THE EFFECTS OF VARIOUS CONCENTRATIONS OF LEAD TO CHLOROPHYLL A AND CHLOROPHYLL B OF *Elodea canadensis* Michx.

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ABSTRACT: This study aims to determine the changes in quantities of chlorophyll a and chlorophyll b in various lead concentrations. The main parts of *Elodea canadensis* have been subjected to lead concentrations, such as 0.1, 0.5, 1, 5, 10, 20, 50 and 100 mg L^{-1}, with periods of 24, 48, 72, 120, 168 and 216 hours. Chlorophyll a and b quantities were measured in control plants and lead concentrations of 5, 10, 20 and 100 mg L^{-1} as 30 – 120 mg L^{-1} and in lead concentrations of 0.1, 0.5 and 1 mg L^{-1} as 20-70 mg L^{-1}. Some morphological indications related with senescence were observed on leaves of the samples that were exposed to 50 and 100 mg L^{-1} lead concentrations beginning from the 168th hour.
KEY WORDS: *Elodea canadensis*, lead concentrations, chlorophyll a , chlorophyll b

FARKLI KURŞUN KONSANTRASYONLARININ *Elodea canadensis* Michx. ' İN KLOROFİL A VE KLOROFİL B MİKTARLARI ÜZERİNE ETKİLERİ.

ÖZET: Araştırmada farklı kurşun konsantrasyonlarında klorofil a ve klorofil b miktarlarının değişimlerini tespit etmek amaçlanmıştır. *Elodea canadensis* gövde parçaları 0.1, 0.5, 1, 5, 10, 20, 50, ve 100 mg L^{-1} kurşun konsantrasyonlarına 24, 48, 72, 120, 168 ve 216 saatlik peryotlarda tutulmuşlardır. Kontrol bitkilerinde ve 5,10,20, ve 100 mg L^{-1} kurşun konsantrasyonlarında klorofil a ve b miktarları 30-120 mg L^{-1} , 0.1 ,0.5, ve 1 mg L^{-1} kurşun konsantrasyonlarında ise 20-70 mg L^{-1} ölçülmüştür. 168. saatten itibaren 50 ve 100 mgL-1 kurşun konsantrasyonlarına maruz bırakılan örneklerin yapraklarında senesens ile ilgili morfoıolojik belirtiler ortaya çıkmıştır.
ANAHTAR KELİMELER: *Elodea canadensis*, kurşun konsantrasyonları, klorofil a, klorofil b

1. INTRODUCTION

Since the analytical tests of the chemical polluters are very expensive and time consuming, finding cheap, fast and easy environmental monitoring methods are of high interest (1, 2).

Basic macrophytes are defined as a potentially useful group for biological remediation and biological observation (3,4). There are many advantages of using macrophytes. They take doused polluter through their roots (3,5,6) and also absorb chemicals from water column through their leaves (6,7). In addition, growing of many macrophtye allow to observe them in time.

Heavy metals join fresh water basins, streams etc. (8,9), which are also known as herbicide, or as a by-product of human activities (9,10). If high values are reached, water organisms may become toxicated. When the lead concentrations in water is less than 0.1 mg.L^{-1}, they are not toxic to livings in water (11). It is known that some of the heavy metals influence photosynthetic activity negatively. Chlorophyll a and chlorophyll b are the most important pigments in the photosynthetic activity. In this study, it is aimed to determine the changes in quantities of chlorophyll a and chlorophyll b in various lead concentrations.

2. MATERIAL AND METHODS

Elodea canadensis is a endemic water plant in United States and Canada and can also be seen in Europe, New Zeeland and Asia as an aggressive invader. It grows in lakes, pools, spring water and calm streams and is widely used in aquariums. The body floats on water or under water, there are oval leaves as triple bunches, supported tightly along the body, which can grow more than 3 meters. *E. canadensis* has two housings and it flowers and forms blooms between June and September. It spreads with the body parts, which can form independent plants by growing, as colonies (8). Since *Elodea canadensis* is a cosmopolite and a well-studied plant, it is deemed as being a good candidate for being used in intoxication studies due to heavy metals (12) and it is proved that it stores chemicals from both water and sediments (8, 13). Because of such characteristics, *Elodea canadensis* has been preferred as an experiment object.

