Comparative study of bio sorption of heavy metals in tow Species of Algae_Phaeophyta (Cystoseira compressa)and hlorophyta(Chaetomorpha aerea) from different locations in the Inebolu coasts (Turkey)

NURI MOHAMED AHMED ELDERWISH
College of Medical Technology - Misurata
nurieldrwish72@gmail.com

دراسة مقارنة للامتصاص الحيوي للمعادن الثقيلة في نوعين من الطحالب –البنية Phaeophyta (Cystoseira compressa) والخضراء Chlorophyta (Chaetomorpha aerea) جمعت من مواقع مختلفة في سواحل إينيبولو (تركيا)

الملخص:

في هذه الدراسة تم قياس تركيزات العناصر الثقيلة وهى الكادميوم، والنيكل، والكروم، والزئبق، والنحاس، والحديد، والمنغنيز، والرصاص، في نوعين من الطحالب البنية Phaeophyta (*Cystoseira compressa)* والخضراء Chlorophyta (Chaetomorpha aerea) تم جمعها من مناطق مختلفة على طول شواطئ إينيبولو (تركيا) بداية من خريف 2017 ونهاية صيف 2018، بعد جمع العينات وتحضيرها ثم تحليلها بجهاز ICP–OES لم تظهر النتائج فروقًا ذات دلالة إحصائية في النحاس والزنك والحديد والرصاص والكادميوم بين نوعين من الطحالب حيث كانت قيمة مستوى المعنوية ($p> 0.05$) ووجدت في باقي العناصر حيث كانت قيمة مستوى المعنوية ($p<0.05$)، كما أظهرت النتائج عدم وجود فروق ذات دلالة إحصائية بين المواسم في الزنك، الحديد، الكادميوم، المنغنيز حيث كانت قيمة مستوى المعنوية ($p>0.05$) ووجدت في باقي العناصر الأخرى حيث كانت قيمة مستوى المعنوية ($p<0.05$)، بشكل عام أظهرت النتائج تباينًا في تراكيز العناصر الثقيلة في نوعي الطحالب المدروسة خلال جميع الفصول، يمكن القول أن التلوث بالعناصر الثقيلة في سواحل إينيبولو (تركيا) لم يصل إلى مستويات خطيرة حتى الآن ، نوصي بإجراء دراسات التلوث على فترات منتظمة والإبلاغ عنها بشكل روتيني.

الكلمات المفتاحية: *الامتصاص الحيوي، Enibolu، الطحالب البنية، الطحالب الخضراء، Cystoseira Compressa، Chaetomorpha aerea.*

Abstract

in this study measured the heavy metals concentrations, including Cd, Ni, Cr, As, Hg, Cu, Fe, Mn, and Pb, in two species of marine brown algae Phaeophyta(*Cystoseira compressa)* and green algae Chlorophyta (Chaetomorpha aerea), which were collected from various areas along the Inebolu beaches (Turkey) after that were Analysis of Samples by ICP-OES, the results were no significant differences in Cu, Zn, Fe, Pb, or Cd between two species of algae when the observed threshold of significance was ($p>0.05$). And the other elements there are significant differences ,also the results showed that no significant differences between seasons in Zn, Fe, Cd, Mn And the other elements there are significant differences, it can be said that heavy metal pollution in the Inebolu coasts

(Turkey) has not reached a dangerous levels yet, we recommend should be carried pollution studies out at regular intervals and reported routinely.

