Egypt. J. of Appl. Sci., 36 (9-10) 2021 *289-308*

MICROBIOLOGICAL AND PHYSICO-CHEMICAL CHARACTERISTICS OF TAP WATER IN FAYOUM GOVERNORATE, EGYPT

Fatma R.A. Mohamed ; Magda S. Abdalla ;
O.A. Soeudi and Y.M. Hafez
Agric. Microbiology Dept., Faculty of Agriculture, Fayoum University, Egypt.

ABSTRACT

This study was focused on the microbiological and physicochemical evaluation for tap water which collected from six districts namely, Fayoum City, Senoris, Tamiea, Ietsa, Abshway and Youssef El-Sedeek in Fayoum Governorate during summer and winter seasons 2018/2019.

Results indicated that, in general, all tested water samples showed high appearance rate of total bacterial counts (log cfu/ml) at incubation of 37^0C than incubation of 22^0C. The highest bacterial counts were recorded for both incubation at 22^0C and 37^0 C during summer. Total coliform, faecal coliform as well as faecal *Streptococci* were absolutely absent in all tested samples during both seasons. No detectable bacteria (*Staphylococci* sp., *Peudomonas* sp. *Aeromonas* sp., *Salmonella*, sp. *Vibrio* sp., *listeria* sp. , as well as yeast and fungi in all tested water samples.

Also, results showed that, in general, temperature and pH as well as electric conductivity (EC), total hardness , total dissolved salt (TDS) values were fluctuated between 16-34 ^{0}C, 6.7- 7.8, 0.30-0.49 mg/L, 40-60 mg/L.,3.83-31.83 mg/L respectively. In addition, results indicate that, the values of calcium, magnesium, sodium , potassium, chloride and sulphate values were ranged 15.37-35.72 mg/L, 25.19-43.32 mg/L , 16.33- 31.97 mg/L, 6.28- 14.8 mg/L, 29.24- 48.52 mg/L and 55.52- 91.52 mg/L respectively in all tested tap water samples at different location. No carbonate detection in all tested tap water samples except low concentration (0.1mg/L) was obtained in summer in Senoris. The highest and lowest bicarbonate values were recorded in winter in Youssef EL-Sedeek and Senoris respectively.

Also, results indicated that, no ammonia was detected in water samples in winter in Senoris, Tamiea and Youssef EL-Sedeck. The lowest value of ammonia was obtained in winter in Ietsa but the highest value was recorded in summer in Fayoum and Abshway cities.Nitrate concentrations in tap water in summer season ranged (0.01mg/L) and (0.22 mg/L). In winter, nitrate contents ranged between (0.003 mg/L) and (0.09 mg/L) No nitrite content was detected in Fayoum and in Senoris cities in both two seasons. The highest value (0.6 mg/L) was recorded in summer in Abshaway, but the lowest value (0.05 mg/l) was obtained in winter in Abshway too. The highest value of total phosphorus was recorded in summer in Fayoum while the lowest value was observed in winter in Youssef EL-Sedeck. No lead detected in all tested water samples in both seasons except, very low lead concentration (0.007 mg/ml) was detected in Ietsa in summer. No cadmium was detected in all tested water samples in both

seasons of the study. No copper were detected in all water samples under investigation in winter. While in summer, copper values ranged between (0.01mg/L- 0.05 mg/L) and the lowest value was obtained in Fayoum but the highest value was in Abshaway.

Key Words: Classical, new and pathogenic indicators, physico-chemical properties, tap water

INTRODUCTION

Water is one of the most important and most precious natural resources. It is essential in the life of all living organisms from simplest plants and microorganisms to the complex living systems known as human body (**Onifode & Ilori 2008** and **Olajubu & Ogunika 2014**). Man uses water not only for drinking and domestic purposes but also for agriculture, industrial purposes **(EL-Nomerossy, 1978).**

The World Health Organization **(WHO, 2002)** informs that every year more than 3.4 million people die as a result of water related diseases, making it the leading cause of disease and death around the world. Water quality is the physical, chemical and biological characteristics of water in relationship to as set of standards. The primary uses which relate to drinking water, safety of human contact and for health of ecosystem. Interest in water analysis is due to the enormous importance of water to all categories of living things. It is necessary for the healthy development of man, animals and plants (**Singh 2007 and Shareef *et al.*, 2009)**.

Microorganisms play a major role in determining water quality. The dangerous form of water pollution are caused when faecal contaminants like *Escherichia coli* enters the water supply (**Faparusi *et al.*, 2011**), pathogen such as *Salmonella* sp. **,** *Shigella* sp**.,** *Vibrio cholera* and *E.coli* that are shed into water body through faecal contamination perpetuate many diseases (**Muchuweti *et al.*, 2006 , Faparusi *et al.*, 2011**). Others agents of water borne diseases are protozoan that cause diarrhea, *Entamoeb histolytica, Giardia lamblia, Balantidium coli* and *Cryptococcus pervum* (**Kelly *et al.*, 1997**). Other causal organisms are viruses and helminthes (**Raji** and **Ibrahim 2011**).

The main goals of the present study, were to evaluate the microbiological and physicochemical quality of tap water, in Fayoum governorate during two seasons (summer and winter) at 2018/2019.

MATERIALS AND METHODS

Water samples:-

In this study, samples of tap water were collected from six districts namely, Fayoum, Senoris, Ietsa, Tamiea, Abshaway and Youssef EL-Sedek at Fayoum Governorate during summer and winter at 2018/2019. Samples were taken in one liter sterile glass bottle and transported in ice - box. Samples were preserved under cooling conditions at 5°C and the microbiological examination was done within 18 hours. One ml of thiosulphate solution (10%) was added to

the bottle samples of chlorinated drinking water in order to eliminate chlorine residual.

Microbiological determinations:

Water samples used in this study were subjected to analyses for the following microbiological parameters.

Total bacterial count:-

The standard plate count procedure was applied according to the Standard Method for the Examination of Water and Wastewater (**APHA, 1998**) using nutrient agar medium. These plates were incubated at 22^0C for 48 h while the other plates were incubated at 37^0C for 24 h. Then bacterial number of both incubation was calculated.

Classical bacterial indicators:-

Total coliform count:-

The most probable number technique (MPN) was applied to Standard Method for the Examination of Water and Wastewater (**APHA, 1998**).

Three decimals dilutions for each sample in five replicate tubes containing MacConkey broth medium was used. The inoculated tubes were incubated at 37^0C for 48h. Acid and gas production were recorded as positive presumptive test (**APHA, 1998**). For the confirmed test, the positive presumptive tubes were used to inoculate Eosin Methylene Blue agar plates. The metallic sheen colonies considered as a positive confirmed test. Confirmed organisms (typical coliform colonies) were transferred into MacConkey broth and onto agar slants. After incubation at 37^0C for 24-48 h, the production of acid and gas in the MacConkey broth medium and the presence of Gram negative short rods in smears prepared from slants were considered as a positive test. The density of total coliform was calculated by using Swaroop's tables (**Swaroop 1951**).

