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Study of the Physiochemical and Microbial Properties of the Waters of the Seashore in the City of Tocra, Libya

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دراسة الخصائص الفيزوكيميائية والميكروبية لمياه شاطئ البحر بمدينة توكرة، ليبيا

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Abstract

The current study aimed to assess the state of water quality in Tocra beach (Libya). The physical, chemical, and bacterial properties of water were also studied. Water samples were collected from the sea and sediments for three consecutive months in the year (2020-2021) to study the following factors (water temperature, salinity, electrical conductivity, pH, total dissolved salts, chemical and biological requirements for oxygen, dissolved organic matter, and active nitrate). It was noted through these results that the proportions of these variables did not exceed the record numbers of seawater, in addition to the presence of contamination with the bacteria Escherichia coli (Negative gram) and it has proven its effectiveness for antibiotics, which indicates sewage pollution.

***Keywords**: Bacterial properties; Physicochemical properties; Seawater; Tocra.*

الملخص

هدفت الدراسة الحالية إلى تقييم حالة نوعية المياه في شاطئ توكرة (ليبيا). كما تم دراسة الخصائص الفيزيائية والكيميائية والبكتيرية للمياه. تم جمع عينات الماء من البحر والرواسب لمدة ثلاثة أشهر متتالية خلال عامي (2020-2021) لدراسة العوامل التالية (درجة حرارة الماء والملوحة والتوصيلية الكهربائية والأس الهيدروجيني والأملاح الذائبة الكلية والمتطلب الكيميائي والحيوي للأكسجين والمواد العضوية الذائبة والنترات الفعالة). وقد لوحظ من خلال النتائج أن نسب هذه المتغيرات لم تتجاوز الأرقام القياسية لمياه البحار بالإضافة لوجود تلوث ببكتيريا *Escherichia coli* (-ve gram) وقد أثبتت فعاليتها للمضادات الحيوية مما يشير لتلوث بالصرف الصحي.

الكلمات الدالة: الخصائص البكتيرية، الخصائص الفيزيوكيميائية، مياه البحر، توكرة.

1. Introduction

The coastal environment has witnessed significant economic growth in recent years, the fruits of which have benefited many the vital sectors, which are found mainly along the coastal strip and around the major urban communities, however, this economic growth did not always take into account the environmental dimension, as it resulted in polluted waste taking the form of

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solid, liquid and gaseous waste that affected natural resources and harmed the quality of life in it on the one hand. On the other hand, it is of environmental and economic importance as the main pillar on which the various recreational and tourism activities are based. Due to the specificity of pollution in the marine environment, which differs from its counterparts in the terrestrial environment, which is mainly due to the natural and physiological aspects of the water, the pollution of the aquatic environment has become one of the major global problems that preoccupied governments and countries around the world, due to the risks arising from the pollution of consumption elements and the goods that are exploited from These aquatic environments are threatened with disappearance and depletion if the situation continues on the borders that they are. Due to the instability of sea water quality, physical and chemical properties are very important parameters for monitoring (Vaghelal *et al.*, 2010). Effective monitoring should include samples of surface seawater from different regions taken at different times, evaluation of environmental quality indicators and identification of chemical particles associated with hydrological conditions (Bengraïne and Marhaba, 2003). The nature and propagation of all life within the marine environment is primarily controlled by variation in Physical and chemical properties of water, such as temperature, dissolved oxygen, pH, etc.

Sewage pollution is the most important and most prominent type of pollution in the marine field on several levels due to the large population concentrations on the coasts and the large cities that throw their waste into the sea in many cases without treatment, as it contains wastes that deplete oxygen, and it includes dissolved organic matter or suspended matter that It also depletes oxygen during its decomposition, such as human and animal waste, and includes the three main substances: carbohydrates, proteins, and fats. Wastewater consists of the total water used in homes, kitchens, and bathrooms, as well as toilet waste, rainwater, and water used for washing roads, spaces, cars, and machinery. It can carry high levels of toxic substances and pathogenic germs, which may be transmitted to humans or marine organisms while swimming (Griffin *et al.*, 2003; and Ralston, 2011) or affect the physicochemical properties of seawater that play an important role in the marine ecosystem.

