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Biotechnology of metal removal from industrial wastewater: zinc case study

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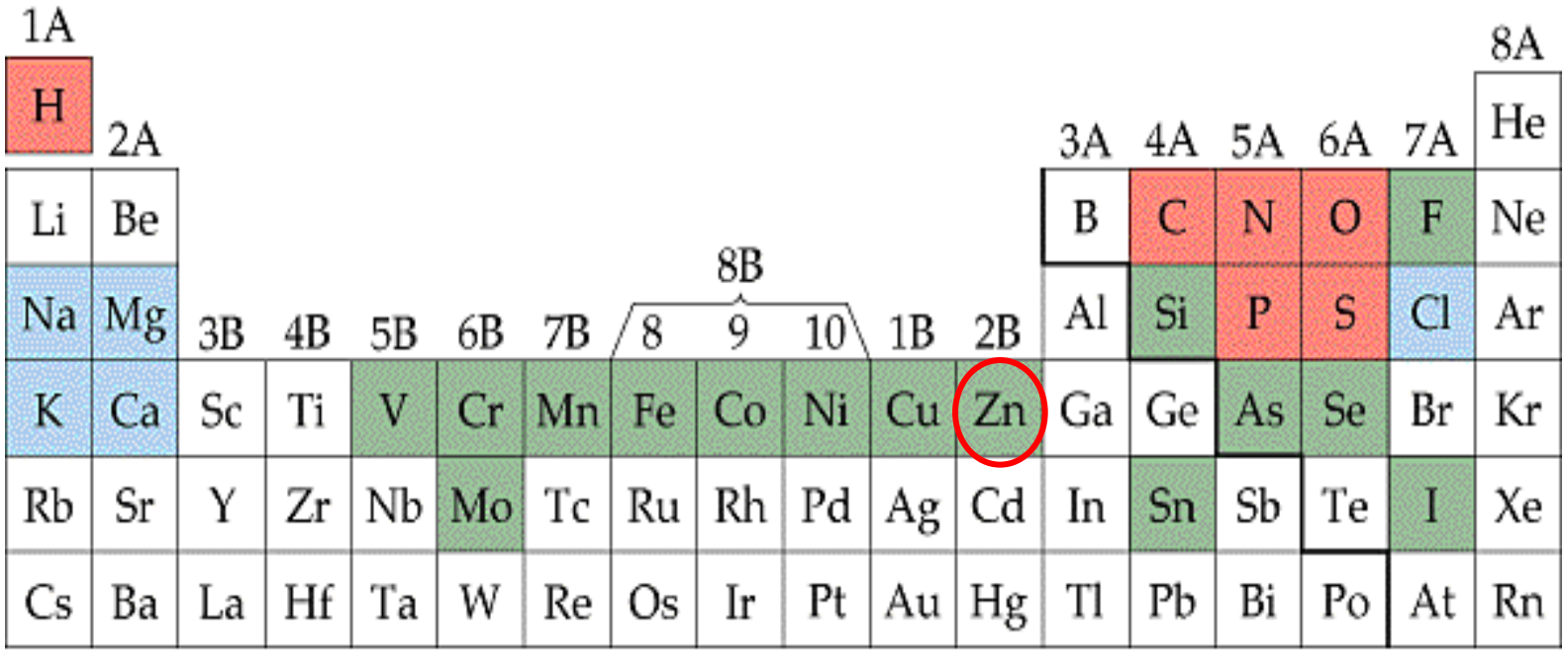
Zinc in organism



- **Catalytic**
- **Structural**
- **Regulatory**

Zinc is a critical element for human health, because even its small deficiency can have disastrous consequences

