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Accumulation of Some Heavy Metals in Green Algae as Bio Indicators of Environmental Pollution at Al-Haniea region: Libya Coastline

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Abstract

This study aimed to estimate metal pollution in the marine coastal line environment is an important topical issue in the context of ecological disturbance. The concentration of nine trace elements: Cu, Zn, Cd, Pb, was determined in green alga ***Ulva lactuca*** (L.), which collected from several sites at three main area (Al Haneia region). The abundance of metal concentrations in algae samples was in the following order: Pb > Zn > Cd> Cu in the studied area. The variations at this order of abundance were according to the different in activities and metal sources in these different areas. The high uptake of metals in green alga ***Ulva lactuca*** suggested that this alga may be used as potential bio monitors for heavy metal pollution. The results recorded that their increase of metals contents in summer season comparing to Winter season.

Keywords: Heavy Metals, Algea, Al Haniea, Libya

Introduction

The presence of these heavy metals affects numerous metabolic and/or developmental processes in all living organisms. The presence of these heavy metals affects numerous metabolic or developmental processes in all living organisms (Verma *et al*. 2008) [14] because of its toxicity, non-biodegradability, bioaccumulation and persistence in nature. Unlike organic contaminants, heavy metals cannot be broken down by chemical or biological processes. Hence, they can only be transformed into less toxic species (Ayangbenro and Babalola, 2017) [1]. The toxicity and bioaccumulation tendency of heavy metals in the environment is a serious threat to the health of living organisms. Macro algae have been used extensively to measure heavy metal pollution in freshwater and marine environments throughout the world (Conti and Cecchetti, 2003) [3]. This fact has made marine macro algae to be used extensively in many coastal waters around the world as bio monitors of metal contamination in (Okuku and Peter, 2012) [9]. An important assumption underlying use of seaweeds as bio monitor is that metal concentrations in the seaweeds are directly proportional to the bioavailable metal concentrations in environment. Also, macro algae are the most complex and reliable organisms in studies of heavy metal pollution due to their rapid rate of metal accumulation from aqueous solutions and they show the high degree of accumulation of dissolved metals in their cell walls (Salgado *et al*. 2005) [10]. Macro algae can accumulate heavy metals, either essential or non–essential, from their living environments (Salt *et al*. 1995) [11].

The present study aims to provide information on the ***Ulva lactuca*** to act as an efficient bioindicator of metals in Al Haniea region, coastal environments. The study described the spatial variation in Cu, Zn, Cd and Pb, concentrations in ***Ulva lactuca*** in these coastal areas. The study investigated the variation in metal contents in this macroalga reflects the variation in their ambient abundances and if it is significantly affected by certain variables. Provided that metal contents in seaweeds often indicate their ambient bioavailability. We predicted that Ulva lactuca would reflect the ambient abundances of the metals analyzed, i.e. that it satisfies the basic prerequisite for its use as bioindicator of these elements in Algea samples collected from Al-Haniea region coast, Libya.

Experimental Part

The *Ulve* algae samples were collected from three different locations distributed along (El Haniea Region) Al Gabal Al khder coastline, Libya, the collected Al Haniea locations during winter and summer seasons (2024). The washed by tab water and then by distilling water several times, then the samples were dried in open air and dried place, then dried in oven for 24 h. (Hasan *et al*., 2008), (Masoud *et al*., 2012), (Hasan, 2006) [4]. Each dried sample (1 gm on dry weight basis) was digested with a mixture of nitric acid and hydrogen peroxide followed by addition of hydrochloric acid (Kumar *et al*. 2012). The extracts were made up to 50 ml with distilled water. The digested samples were analyzed for Cu, Zn, Cd and Pb, and against standard concentration of each metal on a Perkin Elmer Atomic Absorption Spectrophotometer (Model A Analyst 100). The obtained data were expressed as µg/g dry wt. Blank correction was done to bring accuracy to the results. (Nabil *et al*., 2018, Hasan, 2006) [8, 4], Hasan and Mojahid, 2010) [5].

Results and Discussion

The contents of heavy metals of (Cd, pb, Zn and Cu) of algae samples in winter were fluctuated in the ranges of (1.54 – 2.87), (4.28 – 8.65), (4.25 – 4.89) and (0.69 – 1.35 µg/g), whereas the same metal contents in the summer season were ranged between (1.87 – 3.04), (5.14 – 9.98), (5.36 – 8.95) and (0.79 – 1.62 µg/g), for the above metals, respectively. The results showed variations between the samples, also there is relative increase in heavy metal contents in summer comparing to their contents in winter values.

The concentrations of the selected heavy metals were recorded for Lead (pb), on the other hand the lower contents were obtained for Copper in this study. Generally the order concentrations of the studied metals in this study is pb > Zn > Cd > Cu. However, in the most studies on the accumulation of heavy metals by Ulva showed that only concentrations of these elements characterized in the organisms (more than water and sediments). ***Ulva lactuca*** is a widespread macro alga occurring at all levels of the intertidal zone, in calm and protected harbors as deep as 10 meters and in northern climates. ***Ulva lactuca*** grows along rocky or sandy coasts of oceans and estuaries (Aslan *et al.* 2010). The analysis of the heavy metal concentrations in the entire natural environment from organisms are sampled, may provide information on the extent of contamination and shall reveal possible applications of using Ulva as bioindicator (Villares *et al*. 2002). ***Ulva*** appears as a valuable bio sentinel of water quality due to its massive developments and wide distribution. ***Ulva*** species have shown to be particularly promising in monitoring trace metal contamination (El-Adl, 2009). Among the seaweeds, U. lactuca was the most abundant marine algae along the coastal regions. Indeed, it has the ability to reflect the levels of trace elements; thereby it can serve as a useful bioindicator for pollution in marine environment (Saleh, 2015).