The samples used in this study were gathered from the experimental pools in the Botanical garden of Istanbul University. These plants were placed in lead nitrate solutions with various concentrations, prepared with filtered water, supplied from Büyükçekmece Lake.

This study was carried out in the laboratory and the body parts of *Elodea canadensis* with 10 cm length were used. A total of 112 plant samples were used. These samples were placed in 1-liter transparent bottles, one containing normal lake water and the others containing lead solutions of 0.1, 0.5, 1, 5, 10, 20, 50 and 100 mgL^{-1}. The plants were aerated through the use of an aeration motor for 2 hours / day and the water temperature was measured as 24 ± 0.5 ^{o}C during the study. The plants were subjected to aforementioned lead concentrations with periods of 24, 48, 72, 120, 168 and 216 hours. Two samples were taken from each bottle at definite times and they were dried in sterilizer for 48 hours, after their water was drawn through the use of a filter paper (14). The dried samples were weighted at precision scale and then pigment analysis was carried out. In the pigment analysis, Lichtenthaler & Welburn (1983) method was used (15).

3. RESULTS

The results of the analysis carried out on some physicochemical parameters of lake water are given in Table 1.

Table 1. Results of some physical-chemical parameters of lake water (May 2005).

PARAMETERS	Values
p H	7.83
Salinity	% 0.3
Ca	0.343 $mg\ L^{-1}$
Mg	0.248 $mg\ L^{-1}$
Total hardness	20.18 ° F
Nitrite	1.284 $mg\ L^{-1}$
Nitrate	5.915 $mg\ L^{-1}$
Ortophosphate	0.104 $mg\ L^{-1}$

The chlorophyll a and chlorophyll b quantities in control plants left for growing in normal lake water first decreased then reached to the maximum value (119.8 mg L^{-1}) in the 72nd hour and then decreased again.

The pigment quantities in the solution containing 0.1 mg L^{-1} decreased significantly and then began increasing after the hour 24.

Chlorophyll a and b quantities of the samples in the solution containing 0.5 mg L^{-1} increased through the time. The quantity of chlorophyll a reached to maximum value at hour 48.

The pigment quantities of the samples in the solution containing 1 mg L^{-1} decreased and then increased, as seen in the control plants.

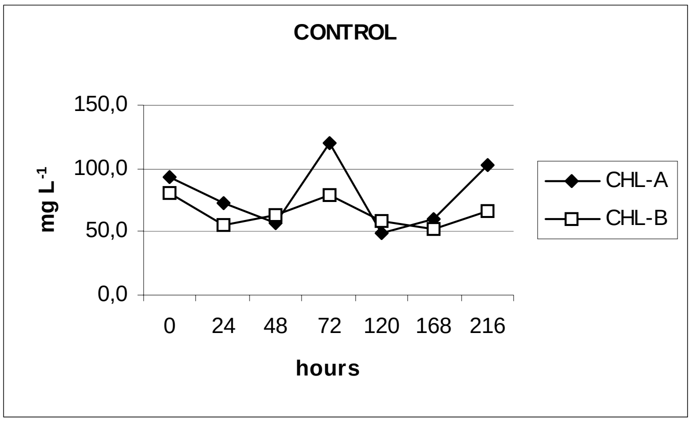
Chlorophyll a and b quantities of the samples in the solution containing 5 mg L^{-1} decreased through the time.

Chlorophyll a and b quantities of samples in solution containing 10 mg L^{-1} decreased at the hour 24 and then some increases.

