RESULTS

I-Water Physico-chemical Characteristics:

1 -Temperature:

In the present work, the waters temperature clearly indicated significantly low ($P < 0.01$) in sector I and sector II compared to that of control. The temperature values were 16.83 ± 0.08 ^{o}C in sector I, and 14.93 ± 0.06 ^{o}C in sector II, while that of the control, was 18.03 ± 0.08 ^{o}C (Table 1 and Fig.1).

2 - The (pH) value:

The pH values were significantly low ($P < 0.01$) in sector I and sector II when compared to that of the control. Data showed that the pH values of collected samples for the control, sector I and II were 8.25 ± 0.10, 7.67± 0.05, and 7.67 ± 0.006 respectively (Table 1 and Fig.2).

3-Total alkalinity (carbonate and bicarbonate):

Concerning the concentrations of carbonate and bicarbonate in water in different location, there were significantly high ($P < 0.01$) in sector I and sector II values compared to that of the control value. The results showed higher alkalinity values in sector I, and II (347.33 ± 0.2, and 229.5 ± 0.2 mg/l respectively) than that of the control 174.46 ± 0.3 mg/l (Table 1 and Fig.3).

4 - Electrical conductivity (EC) and Total dissolved solid (TDS):

The EC and TDS values in sector I and sector II were significantly high ($P < 0.01$) compared to those of control site. The EC values of collected samples from the control, sector I and II were 0.418 ± 0.001, 1.034 ± 0.001, and 0.722 ± 0.00 ms.cm^{-1} respectively (Table 1 and Fig.4).

The TDS were 267.6 ± 0.3, 735.66 ± 0.3, and 461.66 ± 0.3 $mg.L^{-1}$ respectively (Table 1 and Fig.5).

Table (1): Physiochemical parameters of the control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

Locations / Parameter Mean ± SE	Control	Sector I	Sector II
Temperature (^oC)	18.03 ±0.08	16.83 ±0.08 ^{A}	14.93 ±0.06 ^{AB}
pH (unit)	8.25 ± 0.1	7.67 ± 0.05 ^{A}	7.67 ± 0.006 ^{A}
Total Alkalinity (mg/l)	174.4 ± 0.3	347.3 ± 0.2 ^{A}	229.5 ± 0.2 ^{AB}
Electrical Conductivity (ms/cm)	0.418 ± 0.001	1.034 ± 0.001 ^{A}	0.722 ± 0.00 ^{AB}
Total Dissolved Solid (mg/l)	267.6 ± 0.3	735.66 ± 0.3 ^{A}	462.6 ± 0.3 ^{AB}

^{A}: significant difference between the control and any other group ($P < 0.01$).

^{B}: significant difference between sector I and sector II ($P < 0.01$).

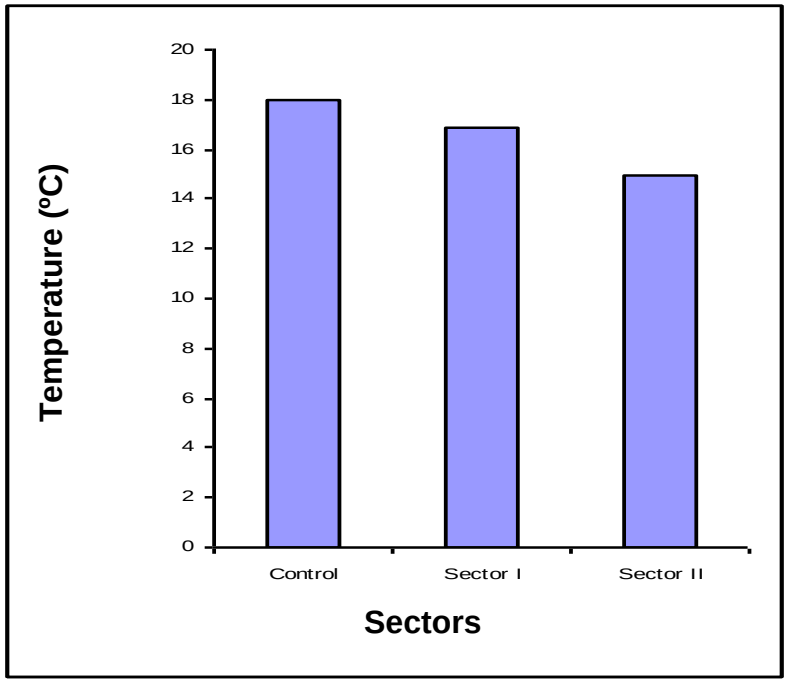

Fig. (1): Temperature (ºC) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

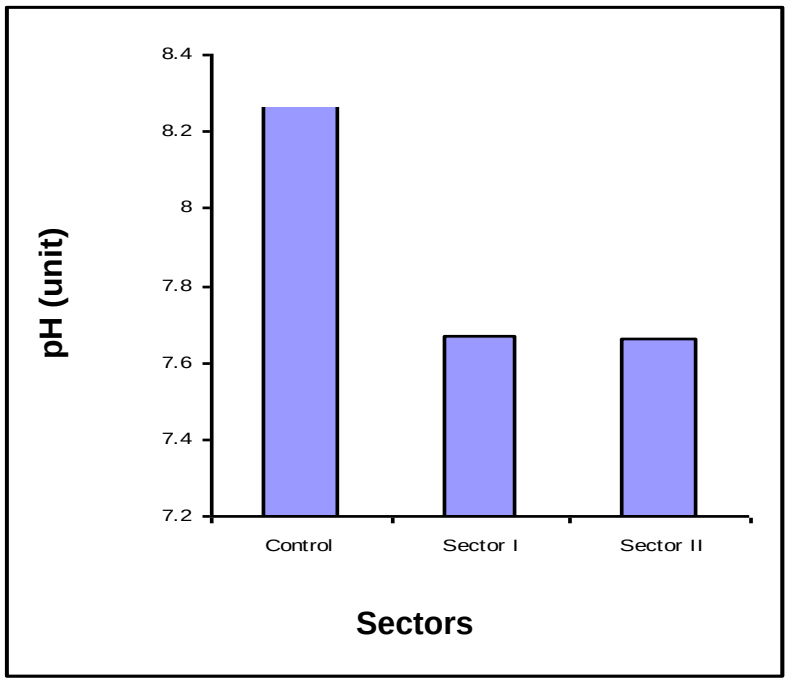

Fig. (2): pH values (unit) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

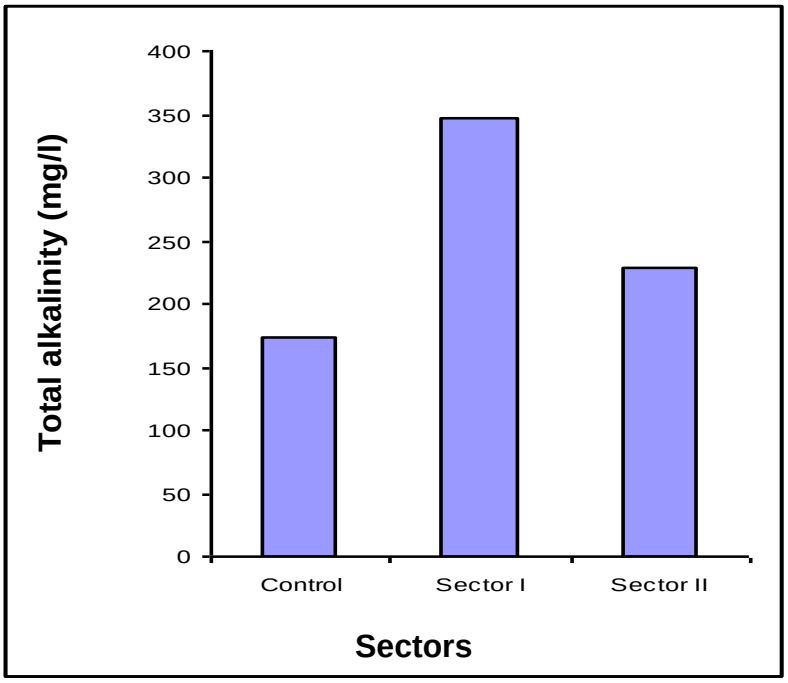

Fig. (3): Total alkalinity (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

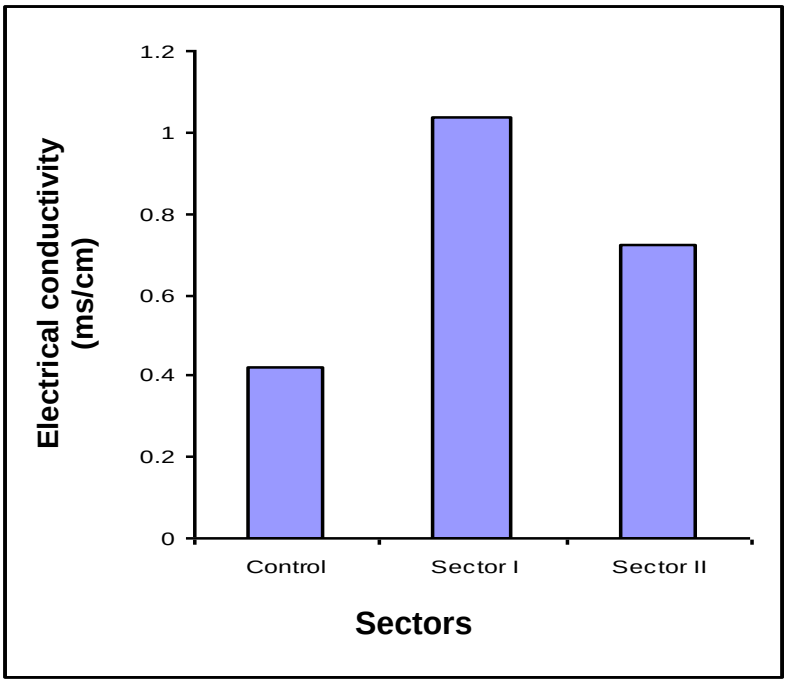

Fig. (4): Electrical conductivity (ds/cm) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

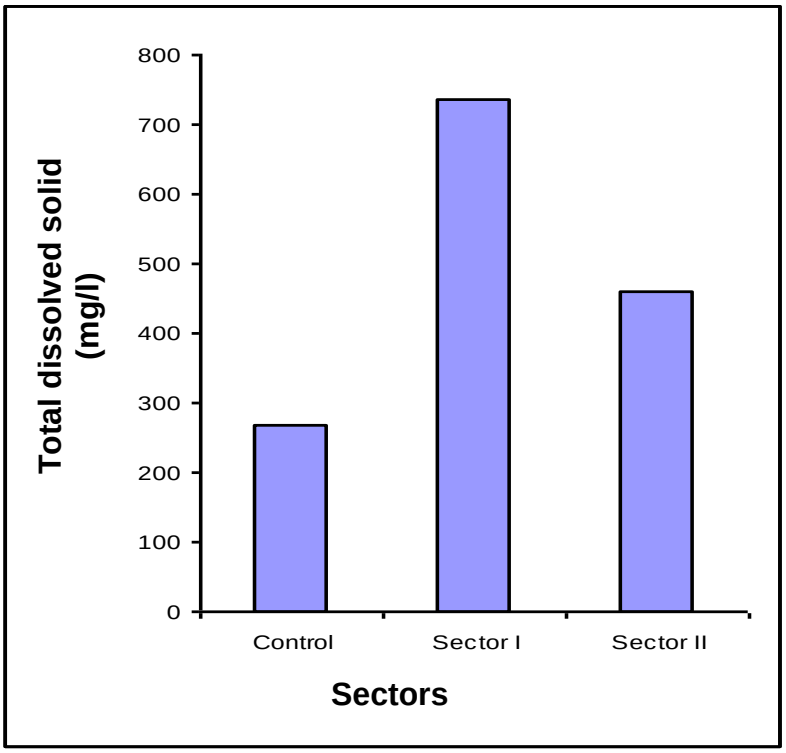

Fig. (5): Total dissolved solid (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

5 –Ammonia:

The concentration of ammonia was significantly high ($P < 0.01$) in water samples of sector I and sector II (5.83 ± 0.1, and 5.01 ± 0.003 mg/l respectively) as compared to the control value 0.29 ± 0.003 mg/l (Table 2 and Fig.6).