Faecal coliform count:-

The direct MPN-technique which adopted by **El-Abagy *et al.*, (1980)** was employed and as described by **EL-Hosainey (2010).**

Faecal *Streptococci* count:-

Faecal *Streptococci* counts were determined according to described by **APHA.** (**1998**).

New bacterial indicator:-

***Staphylococci* count:-**

Staphylococcus sp. count was determined according to described in **APHA.** (**1998**).

***Pseudomonas sp*. count:-**

The count of *pseudomonas* sp. of tested water samples on King's B (KB) medium (**King *et al.*, 1954**) by using pouring plates method. Two replicates were incubated for one day at 37 ^{0}C. White colonies were counted.

***Aeromonas* sp.count:-**

One ml of suitable serial dilutions of tested water samples were inoculated onto Phenol Starch Ampicillin agar medium (**Palumbo *et al.*, 1985**).Two plates for each dilution were made, then the plates were incubated at

30 ^{0}C for one day, then yellow colonies having surrounding clear zone were counted.

***Salmonella* sp. count:-**

Poured plate method was used, one ml of suitable serial dilutions of water samples were inoculated onto *Salmonella* and *Shigella* agar medium **(Difco, 1986).** Plates were incubated at 37^{0}C for 48 h. Colonies producing black pigment were count.

***Vibrios sp.* count:-**

Vibrio group was detected in alkaline peptone water (pH 9) as selective medium from tap water (double strength) after incubated at 37^{0}C for 24 hr. (**Kaper *et al.*, 1979).** The confirmed test from the turbid tubes, the plates of Thiosulphate Citrates Bile Salt Sucrose agar medium were streaked and incubated at 37 ^{0}C for 48 hours. Vibrio colony (yellow, smooth, convex and colonies with halo) were counted as vibrio counts.

***listeria sp* count:-**

The standard plate count procedure was applied according to the Standard Method for the Examination of water and wastewater (**APHA, 1998**) using *Listeria* selective agar medium (**Fraser** and **Sperber, 1988).** Two replicates were incubated at 37 ^{0}C for 24 h. Yellow colonies were counted

Yeast and fungi count:-

The count of yeast and fungi of all samples was carried out on Malt Yeast Extract agar medium (**Difco, 1986**) by pouring plates technique. Two replicates were incubated at 30^{0}C for 1-2 days for yeast and for 4-7 days for mowd.

Physico-chemical determination:

Temperature:

Temperature was measured using thermal thermometer at the same place and time of sampling.

PH values:

pH values were determined by using pH meter with a glass electrod (Lsei Bolo Wien type GTT3 11 o55).

Electrical conductivity (EC):

Electrical conductivity (EC) of water samples were measured by using EC meter as (ds/m) according to **Page *et al*., (1982).**

Total hardness:

Total hardness was measured according to Standard Method for the Examination of Water and Wastewater **(APHA, 2012).**

Total dissolved solids (TDS):

Total dissolved solids were determined according to **Page *et al*., (1982)** and described by (**Al-Afify, 2006**).

Mineral content:

Determination of mineral content of the tested water samples was carried out using the technique described by **Page *et al*., (1982)** as follows:

Soluble cations:

Calcium and magnesium were determined by titration, while Sodium and potassium was photometrically determined using Flame – photometer.

Soluble anions:-

Carbonate, bicarbonate^{-} and sulphate were determined by titration with 0.01 N sulphuric acid using phenolphethaline as an indicator for carbonates and methyl orange for bicarbonates. Then chloride was determined using Mohr's method and sulphate by the difference.

Total phosphorus:-

Total phosphorus was calorimetrically measured according to the method described by **Gloterman *et al.*, (1978).**

Ammonia, nitrates, nitrites and heavy metals:

Ammonia, nitrates, nitrites as well as heavy metals normally, lead; cadmium and copper were determined by Laboratory of Biotechnology of Soil and Water, Fac. of Agric. Moshtooher, Benha University, Egypt.

RESULTS AND DISCUSSION

1. Microbiological determinations:-

Total bacterial counts:-

The collected water samples were microbiology evaluated and total bacterial counts were detected at 22^0C and 37^0C. Generally, the obtained results are presented in Table (1) show that, all tested water samples showed high appearance rate of total bacterial counts (log cfu/ml.) at 37^0C than of 22^0C. Among of all water samples of different locations, the highest bacterial counts were recorded for both incubation at 22^0C and 37^0 C during summer. This might be due to the high temperature prevailing during this season.

Table (1): Total bacterial counts in tap water samples of Fayoum Governorate at 2018/2019.

Location of samples	Total bacterial counts (log cfu/ ml.)* at			
	22^0C		37^0C	
	Summer	Winter	Summer	Winter
Fayoum	1.72	0.69	2.26	1.96
Senoris	2.18	1.83	2.32	2.04
Ietsa	1.51	0.69	2.14	1.67
Tamiea	1.66	1.22	2.14	1.91
Abshway	1.31	1.06	2.25	1.68
Youssef El-Sedeek	1.81	1.74	2.12	1.77
Mean	1.70	1.18	2.20	1.84

***Log CFU = Logarithm of (colony forming unit).**

Means of total bacterial counts (log cfu / ml) in summer and winter at 22^0C and 37^0C were 1.70, 1.18, 2.20 and 1.84 respectively. In addition samples of Senoris were the highest in total bacterial counts in both summer and winter at 22^0C and 37^0C than other locations. Whereas, Fayoum and Ietsa were lower in winter at 22^0C than other locations. Similar results were obtained by **EL-Hosainey (2010**) and **Taha (2019).**

Classical bacterial indicators:-

The coliform groups are probably the earliest water pollution to detect faecal pollution and prevalence of pathogenic bacteria in water and wastewater (**APHA, 2005**). The use of indicator bacteria such as faecal coliform and faecal *Streptococci* assessment of faecal pollution and possible water quality

deterioration in fresh water sources is widely used **(Sabae** and **Rabeh, 2007).** Results presented in Table (2) clearly indicated that, total coliform, faecal coliform as well as faecal *Streptococci* were absolutely absent in all tested samples during both seasons (summer and winter).

The same findings were obtained by **Osman (2006)**; **Silva *et al*., (2008)**; **EL-Hosainey (2010)** and **Taha (2019).** So, the **Egyptian Standard (1995)** for drinking water declared that potable water must be free from total and faecal coliform as well as faecal *Streptococci*. According to **Egyptian Standard (1995)** recommendations, it is evident that tap water are completely save for domestic use.

Table (2): The classical bacterial indicators in tap water samples at Fayoum Governorate during 2018 /2019.

Location of samples	Log number of cell forming unit bacterial indicators (MPN-index/100ml.)					
	Total coliform		Faecal coliform		Faecal *Streptococci*	
	Summer	Winter	Summer	Winter	Summer	Winter
Fayoum	ND	ND	ND	ND	ND	ND
Senoris	ND	ND	ND	ND	ND	ND
Ietsa	ND	ND	ND	ND	ND	ND
Tamiea	ND	ND	ND	ND	ND	ND
Abshway	ND	ND	ND	ND	ND	ND
Youssef ESedeek	ND	ND	ND	ND	ND	ND

Notes: ND = not detected

New pathogenic indicators:-

Staphylococci sp, *Peudomonas* sp and *Aeromonas* sp have been recently investigated as a new possible indicators for pollution of aquatic environments (**De Araujo *et al*., 1990**; **Ali *et al*., 2000**; **De Victoria** and **Galvan 2001; Massa *et al*., 2001** and **WHO, 2003).**

Monitoring of various pathogens in water could be used as a tool to assess the health status of the community. *Salmonella* sp., *Vibrio* sp and *Listeria* sp were determined in this study as pathogenic bacteria.

