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Study of some Physicochemical Parameters in the Water of El-Bagouria Canal at El-Menoufia Governorate, Egypt

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ABSTRACT
Background: Environmental pollution is one of the most serious problems facing humanity in the 20th century and still require great efforts at all levels. This is especially rivers are the main sources for drinking and irrigation.

Objective: The present study was aimed to investigate some physicochemical parameters in the water at different sites of El-Bagouria Canal, El-Menoufia Governorate during the period of study.

Materials and methods: Water samples were collected seasonally from the four stations during the year and stored for the final examination. Environmental factors and heavy metals concentrations were determined by using specific methods.

Results: Spring showed the highest value of pH and turbidity, while autumn and winter showed the highest levels of electric conductivity, total dissolved solids, and chloride. However, alkalinity and total hardness were peaked during autumn. Statistically, there is strong positive correlation between pH, alkalinity with water temperatures, turbidity, (TDS) and total hardness with pH. The results indicated that the maximum levels of the concentrations of studied heavy metals in water were recorded during the hot season compared to the cold seasons. Correlation coefficient indicated that, a positive correlation between cadmium concentration in the water with lead, plus positive correlation between lead, copper with iron were present.

Conclusion: It could be concluded that increased levels of physicochemical factors and heavy metal concentrations may pose a high risk to aquatic organisms and human health. **So**, the present study shows that precautionary measures must be taken to reduce pollution at the freshwater canals in the future.

Keywords: Physicochemical parameters, Heavy metals, Water, El-Bagouria Canal.

INTRODUCTION

The River Nile travels along Egypt for about 940 km behind the High Dam. At the north area of Cairo (El-Kanater El-Khyria), the River Nile bifurcates into two branches namely Damietta and Rosetta branches and four Rayahs (Canals) namely El-Nassery, El-Behery, El-Menofy and El-Toufeky.

The length of Rosetta branch is about 220 km, and the width varies from 50–200 meters, the depth fluctuates from 1.5– 16 meters. Whereas, length of Damietta branch is about 242 km with average width and depth 200 and 12 meters, respectively.

They are the main sources of drinking and irrigation waters for Nile Delta including, El-Qalubia, El-Menoufia, El-Gharbia, El-Dakahlia and Damietta Governorates [(1)]. The River Nile receives a large quantity of domestic agricultural effluents, mostly untreated waste waters [(1-4)].

El-Menoufia Governorate is one of the central parts for Nile Delta and extends along wide area more than 2500 km^2. The area is bordered to the west by the Rosetta branch and to the east by the Damietta branch. The Governorate consists of eight centers; all of them are cultivated lands and densely populated [(1)].

El-Bagouria Canal is diverting from El-Monofy Rayah at km 21.3, it is 90.0 km long and it serves around 326,000 feddans. The total length of this channel in El-Menoufia Governorate is approximately 35-40 km, which considers a support channel. The selective stations (Fig., 1) included four sites (Shubra Zinji, Kafr Shubra-Beloulah, Sengerg and Shubra Bas).

