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Element Concentrations in Mussels and Algae along the coasts of Istanbul Strait

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Abstract: Mussels and algae have been extensively used as bioindicators of coastal contamination. In this study, some mussels and algae were collected from in 2011 and in 2012 Strait of Istanbul. Element concentrations of these samples were carried out by using Skyray EDX-3600 B spectrometry. Concentration of Na, Mg, Si, P, S, K, Ca, Ti, Fe, Cu, Sr, V, Cr, Mn, As, Zr, Rb, Pb in mussel samples and Na, Mg, P, S, K, Ca, Ti, Cu, Zn, Sr, Cr, Mn, Rb, Pb, Zr in algae samples were determined. The results were compared with previous studies which were done in the same stations. The results showed that in some areas, Pb concentrations are higher than the accepted levels.

Istanbul Boğazı kıyılarındaki Yosun ve Alglerin Element Konsantrasyonları

Anahtar Kelimeler
Midye
Yosun
Ağır Metaller
İstanbul Boğazı

Özet: Midye ve algler, kıyı kirliliklerinin biyoindikatörleri olarak yaygın bir şekilde kullanılmaktadır. Bu çalışmada, 2011 yılında ve 2012 yılında İstanbul Boğazı'ndan bazı midyeler ve algler toplanmıştır. Bu numunelerin element konsantrasyonları, Skyray EDX-360 spektrometresi kullanılarak gerçekleştirilmiştir. Na, Mg, Si, P, S, K, Ca, Ti, Fe, Cu, Sr, V, Cr, Mn, As, Zr, Rb, Pb'nin midye örneklerinde ve Na, Mg, P, S, K konsantrasyonları yosun örneklerinde Ca, Ti, Cu, Zn, Sr, Cr, Mn, Rb, Pb, Zr tespit edilmiştir. Sonuçlar aynı istasyonlarda yapılan önceki çalışmalarla karşılaştırılmıştır. Sonuçlar, bazı bölgelerde Pb konsantrasyonlarının kabul edilen seviyelerden daha yüksek olduğunu göstermiştir.

1. Introduction

Marine mussels are significant both ecological and commercially (Markovic et al.,2012). They are available all session of a year. As a sea food, mussels provide cheap source of protein, Ca and Fe, some vitamins, omega-3 fatty acids, selenium and iodine for human consumption (Culha, 2008; Sahin et al,2011; Dahl et al. 2010). Therefore, marine mussels are commercially important species throughout the world (Stankovich et al., 2011) In 2008, mussel production in a year all over the world was around 1.7 mt and approximately 95% of them came from aquaqulture (Sahin et al,2011).
Ulva lactuca is a widespread macro algae occurring at all levels of the intertidal zone, in calm and protected harbours as deep as 10 meters and northern climates. Ulva lactuca grows along rocky or sandy coasts of oceans and estuaries. In some of Britain and Asia, seaweed is consumed by humans and livestock as it is considered valuable to vhuman nitrition. Many of nutrients include iron, protein, iodine and vitamins (A, B1 and C) and trace elements. Because of antibacterial properties, it has been recommended by treating skin irritations typically, including burns (Apaydın et al, 2010)
In that mussel and algae play an important role in the transfer of chemical contaminants along food chains, they are widely used as a natural bioindicator for detecting heavy metals and contamination in marine ecosystem (Jovic et.al., 2011, Stankovich et al., 2011). Heavy metals are too harmful to most organisms at above the certain level of exposure and absorption (Kayhan, et. al.2007) Chronic exposure of humans to metals such as Cu, Pb, Zn, As, Cd and Hg is associated with Human health problems. Due to being toxic metals they cause outbreaks in humans of metal poisoning (Eto,2000; Markovic et al.). The content of heavy metals in mussels and algae such as Cd, Pb, Hg, Zn mainly have been researched in various investigations (Rainbow,1995; Mengi et al., 1998; Bat et al. 1999; Storelli et al., 2000; Besada et al.,2002;

