Afro-Asian Journal of Scientific Research (AAJSR)
المجلة الأفروآسيوية للبحث العلمي
E-ISSN: 2959-6505
Volume 4, Issue 4, 2026
Page No: 137-145
Website: https://aajsr.com/index.php/aajsr/index
SJIFactor 2024: 5.028 ISI 2025: 0.915 معامل التأثير العربي (AIF) 2025: 0.76

# Estimation of pollution in Toukra Coast by Some Heavy Metals in Seagrass "Poisdonia Oceanica"(L.) Delile in Libyan "Mediterranean

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# تقدير التلوث لساحل البحر المتوسط ببعض المعادن الثقيلة لمدينة توكره بواسطة أنواع من الأعشاب البحرية

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| Received: August 02, 2026 | Accepted: October 11, 2026 | Published: October 27, 2026 |
|---|---|---|

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**Abstract:**
In this study, the light shed on the pollution of the sea elements Altqilh where the study included three heavy elements (Pb, Cd and Zn) using samples of kelp Posidonia Oceanica (L) Delile Adlal vital in many previous studies to measure the level of Ilut Sea because it is very sensitive to pollution Dement study 76_77 Municipality distance km from the Libyan coast, where the samples were collected during the months (6-7) in summer 2021 along the coast of the east Toukra Putrabh to the west of Sidi Ali Determine the concentrations of heavy metals (Pb, Cd, Zn) in tissue samples Delile of seaweed Posidonia Oceanica (L.) collected from ten different site of about 77 km along the coast of the municipality Tocra. Collection sites samples from the east to the west is the resort mrhba, resort Bab, El Hara Resort, alshuruq Resort, alorfe resort, Toukra Sea, Bogerar Sea, bursus Sea, almabniu resort and easila resort Deriana. See also 77 km north and south of the municipality Toukra coast, coast of North Africa (Mediterranean Sea).

**Keywords:** Seagrass, Posidonia Oceanica(L) Delile, Toukra.

**الملخص:**
في هذه الدراسة تم تسليط الضوء على تلوث العناصر البحرية في منطقة ساحل البحر المتوسط لمدينة توكره، شملت الدراسة ثلاث عناصر ثقيلة مثل (الرصاص، الكادميوم، الزنك) بأستخدام عينات من عشب البحر (بوسيدونيا اوشيانيكا) وهو عنصر حيوي في الكثير من الدراسات السابقة لقياس مستوي التلوث في البحر نظرا لحساسيته الشديدة لتلوث.
أجريت الدراسة لمسافة 77 كيلومتر من الساحل الليبي، حيث جمعت العينات خلا شهري يونيو ويوليو من صيف 2021 على طول ساحل مدينة توكره من بوترابه شرقا الي سيدي علي غربا. تهدف الدراسة الي تحديد تركيز كلا من المعادن الثقيلة (الرصاص، الكادميوم، الزنك) في أنسجة عشب البحر (بوسيدونيا اوشيانيكا) والتي جمعت من عشر مواقع مختلفة على امتداد 77 كيلومتر من الساحل الليبي لمدينة توكره وتشمل منتجع مرهبه، ومنتجع باب، ومنتجع الحارة، ومنتجع الشروق، ومنتجع اللورفي، وبحر توكره، وبحر بوجيرار، وبحر بورسوس، ومنتجع المباتي، ومنتجع ايسيلة دريانا أنظر شكل (1).

**الكلمات الافتتاحية:** عشب البحر، التلوث بالمعادن الثقيلة، بوسيدونيا اوشيانيكا، توكره.

**Introduction:**

The major source of surface water pollution includes effluent discharges by industries, atmospheric depositions of pollutants and occasional accidental spills of toxic chemicals. Trace metals are regarded as serious pollutants of aquatic environment because of their toxicity. The persistence of their difficult biodegradability and their tendency to concentrate on aquatic organisms. They enter the marine environment through atmospheric and land - based effluent source [1,2].

There is currently a great interest in the use of living organisms as in aquatic ecosystem [3]. Given that the method used previously does not provide sufficient information on the bioavailability of the metals present in the environment. In the Mediterranean Sea, the endemic seagrass, Posidonia Oceanic (L.) Delile, has been used as a metal bio indicator for several over decades [4,5]. Leaves of P. Oceanica can give an indication of the metal concentration in the environment, a short time period (months) with good accuracy [6].

