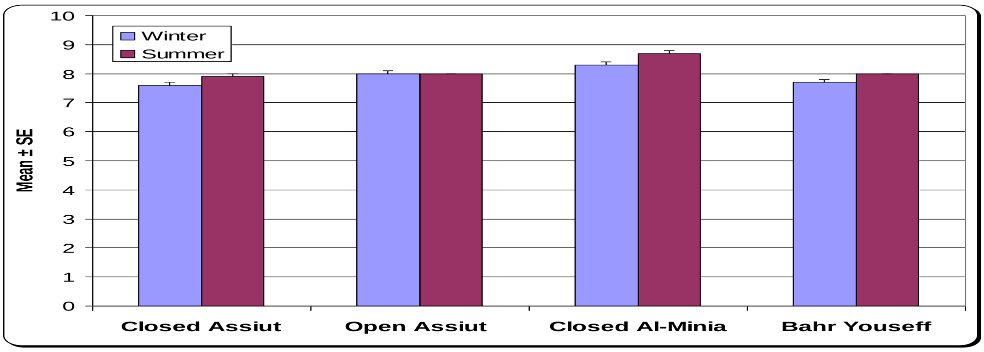

Fig. 2: **pH in fish farms and Bahr Yousef canal in winter and summer (mean ±SE).**

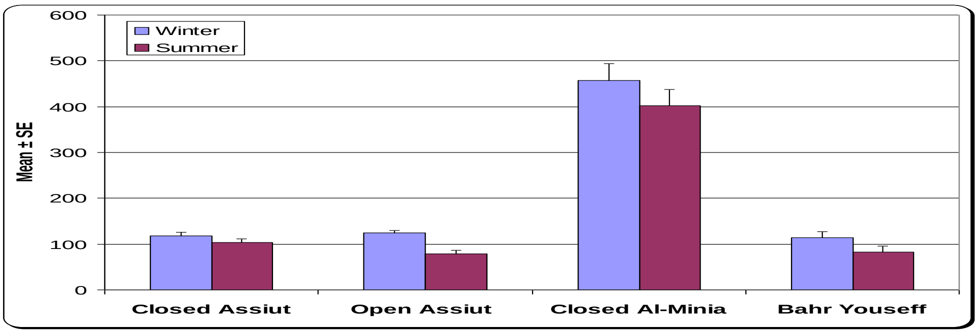

Fig. 3: **Total hardness in fish farms and Bahr Yousef canal in winter and summer**

