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Bacterial Counts and Physicochemical Profile of Wastewater in some Cities at El Gharbia Governorate, Egypt

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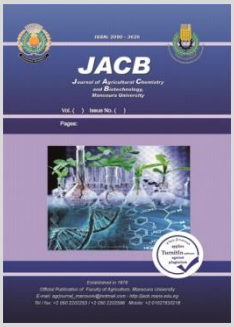

ABSTRACT

Present study aimed to assess the bacterial counts and physicochemical profile of wastewater in some cities (Tanta, El mehala Elkobra, Mahlet Abo Ali, Sammanod and Mahlet Roh) at El Gharbia Governorate, Egypt during four seasons (summer, spring, winter and autumn). The current work was done in wastewater samples for determination of total bacterial counts. The microbiological studies of wastewater showed that the highest number of total bacteria counts were found on summer season at El mehala Elkobra. The physicochemical properties of wastewater were tested to evaluate its suitability for the intended purpose. The physical parameters of wastewater indicated that the color is grey to black and temperature 29ºC in summer at all cities except Mahlet Abo Ali and Mahlet Roh. Results of chemical parameters of the wastewater samples showed that slight variation between different sites and seasons in all wastewater samples. While, pH showed that season has significant role in the acidity by wet of rainy season. The highest turbidity values were recorded in El mehala Elkobera (11.4 NTU) in the spring season. In addition, the highest values of electrical conductivity, total hardness, total dissolved solids, total sulphate, ammonia and nitrate were recorded in summer season with different sities. On the basis of the above mentioned results, efforts should be made to avoid the environmental pollution with wastewater.

Keywords: Bacteria; Physicochemical Parameters; Wastewater

INTRODUCTION

Water is a universal solvent important and essential to human beings for various activities such as cooking, agricultural and industrial processes, human recreation and waste disposal (Oluyemi *et al.* 2010).

One of the main factors of water pollution is the bacterial contamination especially with pathogenic bacteria (Young 1996). WHO(1984) indicated that increasing temperature of water stimulate the biodegradation of organic matters presented in water and the amounts of dissolved oxygen decreased and warm water enhances the growth of microorganisms. Plate count was used for enumeration of characteristic bacteria that tend to develop slowly in water (Ramalho *et al.* 2001). The heterotrophic plate count (HPC), gives a valuable indication of general microbiological method (WHO 2001) & Abd- elhameed *et al.(*2021). Lu *et al.* (2003) reported that total dissolved solids (TDS) are including organic and inorganic matters. Makinde *et al.* (2015) observed that all the physicochemical parameters were varied seasonally exception with pH, alkalinity and water hardness. Conversely, temperature, conductivity, salinity and nitrates were higher in some seasons.

Generally, Afify *et al.* (2021) conculoded that the physicochemical parameters were different from sities and water samples sources. This work was designed to study the microbiological and physicochemical properties of wastewater collected from different cities in El Gharbia Governorate (Tanta, El mehala Elkobra, Mahlet Abo Ali, Sammanod and Mahlet Roh) during four seasons (summer, spring, winter and autumn). This study may suggest the way to avoid enviromental pollution.

MATERIALS AND METHODS

Source of wastewater samples

Wastewater samples were collected to study the total bacterial counts and physicochemical properties. The samples were collected from five different cities: Tanta, El mehala Elkobra, Mehlet Abo Ali, Samanod and Mehlet Roh during four seasons (summer, autumn, winter and spring) at El Gharbia Governorate, Egypt. Samples were collected in liter sterile glass bottles and then transferred from the sites to the lab in ice box and examined within 8 hours. All analyses were carried out in the microbiological laboratory of Microbiology Depatment, Faculty of Agriculture, Mansoura University, Mansoura city, Egypt (Afify *et al.* 2022) .

Total bacterial count

Collected wastewater samples were analyzed for total viable bacterial count using the poured plates. Three plates for replicates and incubated at 37º C for 24 hrs and other plates were incubated at 20º C for 48 hrs using nutrient agar (NA) medium (AHPA 2005).

Physical and chemical parameters

The parameters were estimated quantitatively and the analysis methods were determined according to the method of APHA (2011) and are summarized in Table (1)

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Table 1. Parameters and methods employed in the physicochemical examinations of wastewater samples (Rawway *et al.* 2016).