On the contrary, sheaths which gave an indication of changes over long time periods decades seem to be less sensitive to variations in the metal concentration in the environmental. The use of P. Oceanica as a bio indicator of water quality in relation to implementation of the water frame work directive [7-9]. The state of health of P. Oceanica meadows is good indicator of the ecological status of a particular coastal water body. Therefore, P. Oceanica has been proposed as a biological quality element (BQES) for Mediterranean coastal water. Considerable work is being currently under taken to develop classification tools and metrics that would allow use of P. Oceanica as a BQES for WFD (Water Frame work Directive).

The P. Oceanica eco - system is particularly threatened by anthropogenic coastal pollution and bio indication of heavy metal contaminations have already been used as such in the Mediterranean and elsewhere [10-12]. Thus, the aim of this study is to evaluate the state of metal contamination of the Benghazi coast in Libya metal contamination of the Benghazi coast in Libya using Posidonia.

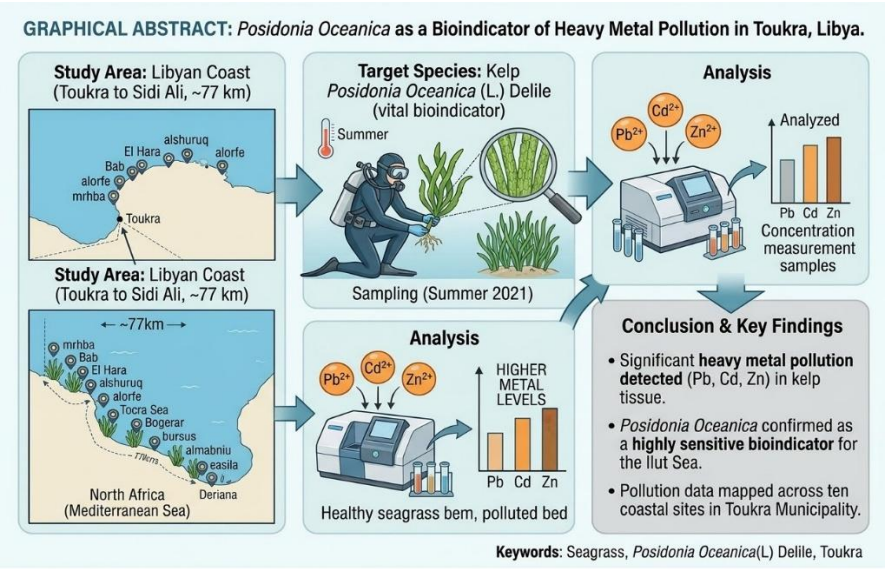



**Figure (1):** Graphic abstract: Posidonia Oceanica L. as a bioindicator of heavy metal pollution Toukra.

**Table (1):** Typical Presentation of the Most Commonly Encountered Metals and Their Treatment [2]

| Metal | Acute | Chronic | Toxic Concentration | Treatment |
|---|---|---|---|---|
| Lead | Nausea, Vomiting, encephalopathy (headache, seizures, ataxia, obtundation) | Encephalopathy, anemia, abdominal pain, nephropathy, foot-drop/wrist-drop | Pediatric: symptoms or [Pb] ≥45µ/dL (blood); Adult: symptoms or [Pb] ≥ 70µ/dL [1] | BAL $CaNa_2$ EDTA succimer |
| Cadmium | Pneumonitis (oxide fumes) | Proteinuria, lung cancer, ostemalacia | Protenuria and/or>15µg/g creatinine | * |
| Zinc | Mff (oxide fumes); vomiting, diarrhea, abdominal pain (ingestion) | Copper deficiency: anemia, neurologic degeneration, osteoporosis | Normal rage:0.6-1.1mg/L (plasma) 10-14mg/L (red cells) | * |

**APPLICATIONS:**

The endemic seagrass P. Oceanica used as a metal bioindicator and used as feed for cows and added to the concrete and heat insulator [2,7,13-14].

This marine plant forms large under water meadows that are considered to be of high important ace to known in environmental conservation of region and know in Italy as the olives sea and depending on the clarity of the water [1,4,7].

It is sensitive to both pollution and human activities and impacts such as bottom trawling anchoring, coastal construction, chemical wastes, fish farm effluents, desalination plant, geodynamic alteration, biological invasions and many others [1,3,14].