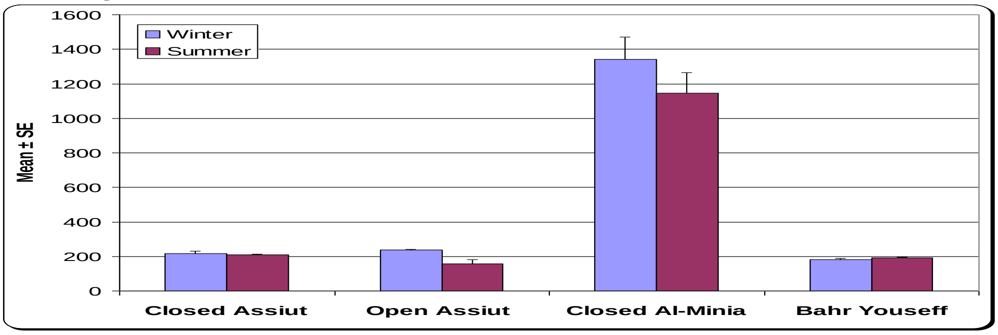

Fig. 4: **TDS level in fish farms and Bahr Yousef in winter and summer**

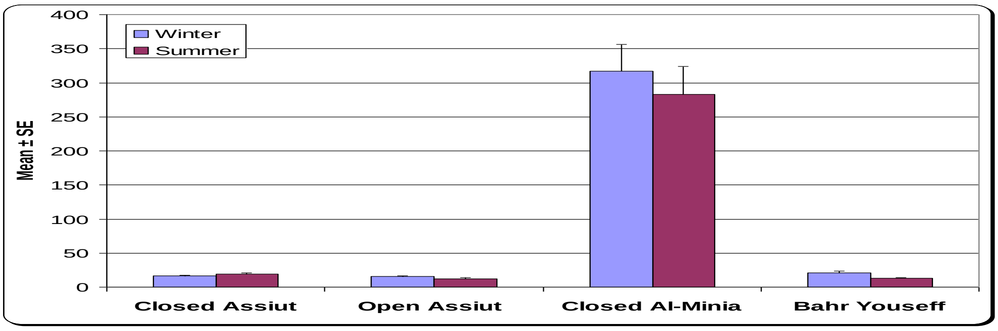

Fig. 5: **Chloride level in fish farms and Bahr Yousef canal in winter and summer.**

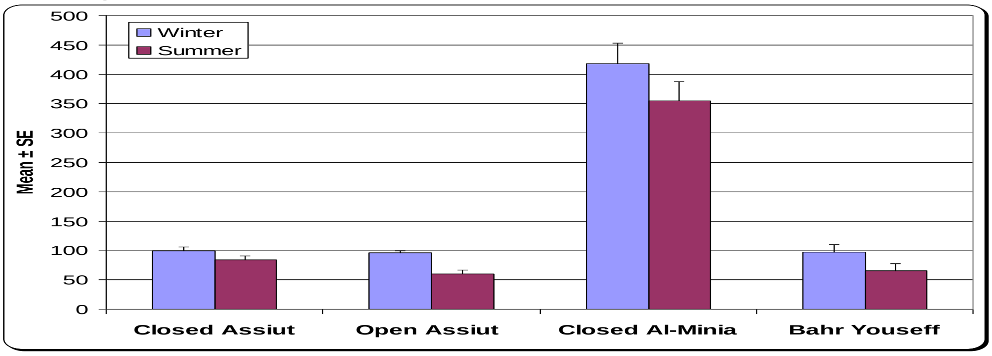

Fig. 6: **Ca concentration in fish farms and Bahr Yousef canal in winter and summer.**

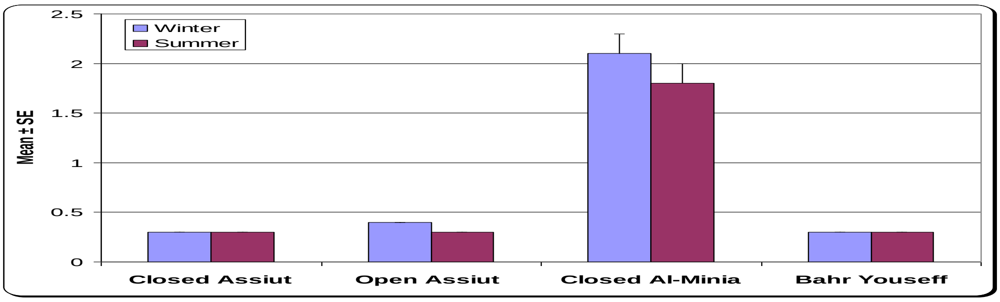

Fig. 7: **Electrical conductivity in fish farms and Bahr Yousef canal in winter and summer.**

DISCUSSION

WATER TEMPERATURE AND PH

Both water temperature and pH recorded higher values in summer season than those recorded in winter season in all examined aquacultures and Bahr-Yousef canal (table 2). Temperature (17.8, 18.5-19.6,18.8) and (29,28-28.3,29.2); pH (8,7.6-8.3,7.7) & (8,7.9-8.7,8) in both in open and closed systems in winter and summer seasons respectively (Table 1). Our estimated values of both temperature and pH were greatly in line with Authman & Abbas (2007). Lower pH in winter may attributed to the decomposition of organic matter while higher summer values could be due to longer photoperiod of the summer which resulting in lowered the amount of CO_2 (Abdel-Moneim, 1991).

