SELENIUM BIOSORPTION AND NANOPARTICLES PRODUCTION BY *SPIRULINA PLATENSIS* BIOMASS

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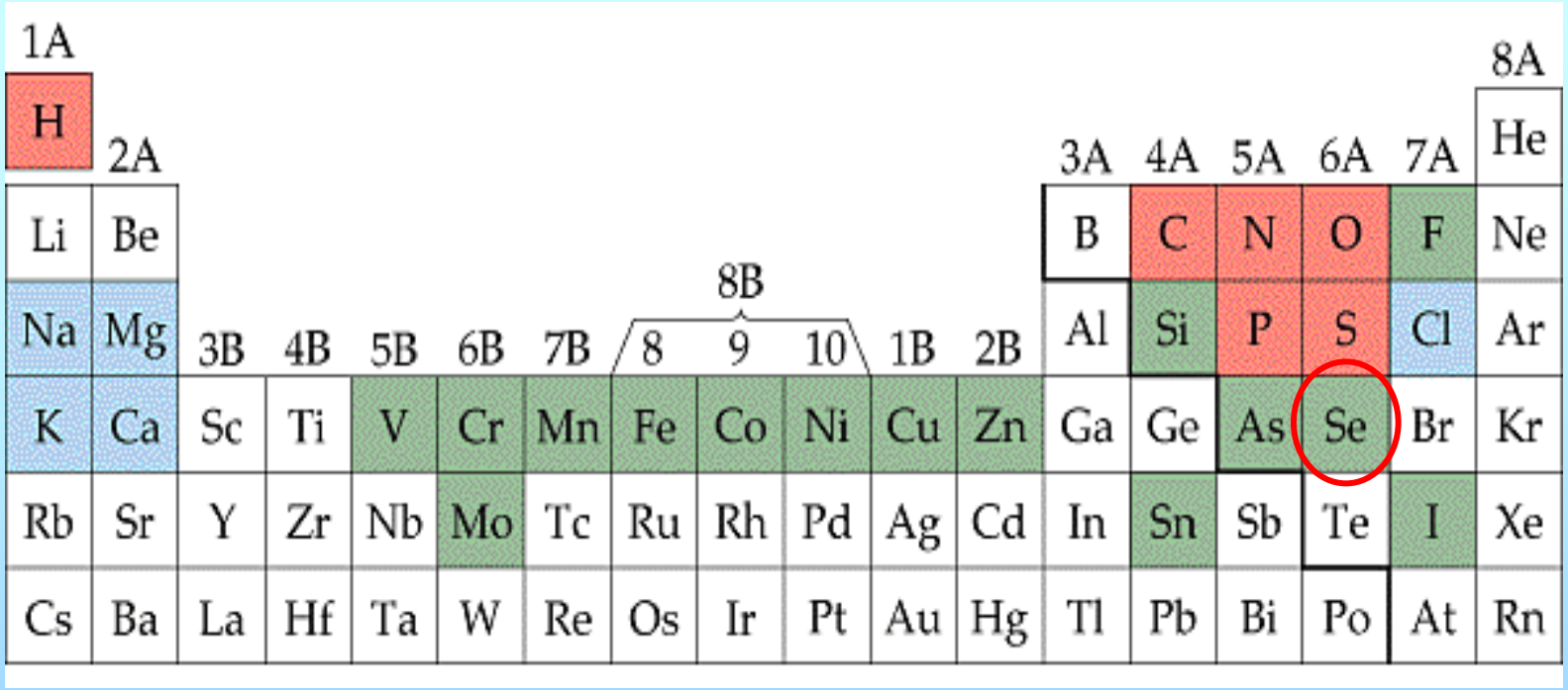
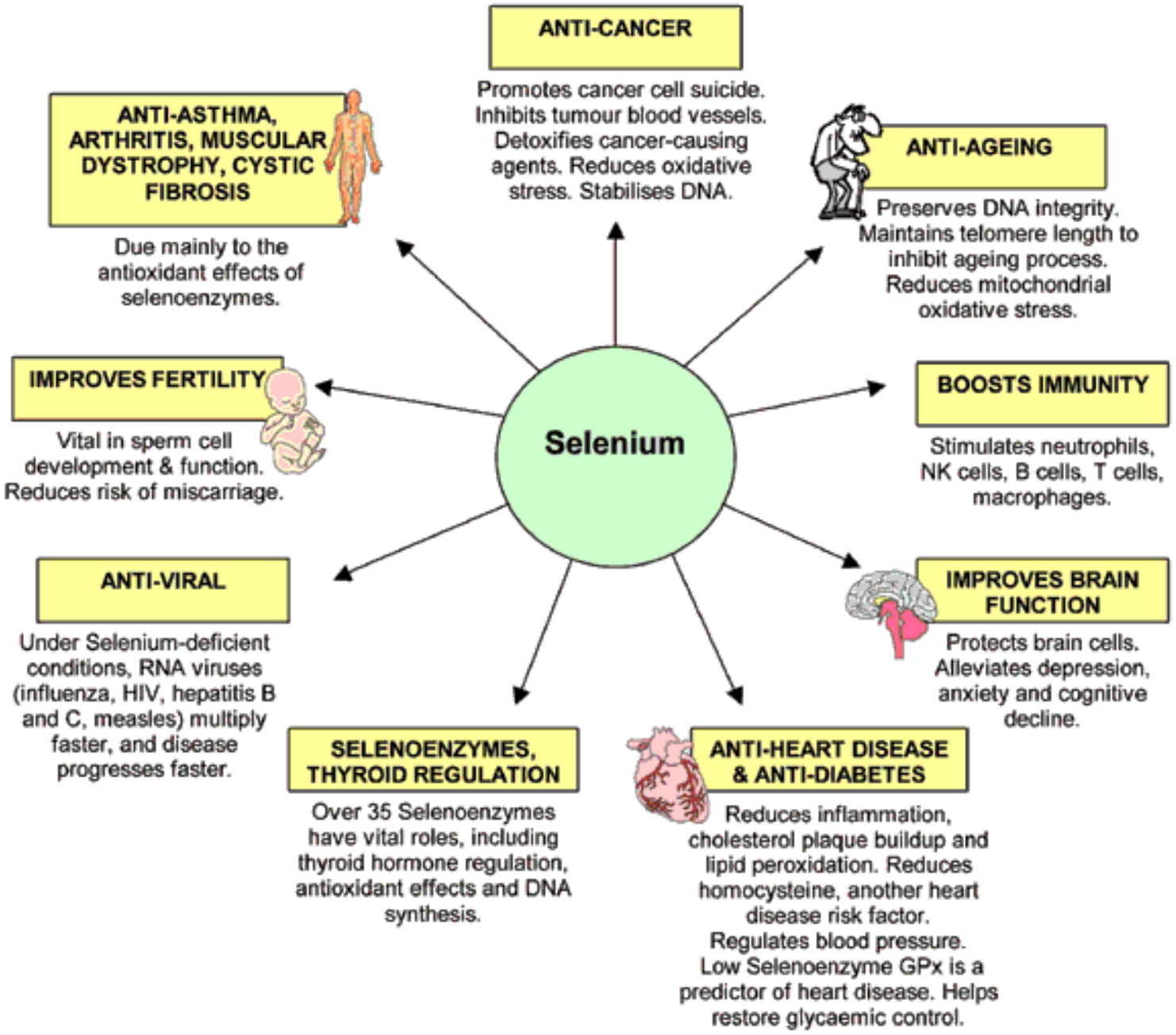
Selenium in organism