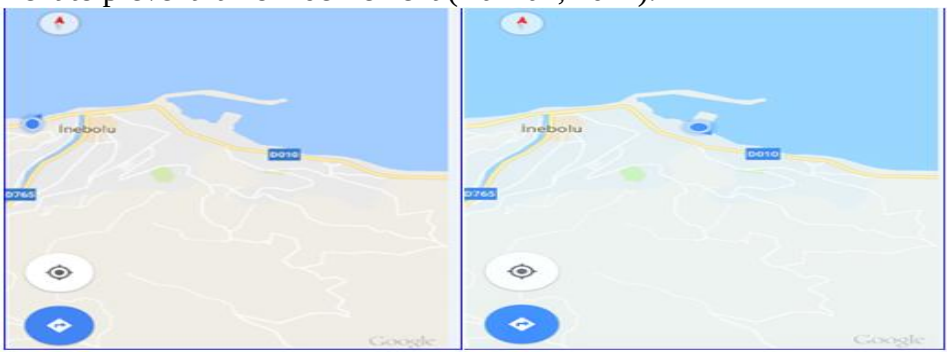
Keywords: *Inebolu, bio sorption, tow Species of Algae*

Introduction

Since the 1970s, pollution has been a contributing factor to the issues. Six states have a gap at the Black Sea, but 18 countries used to discharge toxic wastes through the rivers flowing into the sea. Pollutants carried by rivers area unit the most source of pollution within the Black Sea. The pollution by heavy metals in marine ecosystems has been a problem on a global scale over the last few decades(Strezov, A. 2012; Oros et al., 2010), The Black Sea is the most important natural resource for biodiversity in Turkey (Bat et al., 2011), and its threat is amplified by not existing chemically or biologically decomposed, once released metals can stay in the environ(Noreña et al., 2012) ,the results of serious metals levels within the Turkish coast of the Black Sea were compared with the boundaries of people independent agency and undisputed that the water is additionally contaminated than in other coastal areas(Coban et al., 2009), Some aquatic creatures are being employed more frequently as bioindicators to evaluate contamination. Among the creatures most frequently employed for this are mollusks and algae. (Villares et al., 2002; Lavoie et al., 2009),One of the main categories of algae studied is green-brown algae, all of which include pigments that aid in photosynthetic activity. Brown algae's characteristic hue is caused by an increase in the pigment content. PhycoAxanthin, whereas the green hue of green algae is caused by an increase in the amount of the photosynthetic pigment chlorophyll (Abu Habeel et al., 2019، the pH value has an impact on two components of the biosorption phenomena (Guibal et al., 1994). The biomass concentration is another crucial factor during metal uptake. The biomass, which includes green algae (Chlorophyta), mosses, ferns, and other plants, takes up more metal ions at lower cell densities than at higher cell densities at a given equilibrium concentration (Mehta and Gaur, 2001). These varieties of algae differ mostly in their cell walls, where sorption occurs (Romera et al., 2007).

Study area

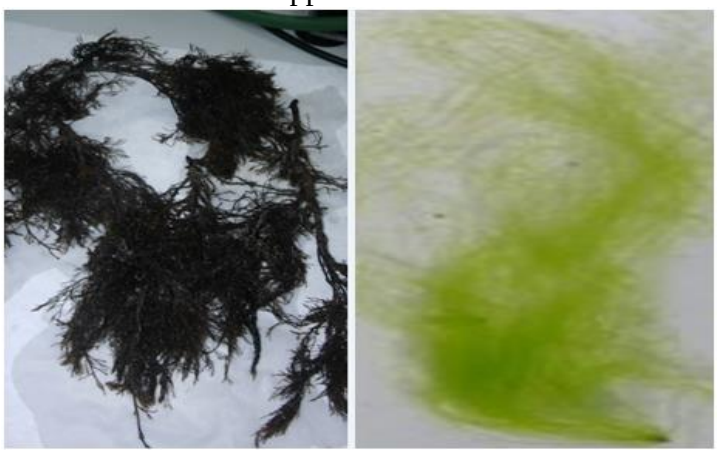
The samples were collected by hand from tow locations in the Inebolu coasts (Turkey). After that, they were washed with ambient water to remove clay sands, dusts, associated algae, sediments and debris. The cleaned algae were then placed separately in polythene plates. Finally, the seaweeds were shade dried for 10 days in a clean environment to prevent it from defilement (Kannan, 2014).