Higher pH values recorded in summer could be an important cause of decreasing manganese concentration in summer season and its increased winter values due to increasing the rate of insoluble manganese (Mn) precipitation rates (Pardo et al., 1990 and Facetti *et al*. (1998). Water pH play a role in the probability of either increasing or decreasing metal concentrations in

fish, where lower pH values could affects the bioaccumulation process of metals in fish body by indirect way; through changing solubility of metals compounds or directly; by damaging gills epithelia which become more permeable to metals, on the other hand competitive uptake of hydrogen ions may inhibit some heavy metals absorption (Jezierska & Malgorzata, 2006).

Pillay & Kutty (2005) found that the most suitable pH of water for aquaculture farms was considered to be in the range of 6.7-8.6 and values above or below that level inhibit growth and production depending on the species and environmental conditions. Acid water with pH range of 5.0-5.5 can be harmful to the adults of many species. Moreover, acidity reduces the rate of decomposition of organic matter and inhibits nitrogen fixation and affecting the overall productivity. A pH level of 11 may be lethal to some fish species.

TOTAL HARDNESS (TH)

The results revealed that in open system, closed system, Bahr-Yousef in winter and summer respectively as following (124,118-457.3,114 mg/l) & (78,104-402.7, 82.4 mg/l); Winter season showed higher values of total hardness concentrations than summer season in most examined sites, where fish farms 2,4,5 and Bahr-Yousef canal showed higher values in winter (680.0±14.4, 124.0±5.4, 118.0±7.7 and 114.0±13.6 mg/l) than summer (484.0±40.7, 78.0±8.5, 104±7.8 and 82.4±13.2 mg/l) (table 2).

Higher values of total hardness in winter than summer was in line with Cole *et al.* (1997) as the elevated winter values may result of increased dissolved oxygen concentration with temperature decrease, but the decreased levels of summer may be due to the carbonic acid decrease as the result of precipitation of $CaCO_3$. Elevation of total water hardness in winter season may be attributed to increase concentration of dissolved oxygen which accompany with decrease water temperature, while decreasing total hardness in summer season may be due to deacrease carbonic acid as the result of precipitation of calcium chloride. Our estimated values of water hardness in Assiut city (Fish farm number 4 & 5) which were 124.0±5.4 & 118.0±7.7 & 78.0 ± 8.5 & 104.0 ± 7.8 mg/l in winter and summer season respectively were higher than those recorded by (Osman & Werner, 2010).

Authman & Abbas (2007) found that TH in water samples collected from Qarun Lake in El-Fayoum Provience, Egypt was low during spring (644.3 mg/l) and high in summer 664.3 mg/l. Osman & Werner (2010) showed that TH in the part of the River Nile in Assiut city from three different sites of sampling was 140.36 mg/l. Karthikeyan *et al.* (2007) reported that heavy metal accumulation and toxicity were greatly reduced by increase water hardness.

TOTAL DISSOLVED SOLIDS (TDS)

The results of total dissolved solids revealed that in open system, closed system, Bahr-Yousef in winter and summer respectively as the following (237, 217-1341.1, 181.6 mg/l) and (158, 208.6-1146.7, 191.4 mg/l). Fish farms number 1, 2 and 3 showed the highest mean concentrations in winter and summer seasons, where their mean value of TDS were 1525.6 ± 22.0 & 2083.2 ± 8.9 and 414.4 ± 10.6 mg/l & 1527.6 ± 158.7 & 1375.0 ± 122.1 & 537.6 ± 178.4 mg/l, respectively. Statistical analysis of TDS showed positive significant correlations with almost all examined

water quality parameters (TH, EC, chloride, pH and calcium), this finding was in agreement to great extent with that of Amaal (2005). Yanong (2003) pointed out that high TDS values were estimated during hot period and ranged between 4062 to 5600 mg/l where lower values were recorded during cold period and ranged from 3412-4988 mg/l. Authman & Abbas (2007) found that TDS values that were estimated in water samples collected from Qarun Lake in El-Fayoum Province, Egypt ranged from 9.3 to 27.4 g/l in winter and summer seasons, respectively.