Total yeasts can be used as a useful indicator of pollution, where they had significant correlation with classical bacterial indicators, physico-chemical characters and phytoplankton biomass (**Ali *et al*., 2000**).

***Staphylococci sp., Peudomonas sp.* and *Aeromonas sp.* count:-**

Results of new bacterial indicators of pollution were presented in Table (3) for tested samples collected from tap water at Fayoum Governorate during (2018/2019). *Staphylococci* sp, *Peudomonas* sp and *Aeromonas* sp counts were determined during two seasons (summer and winter). Results clearly show that, there were no detectable bacteria (*Staphylococci* sp, *Peudomonas* sp and *Aeromonas* sp) in all tested water samples. The obtained results are in accordance with **Taha (2019**), in which he reported that, *Pseudomonas aerugninosa* was not detected in all testing samples of Cairo drinking water in Road EL-Farag, EL-Azher and EL-Abasia. Similarly, **Havelaar *et al*., (1990)** as well as **Massa (2001)** did not observe growth of Aeromonads in any of 64 samples of still mineral water examined using the membrane filtration method

while, **Schubert (1991), Gavriel *et al.*, 1998** and **EL-Hosainey (2010)** confirmed the presence of *A.hydrophila* in drinking water along with other Enteropathogens such as *Salmonella* and *E.coli* reflecting contamination of the environment. Although *Staphylococci* are slightly more resistant to chlorine residuals than *E.coli*, their presence in drinking water is readily controlled by conventional treatment and disinfection processes. Since faecal materials are not their usual source, *E.coli* or, alternatively, thermotolerant coliform is not a suitable index for *Staphylococci aureus* in drinking water supplies (**Lechevallier & Seidler 1981**; **Osman 2006** and **EL-Hosainey (2010)**.

Table (3): New indicators counts in tap water samples at Fayoum Governorate during 2018/2019.

Locations of samples	*Staphylococci sp.* (log cfu/ml)*		*Peudomonas sp.* (log cfu/ml)*		*Aeromonas sp.* (log cfu/ml)*	
	Summer	winter	Summer	winter	Summer	winter
Fayoum	ND	ND	ND	ND	ND	ND
Senoris	ND	ND	ND	ND	ND	ND
Ietsa	ND	ND	ND	ND	ND	ND
Tamiea	ND	ND	ND	ND	ND	ND
Abshway	ND	ND	ND	ND	ND	ND
Youssef El-Sedeek	ND	ND	ND	ND	ND	ND

ND = not detected ***Log CFU = Logarithm of (colony forming unit).**

***Salmonella* sp., *vibriosp.* and *listeria* sp.counts:**

Results presented in Table (4) indicated that, no pathogenic bacterial indicators e.g. *Salmonella*, *vibrio* and *listeria* counts were found in all tested samples in tap water during the both two seasons (summer and winter).

Our results are in agreement with **Shaban** and **El -Taweel (2002); Osman (2006)** and **El- Hosainey (2010).**

Table (4) Pathogenic indicators counts in tap water samples at Fayoum Governorate at 2018/2019.

Location of samples	*Salmonella* sp. (log cfu/ml)*		*Vibrio* sp. (log cfu/ml)*		*Listera* sp. (log cfu/ml)*	
	Summer	Winter	Summer	Winter	Summer	Winter
Fayoum	ND	ND	ND	ND	ND	ND
Senoris	ND	ND	ND	ND	ND	ND
Ietsa	ND	ND	ND	ND	ND	ND
Tamiea	ND	ND	ND	ND	ND	ND
Abshway	ND	ND	ND	ND	ND	ND
Youssef El-Sedeek	ND	ND	ND	ND	ND	ND

ND = not detected ***Log CFU = Logarithm of (colony forming unit).**

Yeast and mould counts:-

Regarding to new indicators yeast and mould are very important to evaluate the potential health hazard in drinking water **(Osman, 2006**). Results in Table (5) clearly show that, there was no detectable yeast and mould in all tested samples during both tested seasons. **Hinzelin** and **Block (1985)** examined the mycoflora of chlorinated drinking water of 38 samples, 50% and 81 % were yeast and filamentous mould contaminated respectively.

Table (5) Counts of yeast and mould in tap water samples at Fayoum Governorate during 2018/2019.

Location of samples	Yeast (log cfu/ml)*		Fungi (log cfu/ml)*	
	Summer	Winter	Summer	Winter
Fayoum	ND	ND	ND	ND
Senoris	ND	ND	ND	ND
Ietsa	ND	ND	ND	ND
Tamiea	ND	ND	ND	ND
Abshway	ND	ND	ND	ND
Youssef El-Sedeek	ND	ND	ND	ND

ND = not detected ***Log CFU = Logarithm of (colony forming unit).**

2. Physico-chemical determinations:-

Physico-chemical considered principle tools in identifying the nature, quality and type of water for any aquatic ecosystem. Increased, industry, agriculture urbanization, tourism and human activities are responsible for chemical pollution of water resources **(Abdo, 2005).**

1- Temperature:-

Water temperature plays an important role on bacterial activity, decomposition of organic matter and the solubility of dissolved oxygen. As well as it has a pronounced effect on the rate of phytoplanklon photosynthesis **(Caumette, 1992; Kato, 1994; AL-Afify, 2006; Rashed & Younis, 2012** and **Ezzat *et al*., 2017).**

Results are graphically illustrated in Fig. (1) show that, in general, temperature values fluctuated between 16-34^{0}C and the highest water temperature was recorded during summer season whereas, the lowest value was recorded in winter season in all tested locations. These results are in-harmony with (**EL-Hosainey, 2010; Abdel-Satar *et al*., 2017 and Taha, 2019).**

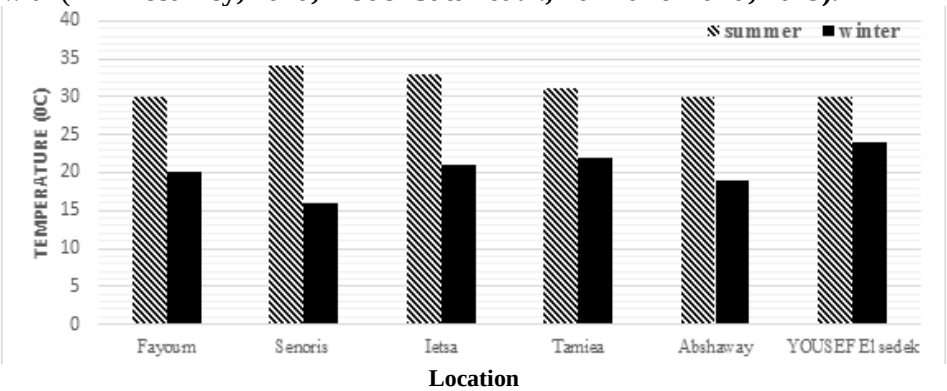

Fig. (1) Temperature of tap water samples at Fayoum Governorate during 2018/2019.