No.	Parameters of wastewater	Method
1	Temperature (ºC)	Thermometric
2	pH	Potentiometric
3	Turbidity (NTU)	Nephelometric
4	Electrical Conductivity (µS/cm)	Potentiometric
5	Total harhness	Titrimetric
6	Total dissoloved solide	Gravimetric
7	Sulphate (as SO_4^{--}) mg/l	Titrimetric
8	Chorides (as Cl^-) mg/l	Titrimetric
9	Ammonia (as NH_3^-) mg/l	Spectrophotometric
10	Nitrate (as NO_3) mg/l	Spectrophotometric

RESULTS AND DISCUSSION

Bacteriological examinations

The results of total bacterial counts are given in Table (2). The obtained results indicated that the highest total count was found at 20ºC during summer at El mehala Elkobra (6.1 cfu x 10^9 /100ml). On the other hand, total bacterial counts at 37ºC varied from 0.02 to 5.7 cfu x 10^{10} /100 ml, the maximum value was in summer at Mehlet Roh but the minimum value in spring at Samanod city. Also, means of the total bacterial counts at 20ºC 3.8, 2.6, 2.5, and 2.2 cfu x 10^9/100 ml and at 37ºC 3.2, 2.0, 1.8 and 1.8 cfu x 10^{10}/100 ml during four seasons respectively. These results are in agreement with those obtained by Niemi and Niemi (1991) & Putheti and Lebure (2009) who stated that domestic and industrial wastewater, agriculture waste are sources of bacteria.

Table 2.Total bacterial counts (cfu/100ml) in wastewater of some cities at El Gharbia Governorate.

City	Total bacterial count (cfu x 10^9/100 ml) at 20 ºC				Total bacterial count (cfu x 10^{10}/100 ml) at 37ºC			
	Su	Au	Wi	Sp	Su	Au	Wi	Sp
Tanta	3.8	2.9	3.1	2.4	3.2	2.6	2.0	2.3
El mehala Elkobra	6.1	5.2	3.4	4.8	4.1	2.6	1.5	1.9
Mehlet Abo Ali	2.3	1.3	1.5	0.9	2.8	1.7	1.5	1.4
Samanod	1.1	0.9	0.7	0.4	0.1	0.0	0.0	0.0
Mehalet Roh	5.7	3.1	4.0	2.9	5.6	3.4	3.9	3.5
Means	3.8	2.6	2.5	2.2	3.2	2.0	1.8	1.8

Physicochemical parameters

Physical parameters include color and temperature of wastewater while chemical parameters include, pH value, Turbidity, electrical conductivity(EC), total hardness, total dissolved solide, sulfate, chloride, ammonia, and nitrate. All these factors have their own as they are part of environment necessary for the continuity of life processes. For example pH is a measure of hydrogen ion concentration or measure of acid-base equilibrium dissolved in water as well as extent of coagulation and flocculation process of chemicals. Higher value of EC is a good indicator of the presence of contaminants and pollutants such as chloride, sulphate, sodium and potassium while hardness of water is defined as the measure of concentration of dissolved calcium and magnesium ions in water (Ruqia *et al.* 2015).

Color: Wastewater samples collected were grey to black color.These colors of wastewater are in agreement with Environmental Protection Administration, Taiwan (2013), which reported that domestic wastewater is defined as sewage which generally consists of black water composed of fecal matter (human and animal wastes) together with grey water sources composed of various wastewater constituents. These components originate from a range of household activities (washing and bathing) with each forming approximately 32.5% and 67.5% of domestic sewage respectively.

Temperature: Temperature of wastewater is shown in the Fig. 1. High value of water temperature was recorded i.e. 29ºC in summer at Tanta, El mehala Elkobra and Samanod. High temperature of wastewater was recorded because of high atmospheric temperature (Medudhula *et al.* 2012).

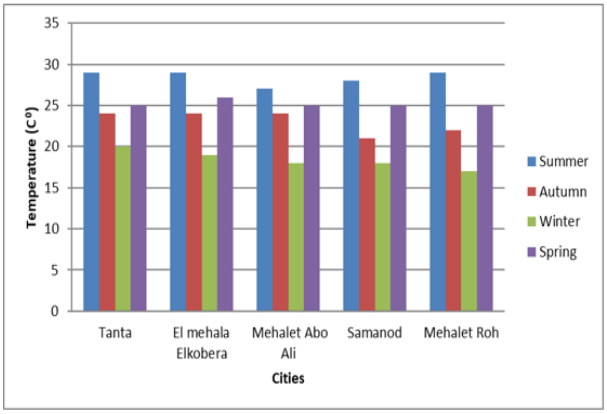

Fig. 1. Temperature (ºC) determination in wastewater during four seasons of some cities at El Gharbia Governorate.

pH: As shown in the Fig. (2) the recorded pH values of wastewater samples ranged from 6.1 to 6.9. The pH is the most important physicochemical parameters. In this respect that season has significant main in the pH by the wet of rainy season (Egborge 1994). It affects mineral nutrient and much microorganism activity (Borkar 2015). According to WHO normal means of pH for water is 6.5 (Zaigham *et al.* 2012).