Phyllis *et al.* (2007) showed that TDS cause toxicity through increasing in water salinity, changes in the ionic composition of the water and toxicity of individual ions. Increases in salinity have been shown to cause shifts in biotic communities, limit biodiversity, exclude less-tolerant species and cause acute or chronic effects at specific life stages. They added that regulations require the periodic monitoring of TDS, which was a measurement of inorganic salts, organic matter and other dissolved materials in water. Shuhaimi-Othman *et al.* (2009) approved that TDS is one of the water physical-chemical parameters that has significant correlation ($p<0.05$) with metals concentration in the water. Osman & Werner (2010) found that TDS in the part of the River Nile passed through Assiut city was 227.75 ± 16.297 mg/l. Moreover, Abdel-Rahman (2010) found that the maximum values of TDS in Tilapia fish ponds in Cairo were 7.46±0.59 & 9.38±0.12 g/l in autumn and summer season, respectively.

CHLORIDE (CL)

Cl values (mg/l) in open system, closed system, Bahr-Yousef in winter and summer seasons respectively were (16, 16.8-317, 20.6) & (12, 19-283.1, 13). The highest concentrations were recorded in fish farms numbers 1 and 2 in winter season and farms 1, 2 & 3 in summer seasons, where their values were 404.0±2.7 & 522.0±3.3 mg/l and 371.2±75.5 & 364.0±47.5 and 114.0±57.7 mg/l, respectively. Winter season showed higher Cl values than summer season in most examined fish farms, where fish farm number 1, 2, 4 and Bahr-Yousef canal showed elevated winter values (404.0± 2.7, 522.0±3.3, 16.0± 0.6 & 20.6±2.6 mg/l) than summer ones (371.2±75.5, 364.0±47.5 and 12.0±1.7 and 13.0±1.3 mg/l) respectively. This seasonal finding was in line with Amaal (2005). The values of chloride were lower than those values of Abdel-Rahman (2010) while the results were higher than the finding of Fedel (2002) and Osman & Werner (2010).

Statistical analysis of chloride concentration showed significant positive correlation with all examined water quality parameters (pH, total hardness, total dissolved solids, electrical conductivity, and calcium) (table 2). This finding was in agreement with Amaal (2005)

Authman & Abbas (2007) showed that chloride values were fluctuated in range from 1.76 to 6.67 g/l in water samples collected from Qarun Lake in El-Fayoum Provience, Egypt in winter and summer seasons. Bujar *et al.* (2008) showed that chlorides have constituted the utmost of anions of natural waters which may come as pollution cross sanitary and industrial waters. Abdel-Rahman (2010) studied water quality parameters in tilapia fish ponds in Cairo, he found that the maximum mean values of chloride were 3291.69, 3348.33, 5198.00 & 6967.50 mg/l in autumn, spring, summer and winter seasons, respectively. Osman & Werner (2010) found that

water chloride values in different districts of River Nile in Assiut city from three different sites of sampling was 10.03.

CALCIUM IONS CONCENTRATION (CA^{+2})

Our results revealed

Ca concentration in open system, closed system, Bahr Yousef in winter and summer, respectively as (95.6, 99.4-417.7, 97) & (95.6, 84.2-354.7, 66). Fish farms numbers 1, 2 & 3 showed the highest mean concentrations among the examined sites where they recorded calcium values of 448.0±13.1, 629.8±13.7, 175.2±9.0 & 457.6±42.2, 429.8±38.8 & 175.4±38.4 in winter and summer seasons, respectively. Moreover, Fish farms 2,4,5 and Bahr-Yousef canal showed higher winter values of Ca concentrations (629.8±13.7, 95.6±3.3, 99.4±6.0 and 97.0±13.0 mg/l) than their summer values (429.8±38.8, 59.6±7.5, 84.2±6.7 & 66.0±11.0 mg/l).

Ca concentration in Assiut fish farms 4,5 were higher than that recorded in the part of the River Nile at Assiut city by (Osman and Werner, 2010). The decreased metal uptake and accumulation in fish with increased calcium values is due to the ability of calcium to compete with other heavy metals for binding sites on the gill surface (Pagenkopf, 1983), hence decreasing the possibility of metal uptake and accumulation, similar findings were also approved by (Baldisserotto *et al.*, 2005).