Site 1 Site2

Sample analysis

Heavy metal analyses For samples were performed in Kastamonu University Central Research Laboratory, 0.5 g of each sample was taken and HNO3 and H2O2 were added. the samples were then dried under a pressure of 200 and 45 bar for 15 minutes and then cooled to room temperature. After cooling, the samples were added to ultra-pure water and the readings were performed in ICP-OES (SpectroBlue), the ICP-OES device used performs three readings for each heavy metal and yields in ppb. There is a dilution factor 200 for all samples. Therefore, the results obtained were multiplied by 200 and all results were divided by 1000 and converted to ppm.



(Cystoseira compressa) **Chlorophyta** (Chaetomorpha aerea) (**Phaeophyta)**

Statistical Analysis

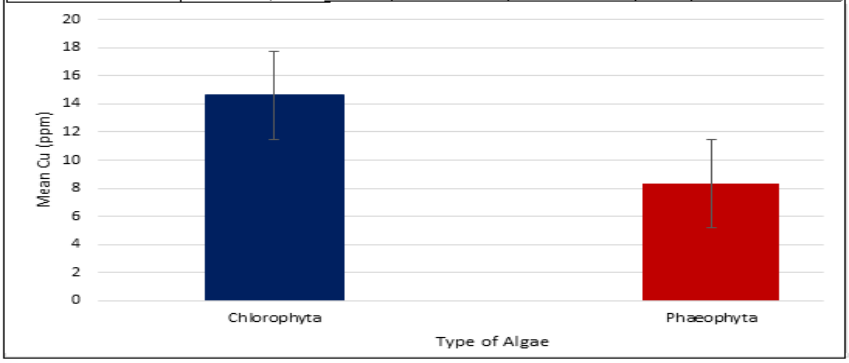
All statistical analyses were performed with SPSS .V24 version for Windows. The comparison between two Species of Algae was studied by T-test for the two independent samples and the comparison between the seasons of the study data was studied by one way ANOVA.

Results and Discussion.

The comparison between two types of algae was studied by t-test for the independent samples.

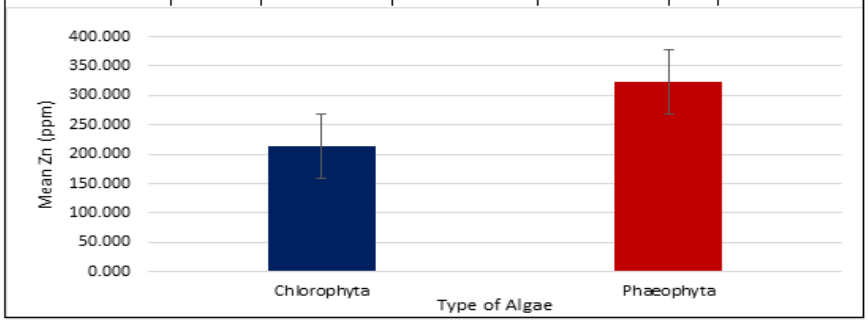
Cu:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Type of algae
There is no differences	0.096	2.615159	9.059175	14.60500	12	Chlorophyta
		2.468541	8.551275	8.35508	12	Phaeophyta



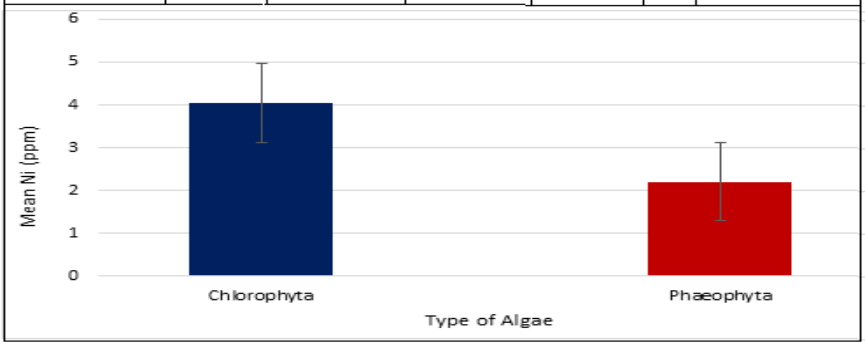
Zn:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Type of algae
There is no differences	0.053	45.217383	156.637610	213.92508	12	Chlorophyta
		26.444853	91.607659	322.50583	12	Phaeophyta