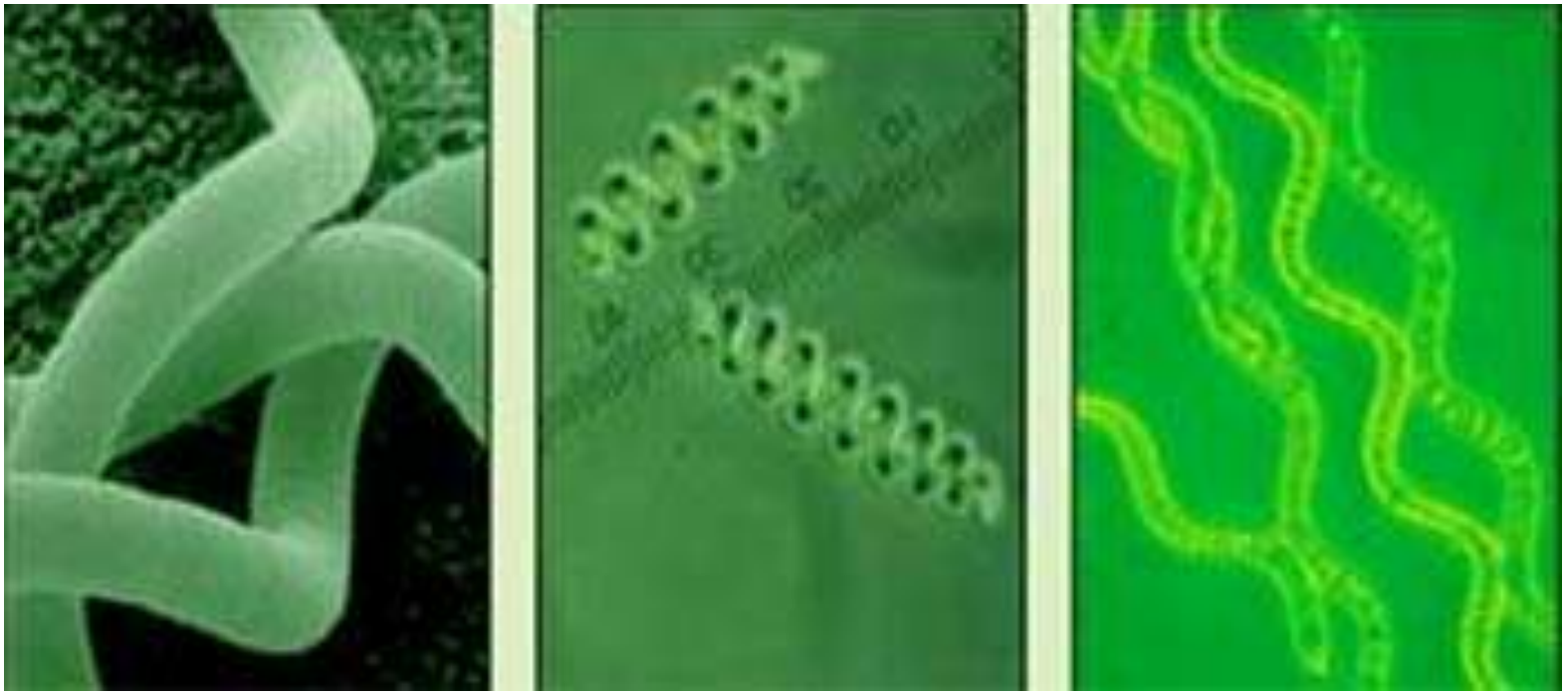
Application of zinc

Zinc

Microorganisms use in remediation of water

- low cost
- prompt availability
- relatively high specific surface area
- good binding affinity

Object of study



Spirulina platensis

Spirulina is a filamentous plankton cyanobacteria (gram-negative), or a multicellular helical filamentous alga. To carry out the experiment, algological pure culture of *Spirulina platensis CNM-CB-02* strain from the National Collection of Nonpathogenic microorganisms (Institute of Microbiology and Biotechnology, Academy of Sciences of Moldova) was used.