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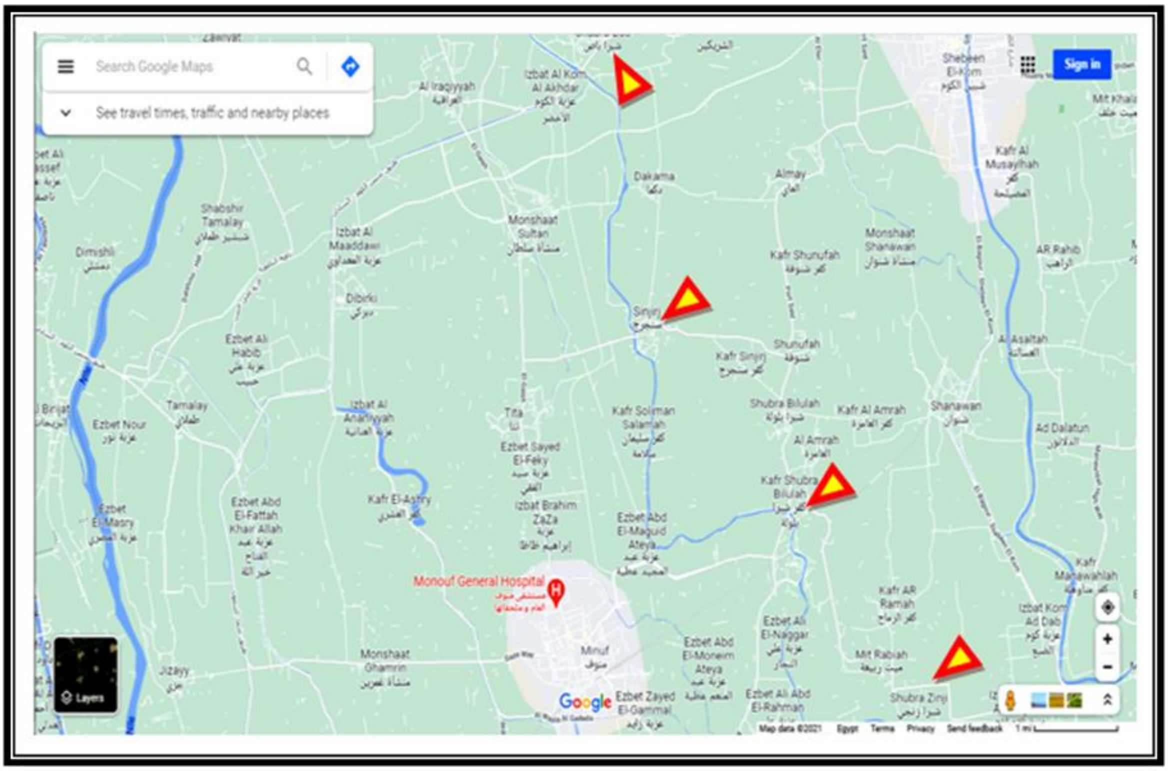

Fig. (1): Map of selective stations at El-Bagouria Canal, El-Menofia Governorate.

Environmental pollution is one of the most serious problems facing humanity in the 20th century and still require great efforts at all levels, nationally and internationally. This is especially true with regard to the pollution of rivers, as they serve as receptors water of urban, rural and industrial waste containing frequently dangerous contaminants in fairly high concentrations [(5)].

Excessive use of slurry and sludge, excessive fertilization, excessive use of manure for irrigation purposes has dangerous effects on plants, animals and human health. In addition, the discharge of liquid or solid waste of different type of contaminants into the geologic environment causes ground water deterioration [(1)].

Domestic and industrial sewage represent major sources of nutrient enrichment to waters of the Nile Delta. Wastewater contributes to the development of eutrophication and the degradation of water quality, often, municipal and rural domestic wastewater is discharged directly. It contributes pathogens, nutrients, trace metals, suspended solids, salts and oxygen-demanding materials [(1,3,6)]. Untreated or poorly treated for wastewaters, heavy metals and other pollutants are released into the Nile Delta canals network and are discharged with sewage and agricultural wastes into the northern delta lakes and associated wetlands [(7)].

This study was intended to assess the effects of certain pollutants on the changes in the water quality of the El-Bagouria Canal through surveillance the seasonal variations of physicochemical parameters including water temperature, pH, turbidity, electrical conductivity, total dissolved solids, chloride, total alkalinity and total hardness. Also, the study designed to detect the effects of selected heavy metals (cadmium, lead, copper, iron, manganese and zinc) in the water on water quality and its direct / indirect harmful stress on organisms and consumers of human.

MATERIALS AND METHODS

• Field investigated:

The investigated area (El-Bagouria Canal) included four stations (Shubra Zinji, Kafr Shubra-Beloulah, Sengerg and Shubra Bas). These stations covered 24 Km, the length between every two stations is 8 Km (Fig., 1).

Ethical approval:

The study was approved by the Ethics Board of Al-Azhar University.

• Water analysis:

- **Collection of water samples:**

Water samples were collected (subsurface about 30 cm) seasonally from the four stations during the period from autumn, 2019 to summer, 2020. A Van Dorn water sampler with capacity of 1.2 litters was used to obtain samples. After collection, water samples were kept in cleaned poly propylene bottles for latter examination; while some of physicochemical properties as (temperature, turbidity, pH and conductivity) were measured in the field during sample collection.

❖ **Environmental factors:**

• Water temperature:

Water temperature was measured during samples collection using WTW instrument model 315i [8].

• Hydrogen ion concentration (pH):

The hydrogen ion concentration (pH) was measured directly after sampling using Model pH meter (WTW 330i) after calibration with standard buffer solutions of pH 4.7 and 10 [9].