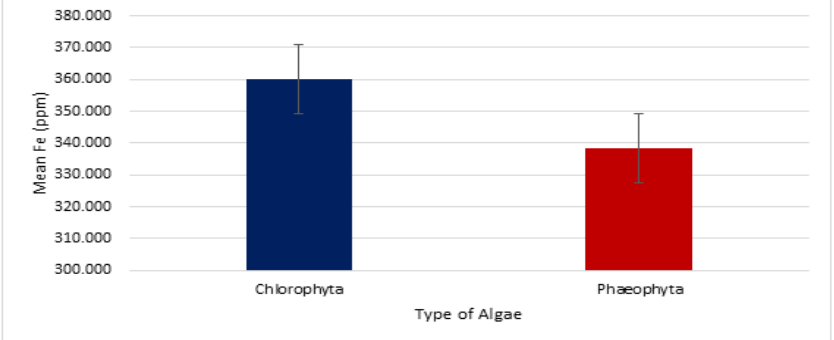
Ni:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Type of algae
There is adifference	0.045	.6625456	2.295125	4.04092	12	Chlorophyta
		.5501974	1.90594	2.20958	12	Phaeophyta



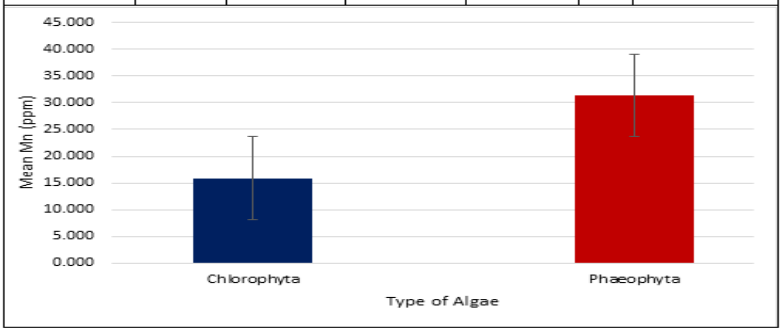
Fe:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Type of algae
There is no differences	0.784	54.365415	188.327321	360.02375	12	Chlorophyta
		55.715920	193.005609	338.39375	12	Phaeophyta



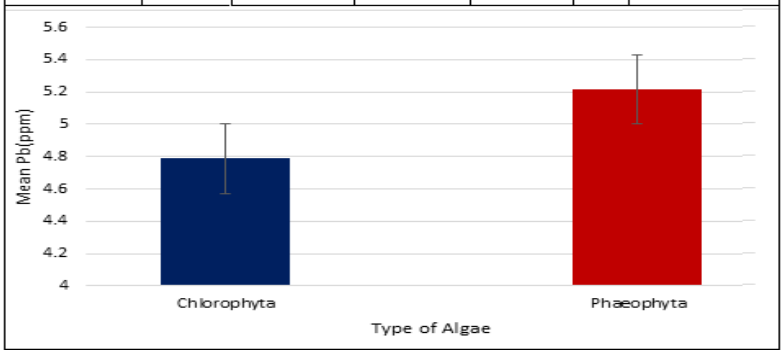
Mn:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Type of algae
There is adifference	0.002	4.177773	14.472229	15.37275	12	Chlorophyta
		.756363	2.620120	31.36008	12	Phaeophyta