In order to reveal the effects that pollution of the marine environment has on the overall marine activities, especially fishing, which is one of the most important crafts practiced in our country, as well as due to the lack of studies that dealt with the marine environment, especially those related to the Libyan environment in an attempt to touch on part of the issues of environmental pollution, this research came to study Bacterial and physiochemical characteristics of the water in this area, the isolation of enterococcus bacteria and the identification of resistant antibiotics.

2. Material and Methods

2.1. Study location

The city of Tocra is located in the northeast of Libya, about 70 km from the city of Benghazi to the east, the search area is about 2 km to the east of the citadel of Tocra. From each point, 3 samples of surface water and 3 samples of sediment were collected, each point was

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approximately 5 meters away from the other, and the study period was extended for 3 months (December 2020 to February 2021).

2.2. Physiological assay

For the physicochemical assays of all the studied samples, the water temperature was measured using a mercury thermometer. Salinity (TDS), electrical conductivity (EC), pH (pH), chemical oxygen demand (COD), biological oxygen demand (BOD), total suspended solids (TSS), Generated organic compounds (TOC), and nitrate (NO_3) were also measured. Then, packed 1 mL of the sample into sterile glass tubes and measured the previous parameters so that the time required for testing a single sample did not exceed 60 seconds. Then the results were compared with the mandatory standards for water pollution standards.

2.3. Bacterial assay

As for the bacterial assays, the samples were collected in sterile crystal vials, and they were cultured in food media (Blood agar, Chocolate agar, MacConkey agar, and Cled Agar), then the samples were cultured on the media by the method of gradient streaking, then the dishes were accurately detected and bacteria diagnosed.

3. Results and Discussion

3.1 Temperature

Temperatures were moderate (18.73-18.60 ^{o}C), as the study did not record a rise in temperature as presented in Figure (1). The rise in water temperature is an indicator of its pollution, as the rates of chemical and biological reactions increase with the increase in temperature (Alibi *et al.*, 2020).

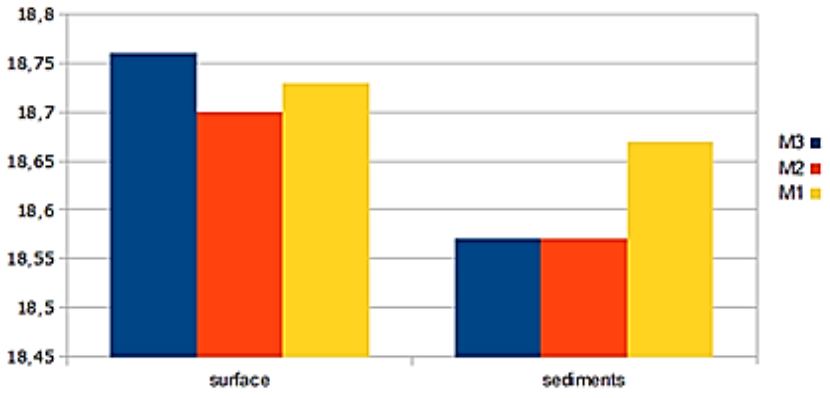

Figure 1. Monthly changes in temperature (^{o}C) for surface and sediment samples

3.2. Salinity "Total Dissolved Solids" (TDS)

Salinity ranged between (28.1-28.6) as shown in Figure (2), this can be explained as a result of low or moderate temperatures, low evaporation rate, and increased rainfall, especially since

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the sampling time coincided with rainy and low-temperature days. It is known that sea salts consist of "sodium chloride, calcium carbonate, and magnesium bromide, in addition to other soluble salts such as iron, gold, and silver. These percentages vary according to the type of sea, either closed or open. The percentages of salts increase to more than 40%, due to evaporation". Also, the losses are relative to the quantities entering the sea, and they decrease with the open seas, which contain important estuaries, in addition to the quantities of precipitation, the area of the coast, the effect of temperature, and other factors. These salts also work to reduce the freezing rates and create the vertical fluctuation of the water with the rise of the least water. Weight upwards, and the thick water drops due to saturation and heating to the bottom, as this feature helps to create movement in the depths and provides food from plant and animal plankton suspended in the water in all layers of marine water. All these conditions help fish to maintain their internal environment, their liquids, and their internal and external pressure, and therefore any significant increase in the concentration of salts is a real danger to the life of marine organisms.