6 – Turbidity:

High turbidity values were 31.66 ± 0.8, and 21.66 ± 0.8 ntu, for water samples of sector I and sector II respectively and 7.21 ± 0.10 in the control site (Table 2 and Fig.7).

7-Dissolved Oxygen (DO):

The variations in dissolved oxygen values of water samples were apparent. These values were significantly low ($P < 0.01$) in sector I and sector II (2.1, and 2.8 mg/l respectively) when compared the control value 5.5 mg/l (Table 2 and Fig.8).

8 - Biological oxygen demand (BOD):

The BOD values of collected samples from sectors I and II (30.66 ± 0.6 l, and 7.0 ± 0.57 mg/l respectively) were significantly high ($P < 0.01$), compare to that of control 4.6 ± 0.02 mg/l (Table 2 and Fig.9).

9 - Chemical oxygen demand (COD):

It is apparent that, the COD of samples collected from sector I and II recorded more than six and five folds respectively in relation to that of control. COD in sector I and II were 35.30 ± 0.1, and 28.33 ± 0.3 mg/l,

respectively while in the control water it was 6.2 ± 0.2 mg/l (Table 2 and Fig.10).

Table (2): Ammonia, turbidity, dissolved oxygen, biological oxygen deman and chemical oxygen demand of the control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

Locations / Parameter Mean ± SE	Control	Sector I	Sector II
Ammonia (mg/l)	0.29 ±0.003	5.83 ± 0.1 [A]	5.01 ±0.003 [A]
Turbidity (NTU)	7.21 ± 0.10	31.66 ± 0.80 [A]	21.66 ± 0.8 [AB]
Dissolved Oxygen (mg/l)	5.31 ± 0.01	2.12 ± 0.01 [A]	2.81 ± 0.02 [A]
Biological Oxygen Demand (mg/l)	4.6 ± 0.02	30.66 ± 0.6 [A]	7.0 ± 0.5 [AB]
Chemical Oxygen Demand (mg/l)	6.2 ± 0.2	35.30 ± 0.1 [A]	28.33 ± 0.3 [AB]

[A]: significant difference between the control and any other group ($P < 0.01$).

[B]: significant difference between sector I and sector II ($P < 0.01$).

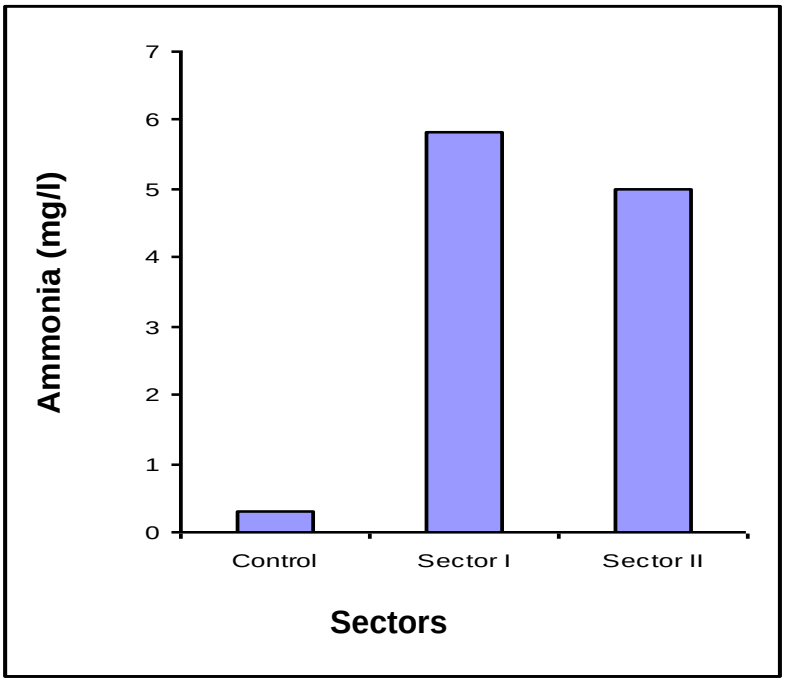

Fig. (6): Ammonia concentration (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

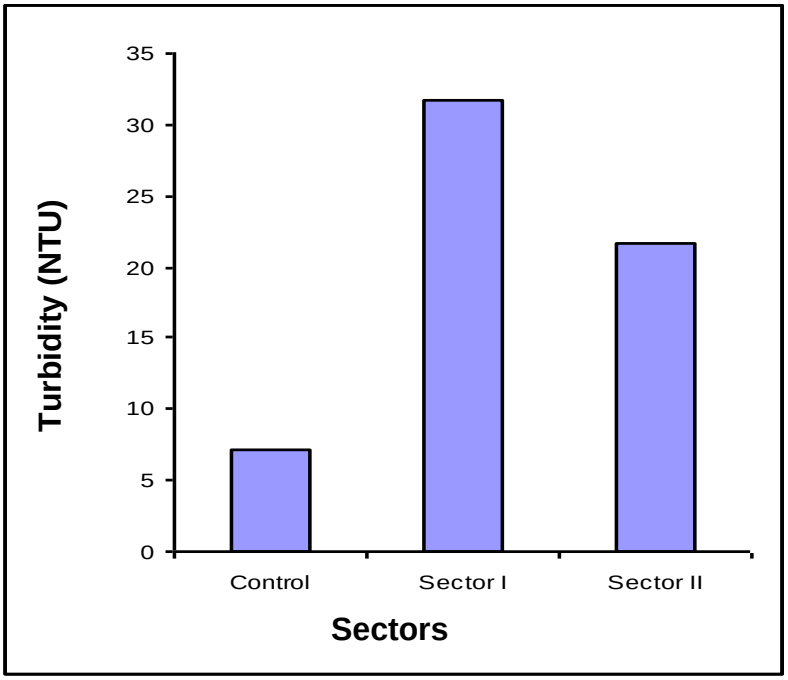

Fig. (7): Turbidity values (NTU) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

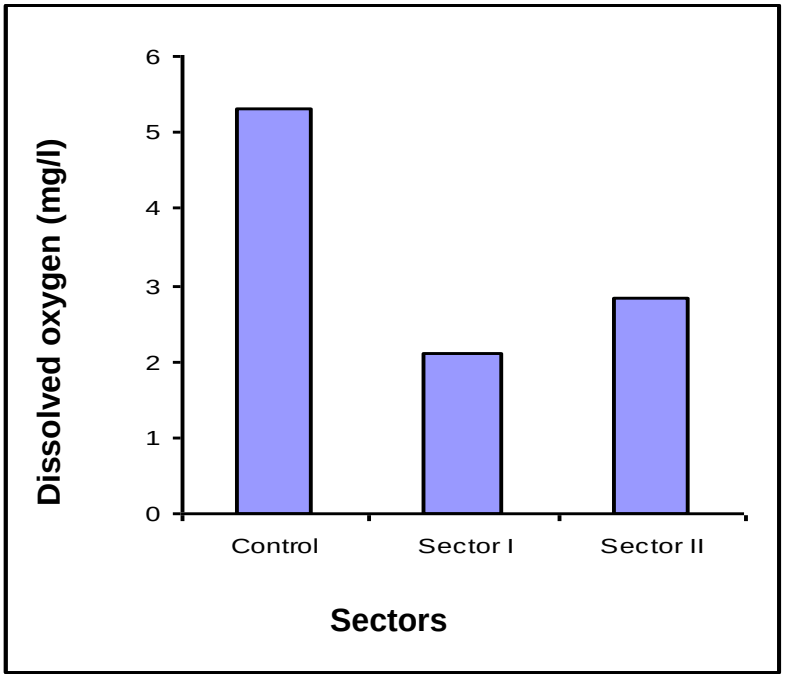

Fig. (8): Dissolved oxygen (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

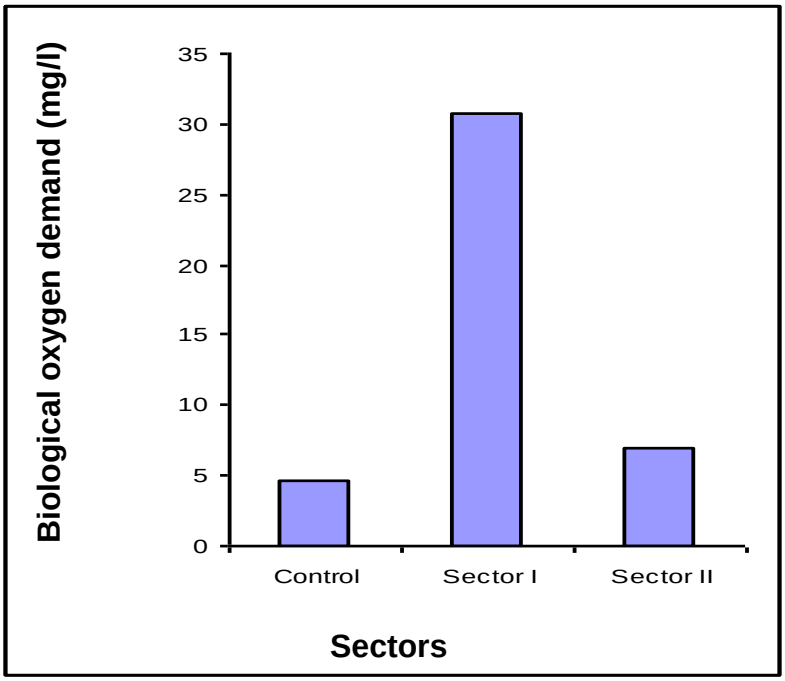

Fig. (9): Biological oxygen demand (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

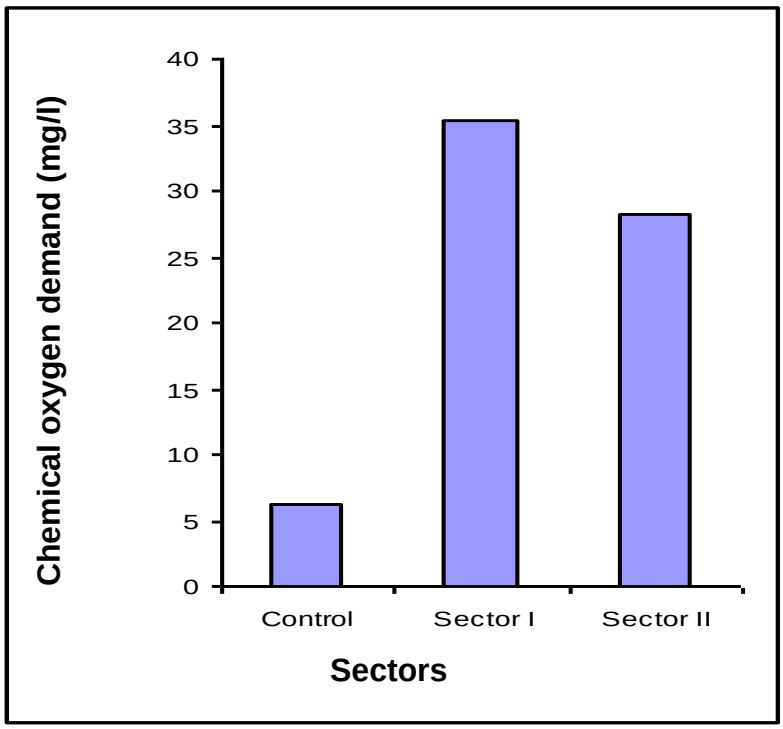

Fig. (10): Chemical oxygen demand (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

10 - Major cations:

a) Sodium (Na^+):

Sodium concentrations in water of the studied locations were significantly high ($P < 0.01$) in sector I and sector II compared to that of the control. The value of sodium concentration in sectors I was 81.6 ± 0.8 mg/l (about 2.5- fold of the control value), and in sector II was 60.33 ± 0.3 mg/l (about 2- fold of the control value) (Table 3 and Fig.11).

b) Potassium (K^+):

In the present work, the potassium concentration clearly indicated a significantly high values ($P < 0.01$) in sector I and sector II compared to that of control. The potassium value was 15.26 ± 0.7 mg/l in sector I, 11.16 ± 0.1 mg/l in sector II and 8.73 ± 0.2 mg/l in control site (Table 3 and Fig.12).

c) Calcium (Ca^{++}):

Calcium concentration values were significantly high ($P < 0.01$) in sector I and sector II when compared to that of control. Data showed that the calcium values of collected water samples of the control, sector I and II were 34.44 ± 0.2, 87.76 ± 0.3, and 57.66 ± 0.3 mg/l respectively (Table 3 and Fig.13).

d) Magnesium (Mg^{++}):

The concentrations of magnesium in water in the studied locations were significantly high ($P < 0.01$) in sector I and sector II compared to that of the control value (36.00 ± 0.3, 18.33 ± 0.3, and 17.33 ± 0.3 mg/l respectively) (Table 3 and Fig.14).