In addition, results presented in Fig. (1) show that, the highest value was in summer in Seniors (34^{0}C) followed by Ietsa (33^{0}C), Tamiea (31^{0}C),

Fayoum(30) Abshway (30^0C) and Youssef –EL-Sedeek (30^0C) respectively. Whereas, the lowest value was in winter in Seniors (16^0C), followed by Abshway (19^0C), Fayoum (20^0C), Ietsa (21^0C), Tamiea (22^0C) and Youssef EL-Sdeek (24^0C) respectively.

pH values :-

pH is affected not only the reaction of carbon dioxide but also ,by organic and inorganic solutes present in water **(Abo-State *et al*., (2016).**

Fig. (2) Illustrated the pH values in tap water during 2018/ 2019. pH varied between 6.7 –7.8. The highest value was in Yossef EL- Sedeek in summer but the lowest value in Fayoum for both in summer and winter seasons was recorded. The pH value of water samples was comparable to standard pH values (6 - 8.5) recommended by **WHO, (1996**).

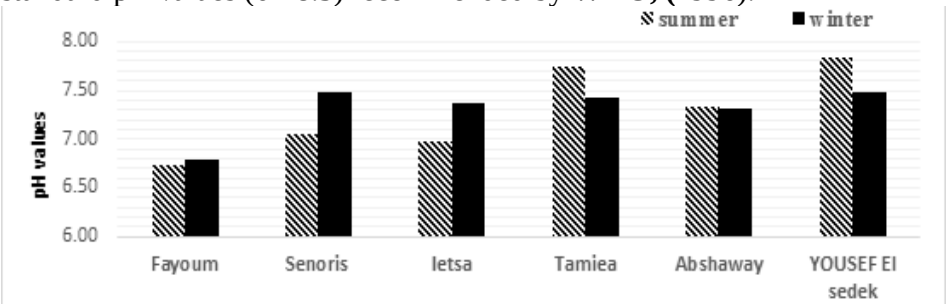

Fig. (2) pH values in tap water samples at Fayoum Governorate during 2018/2019.

Electrical conductivity (EC):-

Electrical conductivity is used as an indicator of water ability to carry electric current **(Mara and Horan, 2003).** EC measurements of the tap water samples under investigation are shown in Fig.(3).The minimum value was 0.30 ds /cm. in winter in Senoris, and the maximum value was 0.49 ds/cm. in summer in Fayoum. This result goes in line with those obtained by **Hamed *et al.*, (2003).**

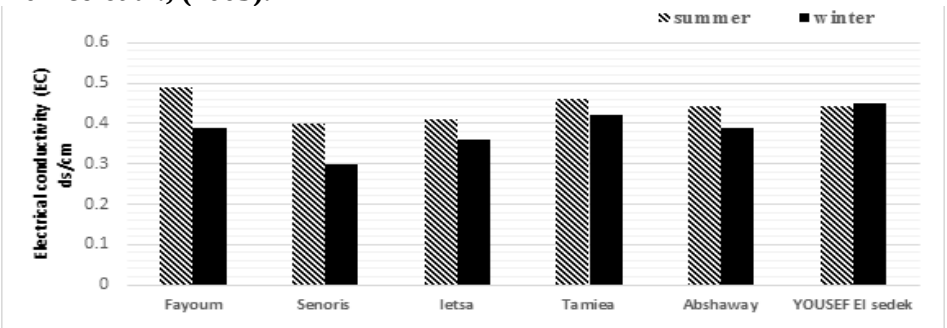

Fig. (3) Electrical conductivity (EC) in tap water samples at Fayoum Governorate during 2018/2019

Total hardness:-

Water hardness is mainly caused by the presence of calcium and magnesium and is expressed as the equivalent quantity of calcium carbonate. Fig. (4) Illustrated the results of total hardness in tap water during 2018/2019. The total hardness values in tap water varied between 40-63 mg/l. The lowest total hardness was in winter in Senories while the highest value was in winter in Youssef El-Sdeek.

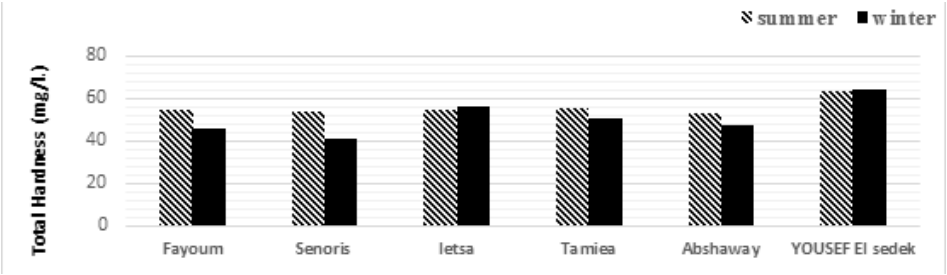

Fig.(4) Total hardness in tap water samples at Fayoum Governorate during 2018/2019 ..

Total dissolved solids (TDS):-

Total dissolved solids (TDS) indicate the degree of dissolved substances such as metal ions in the water. Dissolved substances may be organic and inorganic in nature and many are undesirable and produce displeasing colour, taste and odour and may also, exert osmotic pressure that affects aquatic life or become carcinogenic especially halogenated compounds **(Ayers and Westcott, 1985).** Results illustrated in Fig. (5) indicated that, in general TDS values fluctuated between 3.83-31.83 mg/l and the highest TDS were recorded during summer season whereas, the lowest value was recorded in winter season in all tested locations. These findings come to support the results of **Taha,** (**2019).**

Also, results indicated that, the highest values of TDS was obtained in summer in Ietsa while the lowest value was observed in winter in Ietsa too.

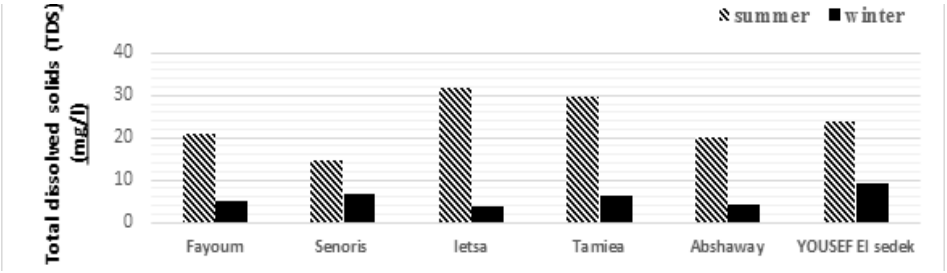

Fig.(5) Total dissolved sdids in tap water samples at Fayou Governorate during 2018/2019 .

