RED ALGAE AS BIOINDICATORS OF HEAVY METAL POLLUTION FROM SAMSUN COASTS OF TURKEY

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Abstract

A total of four macroalgae species (*Porphyra umbilicalis, Corallina panizzoi, Antithamnion cruciatum, Ceramium rubrum*) belonging to Rhodophyta division were collected in 2013 along the Black Sea coast of Samsun in Turkey. Concentrations of Fe, Zn, Ni, Cu, Mn, Co, Pb and Cd were measured. As a result the highest concentrations of the trace elements found in algae were as follows: Fe (1714 ± 53 mg/kg dry wt.), Cd (0.04 ± 0.02 mg/kg dry wt.) and Co (0.6 ± 0.07 mg/kg dry wt.) in *A. cruciatum*; Zn (41 ± 6 mg/kg dry wt.), Cu (10 ± 3 mg/kg dry wt.), and Mn (31 ± 4 mg/kg dry wt.) in *C. panizzoi*; Ni (3 ± 0.21 mg/kg dry wt.) in *C. rubrum*; and Pb (0.06 ± 0.01 mg/kg dry wt.) in *P. umbilicalis.* All species can be used as bioindicators of heavy metal pollution in this area.

Keywords: Algae, Black Sea, Bio-indicators

Introduction

The metal levels have increased in the Black Sea due to some contaminants that are introduced into through rivers or discharges of effluents from industries, agricultural and municipal usage. Samsun extends along the coast between two major rivers: Kizilirmak and Yesilirmak in the Black Sea in Turkey (Fig. 1).
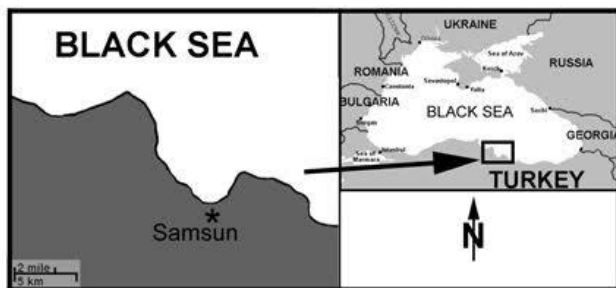

Fig. 1. Study area from Samsun coasts of the Black Sea, Turkey.

Therefore, Samsun coastline is mainly being affected by rivers. Moreover, fast-paced population, urbanization, intensive agricultural activities, small or full scale industrial activities and the commercial port activities present some of the major problems and all of these problems create heavy metal pollution along the Samsun coasts [1]. Macroalgae are useful and generally used in the monitoring of metal pollution because of their distribution, reasonable size, longevity, presence at pollution areas, ability to accumulate metals to an adequate degree and ease of identification [2]. They are primary producers in the coastal marine areas and transfer energy between trophic levels and also give information on concentrations of heavy metals in the surrounding environment [3]. The aim of the study was aim to measure essential and non-essential heavy metals (Fe, Zn, Ni, Cu, Mn, Co, Pb and Cd) in four macroalgae species named *Porphyra umbilicalis, Corallina panizzoi, Antithamnion cruciatum, Ceramium rubrum* belonging to Rhodophyta division in 2013 summer from Samsun coasts of the Black Sea, Turkey.

Materials and Methods

Porphyra umbilicalis, Corallina panizzoi, Antithamnion cruciatum, Ceramium rubrum macroalgae species were collected from Samsun, in the Black Sea city of Turkey. Samples firstly washed with clean sea water, then with tap and distilled water. Afterwards they were dried at $70^{o}C$ and homogenized. Then selected algae were digested with concentrated HNO_3 (Merck) and evaporated. Metal concentrations were measured by using Flame Atomic Absorption Spectrophotometer (UNICAM 929) with 3 replicates for each measurement and were expressed mg kg^{-1} dry weight.

Results and Discussion

This study was performed for assessment of heavy metals (Fe, Zn, Ni, Cu, Mn, Co, Pb and Cd) in the red macroalgae collected from Samsun in the Black Sea, Turkey in 2013. Samsun coastline is mostly affected by urban processes, discharges of small industries and also harbor activities. As a result of study, the highest Fe (1714 ± 53 mg/kg dry wt.), Cd (0.04 ± 0.02 mg/kg dry wt.) and Co (0.6 ± 0.07 mg/kg dry wt.) values were found in *A. cruciatum*; Zn (41 ± 6 mg/kg dry wt.), Cu (10 ± 3 mg/kg dry wt.), and Mn (31 ± 4 mg/kg dry wt.) concentrations were detected in *C. panizzoi*; Ni (3 ± 0.21 mg/kg dry wt.) was found in *C. rubrum*; and the last Pb (0.06 ± 0.01 mg/kg dry wt.) level was determined in *P. umbilicalis* (Table 1). It was concluded that selected macroalgae were safe as regards the heavy metal studied. However, monitoring should be continually to assess environmental condition and Monitoring of coastal waters by indicator macroalgae is required for future studies according to Marine Strategy Framework Directive.

Tab. 1. The heavy metal concentrations (Mean±SD) in red macralgae species in Samsun coast.

Metals		(mg/kg dry wt.)	Species
Fe	min	280 ± 11	*P. umbilicalis*
	max	1714 ± 53	*A. cruciatum*
Zn	min	18 ± 2	*A. cruciatum*
	max	41 ± 6	*C. panizzoi*
Ni	min	0.4 ± 0.01	*P. umbilicalis*
	max	3 ± 0.21	*C. rubrum*
Cu	min	5 ± 1	*P. umbilicalis*
	max	10 ± 3	*C. panizzoi*
Mn	min	11 ± 1.5	*A. cruciatum*
	max	31 ± 4	*C. panizzoi*
Pb	min	<0.05	*A. cruciatum, C. rubrum*
	max	0.06 ± 0.01	*P. umbilicalis*
Cd	min	<0.02	*P. umbilicalis, C. rubrum*
	max	0.04 ± 0.02	*A. cruciatum*
Co	min	0.1 ± 0.02	*C. rubrum*
	max	0.6 ± 0.07	*A. cruciatum*

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