Table (3): Major cations concentrations of the control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

Locations / Parameter Mean ± SE	Control	Sector I	Sector II
Sodium (mg/l)	30.4 ± 0.2	81.6 ± 0.8 ^{A}	60.33± 0.3 ^{AB}
Potassium (mg/l)	8.73 ± 0.2	15.26 ± 0.7 ^{A}	11.16 ± 0.1 ^{AB}
Calcium (mg/l)	34.43 ± 0.2	87.66 ± 0.3 ^{A}	57.66 ± 0.3 ^{AB}
Magnesium (mg/l)	17.33 ± 0.3	36.00 ± 1.00 ^{A}	18.33 ± 0.3 ^{B}

^{A}: significant difference between the control and any other group ($P < 0.01$).

^{B}: significant difference between sector I and sector II ($P < 0.01$).

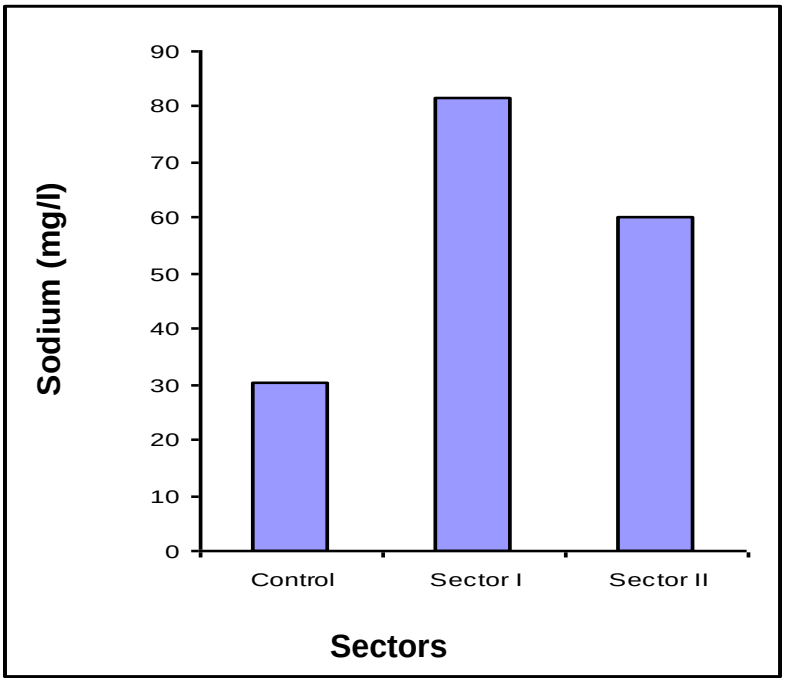

Fig. (11): Sodium concentration (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

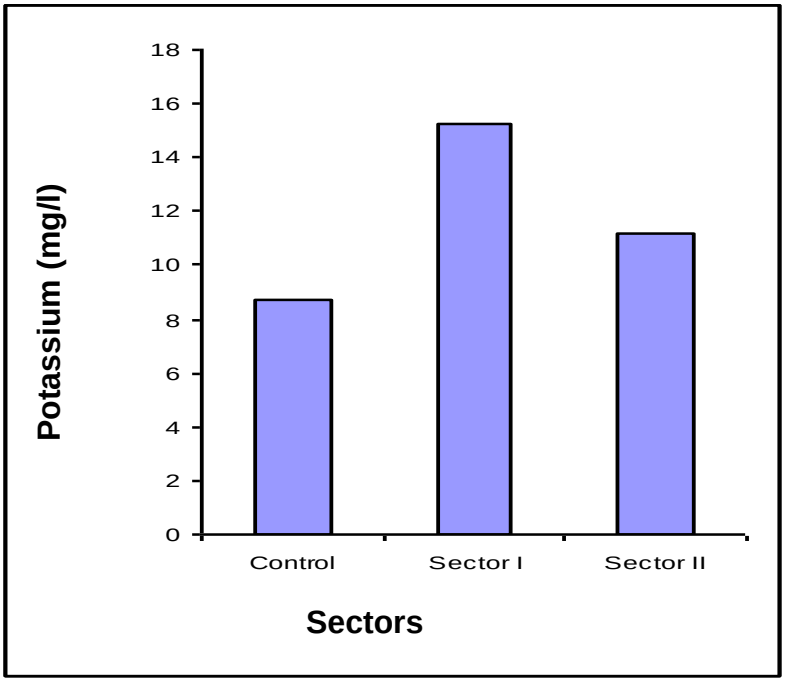

Fig. (12): Potassium concentration (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

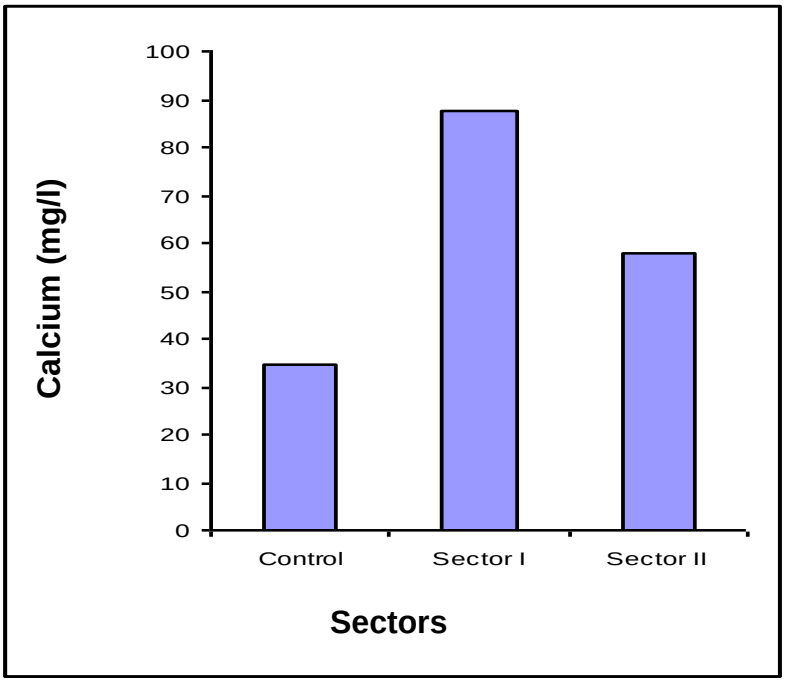

Fig. (13): Calcium concentration (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

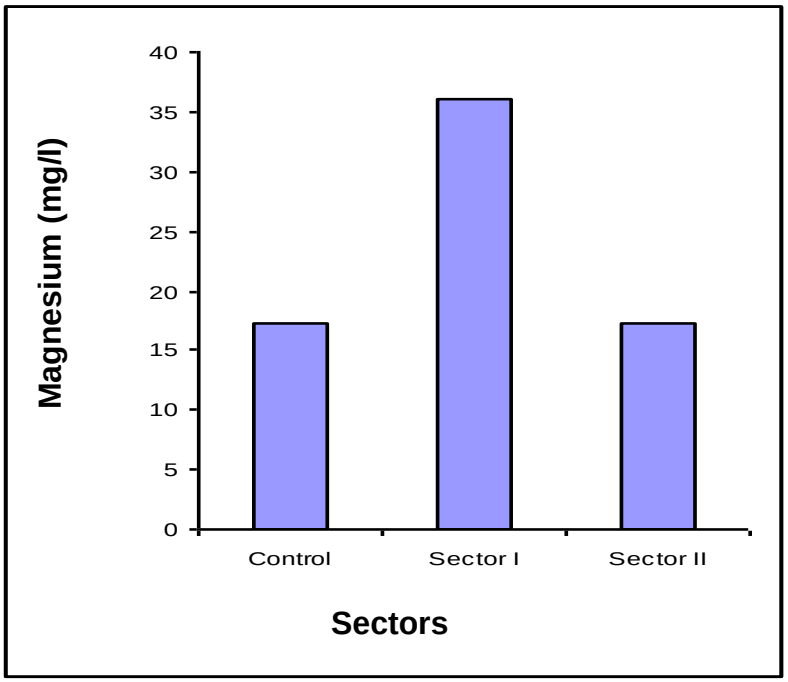

Fig. (14): Magnesium concentration (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

11 - Major anions:

a) Chloride (Cl^-):

There were significantly high ($P < 0.01$) chloride concentrations in sector I and sector II compared to that of the control. The chloride values of collected water samples from the control, sector I and II were 34.6 ± 0.3, 91.2 ± 0.6, and 72.0 ± 0.5 mg/l respectively (Table 4 and Fig.15).

b) Sulphate (So_4^{--}):

The concentrations of sulphate were significantly high ($P < 0.01$) in sector I and sector II (60.66 ± 0.6, and 71.66 ± 0.8 mg/l respectively) compared to the control value (26.83 ± 0.4 mg/l) (Table 4 and Fig.16).

c) Phosphate (Po_4^{---}):

There were significantly high ($P < 0.01$) water phosphate concentrations in sector I and sector II (0.41 ± 0.006, and 0.31 ± 0.007 mg/l respectively) when compared to the control value (0.17 ± 0.003 mg/l) (Table 4 and Fig.17).

d) Nitrate (No_3^-):

The nitrate concentration values of collected water samples from sectors I and II (21.3 ± 0.3, and 0.90 ± 0.05 mg/l respectively) were significantly high ($P < 0.01$), as compared to that of the control (0.48 ± 0.01 mg/l) (Table 4 and Fig.18).

Table (4): Major anions of the control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

Locations / Parameter Mean ± SE	Control	Sector I	Sector II
Chloride (mg/l)	34.6 ± 0.3	91.2 ± 0.6 ^{A}	72.0 ± 0.5 ^{AB}
Sulphate (mg/l)	26.0 ± 0.4	60.66 ± 0.6 ^{A}	71.66 ± 0.8 ^{AB}
Phosphate (mg/l)	0.17 ± 0.003	0.41 ± 0.006 ^{A}	0.31 ± 0.007 ^{A}
Nitrate (mg/l)	0.48 ± 0.01	21.3 ± 0.3 ^{A}	0.9 ± 0.05 ^{AB}

^{A}: significant difference between the control and any other group ($P < 0.01$).

^{B}: significant difference between sector I and sector II ($P < 0.01$).