- **Turbidity:**

Turbidity of the water was measured during the sampling time in 1 liter of each sample using WTW instrument model Turb.430T [9], after calibration with standard formazin solutions (0.02, 10 and 1000 NTU); results were expressed in nephelometric turbidity units (NTU).

• Electrical conductivity:

It was measured immediately after sampling using the WTW conductivity meter (model 315i) calibrated with a solution of potassium chloride (1413 µS / cm); the results were expressed in µS / cm [8].

• Total dissolved solids (TDS):

According to [10], the conductivity was used to estimate the total dissolved solids (mg / l) in a multiplication sample. Conductivity (in micromhos per centimeter) of an empirical factor which vary from 0.55 to 0. 9, depending on the soluble components of the water and on the temperature of measurement. The factor in the current method is 0.53 who attributed to the calibration of the conductimeter with a solution of 0.01 M KCl. TDS (mg/L) = conductivity × 0.53

• Chloride:

It was determined through argentometric method according to [9].

• Alkalinity:

It was determined as $CaCO_3$/L by titrimetric method according to [11].

• Total hardness:

The total hardness (calcium and magnesium) was determined by EDTA titration method according to [9].

❖ **Determination of heavy metals:**

Concentrations of heavy metals in the water were measured using inductively coupled plasma optical emission spectrophotometer (model 3400 DV, Perkin Elmer, Shelton, USA) according to the standard methods of [12].

Statistically, the results were expressed in tables as mean ± S.D. The data were analyzed using the correlation coefficient for environmental factors and interactions between the concentrations of heavy metals in the water according to [13].

Ethical approval:

The study was approved by the Ethics Board of Al-Azhar University.

RESULTS

I- Physico-chemical parameters of water at the area of study:

In the present study (Table, 1) shows a seasonal variation of many physico-chemical parameters obtained from the four sites of the canal during the period of study.

Water temperatures were measured in the field and showed significant differences among the different seasons. They increased during summer, while winter exhibited the lowest values at most sites. **Water temperature** varied from 17.05±1.23ºC during winter at Sengerg to 30.73±1.37ºC during summer at Shubra Bas area.

Data indicate that, water body showed moderately an alkaline character with **pH** values ranging between 7.62±0.18 during summer at Kafr Shubra-Beloulah and 8.47±0.17 during spring at the same site (Table, 1).

The present study (Table, 1) exhibit the maximum value of water **turbidity** at Sengerg Village during spring (11.34 ± 0.37 NTU) and the minimum value occurred at Shubra Zinji Village during summer (3.46 ± 0.43 NTU).

Results in table (1) revealed that, the highest value of **electric conductivity** was recorded at Shubra Bas Village during winter (434.18 ±2.34 µS/cm) and the lowest value occurred at Kafr Shubra-Beloulah Station during spring (352.26 ± 2.18 µS/cm).

Results indicate that, the maximum values of **total dissolved solids** are varied considerably from season to season, however, the highest value of total dissolved solids was detected at Shubra Bas during autumn, while, the lowest value occurred at the same site during spring; being 229.72 ± 1.81 and 179.58 ± 2.72 mg/L, respectively (Table, 1).

Table (1): Seasonal variations of some physico-chemical parameters (Mean ± S.D) of El-Bagouria Canal water at El-Menoufia Governorate, during the period of study.