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Sunlu, 2002). Given results in many studies (Cevik et al. 2008; Joksimovic et al. 2011) showed that the metal content of mussels in particular areas exceeded the limits of regularity bodies according to WHO (World Health Organisation) (Çayır et al., 2012) Therefore in Montenegro, the mean concentrations in the mussel were detected and were determined the range of heavy metals (Markovic et al. 2012)
The industrial cities in Turkey are generally located around the coastal area of the Marmara Sea, Aegan Sea, Mediterian Sea and Black Sea, in the marine organisms that are affected by different kinds of pollutions such as residential housing, marine transportations and industrial waste. Therefore, in last decade the trace elements accumulation in fish and marine organisms has been investigated along the coasts of Turkey. Turkish legal standarts are 1.0 ppm for Cd and 2.0 ppm for Pb in bivalve of molluscs (Kayhan et al., 2007). Bosphorus (Istanbul strait) is a narrow channel between the Black Sea and Marmara Sea that is about 30 km long and has mean depth and with of 37 and 700 m respectively (Kut et al., 2000) The aim of this study is that measuring of concentrations of the trace elements in mussel (Mytilus galloprovincialis) and green algae (ulva lactuca) which are collected from Istanbul coasts and compare the current results with the previous studies.

2. Materials and Methods

In order to determine the content of trace elements in mussels (Mytilus galloprovincialis) and green algae (ulva lactuca) were taken in the month of July in 2011 and in 2012 from the coasts of the Istanbul Strait. After collection the all samples were transported to the laboratory and they were rinsed with clean water. All samples were prepared under laboratory controlled conditions, including the grinding method, grinding time, pelletized pressure and time. The musssels and algae were dried at 70 °C in a Heraeus furnace and then ground in a spex mill. To reduce particle size effects, the powder obtained was sieved using a 400 mesh sieve and then stirred for 20 min to obtain a well-mixed sample. A five tone hydraulic press was used to compress the sample powder into a solid thick pellet of 40 mm diameter using a boric acide (H_3BO_3-powder) as a protective cover.

Figure 1 Sampling area in Istanbul

Results and Discussion

In this study the mussels and algae collected from Istanbul coasts which may be seen in Figure 1. and they were analysed by ED-XRF. Concentration of Na, Mg, Si, P, S, K, Ca, Ti, Fe, Cu, Sr, V, Cr, Mn, As, Zr, Rb, Pb in mussel samples and Na, Mg, P, S, K, Ca, Ti, Cu, Zn, Sr, Cr, Mn, Rb, Pb, Zr
The elemental concentration of the samples was determined using a Skyray EDX3600B spectrometer equipped with an Oxford Rh anode X-ray tube. The spectrometer has a SSD detector made in Germany having 145 ±5 eV energy resolutions. This spectrometer is capable of 0.05% measurement precision, analytical range of elements from Sodium to Uranium, and ppm-99.99% analysis range. Besides, 24 elements can be analyzed simultaneously using it. The standardization of the samples were made using Panalytical AXIOS Advanced WDXRF. In the work of the standardization IQ+ program was used. This program gives the semi-quantitative results with 95-90% precision for all materials. The standard curves were drawn at the EDX3600B spectrometer using the standard values which were obtained from the IQ+ program and uploaded the system. The concentration of the samples was determined by the system using these standard curves. Analysed samples three times to get correct results.
in algae samples were determined. They can be seen in Table 1 and Table 2. Obtained results were compared with the previous results to see the changes of the contamination along the coasts of Istanbul straight. If the current results were compared with the previous study in 2011, higher K, Ca, Fe, P and lower S concentrations were found in mussell samples in Sarayburnu and Kadıköy. They can be followed in Figure 2 as well as higher Cu concentrations in algae samples in Beykoz, Çubuklu, Kandilli and Sarıyer, higher Sr concentrations were found in Beykoz, Çubuklu, Kuzguncuk, İstinye and Kandilli besides lower Pb, Zr and Rb concentrations were detected in Beykoz, Çubuklu, Kuzguncuk, Istinye, Kandilli and Sarıyer. They can be seen in Figure 3. Another results which were taken from Bakırköy, Anadolu Kavağı, Eminönü and Yedikule the years 2006, 2007 and 2011 showed that the elements Fe, Sr, Ti concentrations in algae decreased year after year. They can be seen the Figure 4.
While measuring pollution of the sea water, as well as mussels analysis algae analysis is done. Thus, marine pollution can be detected due to their biological features. Determined elements for pollutions are Cu and Zr. One of the most important place in Turkey and in the world is Istanbul Strait where the Cu concentration is so significant for mussels if it is in between % 0,0021-0,0029, for algae the range must be in between % 0,0017-0,0054. Cu is an essential element which is a huge part of several enzyms and also it is necessary for hemoglobin synthesis

(Sivaperumal et al. 2007; Joksimovic et al., 2011). However, a high intake of Cu has been recognized to cause adverse health problems (Gorell et.al, 1997) Prasad (1983) claimed that these elements might act alone or together overtime to induce the disease. Strontium reacts vigorously with water and quickly tarnishes in air Strontium in its elemental form occurs naturally in many compartments of the environment including rocks, soil, water, and air. Strontium concentrations can be increased by the human activities mainly by dumping waste directly in the water or industrial processes of the factories.