Specifically, the species P. Oceanica, a Mediterranean endemic, can be efficiently used as a BQE (biological quality elements) due to, at least, **three reasons:**

**a)** it's sensitivity to disturbances, as repeatedly demonstrated by a number of reports of meadows regression and/or deterioration due to different causes.

**b)** It's wide distribution along the Mediterranean coasts.

**c)** The good knowledge about specific response of the plant and of its associated ecosystem to specific impacts [150].

**Aim and Importance of The Study:**

Although there are several studies on the contamination of seagrass P. Oceanica with heavy metals in Mediterranean Sea however we could not find any environmental researches on the area of our study (Toukra *Coast* of Libyan Shore).

Our aim of study is to determine the contamination of this seagrass P. Oceanica a bioindicator and biomonitor of trace metal (Lead, Cadmium and Zinc).

**Experimental and method:**

**Sampling and sample preparation:**

Seagrass Posidonia Oceanica samples were collected in 2022 year, from 10 stations located along Eastern Libyan " Mediterranean " (Eastern of Libyan Coast; Figure (1). Dirt and foreign herbs from sea grass samples was removed and washed with deionized water to. remove marine sediment, soil and others impurities. All sea grass samples were placed in a drying oven at about 65 ° C until most of the liquid has evaporated, then the temperature was increased to 80 ° C. Sea grass samples were placed in desiccators for about 48 hrs and then they were ground by a mill – Machine in figure (3).

**Location of The Study:**

The seagrass P.Oceanica Sample were collected from ten different sites along 77 Km of Toukra *Coast*.

The samples collection sites from east to west are resort mrhba, resort Bab, El Hara Resort, alshuruq Resort, alorfe resort, Toukra Sea, Bogerar Sea, bursus Sea, almabniu resort and easila resort Deriana. see also table (2) and figure (2,3).




**Figure (2):** map of Toukra Coast in Libyan




**Figure (3):** Preparation of Seagrass Posidonia Oceanica.

**Table (2):** The locations and symols of the seagrass (Posdonia Oceancia) (L.) Delile samples in different places for Toukra *Coast* of Libyan Shore).

| Location | Symbol | Date of Sample Collection |
|---|---|---|
| - Resort Marhaba | MMRH | 2022\03\13 |
| - Resort Bab Al-hara | MBBH | 2022\03\13 |
| - Resort Al-Shorok | MSHR | 2022\03\15 |
| - Resort Al-Arofi | MARF | 2022\03\15 |
| - Resort Toucra | MTOK | 2022\03\17 |
| - Sea Pojarar | PJRR | 2022\03\23 |
| - Resort Barses | BRSS | 2022\03\24 |
| - Sea Al-Mabni | MLMB | 2022\03\24 |
| - Resort Al-Asalah | MAIS | 2022\04\06 |
| - Resort Derina | MDRN | 2022\04\06 |

**Trace metals analysis:**

Hundred milligrams of each sample were weighed, transferred into 25 ml beaker, dissolved in (8 ml 65 % nitric acid) by heating to 70 ° C on a hotplate for about 8 hrs and the solution was then cooled, 2 ml of 30 % hydrogen peroxide was added and heated again for another 4 hrs at 70 ° C, then filtered and diluted to the mark [13]. All samples solution were analyzed using Flame Atomic Absorption Spectrometer (FAAS).

**Table (3):** Instrumental conditions for determination of Lead, Cadmium and Zinc by FAAS.

| Parameter | Pb | Cd | Zn |
|---|---|---|---|
| Wave length | 283.3 nm | 228.8 nm | 213.9 nm |
| Slit width | 1.2 nm | 1.2 nm | 0.5 nm |
| Flame Composition | $C_2H_2$/Air | $C_2H_2$/Air | $C_2H_2$/Air |
| Burner type | 50 mm | 50 mm | 50 mm |
| Burner height | 6 mm | 6 mm | 6 mm |
| Lamp type | Pb-HCl | Cd-HCl | Zn-HCl |
| Lamp current | 3 mA | 3 mA | 4 mA |
| Back ground correction | $D_2$- lamp | $D_2$- lamp | $D_2$- lamp |

**Calibration Curve:**

The range of linearity of the concentration absorbance is great importance in determining the elemental concentration of seagrass P. Oceanica samples. Working calibration solutions of the different five elements were prepared from stock solutions (1000 mg /l) [11]. Stock solution is then diluted with distilled deionized water in steps for each element by using auto samples which increases the accuracy by removing variability associated with different dilution techniques [12]. The concentration measurements for Lead, Cadmium and Zinc, are determined from a working curve after calibrating the instrument with standard concentrations.