Alabaster & Lioyd (1980) found that metal uptake and toxicity in freshwater fish are largely influenced by Ca concentration in addition to other factors as water pH, and alkalinity of the water. Pascoe *et al*. (1986) approved that low Ca ions increased permeability and toxicity of cadmium to rainbow trout. Spry & Wiener (1991) concluded that Ca levels in water affect heavy metals uptake and accumulation, and low Ca in waters increases the permeability of biological membranes such as gills. Konswa (2007) studied the ecological characters of fresh water fish farms in El-Fayoum depressions. He found that Ca concentration was ranged from 40 to 264 mg/l with mean concentrations of 103, 146, 162, 138 and 97 mg/l in Shalkany, Goda 1, Goda 2, El-Shora and the Drain respectively. Amaal (2005) studied Ca concentration in River Nile, the results indicated that the lowest values of Ca were recorded in the hot season where they ranged from 20.26 to 31.17 mg/l and the highest in the cold seasons and ranged from 26.05 to 36.07 mg/l, they attributed that to the decrease in the solubility of $CaCO_3$ as the temperature increase. This was achieved by a negative correlation existed between calcium and water temperature during autumn and summer seasons. Osman & Werner (2010) recorded that calcium recorded in the part of the River Nile in Assiut city from three different sites of sampling was 29.21±7.062 mg/l. Adam *et al*. (2011) reported that the physicochemical factors influencing the bioavailability of manganese to fish and invertebrates were calcium, magnesium and pH. They assured that, calcium concentrations affect manganese toxicity to fish and invertebrates.

ELECTERICAL CONDUCTIVITY (EC)

The results of Electric Conductivity (µs/cm) revealed that in open system, closed system, Bahr-Yousef in winter and summer as (0.4, 0.3-2.1, 0.3) & (0.3, 0.3-1.8, 0.3) respectively. Fish

farms number 1, 2 showed the highest values of EC in both winter and summer seasons (2.38±0.04 & 3.25±0.01 and 2.38±0.25 & 2.14±0.19 µs/cm) respectively (table 1).

Spry & Wiener (1991) confirmed that EC is closely related to Ca content of water, so in low conductivity waters, heavy metals are more easily incorporated into fish via respiration. They attributed that to Ca ions, where water with low Ca content increases the permeability of gills. Ravindrak *et al.* (2003) found that Delhi downstream was polluted as indicated by high total hardness, sulphates, electrical conductivity and total dissolved solids. Yanong (2003) reported that high values of EC were recorded during hot seasons (spring and summer) 470-8090 µS/cm, while lower values (337-7000) were recorded during cold season (autumn and winter). Abdou (2005) showed that the high EC values were recorded during hot season 470-8090 µmohs/cm, while the lower values (337-6000 µmohs/cm) were recorded during cold seasons in a study of water samples from Abu Zabaal fish ponds. Authman & Abbas (2007) showed that EC in water of Lake Qarun was of higher value during summer (45.30) µmohs/cm, while it was 32.72 µmohs/cm in winter season. Bujar *et al.* (2008) defined conductivity of water as it expresses the capacity of aqua system to conduct the current. This depended on the presence of ions, their concentration and water temperature. How bigger is the conductivity of current, so bigger it will be its pollution. Abdel-Rahman (2010) studied water quality parameters in 6 earthen Tilapia fish aquacultures in El-Fayoum Governorate, he found that the maximum mean values of EC were recorded in hot period where it ranged from 14.90-18.75 µs/cm.

All examined water quality parameters (pH, TH, chloride, TDS and calcium). This finding agreed with Bujar *et al.* (2008). The positive significant correlation between calcium and EC mainly explains that low conductivity water almost exhibited low calcium content which may result in increasing heavy metals accumulation in the fish body, this mainly due to increasing the gills permeability to heavy metals absorption, this according to (Spry & Wiener, 1991).