- component a number of selenium-dependent enzymes.
- allows detoxification of the organism by helping to bind some toxic elements, such as As, Cd, Hg, Bi.

In humans, Se has the narrowest range between nutritional requirements and toxicity of any essential elements. The optimal dose for one person is in the range of 50–200 μg per day; a dose higher or lower than this is toxic.

The Health Benefits of Selenium.

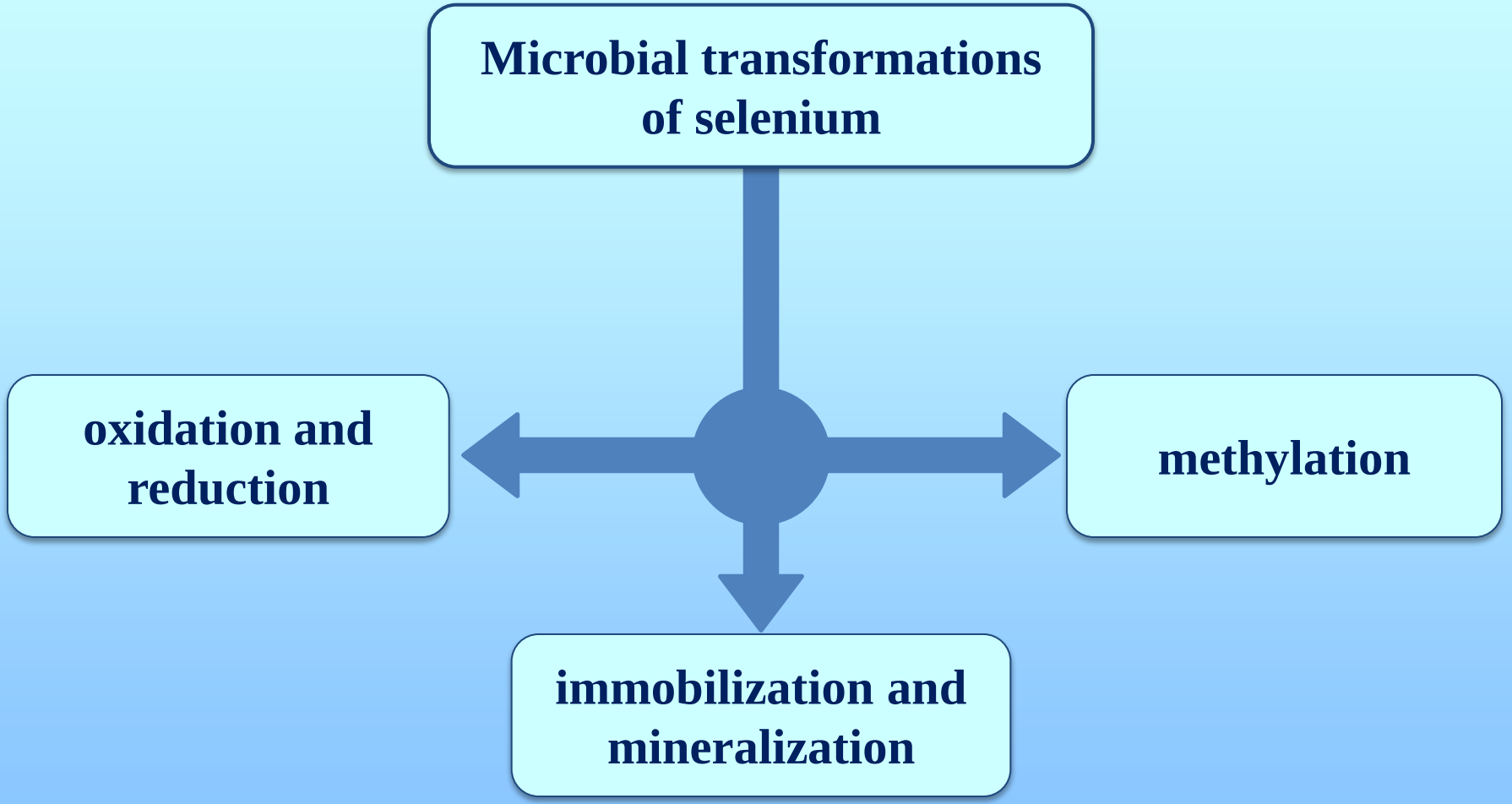


Ways of selenium release in the environment:

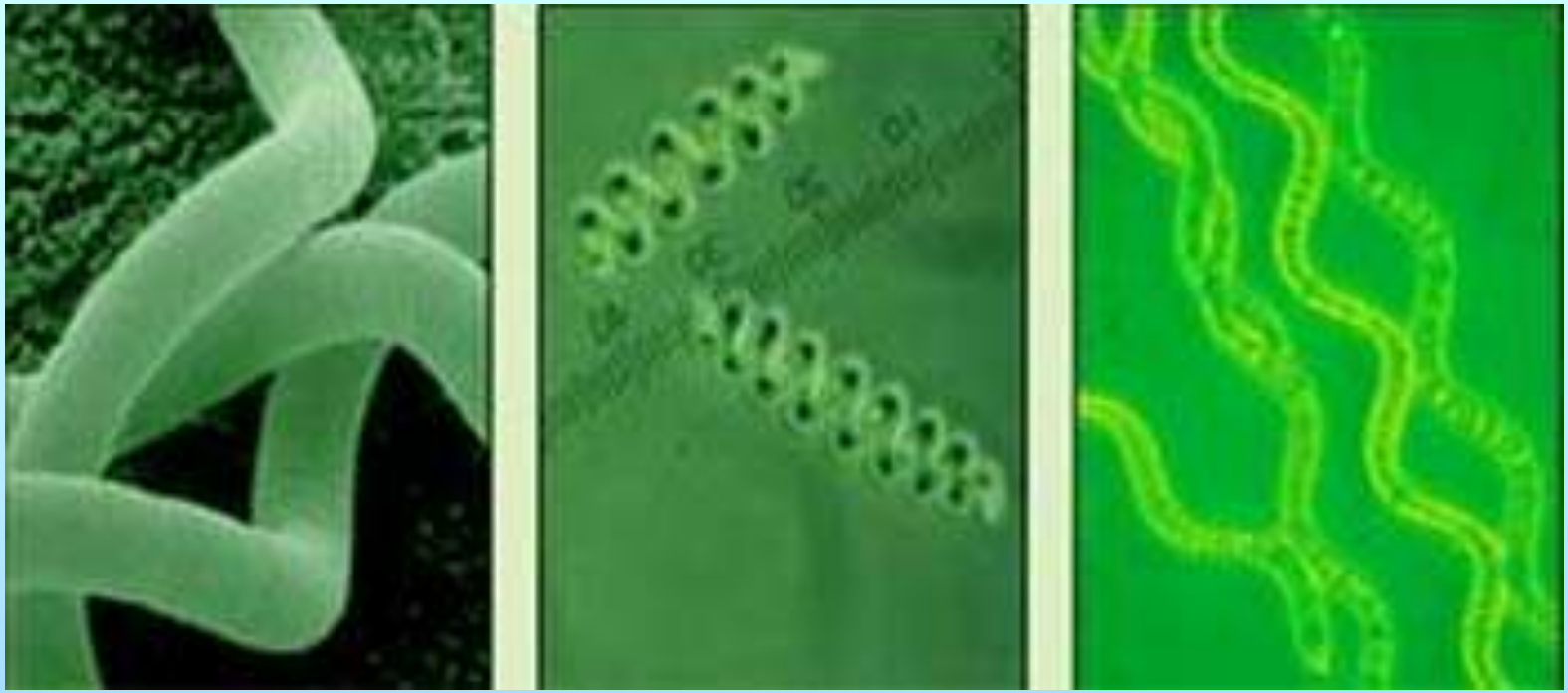
Anthropogenic activity

Natural processes

- **Erosion;**
- **Volcanic activity**


Microbial transformations of selenium
oxidation and reduction
methylation
immobilization and mineralization

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.

Experimental scheme

I experiment

Selenium accumulation by the *S. platensis* cells at the different SeO_3^{2-} concentrations in the solution: 21, 42, 84, 126, 186, 210 mg/L of Se. Samples in all the series were taken after 2 hours.