**Table (4):** The measured absorbed of Lead standard solutions by FAAS, (n = 3) at 25 $C^0$:

| Concentration (mg/l) | Absorbance | SD |
|---|---|---|
| 0.00 | - 0.00262 | 0.000770 |
| 5.00 | 0.02059 | 0.000747 |
| 10.00 | 0.04287 | 0.000476 |
| 15.00 | 0.06427 | 0.000640 |
| 20.00 | 0.08541 | 0.000154 |

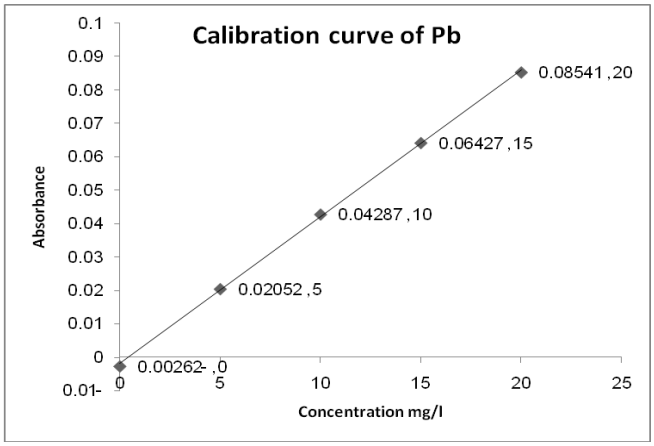



**Figure (4):** Calibration curve of Pb by FAA

**Table (5):** The measured absorbance of Cadmium standard solutions by FAAS, (n = 3) at 25 $C^0$:

| Concentration (mg/l) | Absorbance | SD |
|---|---|---|
| 0.00 | 0.000034 | 0.000157 |
| 1.00 | 0.07634 | 0.000284 |
| 2.00 | 0.1561 | 0.000534 |
| 3.00 | 0.2279 | 0.000634 |
| 4.00 | 0.2977 | 0.000374 |
| 5.00 | 0.3599 | 0.000277 |

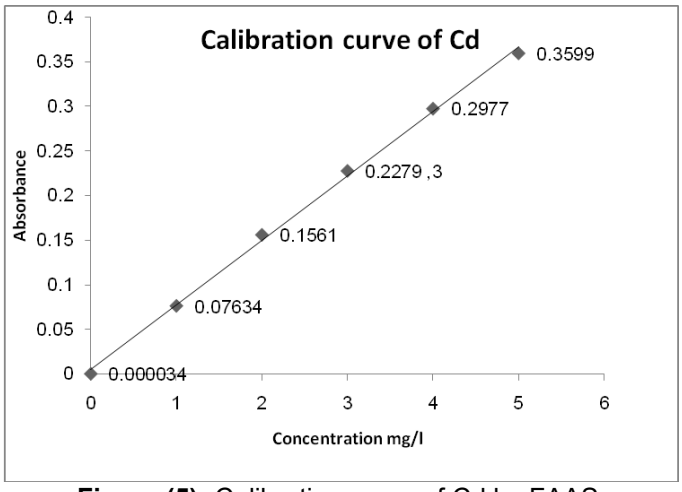



**Figure (5):** Calibration curve of Cd by FAAS.

**Table (6):** The measured absorbance of Zinc standard solutions by FAAS, (n = 3) at 25 $C^0$:

| Concentration (mg/l) | Absorbance | SD |
|---|---|---|
| 0.00 | - 0.00069 | 0.000305 |
| 1.00 | 0.08782 | 0.01736 |
| 3.00 | 0.2762 | 0.000340 |
| 4.00 | 0.3436 | 0.000303 |
| 5.00 | 0.4011 | 0.000470 |