The levels of metals, found in samples of algae from the AL Haniea coast, vary. According to the results obtained, the Zinc had the highest contents and the lowest contents were noted at the level of cobalt. The considerable levels of Zinc obtained in green algae collected from the studied areas of the area under investigated may be linked to the abundance of this metal in aquatic samples. This abundance is also linked to the sea currents responsible for the upwelling of deep waters, especially rich in trace metals. The low Cadmium values can be attributed to the dilution effect caused by the tide, (Vasconcelos and Leal, 2001) [13]. This variability in results can be attributed to the cell wall of macroalgae, which is considered an important site for the complexation of metal cations. For this reason, algae can be considered as good bio indicators of metal contamination. To this end, several studies, using different species of algae (***Ulva***), have been developed. Some macro algae are able to produce exudates (low molecular weight proteins, glutathione, phytochelatins and phytometallothionins) which will compete with algal sites for metals, thus reducing the incorporation of metals into cells, (Coelho *et al*., 2005) [2] & Srinivasan *et al*., 2018) [12].

Table 1: Contents of studied heavy metals at Al Haneia (Al-Gabal Al-Khder) location during winter season

Samples	Cd	pb	Zn	Cu
1	1.89	4.86	5.87	**1.35**
2	1.68	4.65	5.15	1.17
3	**1.54**	4.36	4.69	1.27
4	1.98	**4.28**	4.89	1.29
5	1.54	7.65	7.58	0.89
6	1.66	7.48	7.12	0.78
7	1.58	7.95	**7.63**	0.85
8	1.89	7.36	7.25	**0.69**
9	**2.87**	8.21	4.69	1.15
10	2.34	**8.65**	4.89	1.24
11	2.58	8.47	**4.36**	1.18
12	2.36	8.24	4.25	1.27
Average	1.99	6.84	5.69	1.09
±SD	0.44	1.75	1.32	0.22

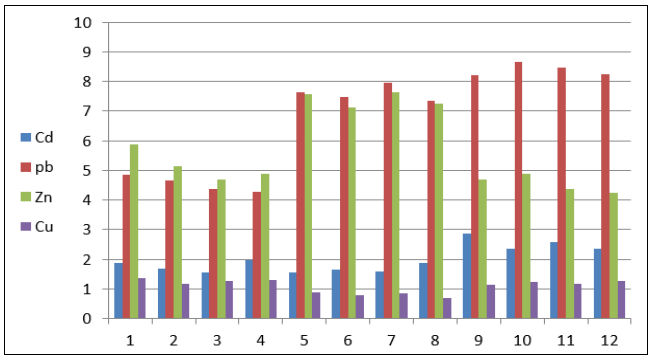

Fig 1: Contents of the selected Heavy metals in the studied locations during winter season

Table 2: Contents of studied heavy metals at Al Haneia (Al-Gabal Al-Khder) location during season

Samples	Cd	pb	Zn	Cu
1	2.54	5.65	6.98	1.62
2	2.34	5.14	6.47	1.25
3	2.65	5.63	6.58	1.42
4	2.47	5.87	6.54	1.35
5	1.98	8.65	8.65	0.98
6	1.87	8.74	8.47	0.89
7	1.97	8.95	8.21	0.78
8	2.14	8.21	8.95	0.89
9	3.04	9.87	5.62	1.35
10	2.89	9.21	5.41	1.42
11	2.94	9.68	5.36	1.36
12	2.76	9.98	5.89	1.51
Average	2.465	7.96	6.92	1.23
±SD	0.406	1.845	1.31	0.277

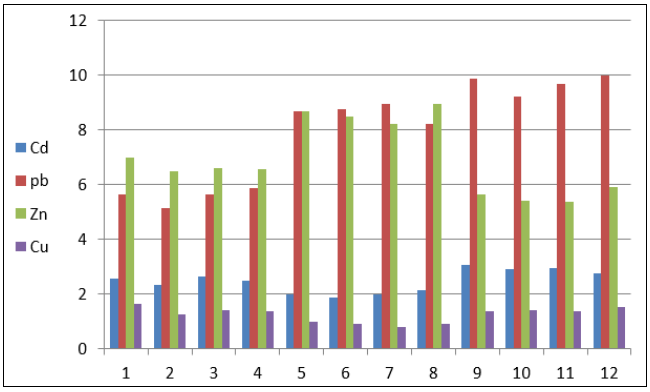

Fig 2: Contents of the selected Heavy metals in the studied locations during summer season

Conclusion

This study recorded high contents of some heavy metals of Cu, pb, Zn and Cd in Algae samples t Al Haniea region, specially of (pb and Zn), metals, the high contents of these metals is indication for marine pollution at area under investigation. The sources of these metals are mainly coming different sources of human activities as sewage, out lets and others.

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