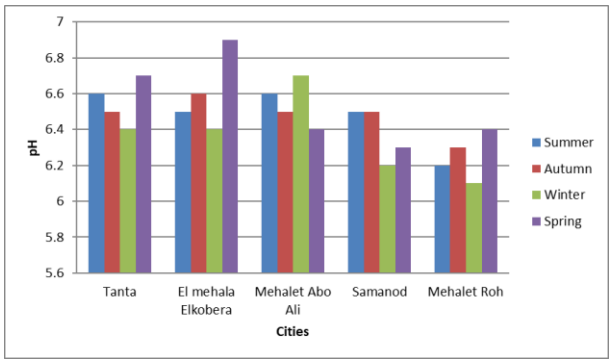

Fig. 2. pH determination in wastewater during four seasons of some cities at El Gharbia Governorate.

Turbidity: The highest turbidity values were recorded in El mehala Elkobera (11.4 NTU) in the spring season (Fig 3). This phenomenon may be in agreement with results of Asuquo and Etim (2012) who reported that high turbidity could be resulted from discharges of sewage and industrial waste.

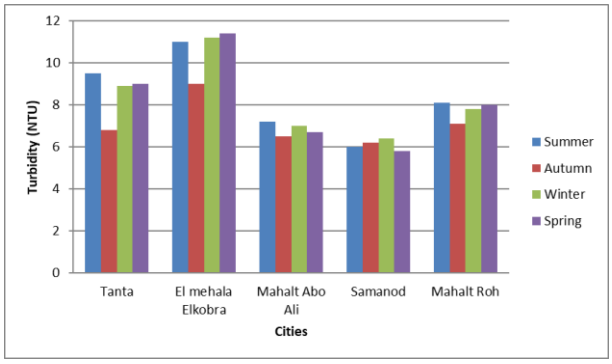

Fig. 3. Turbidity (NTU) in wastewater during four seasons of some cities at El Gharbia Governorate.

Electrical Conductivity (EC): The values of electrical conductivity of wastewater samples are presented in Fig. (4).The highest values was 455 Mmohs/cm in summer season at El mehala Elkobra but the lowest values was 270 Mmohs/cm in winter season at Mahlet Abo Ali. The seasonal differences observed for the conductivity is a clear indication of the role of season in the ionic distribution in the wastewater. The higher conductivity values in the summer season could also be attributed to the combination of low precipitation and high atmospheric temperatures, resulting in high evapotranspiration rates, high ionic concentration from underground sources or the ocean (Nwadiaro 1989).

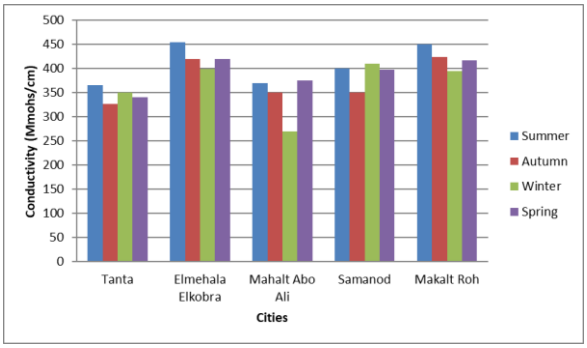

Fig. 4. Electrical Conductivity (EC) in wastewater during four seasons of some cities at El Gharbia Governorate.

Total Hardness (TH): The values of total hardness (ppm) in wastewater samples are shown in Fig. (5). The lowest value was 210 ppm in the autumn at Mahlet Abo Ali while, the highest value was 256 ppm in the summer at El mehala Elkobra. Total hardness is the total hardness of Ca and Mg are measured in ppm the ratio in formula (TH=2.497 Ca 4.115 Mg) are in weights. These TH according to Egyptian LAW (1982) .