In this study all results showed that although taken samples from Istanbul Strait were found clean in view of trace elements Cu and Zn but high Pb concentrations were determined in Arnavutköy, Bebek, Kandilli, Eminönü, Tarabya, Kuruçeşme, Rumeli Hisarı, Sarıyer, Zeytinburnu. In analysed all mussel samples Pb, Cu, Zn, As concentrations were detected respectively in range 0,0192-0,0480 ppm, 0,0147-0,0326 ppm, 0,0693-0,1558 ppm, 0,2888-0,6547. In addition to these in algae samples, Pb, Cu and Zn concentration is detected in order of levels 0,0001±0,0011 ppm Cu levels 0,0027-0,0041 ppm, 0,0040-0,0200 ppm .

As a result, the element concentrations along the strait of Istanbul were found in range of accepted levels for Turkey and worldwide. However, due to increasing industrialialization and urban population in these areas, the elemental concentrations should be repeated periodically in order to prevent from the contamination.

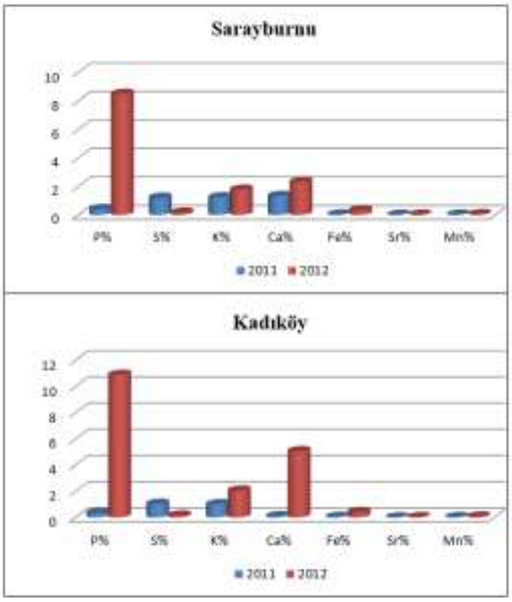

Figure 2. The element comparison for mussels in 2011 and 2012

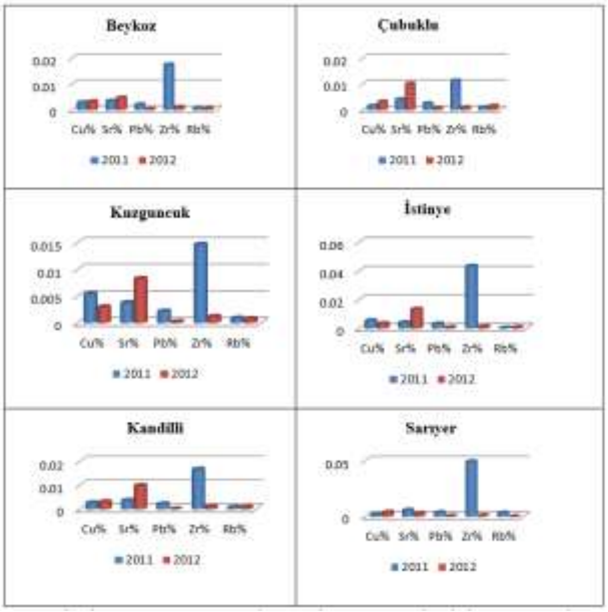

Figure 3. The element comparison of algea samples between 2011 and 2012

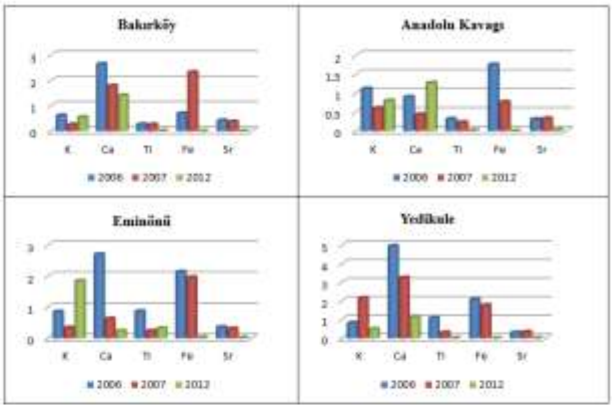

Figure 4. The element comparison of algea samples between 2006, 2007, 2012

Table 1. Mean concentrations in algae samples

Algae Stations	Na	Mg	Al	Si	P	S	K	Ca	Ti	Fe	Cu	Zn	Sr	Cr	Mn	Rb	Pb	Zr
Anadolu Kavağı	0,2446	0,7474	0	0,056	0,1197	0,9006	0,8008	1,274	0,0146	0	0,0027	0,0062	0,0259	0,0003	0,0142	0,0012	0,0002	0,0011
Anadolu Hisarı	0,2776	0,6641	0	0	0,0704	0,9249	0,658	0,3334	0,0038	0	0,0032	0,0102	0,003	0,0024	0,0162	0,0007	0,0004	0,001
Bakırköy	0,2478	0,413	0,0194	0	0,326	0,575	0,5572	1,4129	0,0119	0	0,0038	0,0153	0,0074	0,0057	0,0368	0,0006	0	0,0012