Stations	Parameters / Seasons	Water Temp. (ºC)	pH	Turbidity (NTU)	Electric conductivity (µS/cm)	Total dissolved solids (mg/L)	Chloride (mg/L)	Alkalinity (mg/L)	Total hardness (mg/L)
Shubra Zinji	**Autumn**	**21.45 ±2.43**	**7.88 ±0.22**	**6.86 ±1.09**	**416.44 ±2.34**	**224.94 ±2.06**	**31.19 ±1.21**	**154.91 ±1.20**	**154.37 ±1.68**
	Winter	**18.92 ±1.52**	**8.15 ±0.23**	**4.17 ±0.32**	**423.37 ±1.92**	**218.82 ±1.38**	**33.24 ±1.64**	**137.24 ±1.53**	**141.18 ±1.52**
	Spring	**24.00 ±1.14**	**8.38 ±0.26**	**9.41 ±0.54**	**358.55 ±1.35**	**190.82 ±1.08**	**19.92 ±2.51**	**143.26 ±2.42**	**130.40 ±1.22**
	Summer	**29.25 ±2.62**	**7.76 ±0.40**	**3.46 ±0.43**	**371.28 ±1.64**	**197.67 ±1.22**	**21.33 ±1.26**	**146.91 ±1.26**	**136.72 ±1.29**
Kafr Shubra-Beloulah	**Autumn**	**20.90 ±1.27**	**7.92 ±0.47**	**7.42 ±0.74**	**419.50 ±1.41**	**226.42 ±1.51**	**31.00 ±0.59**	**155.08 ±0.57**	**155.65 ±1.87**
	Winter	**17.25 ±1.34**	**8.22 ±0.39**	**5.15 ±1.03**	**430.52 ±2.39**	**215.83 ±2.86**	**34.16 ±1.27**	**136.61 ±1.73**	**139.85 ±1.54**
	Spring	**26.50 ±2.44**	**8.47 ±0.17**	**11.09 ±1.28**	**352.26 ±1.18**	**186.66 ±1.47**	**20.28 ±1.85**	**142.82 ±1.18**	**129.97 ±1.43**
	Summer	**30.10 ±1.61**	**7.62 ±0.18**	**4.69 ±1.96**	**368.39 ±2.86**	**193.51 ±2.14**	**22.30 ±1.40**	**147.06 ±1.51**	**132.15 ±1.44**
Sengerg	**Autumn**	**21.07 ±1.14**	**7.83 ±0.42**	**7.40 ±0.64**	**420.89 ±2.26**	**228.35 ±2.31**	**31.83 ±1.56**	**153.97 ±1.35**	**152.35 ±1.74**
	Winter	**17.05 ±1.23**	**8.10 ±0.36**	**6.30 ±0.58**	**432.53 ±2.81**	**220.37 ±2.18**	**34.17 ±1.38**	**138.71 ±1.53**	**143.48 ±1.52**
	Spring	**23.82 ±1.46**	**8.32 ±0.19**	**11.34 ±0.37**	**360.37 ±2.52**	**184.64 ±2.60**	**18.22 ±2.32**	**144.25 ±2.53**	**128.86 ±1.34**
	Summer	**30.51 ±2.15**	**7.72 ±0.24**	**4.47 ±0.57**	**373.23 ±1.17**	**199.69 ±1.71**	**19.16 ±1.50**	**149.10 ±1.82**	**133.65 ±1.19**
Shubra Bas	**Autumn**	**19.79 ±1.19**	**8.28 ±0.28**	**8.79 ±0.28**	**425.28 ±1.46**	**229.72 ±1.81**	**32.69 ±0.14**	**155.93 ±0.41**	**154.80 ±2.36**
	Winter	**17.92 ±1.72**	**8.09 ±0.13**	**6.83 ±0.58**	**434.18 ±2.34**	**223.08 ±3.14**	**36.16 ±2.32**	**140.16 ±2.64**	**140.27 ±2.58**
	Spring	**24.53 ±1.34**	**8.41 ±0.74**	**10.46 ±0.74**	**356.65 ±2.41**	**179.58 ±2.72**	**19.77 ±1.25**	**146.27 ±1.29**	**131.84 ±2.73**
	Summer	**30.73 ±1.37**	**7.81 ±0.67**	**5.35 ±0.44**	**375.38 ±1.50**	**188.93 ±2.41**	**23.43 ±1.55**	**151.04 ±1.12**	**136.72 ±2.51**

Data (Table, 1) indicate that, the maximal values of **chloride** content were recorded during winter at Shubra Bas and Sengerg; being 36.16 ± 2.32 mg/L in the former and 34.17±1. 38 mg/L in the latter; then it decreased gradually to 21.33 ± 1.26 mg / L during the summer at Shubra Zinji and reached its minimal value during the spring at Sengerg (18.22 ± 2.32 mg / L).

The present study (Table, 1) shows that the highest **alkalinity** value was determined during autumn at Shubra Bas Village and Kafr Shubra-Beloulah (155.93± 0.41 and 155.08±0. 58 mg/L, respectively) and the lowest value measured at Kafr Shubra-Beloulah Village during winter (136.61 ± 1.73 mg/L).