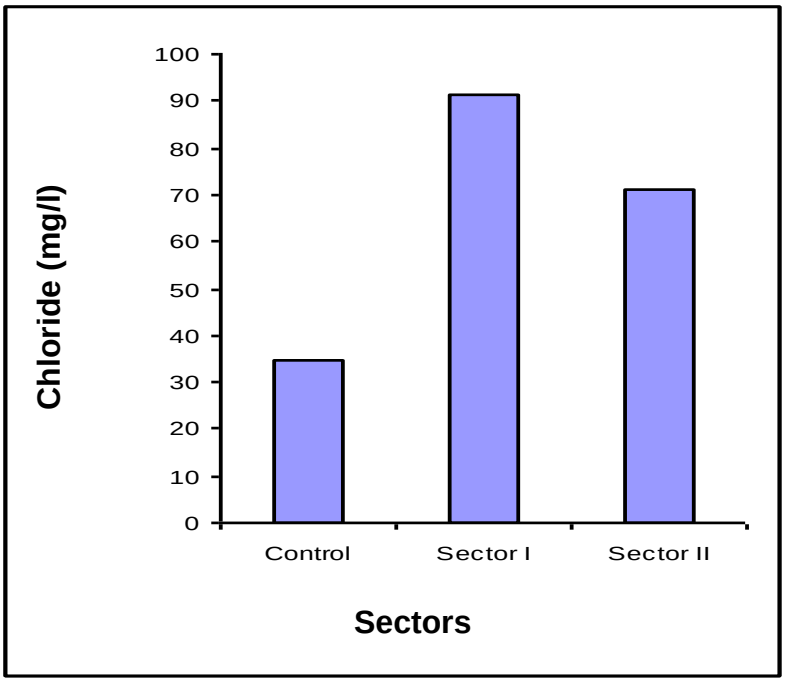

Fig. (15): Chloride concentration (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

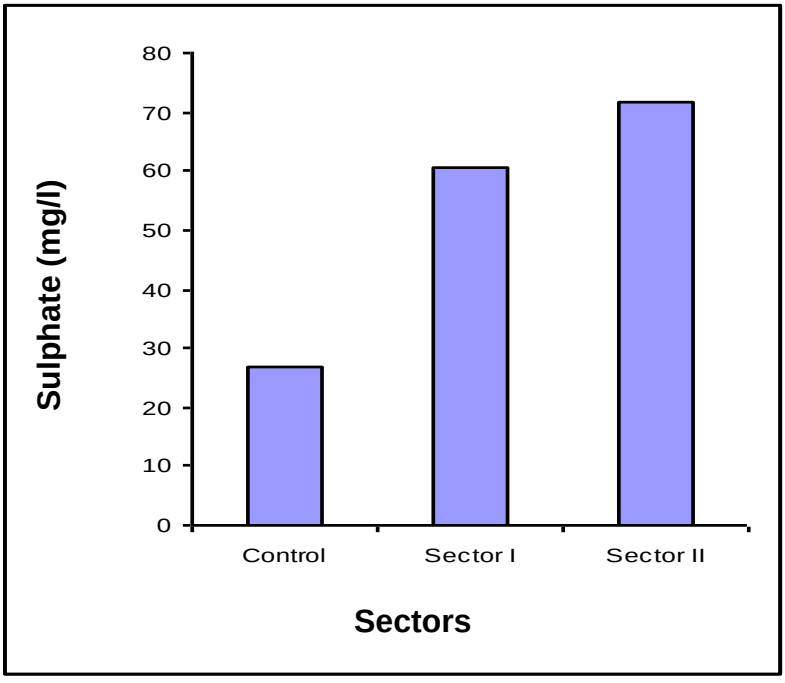

Fig. (16): Sulphate concentration (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

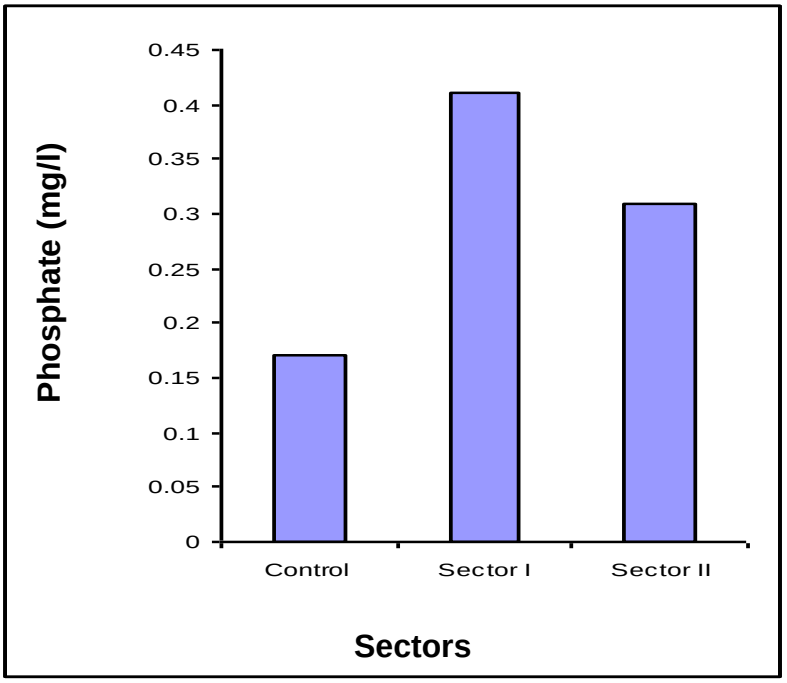

Fig. (17): Phosphate concentration (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

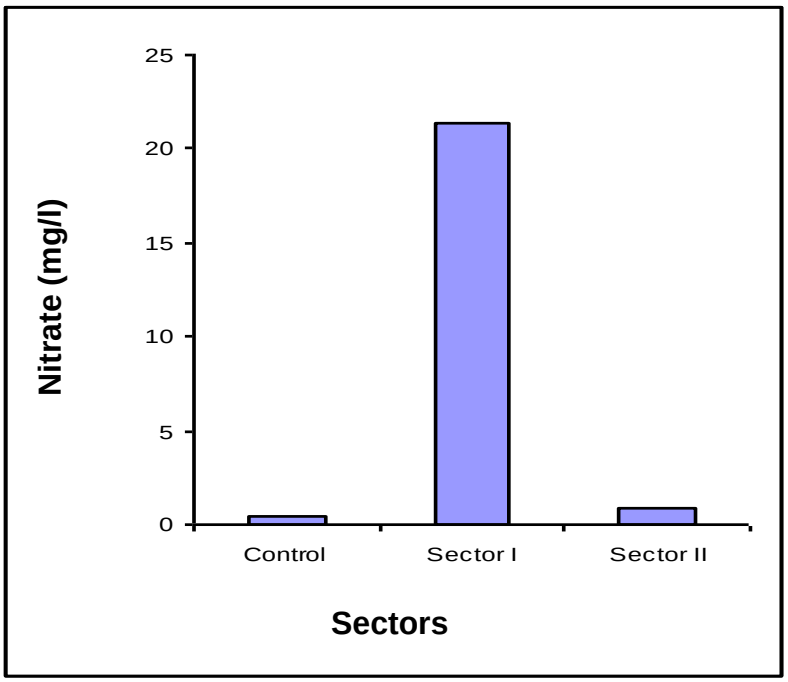

Fig. (18): Nitrate concentration (mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

12 – Heavy metals:

a) Iron (Fe^{3+}):

The iron concentration values in water samples collected from the studied locations were significantly high ($P < 0.01$) in sector I and low ($P < 0.01$) in sector II when compared to that of control site. The iron concentration values of collected samples from the control, sector I and II were 0.20 ± 0.00, 0.51 ± 0.009, and 0.041 ± 0.0 mg/l respectively (Table 5 and Fig.19).

b) Manganese (Mn^{2+}):

Manganese concentration values were significantly high ($P < 0.01$) in sector I when compared to those of sector II and the control site. The manganese concentration of sector I was 0.40 ± 0.003, and of sector II was 0.21 ± 0.006 mg/l, while in the control water was 0.21 ± 0.009 mg/l (Table 5 and Fig.20).

c) Zinc (Zn^{2+}):

The concentration of zinc was significantly high ($P < 0.01$) in sector I and low ($P < 0.01$) in sector II when compared to the value of control site. The zinc concentration was 0.47 ± 0.003 mg/l in sector I, 0.023 ± 0.0 mg/l in sector II and 0.1 ± 0.006 mg/l in the control site (Table 5 and Fig.21).

d) Copper (Cu^{2+}):

The variations in copper concentration values of water samples were apparent. It was significantly high ($P < 0.01$) in sector I and low ($P < 0.01$) in sector II when compared to the value of control site. The copper concentration of control, sector I and II were 0.083 ± 0.003, 0.20 ± 0.003, and 0.002 ± 0 mg/l respectively (Table 5 and Fig.22).

e) Lead (Pb^{2+}):

Lead concentration value was significantly high ($P < 0.01$) in sector I when compared to those of sector II and the control. The lead concentrations values were 0.020 ± 0.00 mg/l in sector I, 0.005 ± 0.0 mg/l in sector II, and 0.005 ± 0.0 mg/l in the control site (Table 5, Fig.23).

f) Cadmium (Cd^{2+}):

The concentration of cadmium was significantly high ($P < 0.01$) in sector I when compared to those of sector II and the control site. Data showed that the cadmium concentration values of the control, sector I and II were 0.005 ± 0.0, 0.008 ± 0.0, and 0.005 ± 0 mg/l respectively (Table 5 and Fig.24).

Table (5): Major heavy metals of the control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

Locations / Parameter Mean ± SE	Control	Sector I	Sector II
Iron (mg/l)	0.20 ± 0.00	0.50 ± 0.009 ^{A}	0.041 ± 0.00 ^{AB}
Manganese (mg/l)	0.21 ± 0.009	0.40 ± 0.003 ^{A}	0.21 ± 0.006 ^{B}
Zinc (mg/l)	0.11 ± 0.006	0.47 ± 0.003 ^{A}	0.023 ± 0.00 ^{AB}
Copper (mg/l)	0.083 ± 0.003	0.20 ± 0.003 ^{A}	0.002 ± 0.00 ^{AB}
Lead (mg/l)	0.005 ± 0.0	0.02 ± 0.00 ^{A}	0.005 ± 0.0 ^{B}
Cadmium (mg/l)	0.005 ± 0.0	0.008 ± 0.0 ^{A}	0.005 ± 0.0 ^{B}

^{A}: significant difference between the control and any other group ($P < 0.01$).

^{B}: significant difference between sector I and sector II ($P < 0.01$).