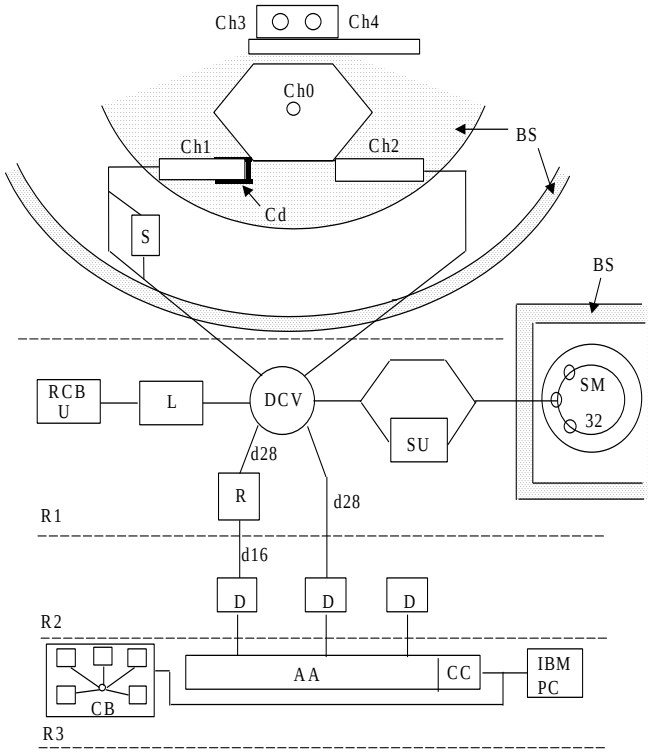
Experiment

C $_{ZnSO4 \cdot 7H2O}$ **:** 100mg/L and 1000mg/L

Experiment time = 1 hour

Samples were obtained in 5, 15, 30 and 60 minutes

IBR-2 and Radioanalytical complex REGATA



Zinc content in the samples was determined by neutron activation analysis at the reactor IBR-2 by the energy 438.6 keV of isotope ^{69m}Zn

irradiation time 4 days;

- neutron flux density ≈ 1.6 10^{16} neutron/(cm^2·s)

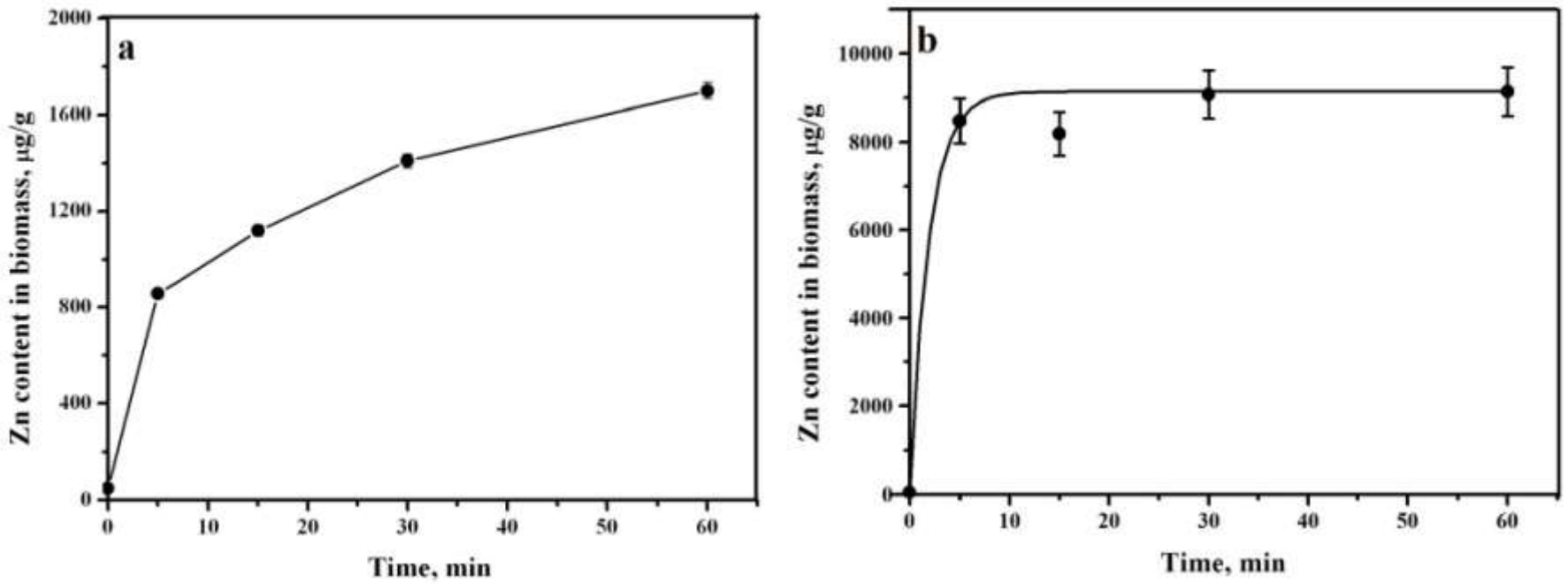


Fig. 1. Zinc content in the *S. platensis* biomass versus to the time of exposure to zinc sulfate: (a) 100 mg/L; (b) 1000 mg/L