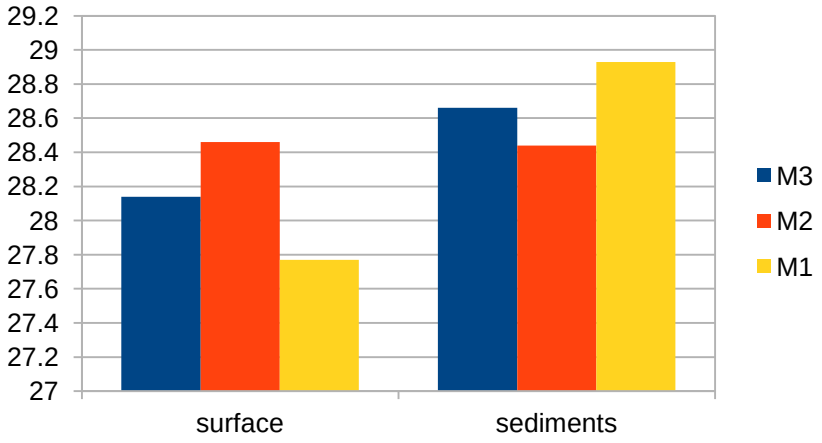

Figure 2. Monthly changes of TDS for surface and sediment samples.

3.3. Electrical Conductivity (EC)

The electrical conductivity of water is defined as a numerical value that indicates the ability of water to conduct electric current, and the electrical conductivity value increases with increasing temperature. There is a strong relationship between electrical conductivity and salinity, as salinity is of great importance in the distribution of living organisms (Alibi *et al.*, 2020). In this study, the conductivity value did not exceed the permissible standards, as shown in Figure (3), which illustrates the presence of differences between the studied sites (surface and sediments) and the most important differences between the months of the study.

ISSN (Print): 2413-5267
ISSN (Online): 2706-9966

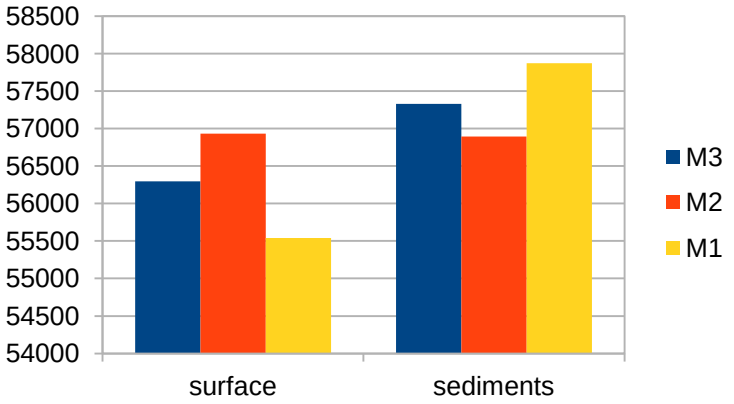

Figure 3. Monthly changes of electrical conductivity of surface and sediment samples.

3.4. pH

The pH of seawater is usually slightly alkaline and ranges from 7.9 to 8.4. This range is created by the balance between biological activity and seawater (Owens, 2009). In this study, the values of hydrogen ion concentration (pH) revealed wide differences, ranging from 7.71 to 8.06 during the study period (Fig. 4), which tends to be light basic, and the reason may be attributed to the possibility of the predominance of bicarbonate ions and total alkalinity. It was noted that the highest value recorded in February was (8.06) in the sediment sites and the lowest value in the month of December was (7.71) from the surface sites, which is evidence of the validity of the waters of the Tocra Sea, as the decrease in the pH value leads to the transformation of the water marine from neutral and dilute alkaline in unpolluted natural waters, to dilute and polluted acidic surroundings (Alibi *et al.*, 2020). The pH affects the distribution of living things, and gives a reflection of many chemical and life processes, as its value is an indicator of the presence and balance of free carbon dioxide, carbonates, and bicarbonates.

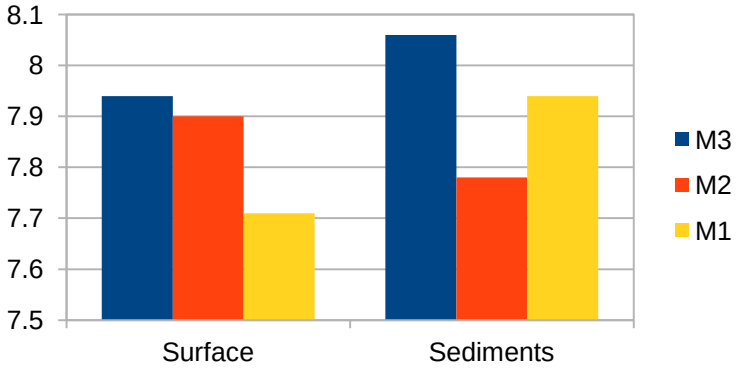

Figure 4. Monthly changes of pH of surface and sediment samples.