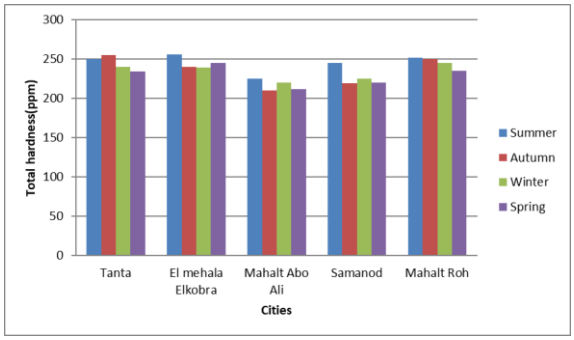

Fig. 5. Total Hardness (TH) in wastewater during four seasons of some cities at El Gharbia Governorate.

Total Dissolved Solids (TDS): Data recorded in Fig. 6 shows the TDS values in wastewater on different seasons. TDS values varied between 200 - 251 mg/l. The highest value was 251 mg/l in summer at Mehlet Roh, but the lowest value was 200 mg/l in spring at Mehlet Abo Ali. The slight variation between different sites were mainly due to different sampling times. TDS analysis has great implications in the control of physical and biological wastewater treatment processes (Medudula *et al.* 2012

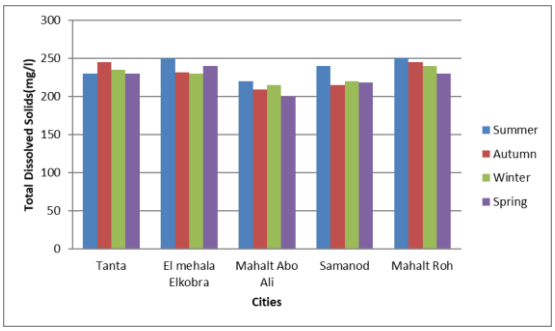

Fig. 6. Total Dissolved Solids (TDS) in wastewater during four seasons of some cities at El Gharbia Governorate.

Total sulphate (SO4--): In the study, the sulphate values were recorded between 30 – 150 mg/l. With the lowest value (30 mg/l) at Mehlet Abo Ali in the winter and the highest 150mg/l at El mehala Elkobra in the summer (Fig. 7). The values of sulphate ions were found to be higher in the summer,s months than the winter,s months, this data are in line with that of Makinde *et al.* 2015.

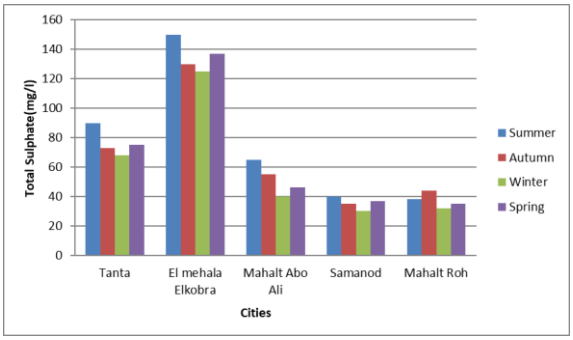

Fig. 7. Total sulphate (SO_4) in wastewater during four seasons of some cities at El Gharbia Governorate.

Chloride (Cl-): In this study values of chloride in wastewater samples ranged from 17 to 35 mg/l. The chloride values were found to be higher in wastewater from Tanta than Mehlet Abo Ali (Fig.8). Correns (1990) reported that high chloride content may harm metalic as well as growing plants.

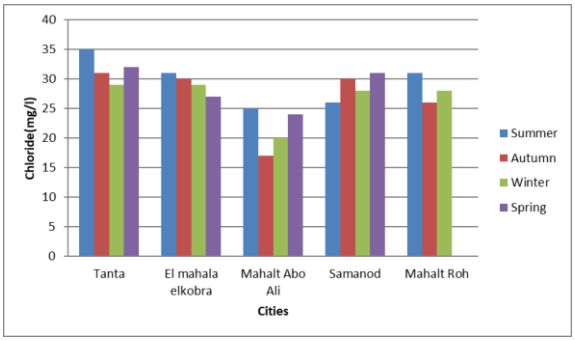

Fig. 8. Total chloride (Cl^-) in wastewater during four seasons of some cities at El Gharbia Governorate.

Ammonia (NH_4^+): During this study, ammonia (mg/l) concentration in wastewater exhibited variations both regionally and seasonally. The values showed ranged between 0.47 to 0.80 mg/l (Fig.9). The highest value in summer at Mehlet Roh and the lowest in spring at Samanod. When ammonia concentrations are increased the organic pollution resulting from domestic sewage and fertilizers runoff could be attributed Egyptian LAW (1982).

