



# STRUCTURAL CHANGES IN CHLOROPLASTS OF *ELODEA NUTTALLII* (PLANCH). H. ST. JOHN LEAVES IN RESPONSE TO CADMIUM

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## Introduction

The effect of cadmium (Cd) on the ultrastructure of plastid apparatus in leaves of *Elodea nuttallii* (Planch). H. St. John was investigated in experimental conditions using transmission electron microscopy (TEM). The experimental plants were cultivated in a green house environment after preliminary adaptation. The plants were exposed to Cd during 5 days period with concentrations 1 mg/l and 3 mg/l, consistent with previous studies. Cultivated plants under condition of the experiment without Cd were used as the controls. The results showed that at concentration 1 mg/l Cd chloroplasts have a well organized internal membrane system relative to the control, but fragmentation and weak swollen thylakoids were observed. Increasing of cadmium concentration at 3 mg/l Cd show hardly affected plastid ultrastructure, as swollen thylakoid membrane and reduction of grana stacks. The established structural changes of photosynthetic apparatus of *E. nuttallii* are analyzed and compared to previous researches of cadmium toxicity on *E. canadensis* under the same conditions.

## Methodology

The experimental plants were cultivated in a green house environment after preliminary adaptation. Cultivated plants under condition of the experiment without Cd were used as the controls. The heavy metal was incorporated into the aquatic environment as CdSO<sub>4</sub>. Methodical settings were compliant with previous results for structural organizations of plastid apparatus of *Elodea canadensis* under the influence of the stated cadmium concentrations (Stoyanova, Tchakalova, 1999). Material for electron microscopic was taken from the middle parts of the leaves, fixed with 3% glutaraldehyde and subsequent dehydration. The material was included in Durkopan, then cut with an ultramicrotome and observed on JEOL1200 electron microscope.

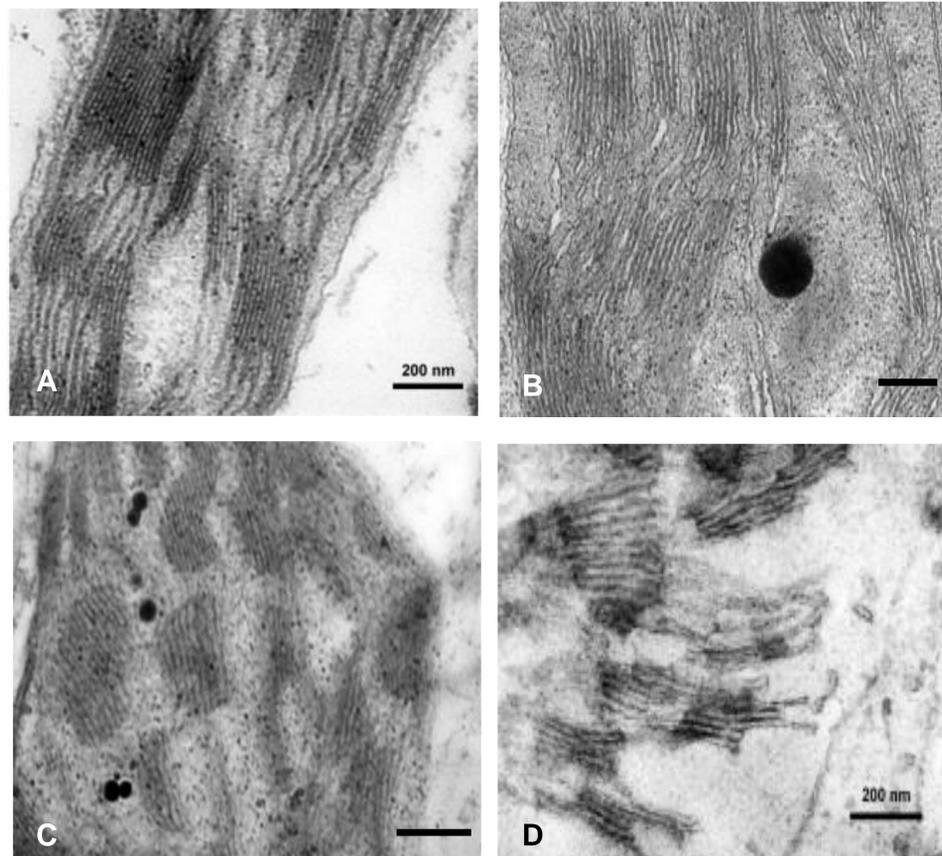


*E. nuttallii* treated with Cd 1 mg/l



*E. nuttallii* treated with Cd 3 mg/l

## Results



After five days treatment of plants with concentration Cd 1 mg/l, changes in the structure organization in the internal membrane system are observed (Fig.B). The thylakoid system with granal and stromal membranes is well organized. Grana consists 6-17 thylakoids. Compared to the control sample (Fig.A), the thylakoid membranes are not oriented along the longitudinal axis of the chloroplasts. Single and larger plastoglobules have been found in the stroma. The outer membrane of the chloroplasts partially retains its integrity. The more pronounced changes are observed when exposed plants with concentration Cd 3 mg/l. At the highest concentration chloroplasts showed disarranged orientation of the inner membrane system (Fig.C). Some chloroplasts presented significantly higher and wider faces and strongly swollen thylakoid membranes filling the entire volume (Fig.D). The shape of chloroplasts is more round and their internal volume is larger than those of the control plants. An increase in the number of plastoglobules in the stroma could be seen. The outer chloroplast shell is almost completely destroyed.

## Conclusion

The structural changes of chloroplasts in *E. nuttallii* (Planch). H. St. John in response to exposure to Cd 1 mg/l, changes in thylakoids is associated with less pronounced swelling of the granular thylakoids and preservation of stromal integrity. A concentration of Cd 3 mg/l seem to be borderline for *E. canadensis* Rich., while the structural organization of the chloroplasts in *E. nuttallii* retained their functionality to the control plants. Based on a comparison of the structural organization of chloroplasts, it can be said that *E. nuttallii* has a greater capacity to accumulate heavy metal and therefore will be more effective in the biological purification of water basins contaminated with cadmium.