Mineral contents:-

Soluble cations:-

Variation of calcium concentrations of tap water samples in the various locations under investigation is shown in Table (6). The values of calcium in all tested tap water samples at different location were ranged from 16.37 mg/l to 25.72 mg/l .The highest and lowest values were recorded in winter at Youssef EL-Sedeck and Senoris respectively. These results come to support finding of **Abdel Magid (2010)**

Table (6) Calcium, Magnesium, Sodium and Potassium concentrations in tap water at Fayoum Governorate at 2018/2019.

Locations of samples	Calcium (mg/l)		Magnesium (mg/l)		Sodium (mg/l)		Potassium (mg/l)	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Fayoum	21.71	18.37	43.32	33.67	31.97	24.61	10.23	8.28
Senoris	21.45	16.37	30.55	25.19	25.19	17.83	10.62	6.28
Ietsa	21.71	22.45	40.54	36.52	29.82	22.46	8.54	12.45
Tamiea	22.05	20.24	35.51	31.49	23.69	16.33	7.56	11.47
Abshaway	21.05	19.04	38.53	34.51	27.91	20.55	7.95	11.86
Youssef-ELSedek	25.39	25.72	34.51	35.85	28.21	24.69	8.08	14.08

Concerning to magnesium concentrations in tested tap water samples, also, results are presented in Table (6). The results show that, magnesium content ranged from 25.19 mg/l. to 43.32 mg/l. The highest value was in summer in Fayoum, while the lowest one was in winter in Senoris. These results are in agreement with (**Khalil *et al.*, 2013).** Regarding to sodium concentration, in all tap water samples in the different locations under this study results in Table (6) clearly show that, sodium value was higher in summer than in winter. The highest value was recorded in Fayoum (31.97 mg/l.) in summer, whereas, the lowest value was obtained in winter in Tamiea (16.33 mg/l.).These results are agreement with **AL-Afify and Aly 2019).**

In this respect to potassium, results presented in Table (6) showed that, the high potassium value was obtained in summer in only Fayoum and Senoris. In addition, results indicate that, the highest value was recorded in winter in Youssef EL-Sedeck while the lowest value was obtained in winter in Senoris.

Soluble anions:-

Results presented in Table (7) revealed that the minimum value of chloride was 29.24 mg/l. in winter in Senoris and the maximum value was 48.52 mg/l. in summer in Tamiea. These results are in good agreement with recently published results by **Ahmed** and **Ali (2009**) and **EL-Hosainey (2010).**

With respect to Sulphate, results showed that, in general, the concentration of sulphate in the tested tap water samples ranged from 55.52 mg/l. to 91.52 mg/l. in summer, while in winter it was 29.32 mg/l to 46.61 mg/l. Also, results indicated that, the highest concentration of sulphate was found in water samples in summer in Fayoum city but the lowest concentration was obtained in water samples in winter in Senories. According to **WHO, (2011)** the sulphate concentrations of the tested tap water samples were below WHO

permissible limits. In addition, these results are a contrary with what found by **Khalil *et al.* (2013)** and **Goher *et al*. (2014).**

Table (7) Chlored, sulphate, carbonate and bicarbonate content in tap water samples at Fayoum Governorate during 2018/2019.

Locations of samples	Chloride (mg/l)		Sulphate (mg/l)		Carbonate (mg/l)		Bicarbonate (mg/l)	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Fayoum	46.74	39.09	91.52	46.61	0.00	0.00	101.67	109.87
Senoris	32.66	29.24	63.84	29.32	0.10	0.00	97.80	95.84
Ietsa	39.64	39.68	55.52	30.93	0.00	0.00	110.82	110.89
Tamiea	48.52	47.37	64.64	41.41	0.00	0.00	115.90	124.10
Abshaway	43.78	41.46	68.00	39.73	0.00	0.00	105.73	113.94
Youssef-ELSedek	41.42	51.13	70.40	38.54	0.00	0.00	108.78	137.67

In addition, result show that, no carbonate detection in all tested tap water samples except low concentration (0.1mg/l.) was obtained in summer in Senoris. With regard to bicarbonate concentration results show that, the highest and lowest bicarbonate values were recorded in winter in Youssef EL-Sedeek and Senoris respectively.

Ammonia, nitrate and nitrite content:-

Ammonia is present in water as a result of the biological degradation of nitrogenous organic matter. Increasing in ammonia concentrations in a water resource is usually attributed to organic pollution resulting from domestic sewage and fertilizers run off the toxicity of which is pH dependent **(Chapman,1992).**

Results presented in Table (8) show that no ammonia was detected in water samples in winter in Senoris, Tamiea and Youssef EL-Sedeck. Also, results indicated that, the lowest value of ammonia was obtained in winter in Ietsa but the highest ammonia value was recorded in summer in Fayoum and Abshway cities. These results was less the maximum permissible level of **WHO (1996**) for drinking water. Nitrate is the major nitrogenous compounds in the aquatic environment. The behavior of nitrate is important in the nitrogen metabolism in natural water (**Seike *et al*., 1990)**. Its behavior may be attributed to the biological, chemical or physical factors. Nitrate is the final oxidation product of nitrogen compounds in aquatic environment. At the sometime, nitrate in generally considered the only thermodynamically stable form of nitrogenous compounds in presence of oxygen (**Horan, 1972)**.

Table (8) Ammonia, nitrate and nitrite content in tap water samples at Fayoum Governorate during 2018/2019.

Location of samples	Ammonia (mg/l)		Nitrate (mg/l)		Nitrite (mg/l)	
	Summer	Winter	Summer	Winter	Summer	Winter
Fayoum	0.08	0.07	0.22	0.09	ND	ND
Senoris	0.05	ND	0.07	0.04	ND	ND
Ietsa	0.02	0.007	0.01	0.08	0.10	0.10
Tamiea	0.04	ND	0.20	0.01	0.30	0.20
Abshway	0.08	0.05	0.02	0.003	0.60	0.05
Youssef El-Sedeek	0.30	ND	0.06	0.03	0.30	0.20

ND = not detected

Results presented in Table (8) show that, nitrate concentrations in tap water in summer season were ranged between 0.01mg/l. and 0.22 mg/l. In winter, nitrate contents ranged between 0.003mg/l. and 0.09 mg/l. Also, results indicated that the highest nitrate value was in summer in Fayoum while, the lowest value was in winter in Abshaway. The concentrations of nitrate in tap water at Fayoum Governorate was below the maximum permissible limit of **WHO (2006**) for human drinking water.

Regarding, nitrite is an intermediate oxidation state of nitrogen, both in the oxidation of ammonia to nitrate and in the reduction of nitrate. Such oxidation and reduction occur in wastewater treatment plants, was distribution systems and natural water **(WHO, 1995)**. Results presented in Table (8) indicated that, no nitrite content was detected in Fayoum and in Senoris cities in both two seasons (summer and winter).The highest value (0.6 mg/l) was recorded in summer in Abshaway, but the lowest value (0.05 mg/l) was obtained in winter in Abshway too.

Total phosphorus

The presence of phosphorus in water is considered a growth limiting factor activating the propagation of microorganisms and phytoplankton **(Al-Zidany, 2006).** Results of phosphorus values are illustrated in Fig (6). Results, in general, indicated that, the total phosphorus values recorded its highest value during summer in all tested locations. These results are a contrary with what found by **EL-Hosainey, (2010).**

In addition, the highest value was recorded in summer in Fayoum while the lowest value was observed in winter in Youssef EL-Sedeck.