The largest manufacturer of modern agricultural machinery in Republic of Moldova

Experimental scheme

Notation of the variants	Form/ amount of spirulina biomass, mg	Amount of residual water, ml	Further additions	Contact time
Ist type of experiment				
I	Filtered/ 50	100	–	30 min
II	Filtered/ 50	100	1.68 g $NaHCO_3$	30 min
III	Filtered/ 50	100	SP-1 in macro environment required amount for 100 ml medium	30 min
IInd type of experiment				
IV	Culture on the third day in 100 ml medium / 50 mg	100	–	3 days

Results

Zn, Fe, K, As and W content in spirulina biomass after its interaction with wastewater

Experimental variant	Content of elements in biomass, mg/ kg					Spirulina survival
	Zn	Fe	K	As	W	
I	2060±90	91300±5900	5410±390	7.6±0.5	8.2±2.5	–
II	74900±1400	74300±5200	6540±560	4.2±0.3	3.6±1.1	–
III	82500±1500	90400±4500	5900±400	4.7±0.3	4.0±1.2	–
IV	52000±9800	51700±3900	9890±990	2.5±0.2	3.5±1.1	+
C	50±1	1360±30	18025±900	0	0	

Experimental scheme

Notation of the variants	Form/ amount of spirulina biomass, mg	Amount of residual water, ml	Further additions	Contact time
III^{d} type of experiment				
V	Filtered/ 75	100	–	5 min
VI	Filtered/ 75	100	–	15 min
VII	Filtered/ 75	100	–	30 min
VIII	Filtered/ 75	100	–	60 min

Results

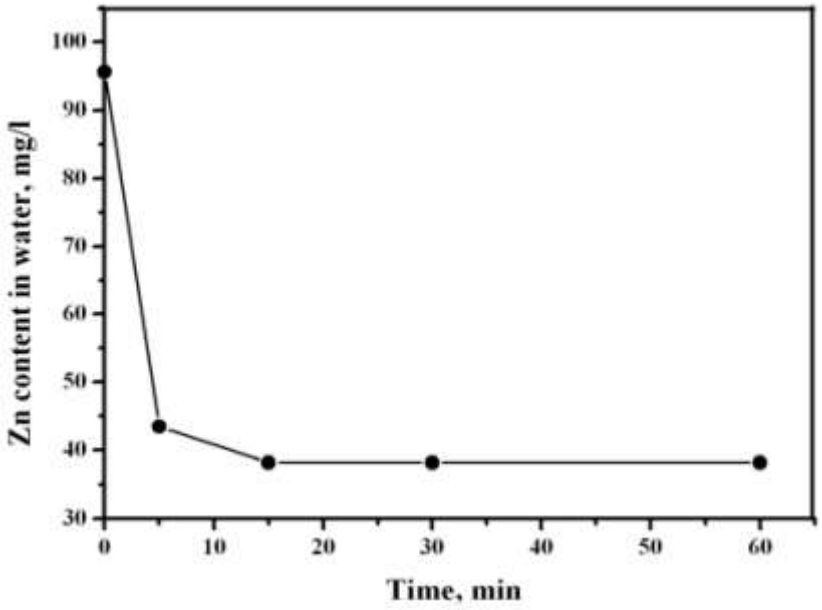


Fig. 2. Zinc content in wastewater versus the contact time with the *S. platensis* biomass