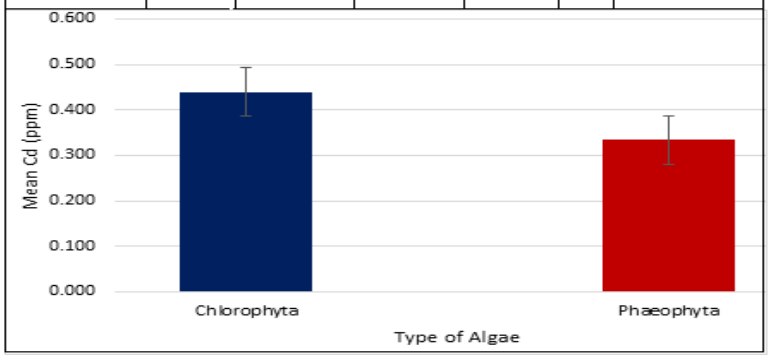
Pb:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Type of algae
There is no differences	0.713	1.050451	3.638867	4.78833	12	Chlorophyta
		.4595627	1.591972	5.21750	12	Phaeophyta



Cd:

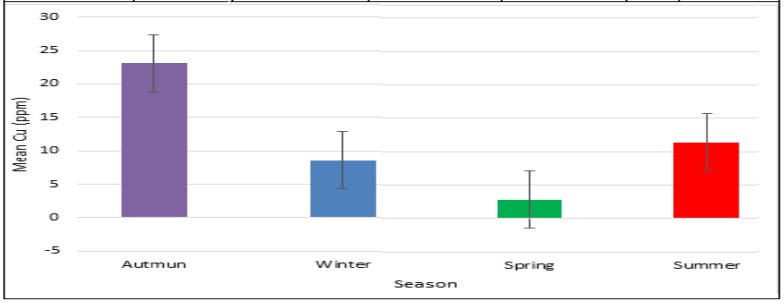
Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Type of algae
There is no differences	0.169	.072495	.251129	.43950	12	Chlorophyta
		.016759	.058053	.33375	12	Phaeophyta



The comparison between the seasons of the study data was done by one way ANOVA.

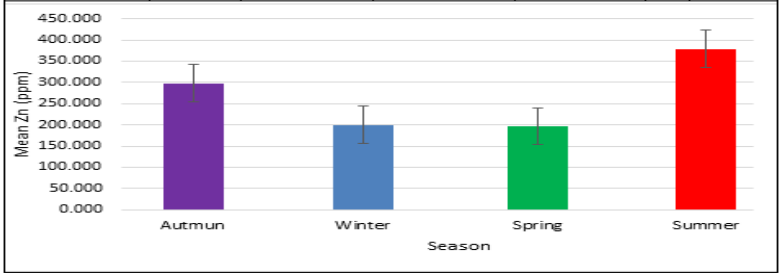
Cu:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Season
There is adifference	0.001<	.854747	2.093693	23.06767	6	Autumn
		.535521	1.311753	8.58033	6	Winter
		.880056	2.155689	2.86067	6	Spring
		4.419114	10.824575	11.41150	6	Summer



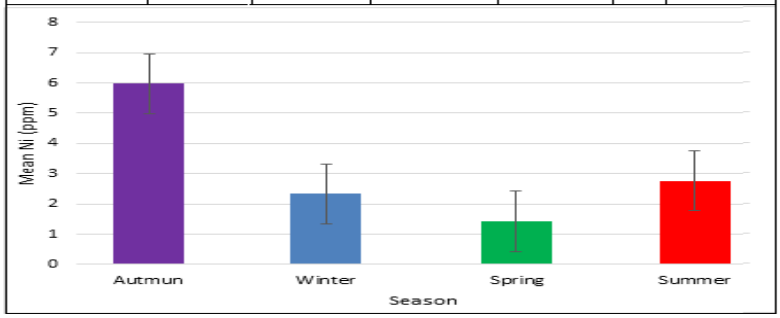
Zn:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Season
There is no differences	0.050	78.676996	192.718495	297.60550	6	Autumn
		33.391122	81.791210	199.78817	6	Winter
		27.394058	67.101464	196.60783	6	Spring
		42.339434	103.710010	378.86033	6	Summe:



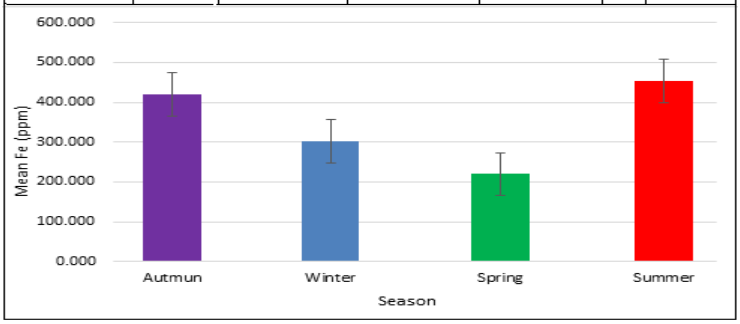
Ni:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Season
There is adifference	0.001<	.594157	1.455381	5.97350	6	Autumn
		.394026	.965162	2.33667	6	Winter
		.594554	1.456353	1.42550	6	Spring
		.365313	.894830	2.76533	6	Summer



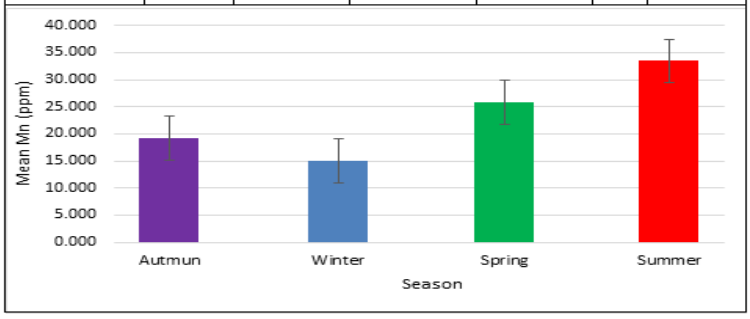
Fe:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Season
There is no differences	0.101	104.986649	257.163720	420.51183	6	Autumn
		21.327954	52.242605	302.78617	6	Winter
		13.035144	31.929453	219.46150	6	Spring
		89.976983	220.397697	454.07550	6	Summer



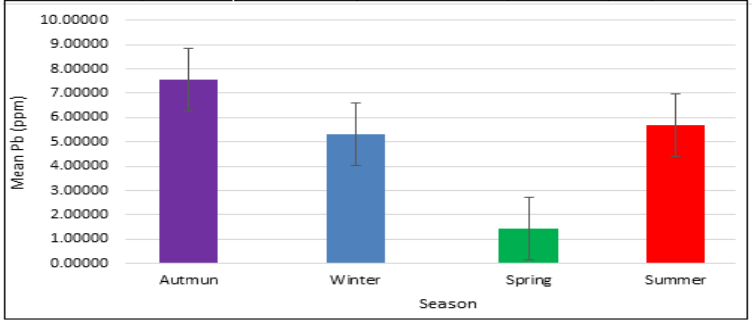
Mn:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Season
There is no differences	0.075	6.756882	16.550913	19.14750	6	Autumn
		6.708762	17.570044	15.00110	6	Winter
		.731046	1.790689	25.86333	6	Spring
		.362638	.888279	33.45333	6	Summer



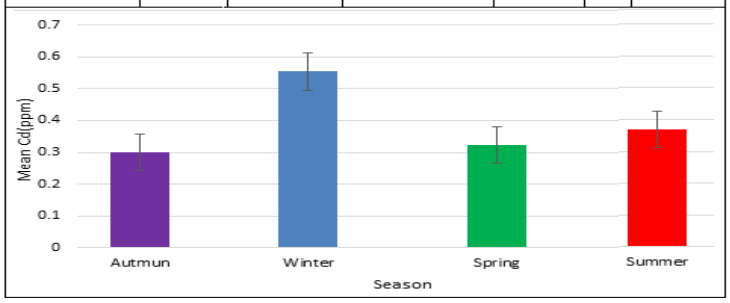
Pb:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Season
There is adifference	0.001<	.576313	2.5207367	7.55567	6	Autumn
		.462760	1.527726	5.32467	6	Winter
		.595206	1.45795	1.42717	6	Spring
		.183081	.48640946	5.70417	6	Summer