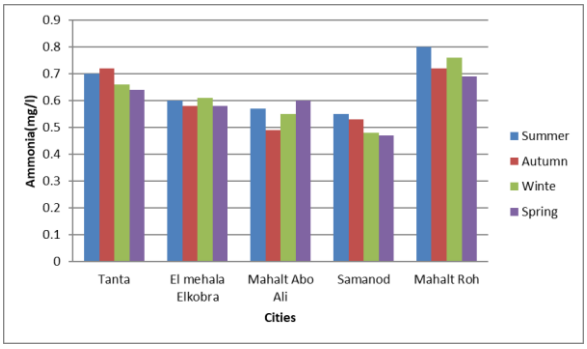

Fig. 9. Ammonia (NH_4^+) in wastewater during four seasons of some cities at El Gharbia Governorate.

Nitrate (NO_3^-): Fig. (10) shows the comparison between the results of nitrate, the lowest value (1.5 mg/l) was in winter at Mehlet Abo Ali while, the highest value (2.7 mg/l) was in summer at El mehala ElKobra. The slight variation between different sites was mainly due to different sampling times. Those results are in agreement with Egyptian LAW (1982) reported that the concentration of nitrogenous compounds indicates the occurrence of extensive anaerobic bacterial activities according to mentioned seasons. The highly nitrate content was in sites indicates that the sites of this point is more polluted.

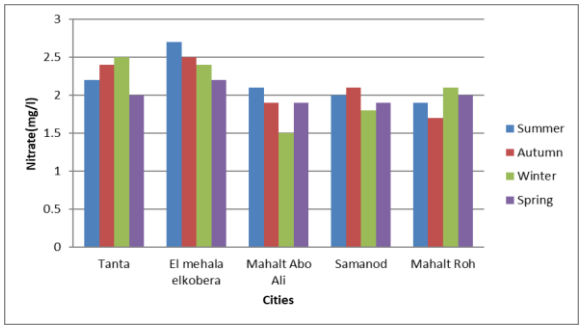

Fig. 10. Nitrate (NO_3^-) in wastewater during four seasons of some cities at El Gharbia Governorate.

CONCLUSIONS

This work concluded that the bacterial total counts and physicochemical parameters in wastewater in some cities at El Gharbia Governorate, Egypt. From this results provides an overview of the treatment wastewater for use this water source in another scale such as hydrological variability and growing agricultural, or prevent enviroment from pollution by wastewater.

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العد البكتيرى و المظهر الفيزيوكيميائى لمياه الصرف الصحى فى بعض مدن محافظة الغربية بمصر

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الملخص

تهدف هذه الدراسة إلى التقييم البكتيرى والفيزيوكيميائى لمياه الصرف الصحى فى بعض المدن (طنطا- المحلة الكبرى – محلة أبو على – سمنود – محلة روح) بمحافظة الغربية بمصر خلال فصول السنه الأربعة (الصيف – الربيع – الشتاء – الخريف). وقد تمت الدراسه الحاليه لتقدير العدد الكلى للبكتيريا التى أظهرت نتائجها أن أعلى عدد للبكتيريا فى فصل الصيف بمدينة المحله الكبرى. بالإضافه إلى التقديرات الفيزيوكيميائيه لمياه الصرف الصحى فى هذا الغرض قد أوضحت نتائج الخصائص الفيزيائيه لهذه المياه أنها ذات لون رمادى يميل للأسود و أن درجة الحراره 29 ^{0}م فى كل المدن ماعدا مدينة محلة أبو على و محلة روح. أما الخصائص الكيميائيه لمياه الصرف الصحى فقد أظهرت قيم عاليه مع إختلافات طفيفه بين فصول السنه فى الأماكن المختلفه حيث سجلت أعلى درجة حموضه فى الفصول الممطره وأعلى درجة عكاره فى فصل الربيع بالمحله الكبرى بينما كانت أعلى درجة للتوصيل الكهربى وتركيز المواد الصلبه والذائبه وكذلك الكبريتات والأمونيا والنترات فى فصل الصيف وذلك فى كل الأماكن المختلفه. وبعد هذه التحليلات يمكن أن نقدم كيف يمكن حماية البيئه من التلوث بمياه الصرف الصحى.