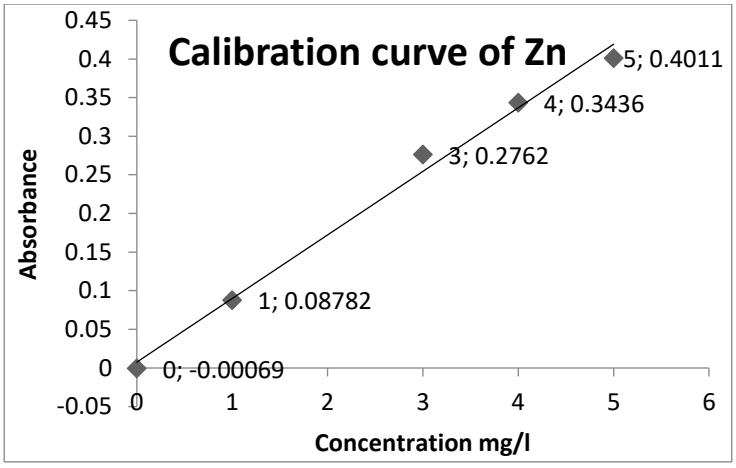



**Figure (6):** Calibration curve of Zn by FAAS

**Results and Discussion:**

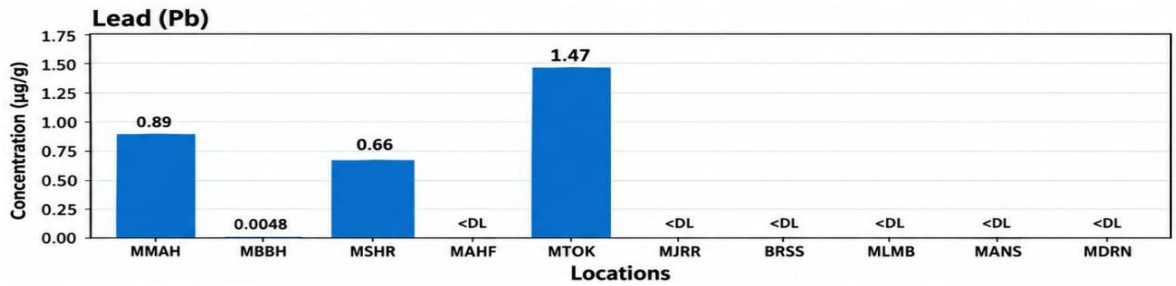
In this research, we discussed the results obtained from the measuring of the heavy metals (lead, Cadmium and Zinc) in seagrass P. Oceanica (L) Delile which collected from different location in Toukra *Coast*

The results were shown in tables and figure, were expressed in µg of metal per g of seagrass (µg\g). Table (7) summarized the locations of which collected the samples Therefore, were will refers to samples number in this research. The concentration of the most metals vary considerably depending on the location of the sampling site.

**Table (7):** metals (Pb, Cd and Zn,) concentration of locations in seagrass " Posidonia Oceanica" (L) Delile

| Location | Mean concentration metals µg/g | | |
|---|---|---|---|
| | Pd | Cd | Zn |
| MMRH | 0.8900 | 11.550 | 46.254 |
| MBBH | 0.0048 | 010.4 | <dl |
| MSHR | 0.6600 | 6.0125 | 8.789 |
| MARF | <dl | <dl | <dl |
| MTOK | 1.4400 | 23.021 | 10.023 |
| PJRR | <dl | <dl | <dl |
| BRSS | <dl | 0.3337 | <dl |
| MLMB | <dl | 1.081 | <dl |
| MAIS | <dl | 0.7787 | <dl |
| MDRN | <dl | 0.8302 | <dl |
| Range | (0,0048-1,44) | (0.3337 – 23.021) | (8.789 -46.254) |

Detection limit of Lead (dl=0.00231 mg/l)
Detection limit of Cadmium (dl= 0.001551 mg/l)
Detection limit of zinc (dl= 0.000915 mg/l)