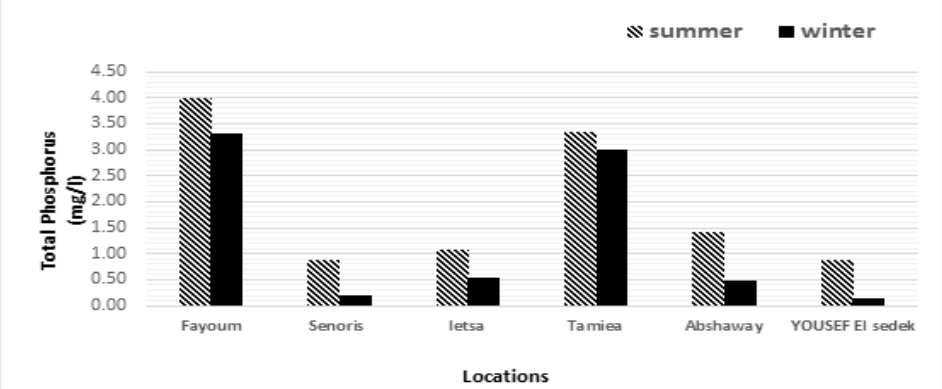

Fig. (6) Total Phosphorus (TP) in tap water samples at Fayoum Governorate during 2018/2019.

Heavy metals:-

Heavy metals are naturally found in water at low concentrations, but the sewage, industrial wastewater discharge and atmospheric deposition cause an increase in their concentrations. Lead, cadmium and copper are the most common metals found in aquatic habitats.

Table (9) presented the results of lead, cadmium and copper contents in tap water samples at Fayoum Governorate during the two seasons of the study (summer & winter) during 2018/2019.

Regarding the lead concentration, results indicate that, no lead detected in all tested water samples in both seasons (summer and winter) except, very low lead concentration (0.007 mg/ml.) was detected in Ietsa in summer. Similar results were demonstrated by **Taha, (2019)** who recorded that no lead was detected in water samples of EL- Abasia region, Very low lead concentrations were detected is some water samples that withdrawn from the distribution system of Road EL- Farag and EL-Azhar regions. According to **WHO (2000)** guidelines for human drinking water pb concentration should not exceed 0.05 mg/l. Lead in drinking water as a result of its dissolution from natural sources, rather, its presence is primarily from household plumbing system containing lead in pipes, solder, fittings or the service connection to houses. The amount of lead dissolved from the plumbing system depended on many factors such as temperature, standing time of the water and water hardness **(WHO, 2008).**

In respect to cadmium values (Table, 9) show that, no cadmium was detected in all tested water samples in both seasons (summer & winter) of the study. It is worthy to mention in this respect that cadmium (Cd) concentration which is health significance in human drinking water as recommended by **WHO (2006)** is 0.003 mg/l. and should not exceed 0.01 mg/l.

Table (9) Lead, cadmium and copper content in tap water samples at Fayoum Governorate during 2018/2019.

Location of samples	Lead (mg/l)		Cadmium (mg/l)		Copper (mg/l)	
	Summer	Winter	Summer	Winter	Summer	Winter
Fayoum	ND	ND	ND	ND	0.01	ND
Senoris	ND	ND	ND	ND	0.03	ND
Tamiea	ND	ND	ND	ND	0.02	ND
Ietsa	0.007	ND	ND	ND	0.04	ND
Abshway	ND	ND	ND	ND	0.05	ND
Youssef El-Sedeek	ND	ND	ND	ND	0.02	ND

ND = not detected

Also, results in Table (9) show that, no copper was detected in all water samples under investigation in winter. While in summer, the results indicate that copper values ranged between (0.01mg/l. - 0.05 mg/l.) and the lowest value was 0.01 mg/l. in Fayoum but the highest value was in Abshaway (0.05 mg/ml). According to **WHO (2000)** guidelines for human drinking water Copper (Cu) concentration should not exceed 1.0 mg/l. The results of the present work agree with **Taha, (2019).**

REFERENCES

Abdel-Magid, H. (2010). Situation analysis of bottled drinking water quality in Sudan. J. Soil Sci. and Agric. Engi. Mansoura Univ.,1 (9): 949-956.

Abdel-Satar, A.M. ; M. H. Ali and **M.E. Goher (2017).** Indices of water quality and metal pollution of Nile River, Egypt. Egypt. Aqua. Res., 43 (1): 21-29.

Abdo, M.H. (2005). Physico-chemical characteristics of Abu Za' baal Ponds, Egypt. Egyptian J. of Aquatic Research. 31: 1-15.

Abo-Satate, M.A.M. ; M.S. EL-Gamal and **M.M. Ibrahim (2016).** Assessment of physico-chemical and water borne pathogens of water plants in Kafer-El-Sheikh Governorate, Egypt.Int. J. Adv. Res. Biol. Sci., 3 (8):226-240.

Ahmed, A.H. and D.S. Ali (2009). Investigation of chemical and radioactive contamination level of the drinking water resources in Erbil City. J. Environ. Studies, 1:9-18**.**

AL-Afify, A.D.G.D.(2006). Biochemical studies on River Nile pollution. M.Sc. Thesis in Agric. Biochemistry, Fac. of Agric., Cairo University, Egypt.

AL-Afify, D.G. and M.Y.M. Aly (2019). Application of Nile chemical pollution index to evaluate the quality of water for drinking and agricultural purposes on Bahr Yusuf Branch, River, Egypt. **E**gyptian J. Aquatic Biolo. and Fishers, 23 (1): 367-379.

Ali, G.H.; G.E. EL-Taweel ; M.M. Ghazy and M.A. Ali (2000). Microbiological and chemical study of the River Nile water quality. Inter. J. Environ. Studies, 58:47- 69.

AL-Zidany, A.A.(2006). Microbiological quality of some water resources used in drinking agricultural purposes and food processing in Libya. Ph.D. Thesis of Environ. Sci. Institute of Environ. Studies & Res. Ain Shamis University.

APHA, (1998). American Public Health Association, Standard Methods for the Examination of Water and Wastewater. (19th ed.)Washington, D.C.

APHA (2005). American Public Health Association, Standard Methods for Examination of Water and Wastewater (21st ed.)Washington, D.C.

APHA (2012). Standard Methods for Examination of Water and Wastewater, APHa, WEF and AWWA, Washington, DC, USA, 22th ed.

Ayers, R.S. and D.W. Westcott (1985). Water quality for agriculture. In: FAO, Irrigation and Drainage, p.29, rev.1, pp.1-83.

Caumette, P.(1992). Bacterial communities in costal lagoons. A overview. Vie Milieu 42: 111-123.

Chapman, D. (1992). Water quality assessments: A guide the use of Biota, Sediments and water .Environmental Monitoring, zed UNESCO, WHO, MNEP. E&FN Spon, London, U.K.