ISSN (Print): 2413-5267
ISSN (Online): 2706-9966

3.5. Chemical Oxygen Demand (COD)

The values of the chemical oxygen requirement varied, reaching 5.6 for the surface, while for the sediments 12 (Fig. 5). By analyzing this requirement, it confirms to us that there is no pollution in Tokara beach, because the chemical oxygen requirement is a good measure of polluted water, especially contaminated with industrial waste, as it reflects the amount of oxidized organic matter and that This variable is important in knowing the characteristics of water, wastewater, industrial water, and water coming out of the treatment plants, so the COD test is important and useful for the purposes of monitoring and controlling water quality.

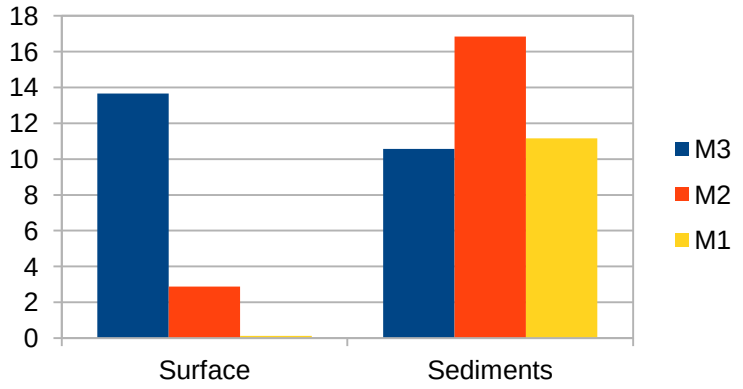

Figure 5. Monthly changes of COD for surface and sediment samples.

3.6. Biological Oxygen Demand (BOD)

The results showed that there are differences in the values of the BOD (Tables 1 & 2). It is considered low, as it did not exceed 4 mg/L, and this is good evidence that the beach is not polluted, as it is adopted as a measure of the extent to which it is used in the respiration of marine organisms and the oxidation of chemical compounds, and expresses the amount of suspended and biodegradable substances to be converted into carbon dioxide and other chemical compounds. Simple, where its value ranges between 0.7 to 2.7 mg/L as a monthly average (Fig. 6), but if it exceeds this percentage, it is considered polluted water, and up to 20 mg/L is considered very polluted water unsuitable for various uses by organisms that are forced to migrate or are exposed to death as another Stage.

3.7. Total Suspended Solids (TSS)

The results of the statistical analysis showed that there were significant differences between the TSS values for the sediment and the surface, although it did not exceed the standard values and for all sampling times, as presented in Tables (1 and 2) and Figure (7). The high levels of TSS, which consists mainly of fish carcasses, algae, and other organic materials, negatively affect the productivity of marine organisms and reduce their diversity due to their blocking of sunlight (Alipour *et al*., 2014; and Poole & Berman, 2001).

ISSN (Print): 2413-5267
ISSN (Online): 2706-9966

Table 1. Physicochemical characteristics of surface samples in the Tocra coast.

Samples / Parameters	M1	M2	M3	Max. Value	Mean Value	±SD
Temp	18.73	18.7	18.76	18.76	18.73	0.03
TDS	27.70	28.65	28.47	28.65	28.27	3.7
EC(µS/cm)	55,541.67	56,930	56,295	56,930	56,255.557	695.00
pH	7.71	7.90	7.94	7.94	7.85	0.12
COD (mg /L)	0.13	2.88	13.65	13.65	5.6	7.14
BOD (mg /L)	0.43	1.32	6.65	6.65	2.8	3.36
TSS (mg/L)	2.70	5.86	28.18	28.18	12.246	13.88
TOC	0.03	1.16	4.98	4.98	2.056	2.59
NO_3 (mg/L)	4.14	4.25	4.22	4.25	4.203	0.05

Table 2. Physicochemical characteristics of surface sediments in the Tocra coast.