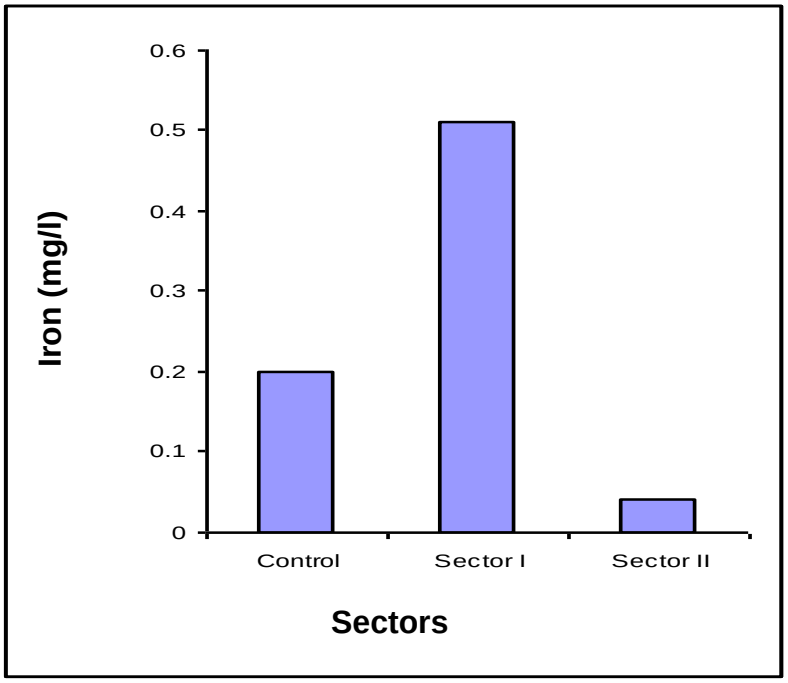

Fig. (19): Iron concentration (Fe^{3+} mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

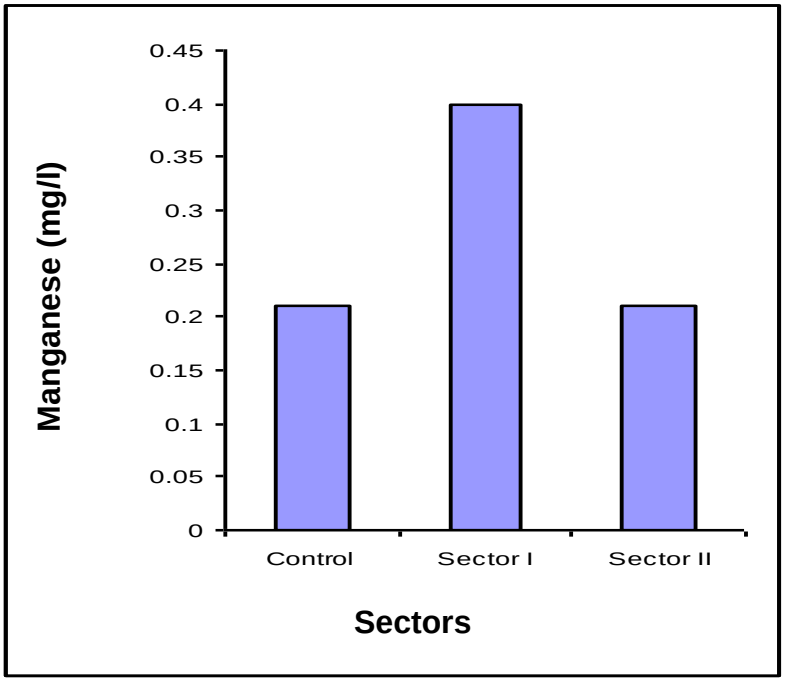

Fig. (20): Manganese concentration (Mn^{2+} mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

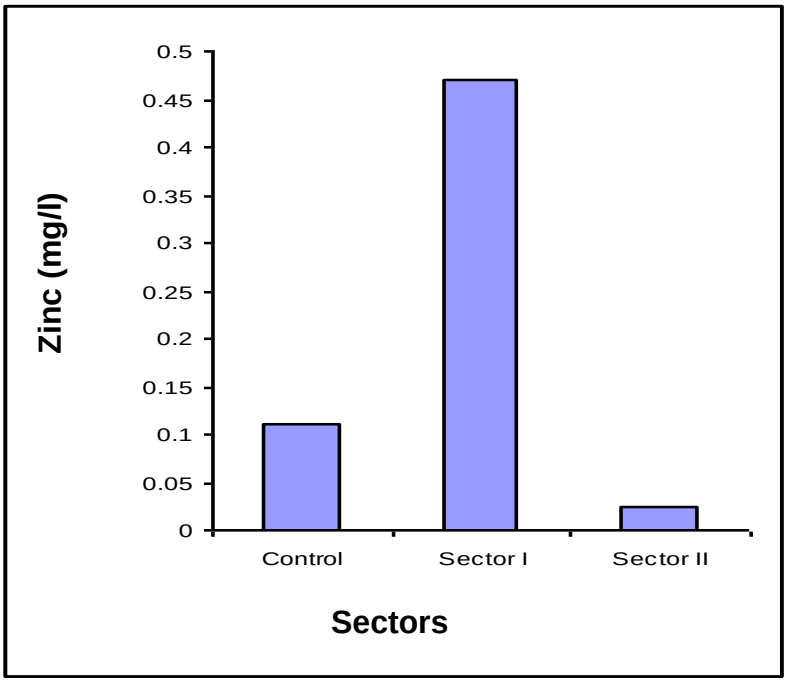

Fig. (21): Zinc concentration (Zn^{2+} mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

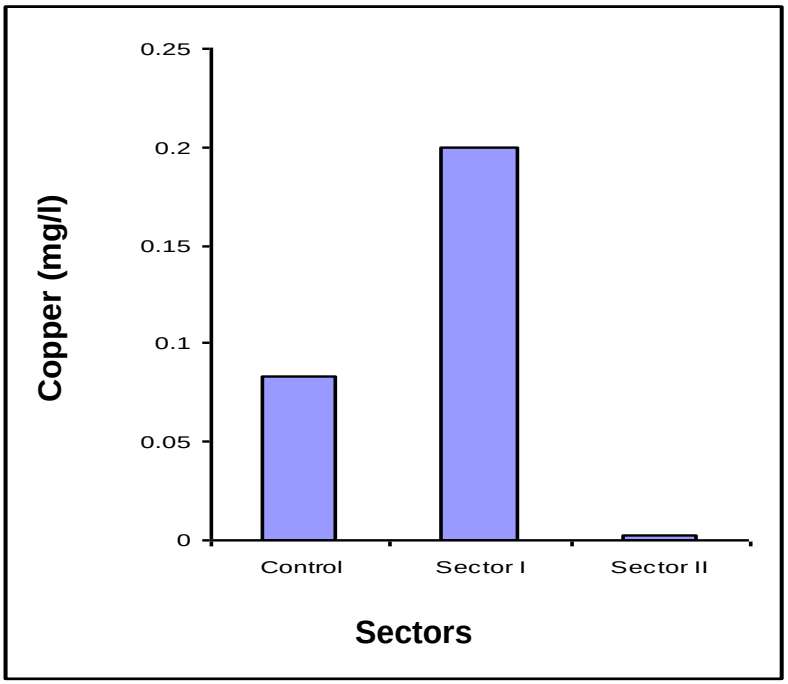

Fig. (22): Copper concentration (Cu^{2+} mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

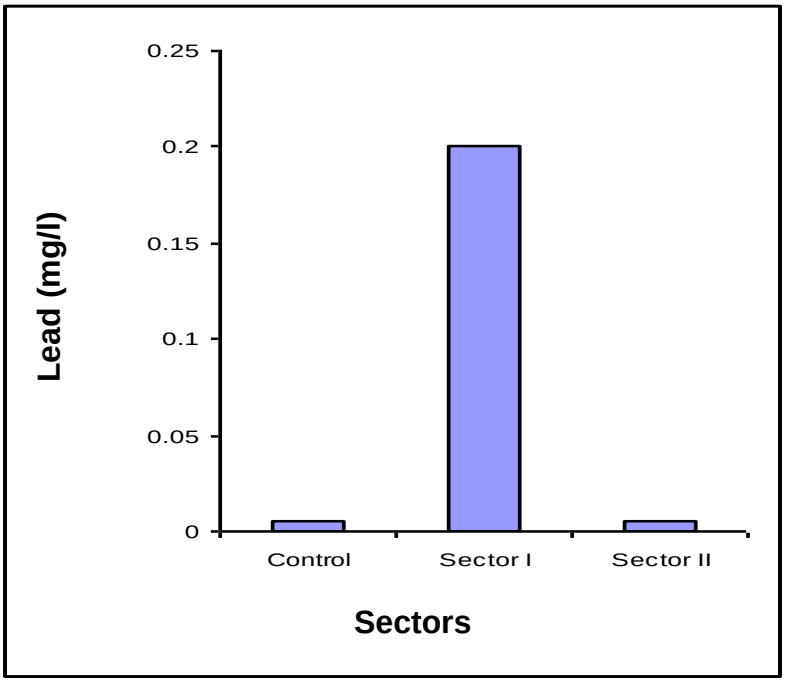

Fig. (23): Lead concentration (Pb^{2+} mg/l) of control water samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

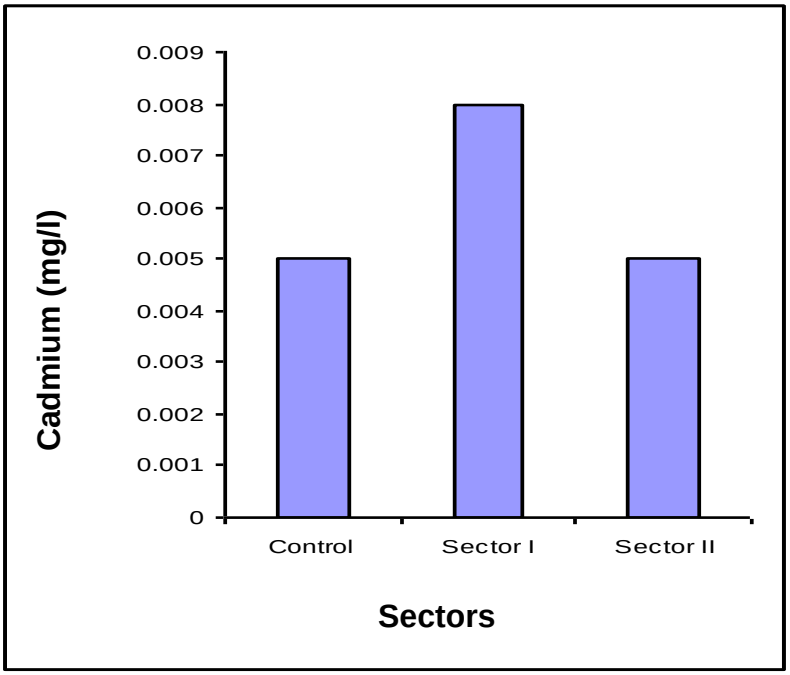

Fig. (24): Cadmium concentration (Cd^{2+} mg/l) of control water samples (taken from El-kanate El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

II- Blood Analysis:

Hemoglobin content (Hb):

In the present work the values of hemoglobin content of blood of the control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial rejoin in Kafer El-zyat at Benofer area respectively) were 0.25 ± 0.001, 0.32 ± 0.001, and 0.31 ± 0.001 g/dl respectively. The Hb contents of blood of fish samples taken from sector I and sector II were significantly high ($P < 0.01$) in comparison with that the control fish (Table 6 and Fig. 25).

Respiratory functions of blood:

1-Blood gases:

a- Blood oxygen partial pressure (PO_2):

In the present work, the arterial and venous blood oxygen partial pressures (P_aO_2 and P_vO_2 respectively) of control, sector I, and sector II fish samples were 130.0 ± 1.0 & 47.7 ± 2.0 mmHg, 41.1 ± 1.0 & 26.2 ± 0.4 mmHg and 47.6 ± 1.0 & 19.2 ± 0.7 mmHg respectively. Blood PO_2 values in fish of sector I and sector II were significantly low ($P < 0.01$) when compared with those in the control site. (Table 7 and Figs. 26 & 27).

b- Blood oxygen saturation ($\%O_2$ Sat.):

The values of percent blood oxygen saturation ($\%O_2$ sat.) for arterial and venous blood of control, sector I, and sector II fish samples were 97.4 ± 0.2 & 59.4 ± 0.3 %, 77.2 ± 2.0 & 55.9 ± 2.0 % and 73.9 ± 2.0 & 26.4 ± 1.0 % respectively. The $\%O_2$ sat. values of fish in sector I and

sector II were significantly low ($P < 0.01$) in comparison with those in the control site. (Table 7 and Figs. 28 & 29).

c- Blood carbon dioxide partial pressure (PCO_2):

The arterial and venous blood carbon dioxide partial pressure (P_aCO_2 and P_vCO_2 respectively) of control, sector I, and sector II fish samples were 16.0 ± 0.3 & 20.0 ± 1.0 mmHg, 11.7 ± 0.4 & 12.2 ± 0.3 mmHg and 21.1 ± 0.2 & 24.4 ± 1.0 mmHg respectively. The values of blood carbon dioxide partial pressure were significantly low ($P < 0.01$) in fish of sector I and high ($P < 0.01$) in fish of sector II when compared with those of the control site (Table 7 and Figs.30 & 31).