Data (Table, 1) appeared seasonal variations in the values of **total hardness** with highest value during autumn at Shubra Bas village (154.80 ± 2.36 mg/L) and the lowest value occurred at Sengerg during spring (128.86± 1.34 mg/L).

Statistical analysis (Table, 2) indicates a strong positive correlation between pH, alkalinity with water temperatures, Turbidity, TDS, total hardness with pH. Also, a positive correlation between TDS with electric conductivity.

Table (2): Correlation coefficient of the environmental factors in the water of El-Bagouria Canalat El-Menoufia Governorate, during the period of study.

E. F.	Water Temp.	pH	Turbidity	Electric conduct.	TDS	Chloride	Alkalinity	Total hardness
Water Temp.	1							
pH	0.68	1						
Turbidity	0.46	0.74	1					
Electric conduct.	0.21	0.38	0.43	1				
TDS	0.49	0.55	0.29	0.63	1			
Chloride	-0.28	-0.49	-0.47	0.18	-0.37	1		
Alkalinity	0.51	0.41	-0.23	-0.12	0.22	0.38	1	
Total hardness	0.37	0.62	-0.59	-0.27	0.24	0.46	0.36	1

II- Heavy metals concentrations in the water:

Results (Table, 3) indicate that, **cadmium** concentrations showed a considerable variation from season to other. The maximal value of cadmium was recorded during spring at Kafr Shubra-Beloulah and Shubra Bas (0.12±0.03 and 0.12±0.04 µg/L, respectively) while, the minimal one (0.04 ± 0.01 µg/L) was observed at Shubra Zinji and Shubra Bas Stations during winter.

Data (Table, 3) shows that, the values of **lead** were varied considerably from season to season, where the highest value of lead concentrations (1.71 ± 0.12 µg/L) was determined at Sengerg Village during spring, the lowest value (0.25 ± 0.11 µg/L) occurred at Shubra Zinji during autumn. At the remaining stations, it was fluctuated between 0.27 ± 0.09 µg/L at Shubra Bas during autumn and 1.66 ± 0.31 µg/L at the same station during spring.

Results revealed that, the maximum value of **copper** concentrations was recorded at Shubra Zinji Village during summer and the minimum value detected at Kafr Shubra-Beloulah during autumn; being 17.28 ± 1.33 µg/L in the first and 4.05 ± 1. 06 µg/L in the second (Table, 3).

Seasonal variations of **iron** concentrations (Table, 3) showed attractive fluctuation in the water of El-Bagouria Canal where, the highest value of iron concentration (89.39 ± 4. 51µg/L) was recorded at Shubra Bas City during spring and the lowest value (25.54 ± 2.34 µg/L) was observed at Sengerg Station during autumn.

Table (3): Seasonal variations of some heavy metalsconcentrations (µg/L) in the water of El-BagouriaCanalat El-Menoufia Governorate, during the period of study.

Stations	Metals / Seasons	Cd	Pb	Cu	Fe	Mn	Zn
Shubra Zinji	Autumn	0.05±0.01	0.25±0.11	4.65±1.21	26.15±2.03	7.28±0.39	4.24±0.32
	Winter	0.04±0.01	0.93±0.06	5.34±1.15	30.22±3.90	14.43±1.73	4.04±0.87
	Spring	0.11±0.04	1.34±0.15	6.41±0.14	87.73±2.47	19.06±1.62	4.86±0.24
	Summer	0.10±0.02	0.52±0.15	17.28±1.33	71.75±2.38	9.21±1.64	6.26±0.72
Kafr Shubra-Beloulah	Autumn	0.06±0.02	0.31±0.07	4.05±1.06	28.12±1.92	8.24±1.34	4.17±0.45
	Winter	0.05±0.01	0.86±0.10	5.90±1.11	34.57±3.74	15.20±1.27	4.33±0.15
	Spring	0.12±0.03	1.43±0.14	6.66±1.53	84.19±5.07	19.83±1.28	4.80±0.83
	Summer	0.09±0.02	0.56±0.08	16.08±1.00	68.58±4.25	9.72±1.34	6.64±0.22
Sengerg	Autumn	0.07±0.01	0.29±0.08	4.89±1.26	25.54±2.34	9.00±1.17	4.27±0.32
	Winter	0.05±0.02	0.94±0.09	6.07±1.19	32.78±3.80	15.46±1.31	4.42±0.50
	Spring	0.09±0.01	1.71±0.12	7.78±1.57	82.28±4.27	20.19±2.11	5.00±0.71
	Summer	0.09±0.01	0.58±0.11	15.13±1.22	66.35±3.14	11.54±1.40	6.92±0.43
Shubra Bas	Autumn	0.07±0.02	0.27±0.09	5.09±1.85	30.37±3.13	8.33±1.09	3.87±0.18
	Winter	0.04±0.01	0.89±0.21	6.86±1.08	37.46±3.41	16.16±1.21	4.40±0.53
	Spring	0.12±0.04	1.66±0.31	7.98±1.14	89.39±4.51	21.15±1.43	5.07±0.42
	Summer	0.08±0.02	0.61±0.12	15.46±1.17	73.47±5.11	10.17±1.41	6.19±0.44