A striking point of observation is that the fish farm number 2 which recorded the highest mean values of TDS, Cl and Ca concentration recorded also the highest mean values of EC during winter season, while fish farm number 1 showed the highest mean values in three previous mentioned parameters also recorded the highest mean values of EC during summer season, this briefly explains how much the value of electrical conductivity depends on the ionic strength of water TDS, Cl and Ca concentration. This finding agreed with that of Abdel-Rahman (2010).

CONCLUSION

Fish farms subjected to different types and sources of pollution. Lowered water quality parameters are evidences for bad hygienic measures of these farms. (1) Fish farm site: should be chosen quite far from the agricultural lands to avoid the possibilities of getting polluted with different agricultural drainage that mostly heavily saturated with different pollutant especially heavy metals. (2) Fish farm water should be of good quality and avoid using water from known polluted sources, which may increase the possibilities of fish pollution with higher concentration of heavy metals. (3) Managing the water used for the aquacultures is one of the most essential components of managing an aquacultures system. It is essential to monitor water quality

frequently and remove wastes constantly, ensuring that water quality is maintained at a premium conditions that reduces the risks associated with water pollution. (4) Finally: Avoid using fish body parts in preparing fish meal for poultry feeding from known fish sources of high metal concentrations to avoid the possibility of increasing of toxic metals in birds, animal and human bodies.

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الحالة الصحية للمياه في مزارع أسماك المياه العذبة فى محافظتى أسيوط والمنيا

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الملخص :

أجريت الدراسة على خمس مزارع سمكية لأسماك البلطى فى محافظتى أسيوط والمنيا ، مزرعتين بمحافظة أسيوط) وثلاث مزارع فى محافظة المنيا بالأضافة الى ترعة بحر يوسف وهو مصدر المياة لتلك المزارع وذلك لدراسة الحالة الصحية للماء فى تلك المزارع وخضعت عينات المياة لتقييم بعض معايير جودة المياة بها وهى درجة الحرارة، تركيز ايون الهيدروجين ، الكلور، الأملاح الكلية الذائبة، عسر المياة، الكالسيوم، التوصيل الكهربى. كانت الدراسة موسمية فى كل من فصلى الشتاء والصيف، وقد أظهرت النتائج ما يلى: أوضحت الدراسة اختلافات كبيرة فى قيم تلك المقاييس بين الأماكن التى تمت دراستها؛ حيث تراوحت تلك القيم بين فصلى الشتاء والصيف على النحو التالى: كانت درجات الحرارة ما بين ١٧.٨±١. ٠ – ١٩.٦±٣. ٠ & ٢٧.٥±٥. ٠– ٢٩.٢±٢. ٠؛ درجة مئوية؛بينما تراوح تركيز ايون الهيدروجين ما بين ٧.٤± ٠.٠ –٨.٨ ±٠.١ & ٧.٩±٠.١ ± ٩.٢ ±٠.٠؛ وكان عسر المياة يتراوح ما بين ١١.٤±١٣.٦– ٦٨٠.٠±١٤.٠ & ٧٨.٠±٨.٥ – ٥٠٨.٠ ± ٤٥.٧ملليجرام / لتر؛ وتراوح تركيز الأملاح الكلية الذائبة ما بين ١٨١.٦±٥.٤– ٢٠٨٣.٢±٨.٩ & ١٥٨.٠±٢٤.٣ – ١٥٢٧.٦±١٥٨.٧ملليجرام /لتر؛ وتراوح تركيز الكلور ما بين ١٦.٠±٠. ٠٦ & ١٢.٠±١.٧– ٣٧١.٢±٧٥.٥ ملليجرام/لتر؛ وتراوح تركيزايون الكالسيوم ما بين ٩٥.٦±٣.٣– ٦٢٩.٨ ±١٣.٧ & ٥٩.٦±٧.٥– ٤٥٧.٦ ±٤٢.٢ ملليجرام /لتر؛ وكانت قدرة التوصيل الكهربى للمياة تتراوح ما بين ٠.٢٨±٠.٠١– ٣.٢٥ ±٠.٠١ & ٠.٢٥±٠.٠٤– ٢.٣٨±٠.٢٥ ميكرو سيمنس/ سم.