Bebek	0,2422	0,5354	0	0	0,1298	0,6511	0,3799	1,0993	0,0221	0	0,0038	0,0159	0,0073	0,0065	0,0359	0,0007	0,0009	0,0013
Beşiktaş	0,2416	0,5758	0	0	0,1359	0,6456	1,0575	0,4077	0,0003	0	0,0034	0,0064	0,0016	0,007	0,0248	0,0003	0,0002	0,0009
Beykoz	0,2609	0,6982	0	0	0,2226	0,7519	1,1366	0,7836	0,006	0	0,0034	0,0076	0,0048	0,0022	0,0277	0,0006	0,0004	0,0012
Beylerbeyi	0,2621	0,6149	0	0	0,1408	0,9407	1,4493	1,5994	0	0	0,0029	0,0051	0,0127	0	0,0138	0,0012	0,0002	0,0012
Burunbahçe	0,2019	0,6288	0	0	0,0857	0,6721	0,9242	0,374	0,0041	0	0,0033	0,0061	0,0062	0,003	0,0264	0,0027	0,0007	0,0012
Çubuklu	0,1319	0,1846	1,0129	3,0912	0,2234	0,383	0,7049	1,8692	0,0712	0,3961	0,0033	0,0102	0,0161	0	0,0186	0,0017	0,0008	0,0011
Eminönü	0,2644	0,461	0,0472	0,1504	0,0735	0,6322	0,5875	0,8358	0,0173	0	0,004	0,02	0,0075	0,0097	0,0377	0,0007	0,0011	0,0014
Emirgan	0,2767	0,7676	0	0	0,1067	0,8238	0,6803	0,507	0	0	0,0028	0,0072	0,011	0,0007	0,0115	0,0009	0,0006	0,0011
İstinye	0,2495	0,6603	0	0,6684	0,1037	0,6683	0,3908	1,0955	0,0113	0	0,0035	0,0135	0,009	0,0027	0,0304	0,0008	0,0007	0,0012
Kabataş	0,2463	0,7335	0	0,5022	0,1575	0,7127	0,9199	0,9658	0,0139	0	0,003	0,0084	0,0083	0,0018	0,0165	0,0014	0,0008	0,0012
Kalamış	0,2606	0,6717	0	0	0,1599	0,7861	0,9467	1,5395	0,0023	0	0,0031	0,004	0,0114	0,0005	0,0178	0,0006	0,0004	0,0011
Kandilli	0,2431	0,62	0	0	0,1501	0,9359	0,6863	1,045	0,0049	0	0,0031	0,0075	0,0099	0,0025	0,0246	0,0009	0,0001	0,0011
Karaköy	0,2238	0,4496	0	0	0,1526	0,7158	0,4841	1,6602	0,0091	0	0,0033	0,0071	0,0177	0,0036	0,0255	0,0004	0,0004	0,001
Küçüksu	0,2533	0,6439	0	0	0,1087	0,7583	1,2113	0,3982	0,0071	0	0,003	0,0074	0,0043	0,0035	0,0207	0,0008	0	0,0011
Kuleli	0,2919	0,789	0	0	0,1185	0,9149	0,8878	0,4123	0	0	0,0028	0,0072	0,0046	0	0,0067	0,0011	0,0001	0,0011

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