De-Araujo, M. A.; V. F.Guimaraes ; L. C. Mendonca- Hagler and A. N. Hagler (1990). *Staphylococcus aureus* and faecal *Streptococci* in fresh and marine waters of Rio De Janeiro, Brazil. Rev. Microbiol., 21(2): 141-147.

De-Victoria, J. and M. Galvan (2001). *Pseudomonas aeruginosa* as an indicator of health risk in water for human consumption. Wat. Sci. and Technd.,43(12): 49-52.

Difco Manual of Dehydrated Culture Media and Reagent for Microbiology (1986). Tenth Edition, 1985 Difco Laboratories, Detroit, Michigan, U.S.A.

Egyptian Standards (1995). Minister's Office, Egyptian Standards for Potable Water, Dissection No. (108) Approved at 26 /2/ 1995.

EL-Abagy, M.M.; EL-Zanfoly and S. EL- Hawary (1980). Direct MPN for faecal coliform. Zbl.Bakt. II.Abt., 135 (5): 396-401.

EL-Hosainey, M.A.(2010). Microbiological studies on water pollution in Dakahlia Governorate. Ph.D. Thesis in Agric. Microbiol., Fac. of Agric., Benha University, Egypt.

EL-Nomrossy, A.M.Z. (1978). Biochemical studies on some water supplies in A.B.E. M.Sc. Thesis in Agric. Biochemistry, Fac. of Agric., Cairo University, Egypt.

Ezzat, S.A.; M.T. Mosustafa ; A. Fouda ; M.S. EL-Gamal and I.A. Mohammed (2017). Assessment of some drinking water putification plants efficiency at Great Cairo in Egypt. Current Sci. Int., 6 (4): 761-776.

Faparusi, F.; H. Ayedun and M.M. Bello-Akinosho (2011). Microbial and physicochemical properties of ground water of Ilaro South West Nigeria. Int. J. Bio. Sci., 5(2): 500-502.

Fraser, J.A. and W.H. Sperber (1988). Rapid detection of Listeria spp. In food and environmental samples by esculin hydrolysis. J. Food Prot., 51(10):762-765

Gavriel, A.A.; J.P.B. Landre and **A.J. Lamb (1998).** Incidence of mesophilic *Aeromonas* within a puplic drinking water supply in north-east Scotland. J. Appl. Microbiol., 84 (3):383-392.

Gloterman, H.L.; R. S. Clymo and M.A.M. Ohnstad (1978). Methods for physical and chemical analysis of fresh water .2nd .IBP and Hand Book No.8.Black well Scientific Publications.

Goher, M.E.; A.M. Hassan ; I.A. Abdel-Moniem ; A.H. Fahmy and S.M. El- Sayed (2014). Evaluation of surface water quality and heavy metal indices of Ismailia canal, Nile River, Egypt. Egypt. J. Aquatic Res., 40 (3):225-233.

Hamed, Y. ; M. Person and R. Berdtsson (2003). Soil solution electrical conductivity measurements using different dielectric techniques. Soil Sci. Soc. Am. J., 67 (4): 1071-1078.

Havelaar, A.; **A. Toorop-Bouma and G. Medema (1990).**The occurrence and significance of *Aeromonas* in water with special reference to natural mineral water. Rivista Italiana di' lgiene., 50: 349-356.

Hinzelin, F. and J. C. Block (1985). Yeast and filamentous fungi in drinkin water. Environ. Technol. Letters, 6:101-106.

Horan, R.A**. (1972).** Marine Chemistry. Wiley Interscience, London, New York.

Kaper, J.; H.Lockman ; R.R. Colwell and S.W. Joseph (1979). Ecology, serology and enterotoxin production of *Vibrio cholera* in Chesapeake Bay. Appl. Environ. Microbiol, 37 (1): 91-103.

Kato, K. (1994). Planktonic bacterial DNA and RNA synthesis from algal extracellular products in a cutrophyc lake. FEMS Microb. Ecol., 15 (3):291-298.

Kelly, A.; P. Baboo ; M. Ndubani ; P. Nchito ; N.P. Luo ; N.P. Okeowo and M.J. Ferthing (1997). Cryptosporidiosis in adult in Lukasa, Zambia and its relationship to Oocyst contamination of drinking water. J. Infections Dis., 176 (4): 1120- 1123.

Khalil, M.A.; Z. E.Salem ; S. F. Gheda and M. M. EL-Sheekh (2013). Quality assessment of drinking water in Tanta city, Egypt. J. of Environ. Sci. and Eng., 2 (5B):257-275.

King, E.O.; M.K. Ward and Raney, D.E. (1954). Two simple media for the demonstration of pyocyanin and fluorescin. Journal of Laboratory and Clinical Medicine., 44 (2):301-307.

Lechevallier, M.W. and R.J. Seidler (1981). *Staphylococcus aureus* in rural drinking water. Appl. Environ. Microbiol., 39 (4): 739-742.

Mara, D. and N. J. Horan (2003). The Handbook of water and Wastewater Microbiology. Academic Press London, U.K.

Massa, S.; C. Altieri and A. D. Angela (2001). The occurrence of *Aeromonas spp*. In natural mineral water and well Water. Int. J. Food Microbiol., 63 (1-2): 169-173.

Muchuweti, M.; J.W. Birkelt ; Zvanya E. Chinyanga ; M.D. Scrimshaw and J.N. Lestes (2006). Heavy metal content of vegetables irrigation with mixtures of wast water and sewage sludge in Zimbabwe Implications for Human Health, Agric. Ecosystem and Environ., 112(1): 41-48.

Olajubu, F. A. and O.F. Ogunika (2014). Assessment of the physic-chemical and microbiologicl properties of Borehole water samples from Akungba-Akoko, Ondo State, Nigeria. Inter. J. Pharma Sci. and Res. (IJPSR)., 5(7):367-373.

Onifade, A. K. and R. M. llori (2008). Microbiological analysis of sachet water vended in Ondo state, Nigeria. Environ. Res. J., 2: 107-110.

Osman, G.O.A. (2006). Studies on the microbial pollution indicators in water. Ph.D. Thesis, Agric. Microbiol. Dept., Fac. of Agric. Ain Shamis Univ., Egypt.

Page, A. L.; R. H. Miller and D. R. Keeney (1982). Methods of Soil Analysis, 2nd. Ed. Agron.No.9. Am. Soc. Agron., Madison, pp.242-322.

Palumbo, S.A. ; F. Maxino ; A.C. Williams ; R.L. Buchanan and W. Donald (1985). Starch –ampicillin agar for quantitative detection of *Aeromonas hydrophila*. Appl. and Environ. Microbiol., 50 (4): 1027-1030.

Raji, M.I.O. and Y.K.E. Ibrahim (2011). Prevalence of water borne infections in North West Nigeria. Retrospective study J. Public Health and Epidemiology, 3(8):382-385.

Rashed, M. N. and M. Younis (2012). Physico-chemical and bacterial characteristics of water quality in three villages west of lake Nasser, Egypt. Clean- Soil Air Water., 40: (11): 1229-1235.