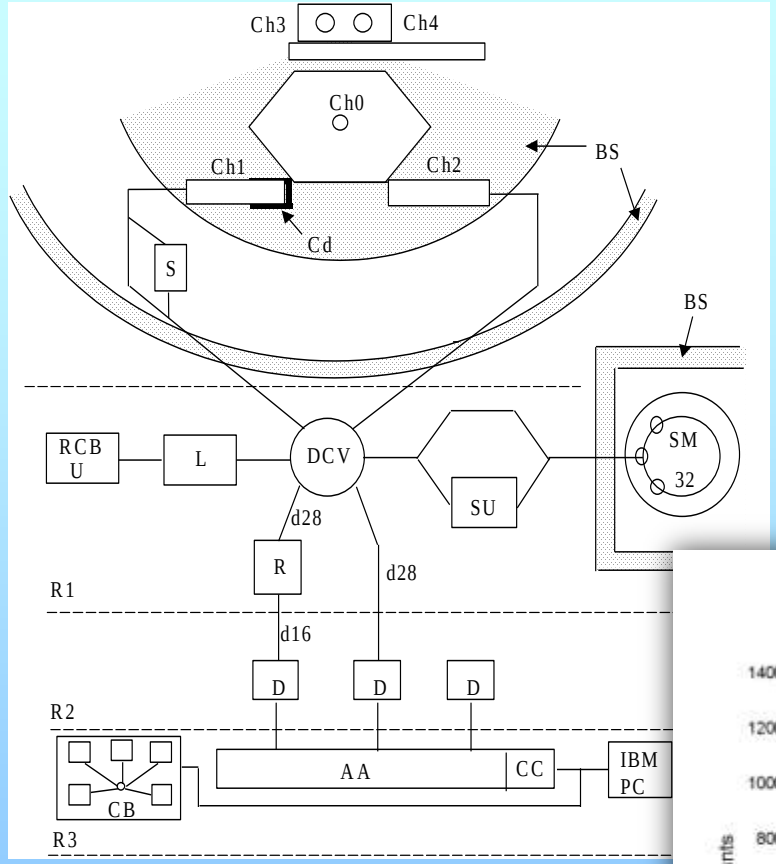
II experiment

The dynamics of the adsorption processes was studied during 1 hour. The samples were obtained in 5, 15, 30, 60, and 120 min.

III experiment

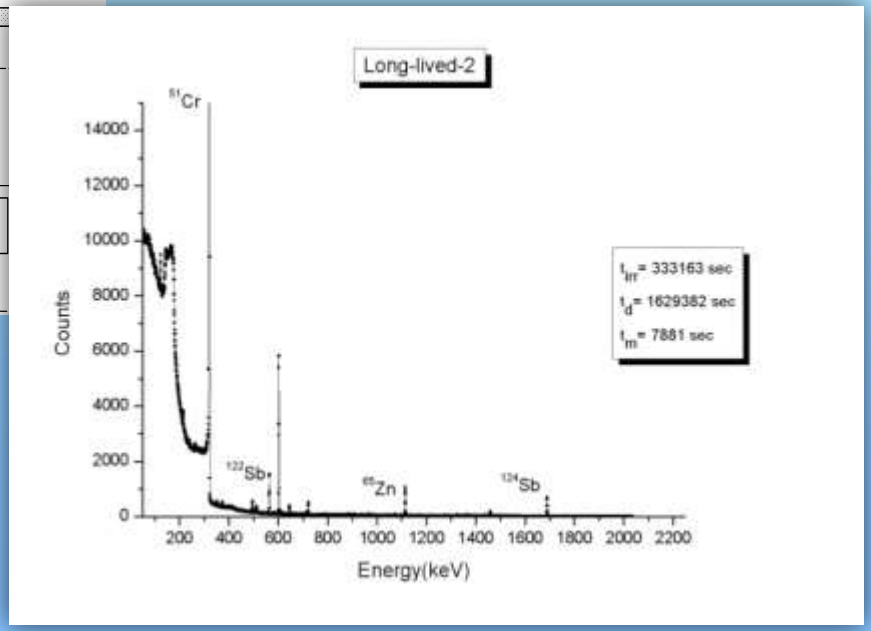
To study formation of selenium nanoparticles the biomass resuspended in 250 ml Erlenmeyer flasks with 100 mL of 100 mg/L aqueous cobalt selenite solution for different periods of time (24-72 hours) at the constant stirring.

IBR-2 and Radioanalytical complex REGATA



Short irradiation – 3 min

Long irradiation- 4 days



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

Experimental scheme

I experiment

Selenium accumulation by the *S. platensis* cells at the different SeO_3^{2-} concentrations in the solution: 21, 42, 84, 126, 186, 210 mg/L of Se. Samples in all the series were taken after 2 hours.