Results show that, the values of **manganese** concentrations exhibited seasonal variations, with highest value during spring at Shubra Bas site and the lowest value, occurred at Shubra Zinji Village during autumn; being 21.15 ± 1.43 in the first and 7.28 ± 0. 39 µg/L in the latter (Table, 3).

The present study (Table, 3) indicates that, concentrations of **zinc** differed from season to season; it was varied from 3.87±0.18µg/L during autumn at Shubra Bas to 6.92±0.43 µg/L during summer at Sengerg.

Correlation coefficient indicated that, a positive correlation between cadmium concentration in the water with lead, plus positive correlation between lead, copper with iron. While, weak positive correlation was recorded between lead with copper, manganese and zinc (Table, 4).

Table (4): Correlation coefficient between some heavy metals in the water of El-Bagouria Canal at El-Menoufia Governorate, during the period of study.

Heavy metals	Cd	Pb	Cu	Fe	Mn	Zn
Cd	1					
Pb	0.52	1				
Cu	0.40	0.29	1			
Fe	-0.04	0.60	0.51	1		
Mn	0.41	0.24	-0.03	0.26	1	
Zn	0.23	0.18	0.12	-0.11	0.31	1

DISCUSSION

I- Physico-chemical parameters of water at the area of study:

Results exhibited increasing rate of **water temperature** during summer. These were in agreement of those obtained by **Ali *et al*. [14], Kadry *et al*. [15], El-Amawy[3], Ghanem *et al*. [4]** who concluded that, variations in water temperature depend mainly on the climatic conditions, sampling times, number of sunshine hours and specific characteristics of waters such as turbidity, winds, plant cover and relative humidity. Changes in water temperature can alter or inhibit the normal growth and development of some organisms, including fish **(Salem *et al.* [16], Elwasify *et al*., [17])**.

Data appeared that, the increasing level in **pH** value may be attributed to photosynthesis and growth of aquatic plants, where photosynthesis consumes CO_2 leading to pH values. Results were in agreement with many authors including **Khallaf *et al*. [18], El-Otify & Iskaros [19], El-Amawy, [3]** and differed with **Ghannam *et al*. [20]** who recorded the highest value of pH during summer and the lowest value during winter.

The present study indicated that the higher level of **turbidity** during spring. Similar observations were found by **Ashry *et al*. [21], El-Amawy[3]** and differ with **Ezzat & Elkorashey[22], Al-Obaidy *et al*. [23]** to those who have observed maximum turbidity during the summer.

The current results refer to the explanation of the variation in **conductivity** which depends mainly on the concentrations of total solids and ions. High values of conductivity during winter may be attributed to stagnation of water and decrease of water level at the Nile during the period when the valves of the High Dam are closed. Similar observations were completely agree with those recorded by **Abdel-Hamid *et al*. [24], Al-Obaidy *et al*. [23], Ghanem *et al*. [4]** and differ with those obtained by **Ezzat & Elkorashey[22], Khallaf *et al*. [18]** whom detected the lowest conductivity during winter.

The present data show an elevation rate of **total dissolved salts** during autumn. This may be attributed to the elevation of water salts during wet weather as a result of blocking period. The present observations were nearly agreed with that obtained by **Moustafa *et al*. [25], El-Amawy[3]** and disagree with **Abdel-Hamid *et al*. [24], Ghannam *et al.* [20]** who recorded the minimum value of total dissolved solids during the winter and **Khallaf *et al*. [18]** who obtained the highest total dissolved solids during spring.