2-Blood acid-base status:

a- Blood pH:

The values of arterial and venous blood pH of fish samples in control site (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial rejoin in Kafer El-zyat at Benofer area respectively) were 7.10 ± 0.01& 7.02 ± 0.03, 7.43 ± 0.01& 7.40 ± 0.01, and 7.19 ± 0.01& 7.28 ± 0.009 respectively. The pH values were significantly high ($P < 0.01$) in fish of sector I and sector II, compared with those of the control site. (Table 8 and Figs. 32& 33).

b- Blood bicarbonate concentration (HCO_3^-):

The arterial and venous blood HCO_3^- of fish samples in control, sector I, and sector II were presented in table 8 and Figs. 34& 35. Blood HCO_3^- concentrations were significantly high ($P < 0.01$) in fish of sector I and sector II, compared with those of the control.

c- Blood total carbon dioxide concentration (TCO_2):

The arterial and venous blood total carbon dioxide (TCO_2) of control, sector I, and sector II fish samples were presented in table 8 and Figs. 36 & 37. Blood total CO_2 values were significantly high ($P < 0.01$) in fish in sector I and sector II, compared with those of the control.

d- Blood base excess concentration (BE):

The arterial and venous blood base excess (BE) of control, sector I, and sector II fish samples were presented in table 8 and Figs. 38 & 39. The blood BE concentrations were significantly high ($P < 0.01$) in fish of sector I and sector II, compared with those of the control.

3-Oxygen equilibrium curve (OEC):

The blood oxygen equilibrium curves of fish of sector I and sector II were located on the left in relation to that of the control. The results showed significantly low values ($P < 0.01$) of the blood oxygen half saturation pressure (P_{50}) of fish in sector I and sector II, compared with that of the control (Table 9 and Fig. 40).

Table (6): Blood hemoglobin content of the control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial rejoin in Kafer El-zyat at Benofer area respectively).

Fish samples / Parameter Mean ± SE	Control	Sector I	Sector II
Blood Hb content (g/dl)	0.25 ± 0.001	0.32 ± 0.001 [A]	0.31 ± 0.001 [A]

[A]: significant difference between the control and any other group (P <0.01).

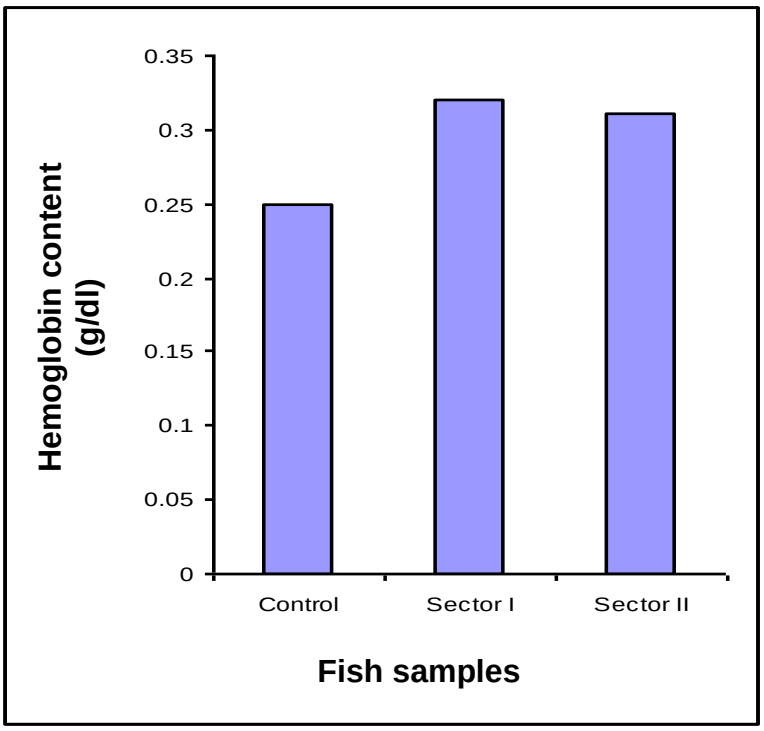

Fig. (25): Blood hemoglobin content (g/dl) of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

Table (7): Arterial (a) and venous (v) Blood gases of the control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

Parameter Mean ± SE \ Location		Control	Sector I	Sector II
PO_2 mmHg	a	130 ± 1.0	41.1 ± 1.0 ^{A}	47.6 ± 1.0 ^{AB}
	v	47.7 ± 2.0	26.2 ± 0.4 ^{A}	19.2 ± 0.70 ^{AB}
% O_2 sat	a	97.2 ± 0.2	77.2 ± 2.0 ^{A}	73.9 ± 2.0 ^{A}
	v	59.4 ± 0.3	55.9 ± 2.0 ^{A}	26.4 ± 1.0 ^{AB}
PCO_2 mmHg	a	16.0 ± 0.3	11.7 ± 0.4 ^{A}	21.1 ± 0.2 ^{AB}
	v	20.0 ± 1.0	12.2 ± 0.3 ^{A}	24.4 ± 1.0 ^{AB}

^{A}: significant difference between the control and any other group ($P < 0.01$).

^{B}: significant difference between sector I and sector II ($P < 0.01$).

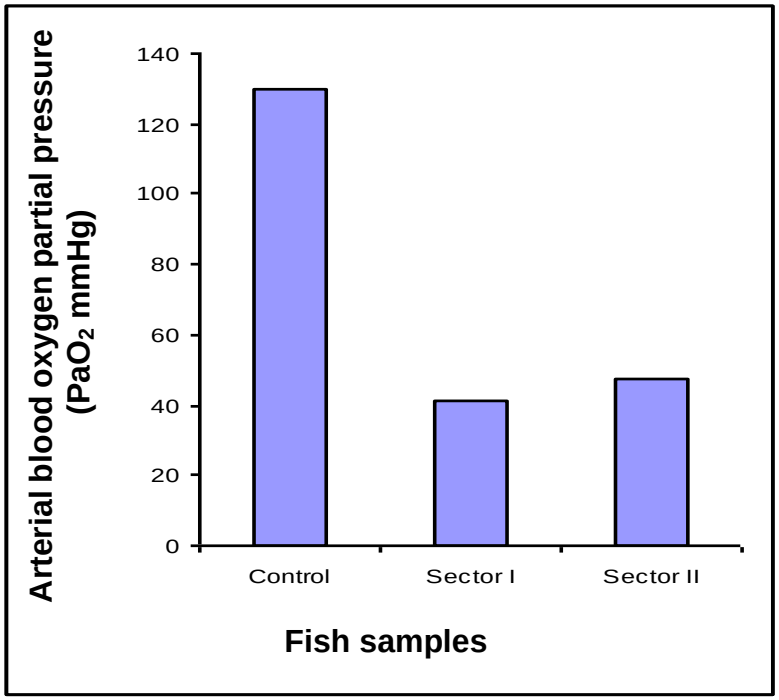

Fig. (26): Arterial blood oxygen partial pressure (PaO_2 mmHg) of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

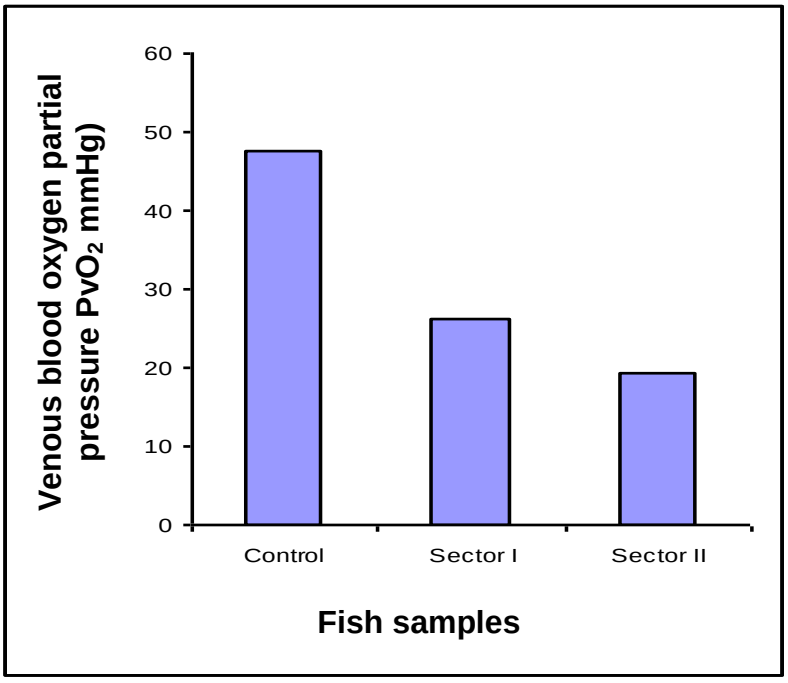

Fig. (27): Venous blood oxygen partial pressure (PvO_2 mmHg) of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

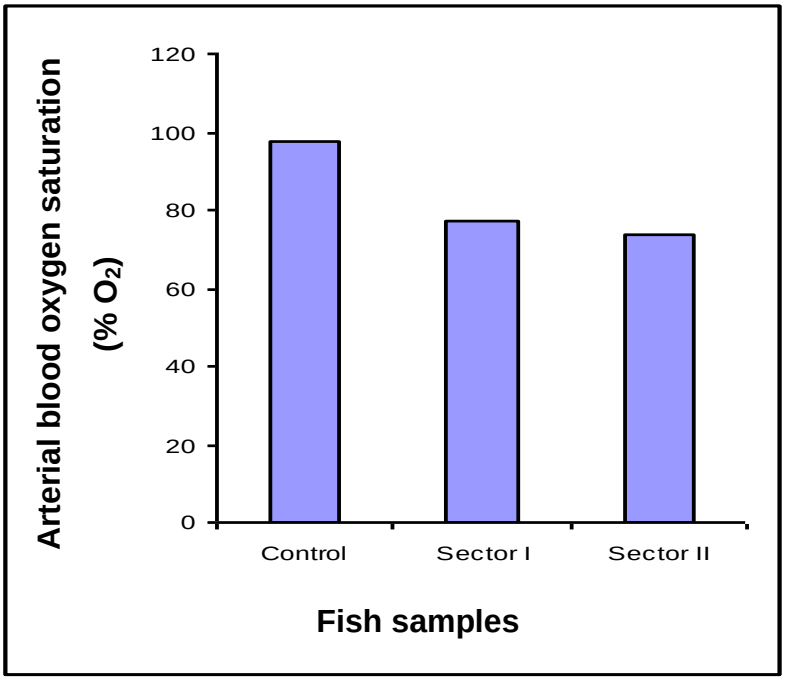

Fig. (28): Arterial blood oxygen saturation (% O_2 sat.) of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

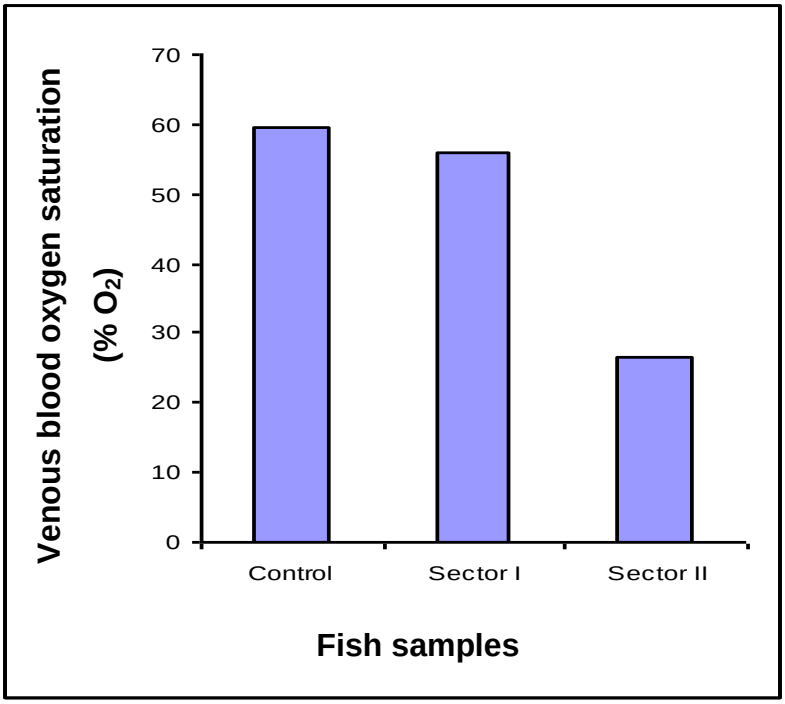

Fig. (29): Venous blood oxygen saturation (% O_2 sat.) of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