Cd:

Differences	P-value	Std. Error Mean	Std. Deviation	Mean	N	Season
There is no differences	0.065	.015928	.039016	.30133	6	Autumn
		.134233	.328803	.55350	6	Winter
		.010654	.026097	.32167	6	Spring
		.016945	.041507	.37000	6	Summer



Results and Discussion:

Tables (1, 2,3, 4, 5,6 and 7) describe measures of the two study algae by making a comparison between heavy metals Mn, Cd, Zn, Cu, Fe, Ni and Pb by the t-test of the two independent samples, the results showed that there were significant differences between the two types of algae where the value of the observed level of significance was ($p<0.05$) in tables (3, 5), the results showed that there were significant no differences between the two types of algae where the value of the observed level of significance was ($p>0.05$) in tables (1, 2, 4, ,6 and 7), the results have shown that the concentrations of Cd,Cu,Fe,Ni in Chlorophyta were higher than Phaeophyta, and the concentration of Pb, Zn, Mn were higher in Phaeophyta, also the study has shown concentrations of heavy metals in Chlorophyta and Phaeophyta in all stations and seasons within the order of Fe >Mn > Cu > Zn> Ni> Pb >Cd, that high Fe and Mn contents compared to the other heavy metals are connected with their function in the organism, the Cu and its compounds usually exist in the biosphere only in trace quantities and participate in the biological cycle only in very low concentrations so that any increase of Cu content may lead to substantial damage in living organisms but is one of the most biologically important metals, the Pb, Cd concentration, both elements are present in the algae in concentrations but are not substantially affect the algal life cycle. (Strezov et al., 2003), these data show that heavy metal contents in two species algea demonstrate various degree of metal accumulation, the obtained higher values of the studied zone can be attributed to the discharge influence of the big rivers entering the Black sea, such as Danube, Dnyeper, Dnyester, and local pollutant emissions , tables (8, 9,10, 11, 12,13 and 14) describe measures of the seasons by making a comparison between heavy metals Mn, Cd, Zn, Cu, Fe, Ni and Pb by one way ANOVA, tables 8,10, and 13) describe measures the comparison between seasons for (Cu, Ni, and Pb) the results showed that there were significant differences between seasons in this elements where the value of the observed level of significance was ($p<0.05$), tables(9, 11, 12, and 14), describe measures the comparison between seasons for (Cd, Zn, Fe and Mn), the results showed that there were no significant differences between the two types of fish in this elements where the value of the observed level of significance was ($p>0.05$), the results have showen a slight

increase in the concentrations of some elements during the autumn season this may be attributed to the fall the heavy metals with the first rain, where the air contains a great amount of pollutants and these pollutants drop down within the first rain period, these results are in agreement with the Chinese study by(Li & Zhang, 2010), where it have showen minimum total concentration of heavy metals was found in spring, and most variables tended to higher levels in the rainy season and many factors may influence the bioavailability of metals in algae including pH, salinity, temperature (Jothinayagi and Anbazhagan, 2009).

Conclusions:

The results obtained indicate that the two Species of Algae investigated show various degrees of metal accumulation and can be used as indicators for the type and quantity of anthropogenic contamination in marine ecosystems, this study have showen a seasonal variation in heavy metal concentrations during all seasons, the results Seemingly depend on biological specificity of the algae, Although that the results obtained do not show any form of danger but the possibility of deleterious effects after long period. generally the results showed Fe concentration Relatively higher than other heavy metalsthis may be attributed to connected with its function in the organism and Cd is least concentrated than other heavy metals, also showed that concentrations of heavy metals in autumn season the higher than other seasons this may be attributed to the fall the heavy metals with the first rain, where the air contains a great amount of pollutants and these pollutants drop down within the first rain period. Finally, a special attention is required for treatment of industrial waste of Turkey before disposal into the coast ,In addition monitor and control ships ballast.