Samples / Parameters	M1	M2	M3	Max. Value	Mean Value	±SD
Temp	18.67	18.57	18.57	18.67	18.603333	0.05
TDS	28.35	28.42	28.64	28.35	28.81	2.6
EC(µS/cm)	57871.67	56891.66	57329.3	57871.67	57364.21	490.93
pH	7.94	7.78	8.06	8.06	7.9266667	0.14
COD(mg /L)	11.15	16.85	10.56	16.85	12.853333	3.47
BOD(mg /L)	4.96	6.12	3.60	6.12	4.8933333	1.26
TSS (mg/L)	18.56	24.23	16.17	24.23	19.653333	4.13
TOC	3.48	3.79	2.45	3.79	3.24	0.70
NO_3 (mg/L)	4.51	3.64	4.12	4.51	4.09	0.43

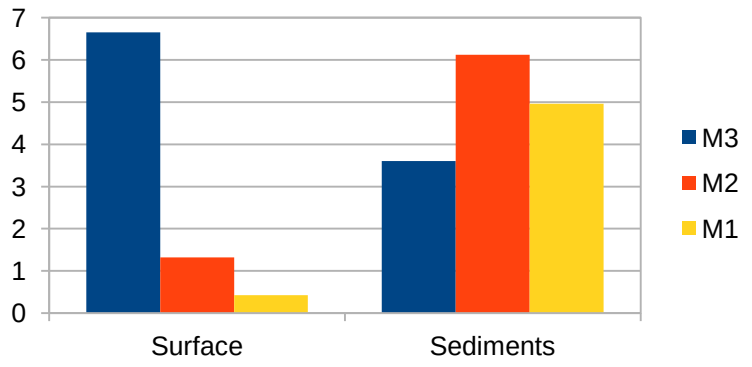

Figure 6. Monthly changes of BOD for surface and sediment samples.

ISSN (Print): 2413-5267
ISSN (Online): 2706-9966

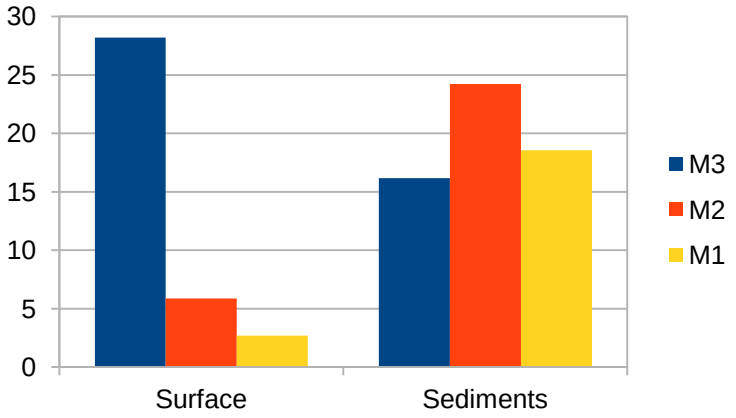

Figure 7. Monthly changes of TSS for surface and sediment samples.

3.8. Regenerative Organic Compounds (TOC)

Observed an increase in the level of the generated organic compounds, the highest of which was 4.98 mg/L (Fig. 8). These compounds are found naturally in surface and groundwater, seawater, and soil (Grimvall *et al.*, 1991) and can also be produced from the natural halogenation of organic matter. Nowadays, the pollution of seawater with these substances is of great interest due to their persistence and bioaccumulation in aquatic organisms (Enell and Wennberg, 1991), in addition to the damage that some of these chemicals can cause at low concentrations (Sun *et al.*, 2007). Detergents are one of the most important organic compounds carried by human waste, as their danger lies in the fact that most of them are made of non-biodegradable hydrocarbons, which are known as hard detergents, while UNEP reported that there are 60,000 tons of detergents annually thrown into the Mediterranean, estimated by 14 countries. The Mediterranean, at least, is not safe for tourism, since 85% of the waste in the Mediterranean basin is not treated for more than a hundred population centers. 80% of its waste is dumped in the sewage that ends up in the sea without treatment, including Lebanon, Tunisia, Alexandria, Tripoli, Algeria, Marseille, Naples, Barcelona, and Lattakia leading to the deterioration in the volume of nutrients, plankton, benthic algae, and fish due to this pollution (Bourhali, 2010).