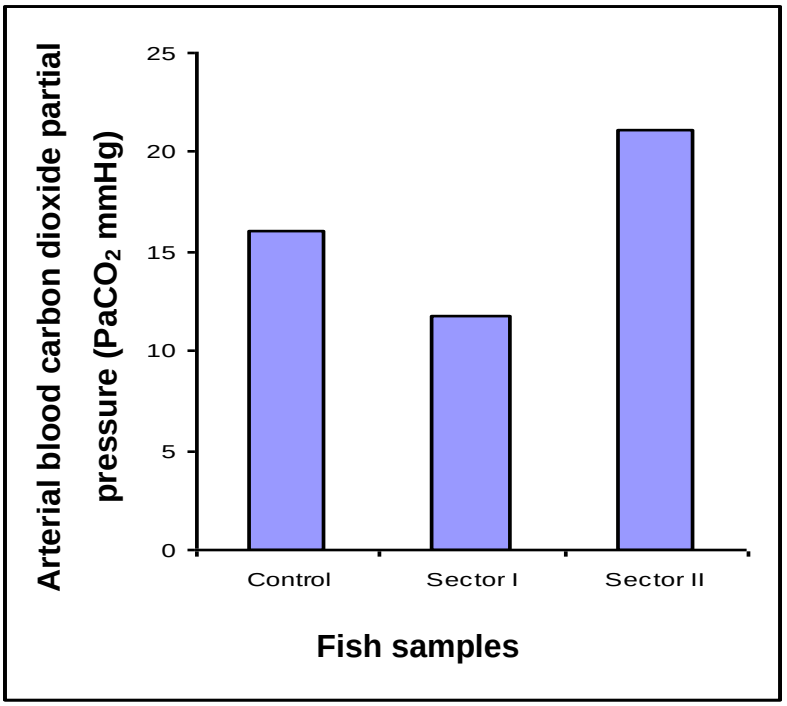

Fig. (30): Arterial blood carbon dioxide partial pressure ($PaCO_2$ mmHg) of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

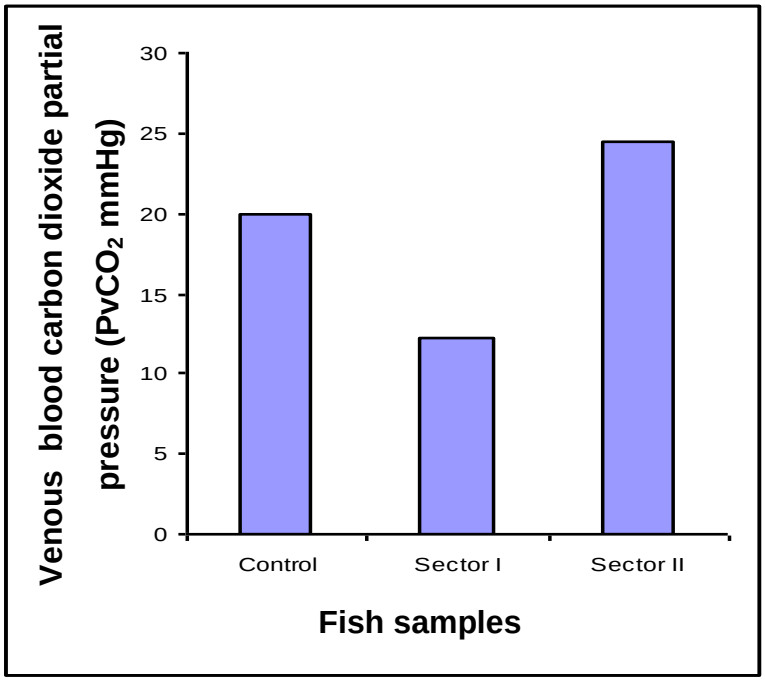

Fig. (31): Venous blood carbon dioxide partial pressure ($PvCO_2$ mmHg) of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

Table (8): Arterial (a) and venous (v) blood acid – base status parameters of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

Parameter Mean ± SE \ Fish samples		Control	Sector I	Sector II
pH (Unit)	**a**	7.10 ± 0.01	7.43 ± 0.01 ^{A}	7.19 ± 0.01 ^{AB}
	v	7.02 ± 0.03	7.40 ± 0.01 ^{A}	7.28 ± 0.009 ^{AB}
HCO_3^- mmol/l	**a**	5.3 ± 0.1	8.03 ± 0.1 ^{A}	7.45 ± 0.1 ^{AB}
	v	5.5 ± 0.1	6.3 ± 0.1 ^{A}	10.1 ± 0.1 ^{AB}
Total CO_2 mmol/l	**a**	5.9 ± 0.1	8.4 ± 0.1 ^{A}	7.74 ± 0.1 ^{AB}
	v	5.7 ± 0.1	6.9 ± 0.1 ^{A}	10.7 ± 0.1 ^{AB}
Base Excess mmol/l	**a**	-24.3 ± 0.5	-17.4 ± 0.2 ^{A}	-19.4 ± 0.3 ^{AB}
	v	-24.9 ± 0.3	-17.6 ± 0.3 ^{A}	-16.6 ± 0.1 ^{A}

^{A}: significant difference between the control and any other group ($P < 0.01$).

^{B}: significant difference between sector I and sector II ($P < 0.01$).

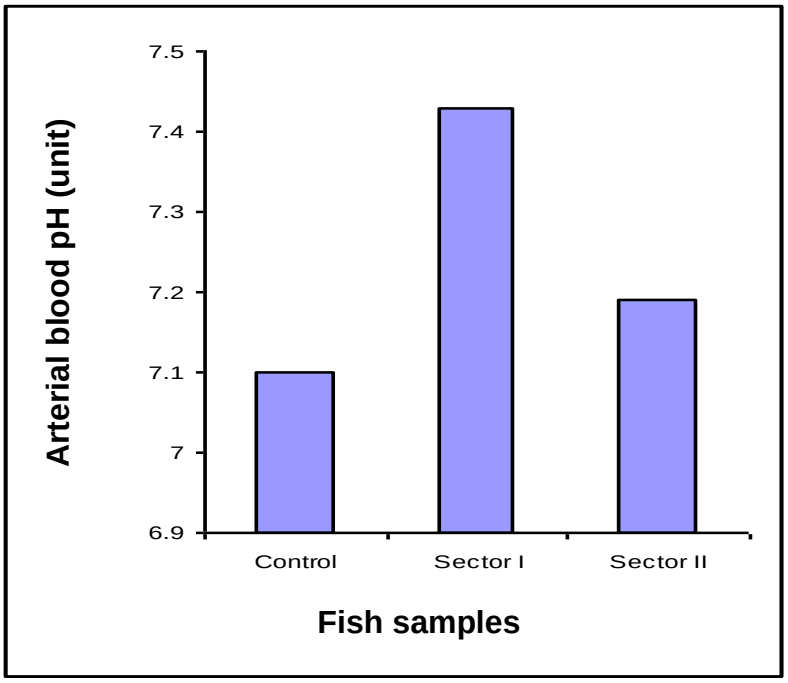

Fig. (32): Arterial blood pH (unit) of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

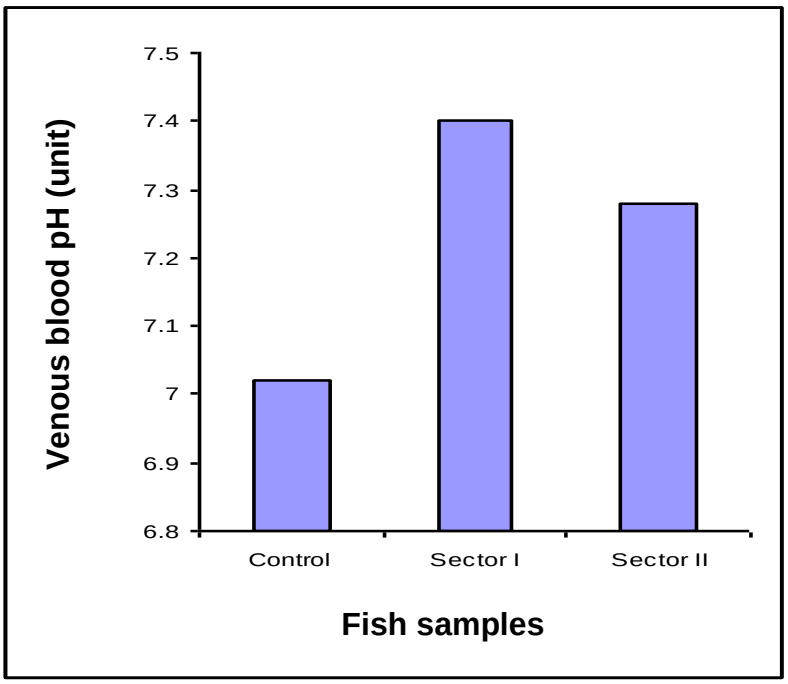

Fig. (33): Venous blood pH (unit) of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

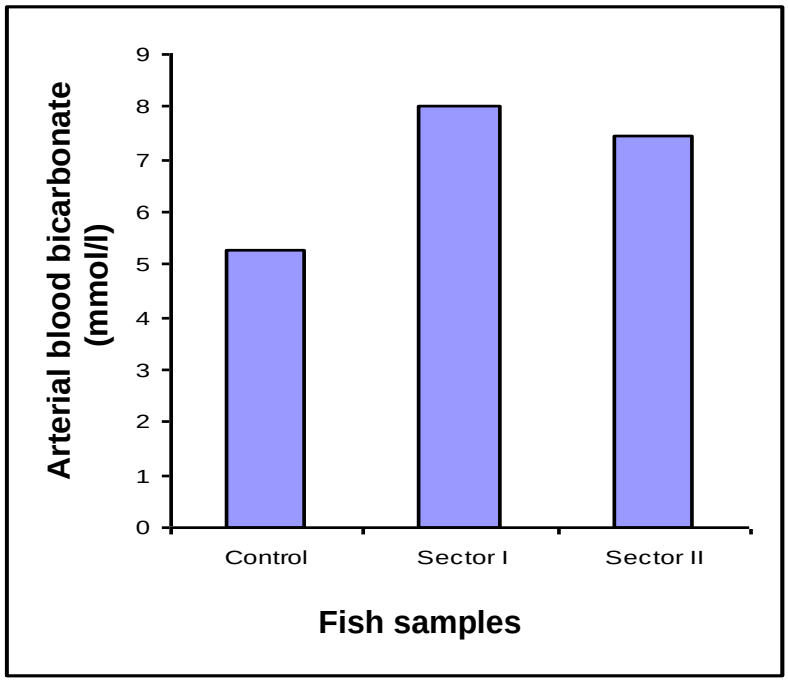

Fig. (34): Arterial blood HCO_3^- mmol/l of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at benofer area respectively).