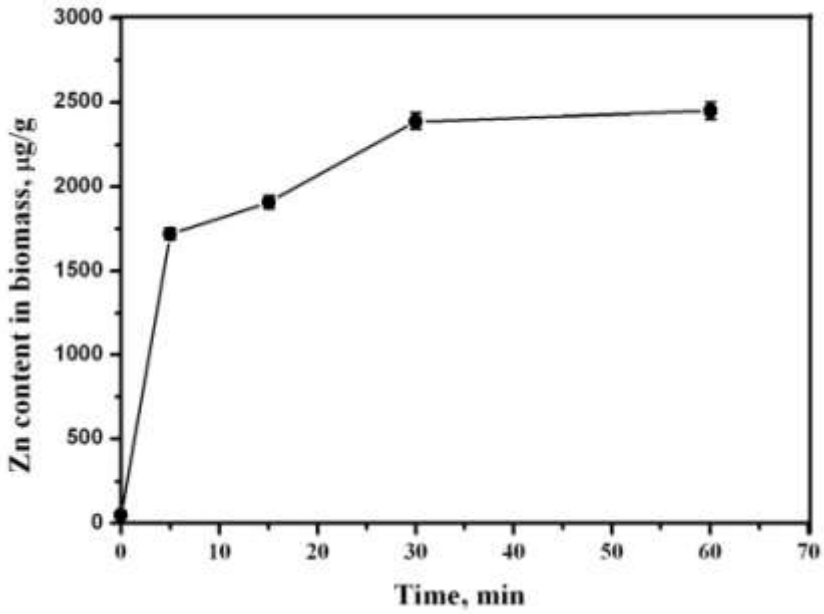


Fig. 3. Zinc content in the *S. plantensis* biomass versus the contact time with the wastewater

Results

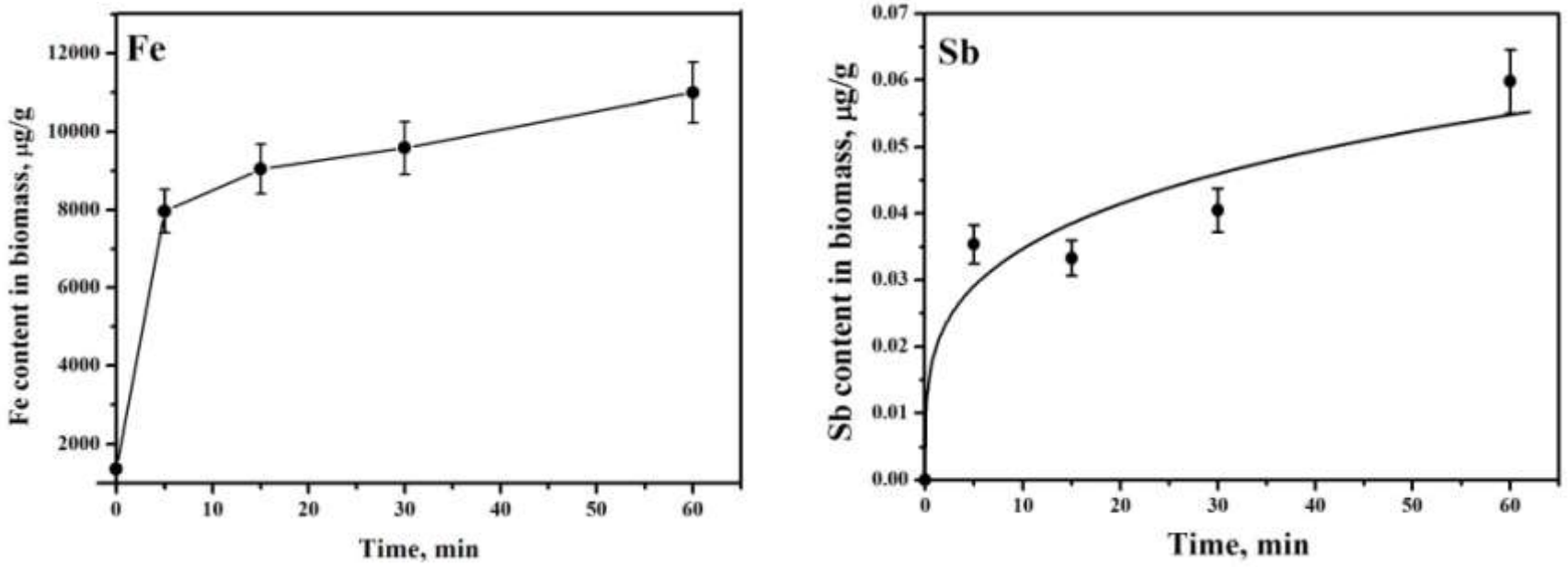


Fig. 4. Fe and Sb distribution in the *Spirulina platensis* biomass

Conclusions

- ***Spirulina platesis*** native biomass is an efficient biosorbent for the removal of zinc from wastewater
- Zinc can be efficiently removed from wastewater when its concentration is less than 100 mg/L
- In addition to zinc, spirulina native biomass accumulates other metals present in wastewater, such as iron, antimony and tungsten
- It is recommended to use microbial biomass in the process of removal of metals from wastewater at low metal concentrations, than conventional techniques are not profitable

Thank you for attention!