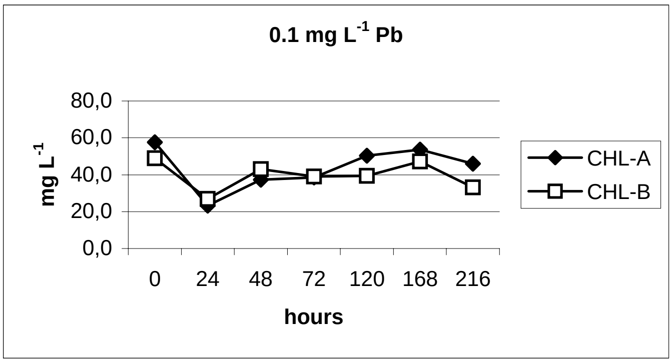
Chlorophyll a quantities of the samples in the solution containing 20 and 50 mg L^{-1} reached maximum values at the hour 120.

Chlorophyll a and b quantities of the samples in the solution containing 100 mg L^{-1} decreased through the time (Figure 1).

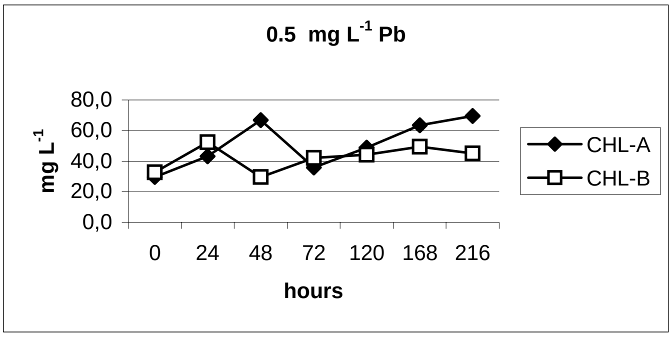
Chlorophyll a and b quantities were measured in control plants and lead concentrations of 5, 10, 20 and 100 mg L^{-1} as 30 – 120 mg L^{-1} and in lead concentrations of 0.1, 0.5 and 1 mg L^{-1} as 20-70 mg L^{-1} as given in a figure (1).



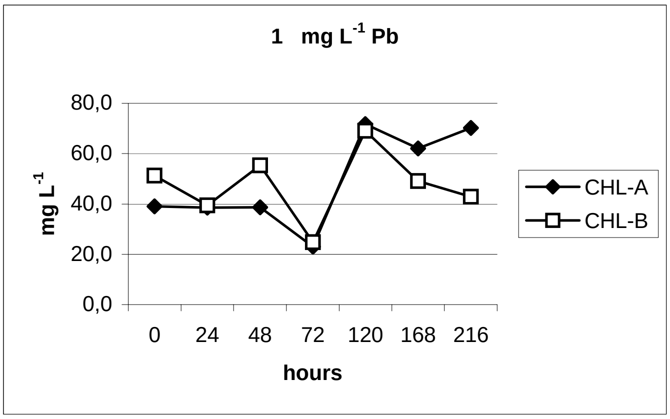
a



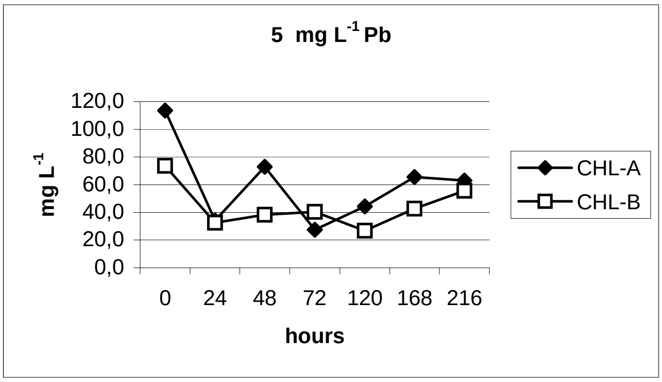
b


0.5 mg L-1 Pb
mg L-1
80,0
60,0
40,0
20,0
0,0
0
24
48
72
120
168
216
hours
CHL-A
CHL-B