The relative low content of **chloride** in this study during spring may be attributed to reduce existence of biological influences. The results almost match those of many authors **(Ali *et al*.[26], Emara *et al*.[27], Ghanem *et al*. [4])** and disagree with those obtained by **Moustafa *et al*. [25], Lokhande *et al*. [28], Ali *et al*. [14]** who recorded the lowest concentration of chlorides during summer.

High level of **alkalinity** during autumn may be attributed to fermentation of domestic wastes in stagnant water leading to carbonate depletion. The results obtained agreed with **Shehata and Badr[29]** and disagree with **Abdel-Hamid *et al.* [24], Khallaf *et al*. [18]** whom reported remarkable decreasing in alkalinity during summer.

Results revealed visible variations in **total hardness**. This may be due to the sum of calcium and magnesium concentrations, expressed as calcium carbonate that may be elevated because of wastes effluents which decrease pH and facilitate carbonate dissolving. The obtained results were matching with **Abdel-Hamid *et al*. [24], Khallaf *et al*. [18], Ghanem *et al*. [4]** and disagree with **Emara *et al*. [27], Hassanein *et al*. [30]** which revealed the maximum value of total hardness during winter.

II- Heavy metals concentrations in the water:

The current study indicated the decreasing rate of **cadmium** concentrations during winter may be due to the high availability of cadmium uptake by zooplankton and other organisms in the surface water. Similar observations were recorded by **Osman *et al*.**

[(31)], **Ghanem *et al*.** [(4)] and differed with **Daifullah *et al*.** [(32)], **Emara *et al*.** [(27)], **El-Battal**[(33)] who reported the lowest cadmium concentrations in the spring.

Data exhibited higher peak of **lead** concentration during spring. This may be due to the difference levels of domestic, industrial, and agricultural wastes during the different seasons of the year. The increasing level of lead during spring may be attributed to degradation of aquatic organisms and organic matter. Similar observations were detected by **Osman *et al*.** [(31)], **Alawy *et al*.** [(34)], **El-Amawy**[(3)], **El-Battal**[(33)] and differ with **Abdel-Satar**[(35)] who found that the highest value of lead concentrations during the winter and the lowest value during summer.

Seasonal variations in **copper** concentrations may be due to fluctuation of the quantity of agricultural drainage water and sewage effluents discharged into this canal. Similar observations were obtained by **Daifullah *et al*.** [(32)], **Ezzat & Elkorashey**[(22)], **Ghanem *et al*.** [(4)] and disagree with the results of **Moustafa *et al*.** [(25)], **Lokhande *et al*.** [(28)], **Abdel-Hamid *et al*.** [(24)], **Goher *et al*.** [(36)], **Alawy *et al*.** [(34)], **El-Battal**[(33)] who obtained the highest level of copper during another season.

The results showed increasing concentration of **iron** during spring. These observations were matching with **Daifullah *et al*.** [(32)], **Osman *et al*.** [(31)], **El-Amawy**[(3)] and disagree with **Khallaf *et al*.** [(18)] whom recorded the highest value of iron during autumn and the lowest during summer.

The elevation of **manganese** during spring may be attributed to the effect of the drought period with probable presence of industrial effluents. Results were in agreement with those reported by **Daifullah *et al*.** [(32)], **Venkatesha *et al*.** [(37)], **Ghanem *et al*.** [(4)] and differ with those observed by **Abdel-Satar**[(35)], **Ibrahim & Omar** [(38)] whom recorded that, the higher value of manganese was detected during summer and the lowest value during winter.

The disturbance in **zinc** concentrations can be attributed to seasonal variations of different pollution levels at the study area. Results were compatible with those obtained by **Emara *et al*.** [(31)], **Abdel-Hamid *et al*.** [(24)], **Ghanem *et al*.** [(39)], **El-Amawy**[(3)] and differed with those observed by **Daifullah *et al*.** [(32)], **Abdel-Satar**[(35)] whom revealed the lowest value of zinc during winter.

The degree of any metal toxicity depends mainly on pH values, water hardness and organic matter. In addition, the solubility of one metal effects on the toxicity of other metals in the water (**Ghallab,**[40]).

CONCLUSION

It could be concluded that increased levels of physicochemical factors and heavy metals concentrations in the fresh water may pose a high risk to aquatic organisms and human health. **So**, the present study shows that precautionary measures must be taken to reduce pollution at the freshwater canals in the future.

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