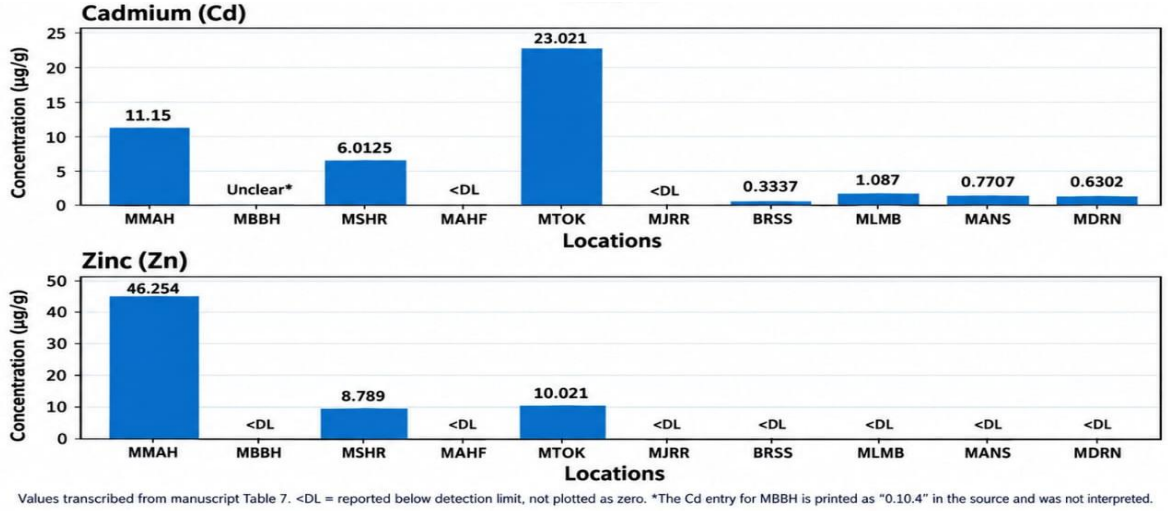



**Figure (7):** metals (Pb, Cd and Zn,) concentration of locations in seagrass " Posidonia Oceanica" (L) Delile

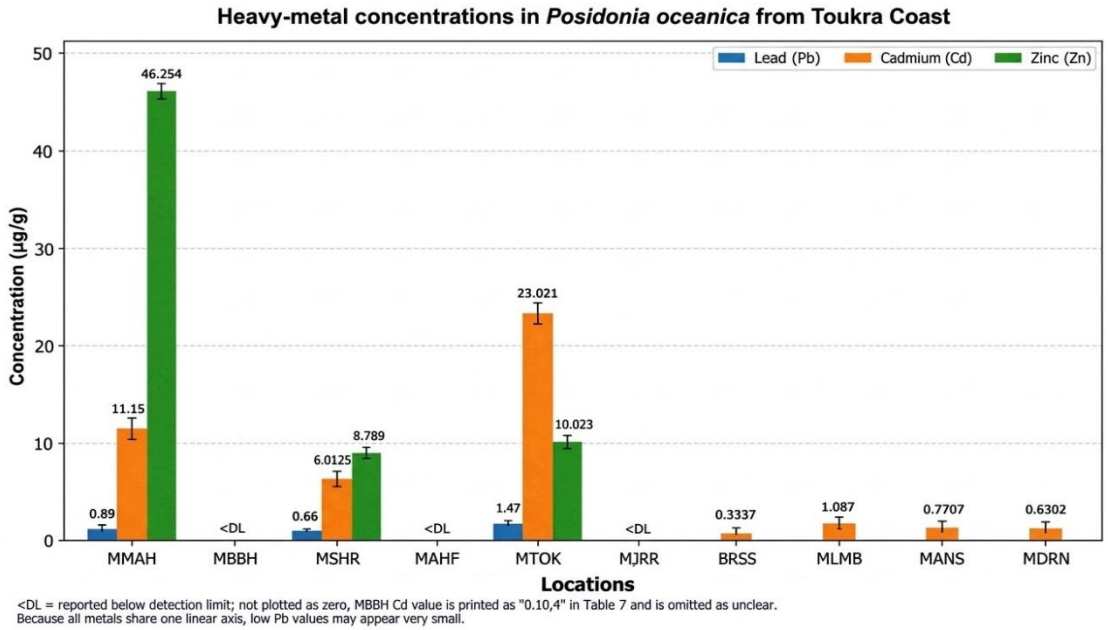



**Figure (8):** comparative metals (Pb, Cd and Zn,) concentration of locations in seagrass " Posidonia Oceanica" (L) Delile.

The results obtained from this study indicate a notable variation in the concentrations of heavy metals (Pb, Cd, and Zn) in the tissues of the seagrass Posidonia Oceanica (L.) Delile collected from different locations along the Toukra Coast. These variations reflect the spatial distribution of pollution sources and the varying degrees of anthropogenic impact across the sampled sites as shown in table 6 and Figures 6 and 7.

1. **Lead (Pb) Concentrations:**

The concentrations of Lead in the seagrass tissue ranged from below the detection limit (<dl) up to 1.4400 µg/g.