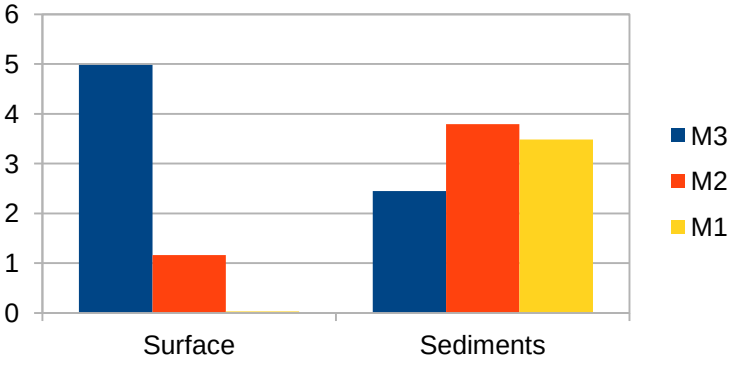

Figure 8. Monthly changes of TOC for surface and sediment samples.

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3.9. Effective Nitrate (NO_3)

The results showed that the nitrate levels were very close and low (Fig. 9), this is a good and strong indicator of non-pollution and toxicity, as nitrate is the predominant form of inorganic nitrogen in the aquatic environment and its concentration in natural water rarely exceeds 10 mg/L. The presence of nitrates is mainly in water due to water drifting from agricultural lands containing fertilizers and chemical fertilizers and from sewage and industrial water, as well as appearing as a result of the decomposition of nitrogen-containing organic compounds such as urea and proteins. food. Nitrates are toxic to aquatic organisms, especially fish. Its toxicity lies in preventing the hemoglobin pigment from carrying oxygen and is more severe in infants. When nitrates enter the human digestive system, they form what is known as carcinogenic nitrosamines, as nitrates turn into nitrites and finally react with amino acids.

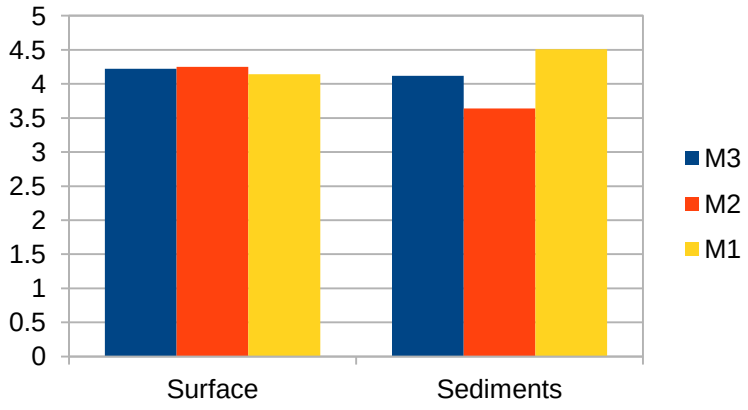

Figure 9. Monthly changes of NO_3 for surface and sediment samples.

3.10. Bacterial assay

The results of the bacterial assays showed that there was no bacterial growth inside the food media dishes: Blood agar, Chocolate agar and MacConkey agar, while the media application Cled Agar showed bacterial growth of *E. coli* and Negative gram in the three samples. An antibacterial sensitivity test was conducted on Escherichia coli, and the following was found:

- Imipenem (imp)
- Gentamicin (GEN)
- CHloraphenicil (CHL)
- Cefoxitiv (cxt)
- Ciprofloxitw(cpk) +
- Amikacin (Amk) +
- Aztreonam (ATm) R

That is, seawater samples from different places containing *E. coli* Negative grams have been shown to be effective against antibiotics. The results showed that there is no bacterial contamination in the samples taken from the surface, but in the sediment samples

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from the water samples, which confirms the concentration of bacteria in the sediments. This is evidence of the existence of a source of sewage flowing into the sea, which may be weak, discontinuous, or remote since the physicochemical properties of the water are not affected by it.

4. Conclusion

While human beings are solely responsible for this pollution, which challenges the aesthetic and economic value of those beaches whose environmental, economic, and aesthetic importance cannot be dispensed with, we stress that beaches are not polluted, as the results indicated that the presence of pathogenic bacteria can cause severe poisoning and diarrheal, in addition to resistance to antibiotics. This research can be supplemented by carrying out a comparative study in which the results of water assays are compared between the seasons of the year.

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