References:

Alkhalifa, A. H., Al-Homaidan, A. A., Shehata, A. I., Al-Khamis, H. H., Al- Ghanayem, A. A., & Ibrahim, A. S. (2012). Brown macroalgae as bio-indicators for heavy metals pollution of Al- Jubail coastal area of Saudi Arabia. *African Journal of Biotechnology*, *11*(92), 15888-15895

Bat, L., Sezgin, M., Satilmis, H. H., Sahin, F., Üstün, F., Özdemir, Z. B., & Baki, O. G. (2011). Biological diversity of the Turkish Black Sea coast. Turkish Journal of Fisheries and Aquatic Sciences, 11(4), 683-692.

Çoban, B., Balkıs, N., & Aksu, A. (2009). Heavy metal levels in sea water and sediments of Zonguldak, Turkey. Journal of the Black Sea/Mediterranean Environment, 15(1).

Guibal, E., Saucedo, I., Roussy, J., & Le Cloirec, P. (1994). Uptake of uranyl ions by new sorbing polymers: discussion of adsorption isotherms and pH effect. Reactive Polymers, 23(2-3), 147-156.

Jothinayagi, N., & Anbazhagan, C. (2009). Heavy metal monitoring of Rameswaram by some Sargassum species. American-Eurasian Journal of Scientific Research, 4(2), 73-80.

Kannan, S. (2014). FT-IR and EDS analysis of the seaweeds Sargassumwightii (brown algae) (red algae). International Journal of Current Microbiology and Applied Sciences, 3(4), 341-351.

Lavoie, M., Le Faucheur, S., Fortin, C., & Campbell, P. G. (2009). Cadmium detoxification strategies in two phytoplankton species: metal binding by newly

synthesized thiolated peptides and metal sequestration in granules. Aquatic toxicology, 92(2), 65-75.

Li, S., & Zhang, Q. (2010). Risk assessment and seasonal variations of dissolved trace elements and heavy metals in the Upper Han River, China. Journal of Hazardous Materials, 181(1-3), 1051-1058.

Mehta, S. K., & Gaur, J. P. (2001). Characterization and optimization of Ni and Cu sorption from aqueous solution by Chlorella vulgaris. Ecological Engineering,18(1),1-13.

Noreña-Ramirez, D. A. (2012). Heavy metals (Cd, Pb and Ni) in fish species commercially important from Magdalena river, Tolima tract, Colombia. Revista Tumbaga, 2(7).

Oros, A., & Gomoiu, M. T. (2010). Comparative data on the accumulation of five heavy metals (cadmium, chromium, copper, nickel, lead) in some marine species (molluscs, fish) from the Romanian sector of the Black Sea. Recherches Marines, 39, 89-108.

Romera, E., González, F., Ballester, A., Blázquez, M. L., & Munoz, J. A (2007). Comparative study of biosorption of heavy metals using different types of algae. Bioresource technology, 98(17), 3344-3353

Strezov,A., & Nonova, T. (2003). Monitoring of Fe, Mn, Cu, Pb and Cd levels in two brown macroalgae from the Bulgarian Black Sea coast. Intern. J. Environ. Anal. Chem., 83(12), 1045-1054.

Strezov, A. (2012). Sustainable environment–Monitoring of radionuclide and heavy Metal accumulation in Sediments, algae and Biota in Black Sea Marine eco systems. Environmental Contamination, 51.

Villares, R., Puente, X., & Carballeira, A. (2002). Seasonal variation and background levels of heavy metals in two green seaweeds. Environmental Pollution, 119(1), 79-90.