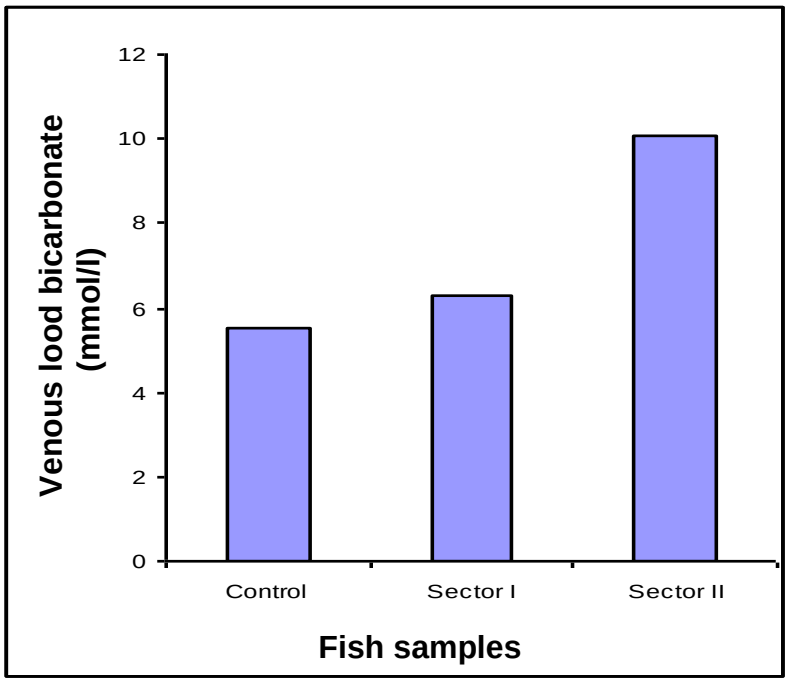

Fig.(35): Venous blood HCO_3^- mmol/l of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

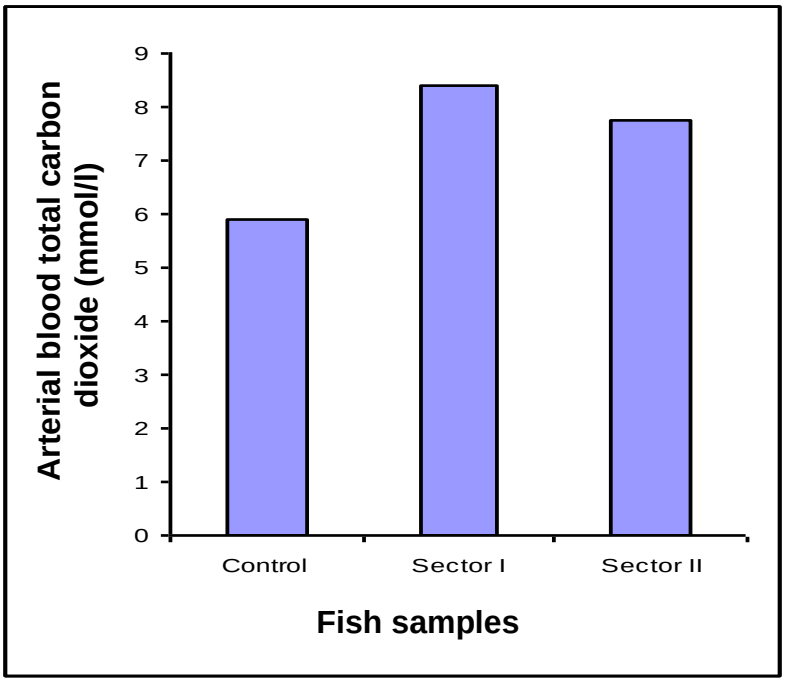

Fig. (36): Arterial blood total CO_2 mmol/l of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

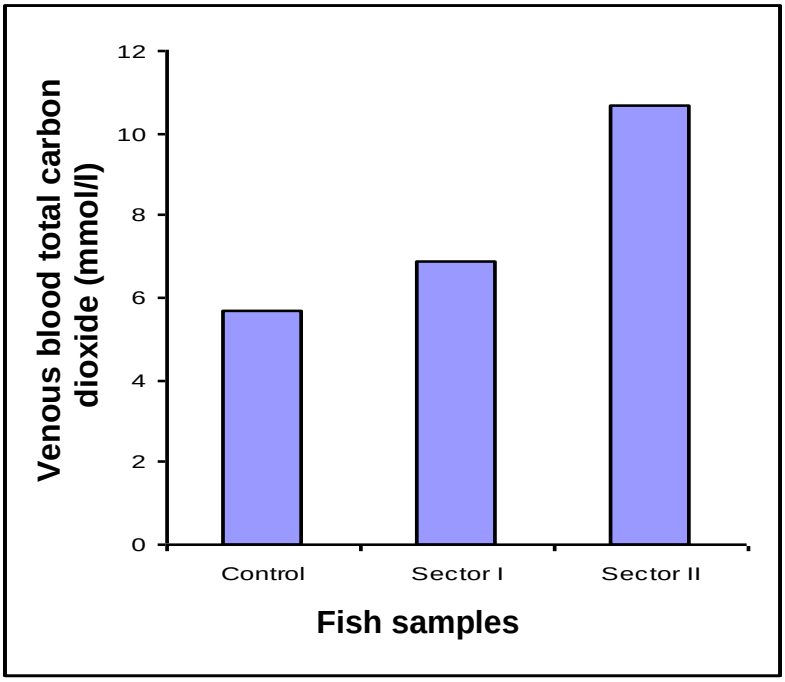

Fig. (37): Venous blood total CO_2 mmol/l of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at benofer area respectively).

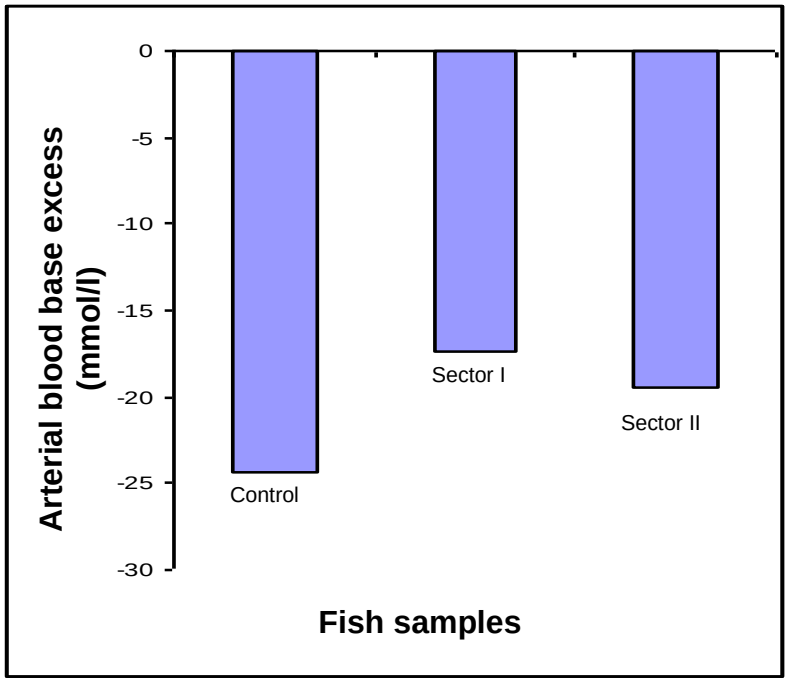

Fig. (38): Arterial blood base excess mmol/l of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at benofer area respectively).

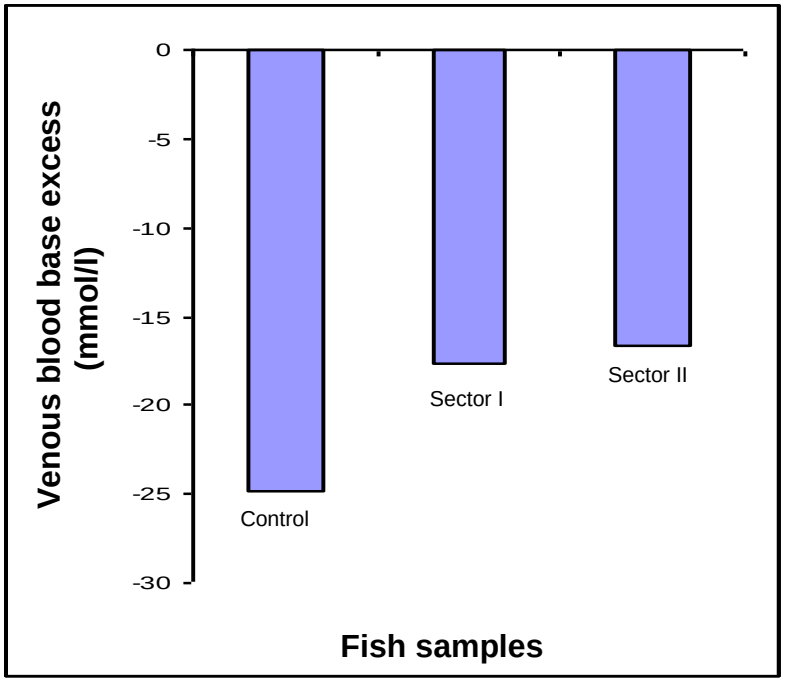

Fig. (39): Venous blood base excess mmol/l of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at benofer area respectively).

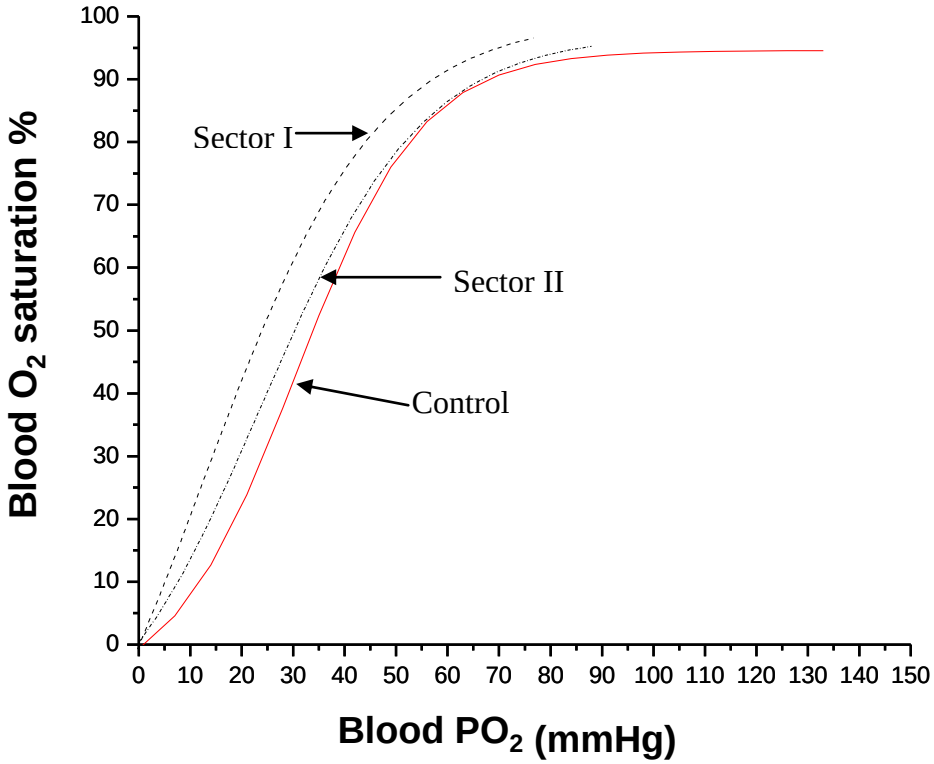

Fig. (40): Blood oxygen equilibrium curves of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at benofer area respectively).

Fig. (31): *Venous*

Table (9): Blood oxygen half saturation pressure (P_{50}) of control fish samples (taken from El-kanater El-khyria) and those of sector I and sector II (taken from downstream Sabal Drainage and industrial region in Kafer El-zyat at Benofer area respectively).

Parameter / Fish samples	Control	Sector I	Sector II
P_{50} (mmHg)	34.11	23.72 ^{A}	30.11 ^{AB}

^{A}: significant difference between the control and any other group (P <0.01).

^{B}: significant difference between sector I and sector II (P <0.01).