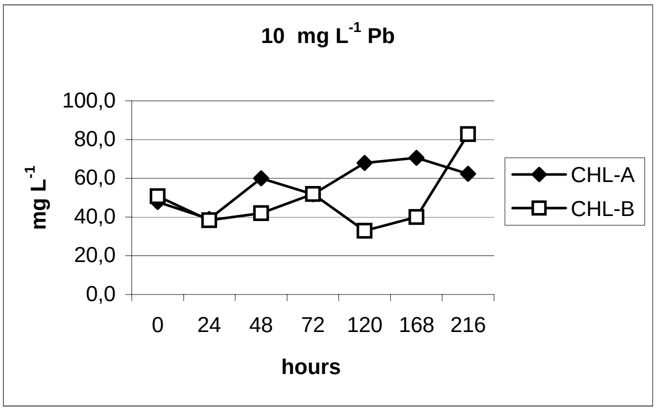
c


1 mg L-1 Pb
mg L-1
80,0
60,0
40,0
20,0
0,0
0
24
48
72
120
168
216
hours
CHL-A
CHL-B

d


5 mg L-1 Pb
mg L-1
120,0
100,0
80,0
60,0
40,0
20,0
0,0
0
24
48
72
120
168
216
hours
CHL-A
CHL-B

e


10 mg L-1 Pb
mg L-1
100,0
80,0
60,0
40,0
20,0
0,0
0
24
48
72
120
168
216
hours
CHL-A
CHL-B