- **Elevated Locations:** Only four locations showed measurable levels above the detection limit (dl = 0.00231 mg/L). The highest concentration was recorded at Toukra Sea (MTOK) with 1.4400 µg/g, followed by Resort Marhaba (MMRH) at 0.8900 µg/g, Resort Al-Shorok (MSHR) at 0.6600 µg/g, and Resort Bab Al-hara (MBBH) at 0.0048 µg/g.
- **Environmental Interpretation:** The higher levels of lead detected in stations such as MTOK, MMRH, and MSHR can be attributed to proximity to local anthropogenic activities, including sewage discharge, boat traffic, coastal runoff, and potential emissions from heavy fuel usage in

nearby power plants or road traffic. Conversely, concentrations in the remaining sites fell below detection limits, reflecting cleaner marine conditions in those areas.

2. **Cadmium (Cd) Concentrations:**

Cadmium concentrations varied widely across the study area, with a range spanning from 0.3337 µg/g to 23.021 µg/g.

- **Elevated Locations:** The highest Cadmium concentration was found at Toukra Sea (MTOK) reaching 23.021 µg/g, followed by Resort Marhaba (MMRH) at 11.550 µg/g, Resort Al-Shorok (MSHR) at 6.0125 µg/g, and Resort Bab Al-hara (MBBH) at 4.010 µg/g.
- **Lower Locations:** Moderate concentrations were observed in other resorts (BRSS, MLMB, MAIS, and MDRN) ranging between 0.3337 µg/g and 1.081 µg/g, while Resort Al-Arofi (MARF) and Sea Pojarar (PJRR) fell below the detection limit (dl = 0.001551 mg/L).
- **Environmental Interpretation:** The elevated Cadmium levels, particularly at MTOK and MMRH, are likely linked to agricultural runoff containing phosphate fertilizers (a major source of cadmium) as well as domestic wastewater inputs along these coastal stretches.

3. **Zinc (Zn) Concentrations:**

Zinc displayed the highest overall concentration range among the three metals studied, spanning from 8.789 µg/g to 46.254 µg/g in the samples where it was detected.

- **Spatial Distribution:** Resort Marhaba (MMRH) recorded the highest Zinc concentration at 46.254 µg/g, followed by Toukra Sea (MTOK) at 10.023 µg/g and Resort Al-Shorok (MSHR) at 8.789 µg/g. All other six locations showed Zinc levels below the instrument's detection limit (dl = 0.000915 mg/L).
- **Environmental Interpretation:** Although zinc is an essential micronutrient for marine flora, its localized accumulation at high levels in MMRH points to point-source pollution, potentially originating from metallic corrosion of marine structures, tourist activities, and municipal effluents.

**Conclusion:**

The results obtained from measuring the concentrations of heavy metals (lead, cadmium, and zinc) in the tissues of the seagrass Posidonia Oceanica (L.) Delile collected from ten different locations along the Toukra Coast indicate a clear variation in pollution levels among these sites.

All samples showed low lead concentrations near the detection limit, except for the locations (MMRH, MBBH, MSHR, and MTOK) where the highest lead concentrations were recorded, with a range of (0.0048 - 1.44 µg/g). This is largely attributed to proximity to sewage wastewater sources or power stations utilizing heavy fuel.

Regarding cadmium, the results showed varying concentrations in most samples, with a range of (0.3337 – 23.021 µg/g), while levels dropped below the detection limit in the MARF and PJRR locations.

Zinc recorded the highest mean concentration range among the three elements, spanning from (8.789 to 46.254 µg/g). Locations such as MMRH, MSHR, and MTOK showed distinctively high levels compared to other remote sites where concentrations fell below the detection limit.

This study confirms the high efficiency and sensitivity of the seagrass Posidonia Oceanica (L.) Delile as an effective bioindicator for assessing environmental monitoring and determining marine water pollution levels caused by heavy metals.

Overall, this study successfully validates the reliability of Posidonia Oceanica (L.) Delile as an efficient and sensitive biological indicator (bioindicator) for assessing heavy metal contamination in the Libyan Mediterranean coastal environment.

Through variance analysis, it is concluded that sampling sites (adjacent human activities) significantly affect the concentration of elements in the seagrass Posidonia Oceanica (L.) Delile, while confirming the absence of immediate toxicological risks by heavy metals in these locations, which calls for continuous and sustainable environmental monitoring of the coast.

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