Sabae, S.Z. and **S.A. Rebeh (2007).**Evaluation of the microbial quality of the River Nile waters at Damietta branch, Egypt. Egyptian J. Aquatic. Res., 33(1):301-311.

Schubert, R.H.W. (1991). Aeromonads and their significance as potential pathogens in water. J. Appl. Bacteriol. Supplement, 70:1315-1323.

Seike, Y.J.; K. Kondo ; H. Hashihitani ; M. Okumura ; K. Fujinaga and Y. Date, (1990). Nitrogen metabolism in brackish Lake Nakanoumi .IV: Seasonal of nitrate – nitrogen Jpn. J. Limol., 51(3):137-147.

Shaban, A.M. and G.E. EL-Taweel (2002). Fate of new indicators of pollution and pathogenic bacteria during water treatment systems. Egypt. J. Microbial., 37 (1): 57-69.

Shareef, K.M.; S.G. Muhamed and N. M. Shekhani (2009). Physical and chemical status of drinking water from water treatment plants on Greater Zap River. J. Appl. Sci. Environ. Manage., 13(3): 89-92.

Silva, M.E.Z.; R.G. Santana ; M. Guilhermetti ; I.C. Filho ; E.H. Endo ; T.U. Nakamur ; C.V. Nakamura and B.P.D. Filho (2008). Comparison of the bacteriological quality of tap water and bottled mineral water. Int. Hyg. Environ. Health, 211:504-509.

Singh, Naveen K. (2007). Chemical analysis of ground water collected from different areas of Antiri and some nearly villages, Gwalior (MP) Current World, Environ., 2 (1): 73-75.

Swaroop, S. (1951). The range of variation of the most probable number of organisms estimated by the dilution method. Indian J. Med. Res., 39 (1):107-134.

Taha, M.M. (2019). Microbiological studies during the different treatmentsof driking water in Road EL-Farag station. M. Sc. Thesis, Agric. Microbiol. Deprt. Fac. of Agric. Benha Univ., Egypt.

WHO, (1995). World Health Organization, Guidelines for drinking water quality, vol 1, Recommendation.

WHO, (1996). Guidelines for Drinking Water Quality, Recommendation vol. 1, 3rd ed. World Health Organization, Geneva.

WHO, (2000). The world health report 2000: health systems: improving performance. World Health Organization.

WHO, (2002). Heterotrophic plate count measurement in drinking water safety management. Report of an expert meeting, Geneva, world Health Organization

WHO, (2003). Guidelines for drinking water quality, 3rd edition draft, Chapter 7, World Health Organization, Geneva.

WHO, (2006). Annual Water Quality Report Municipal Utilities Board of Albertville, 210 West Main Street, Albertville, AL 35950.

WHO, (2008). Water quality, Guidelines, standard and healthy. World Health Organization, Geneva.

WHO (2011). Guidelines for Drinking Water Quality 4th ed. Vol.3: Recommendations. World Health Organization, Geneva.

الخصائص الفيزيقية والكيميائية والميكروبيولوجية لمياة الشرب فى محافظة الفيوم

فاطمة رمضان عبدالله محمد – ماجدة سليمان عبدالله – أسامة عبد التواب سعودى – ياسر محمد حافظ

قسم الميكروبيولوجية الزراعية – كلية الزراعة – جامعة الفيوم – مصر .

تمت هذة الدراسة بهدف نقييم بعض الخصائص الفيزيقية والكيميائية والميكروبيولوجية لمياة الشرب (مياة الصنبور) محافظة القيوم حبث تم جمع غينات المياة من ست مراكز بالمحافظة وهم مركز الفيوم – سنورس – طامية – اطسا–ايشواى – يوسف الصديق خلال فصلى الصيف والشتاء وقد أوضحت النتائج بصفة غامة ارتفاع أعداد البكتريا الكلية لعينات المياة المختبرة المحضنة على درجة حرارة 37 درجة مئوية عن تلك المحضنة على درجة حرارة 22 درجة مئوية وكانت أعلى الاعداد خلال فصل الصيف لكلا من العينات المحضنة على 22 و37 درجة مئوية . وقد أوضحت النتائج أيضا عدم وجود أعداد من بكتريا القولون الكلية وبكتريا القولون البرازية والبكتريا السبحية البرازية فى كل العينات المختبرة سواء فى فصل الصيف او الشتاء وكذا عدم وجود اعداد من كلا من البكتريا الاتية وكذا الخمائر والفطريات

sp., *Staphylococci sp.*, *Pseudomonas sp. Aeromonas sp. Salmonella Vibrio sp.* and *Listeria sp.*

فى كل عينات المياة المختبرة فى كل من الفصلين (الصبف – الشتاء) وقد أوضحت الدراسة أيضا درجة الجرارة – درجة pH درجة التوصبل الكهربى – درجة عسر المياة – المواد الصلبة الكلية – الكالسيوم – المغنسيوم– الصوديوم – البوتاسيوم –الكلوريد والسلفات لعينات المياة المختبرة تتراوح مابين (16– 34 درجة مئوية) – 6.7 – 7.8–ds/cm. – (35 .0 – 49 .0) – (40 – 60 ملجم / لتر) –(3.83 – 31.83 ملجم / لتر) – (16.37 – 25.72 ملجم / لتر) – (35.19 – 43.32 ملجم / لتر) –(16.33 – 31.97 ملجم / لتر) –(29.24 – 48.02 ملجم / لتر) –(55.52 – 91.52 ملجم/ لتر) على النرنيب . عينات المباة المختبرة خالية من الامونيا فى قصل الشتاء فى كلا من سنورس – طامية – يوسف الصديق وكانت أقل قيمة للامونيا فى اطسا فى فصل الشتاء بينما سجلت أعلى قيمة فى قصل الصيف فى الفيوم وابشواى. تراوحت قيم النترات لعينات المياة المختبرة فى فصل الصيف مابين(0.01 – 0.22 ملجم / لتر) بينما كانت فى فصل الشتاء مابين (0.003– 0.09 ملجم / لتر) . لوحظ أيصا عدم وجود نيتريت

فى عينات المياة المختبرة فى الفيوم وسنورس فى كلا من قصلى الصيف والشتاء وكانت أعلى قيمة فى قصل الصيف فى ابشواى بينما ظهرت أقل قيمة فى فصل الشتاء فى ابشواى أيضا. سجلت أعلى قيمة للفوسفورالكلى فى فصل الصيف فى الفيوم بينما أقل قيمة لوحظت فى فصل الشتاء فى يوسف الصديق . كذا لم يلاحظ الحديد فى كل عينات المياة المختبرة فى كلا من القصلين (الصيف – الشتاء) باستثناء وجود تركيز قليل جدا (0.007 ملجم/ لتر) فى اطسا فى فصل الصيف . لم يلاحظ وجود عنصر الكادميوم فى كل عينات المياة المختبرة فى كلا من القصلين . أما بالنسبة لعنصر النحاس لم يلاحظ وجودة فى جميع عينات المياة المختبرة فى فصل الشتاء بينما كانت تراوحت القيم مابين (0.01 –0.05 ملجم/ لتر) وكانت أقل قيم لوحظت فى الفيوم ،اعلى قيمة فى ابشواى.