f

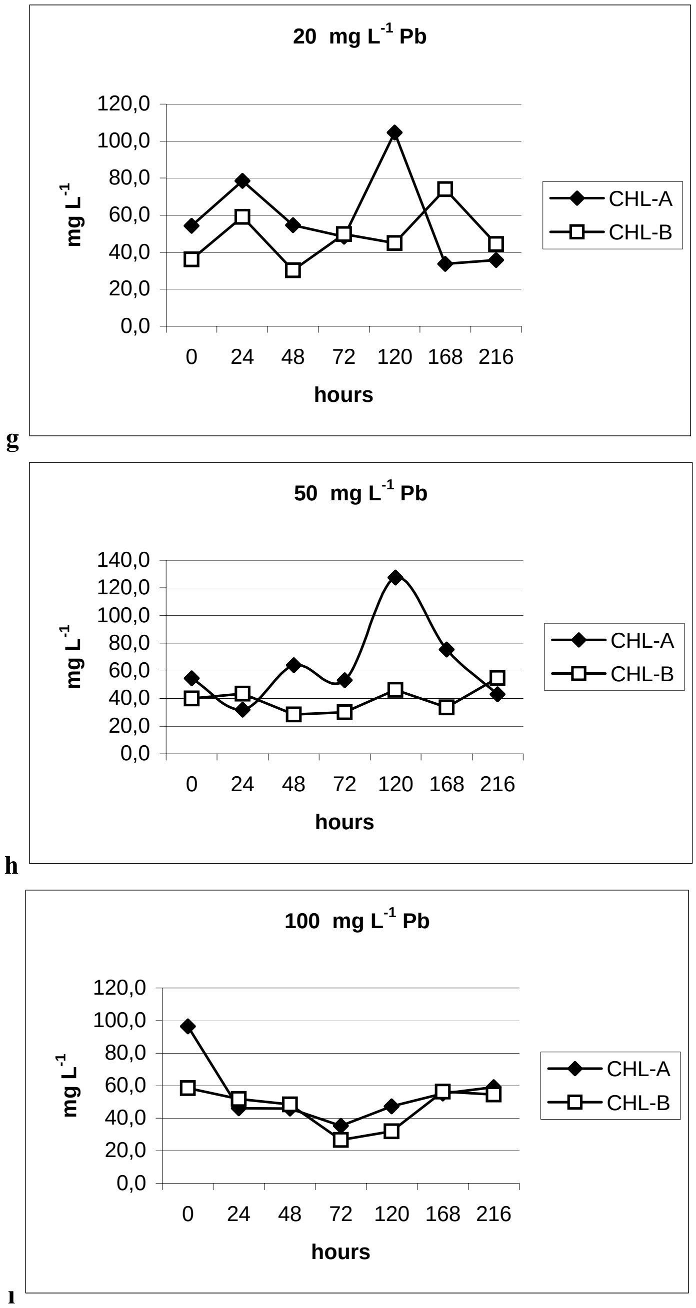


Figure 1. Distribution of chlorophyll a and chlorophyll b quantities based on various lead concentrations

4. DISCUSSION

In this study, water taken from Büyükcekmece Lake was used after filtration. Büyükcekmece Lake is one of the lakes under risk of pollution. Highways pass at northern and eastern sides of the lake. There are some factories, workshops and settlement areas at north and agricultural areas at south. The previous studies showed that there was a pollution problem in this lake (16, 17).

Temel and Yardımcı (2000) measured the mercury and lead concentrations in the lake water, sediment, fish (*Scardinus erythrophthalmus* L., 1758; Cyprinidae), and plants (*Ceratophyllum demersum* L.; Ceratophyllaceae) and determined that the mercury and lead concentrations were 0.0011 ppm Hg and 0.034 ppm Pb in the lake water; 0.436 mg/kg Hg in the sediment (as dry weight), 48.8 mg/kg Pb; in the edible part of *Scardinius erythrophthalmus* L., 1758; Cyprinidae (as wet weight) 0.050 ppm Hg, 0.224 ppm Pb; and in C*eratophylum demersum L* , Ceratophyllacea (as dry weight) 0.030 ppm Hg and 0.846 ppm Pb (16).

The high values observed in lead quantities and the significant scarcity in the macrphyte quantitiy of the lake are the important findings of this study. The scarcity in the phytoplankton quantity, which is the main factor in primer productivity, is also significant (15). There are different reasons for the scarcity in quantities of macrophytes as well as phytoplankton. One of them is the lack of nourishment salts in the water and the other is pollution. Temel (2002) specified in his study that the lake had an oligotrophic characteristic (17).

In the analysis carried out during this study, it was found that the lake leads to mesotrophy. It is known that the heavy metal pollution has a negative influence on the photosynthetic pigments of the plants. Stayonova ve Tchakalova (1993) found in their study that *E. canadensis* contained high levels of copper and lead accumulation, although the plant was dead (18).

The aquatic plants do not only absorb the polluters in water, but they can also return such materials to the water when they decay (16) and they can release such materials from their living tissues. For example, Evevard and Denny found in 1985 that the 90 % of the untied lead taken absorbed by *E. canadensis* returned to water column in time (7).

It was determined that *E. canadensis* performed nickel bioaccumulation from water column but it did not make chrome accumulation . Iron and copper were found as accumulated in the root of *E.canadensis* and nickel, manganese and chrome were found as accumulated in the leaves (13).

Chlorophyll a and b quantities were measured in control plants and lead concentrations of 5, 10, 20 and 100 mg L^{-1} as 30 – 120 mg L^{-1} and in lead concentrations of 0.1, 0.5 and 1 mg L^{-1} as 20-70 mg L^{-1}.

Because of the low values seen at lead concentrations of 0.1, 0.5 and 1 mg L^{-1}, it can be considered that the photosynthetic activity is lower than the other concentrations. Some morphological indications related with senescence have been observed on leaves. The samples that have been exposed to 50 and 100 mg L^{-1} lead concentrations started to senescence after 168^{th} hour from the beginning.

In accordance with the data obtained from this study, chlorophyll a and chlorophyll b quantities did not decrease in response to the increase in lead concentrations and it showed fluctuations as illustrated in graphics. Such results lead to acceptance of restricting the further use of *E. canadensis* as bioaccumulator and biomonitor.

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