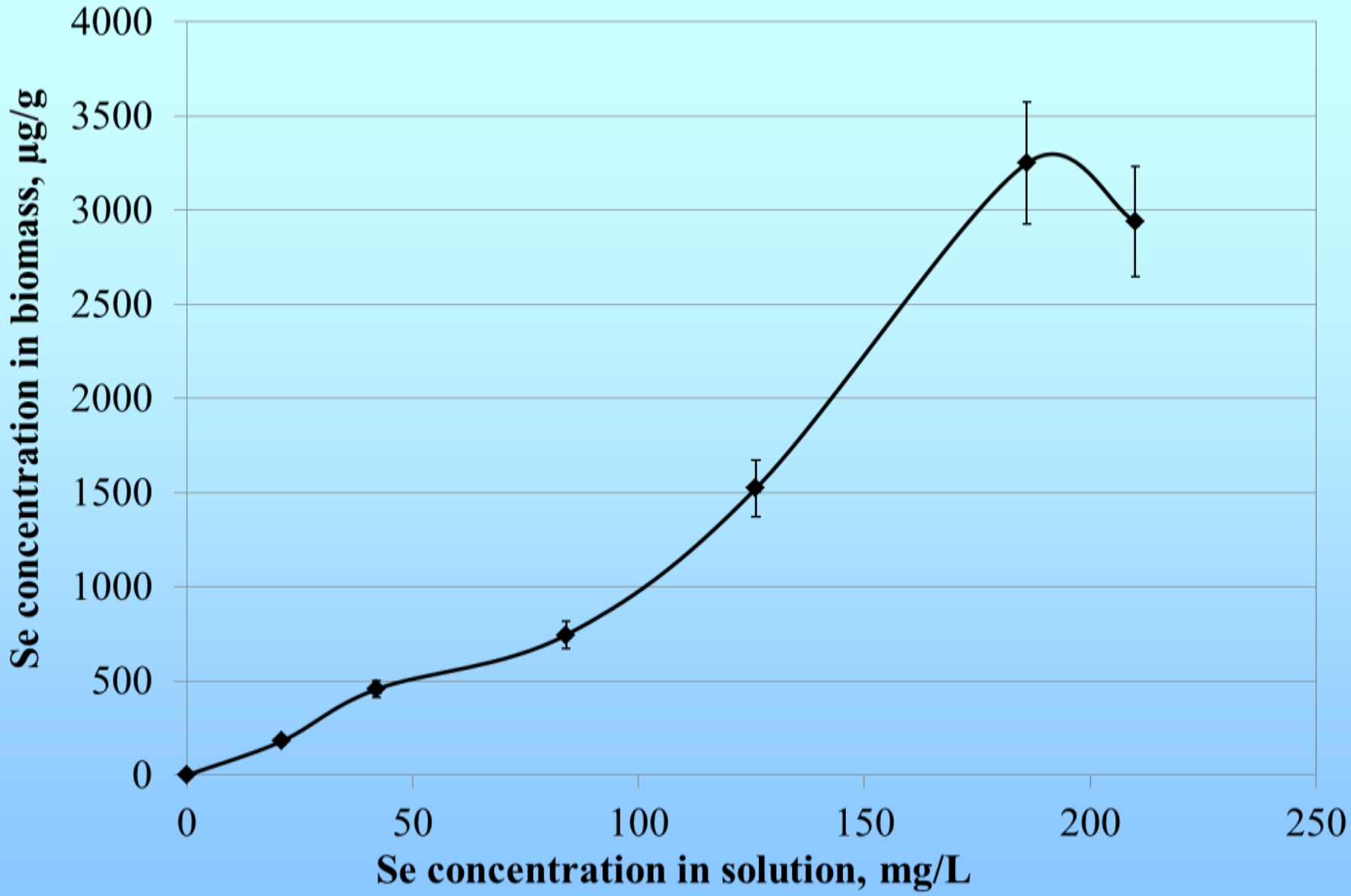


Fig. 1. Concentration of selenium in the *Spirulina platensis* biomass versus the concentration of selenite ions in the solution

Experimental scheme

II experiment

The dynamics of the adsorption processes was studied during 1 hour. The samples were obtained in 5, 15, 30, 60, and 120 min.

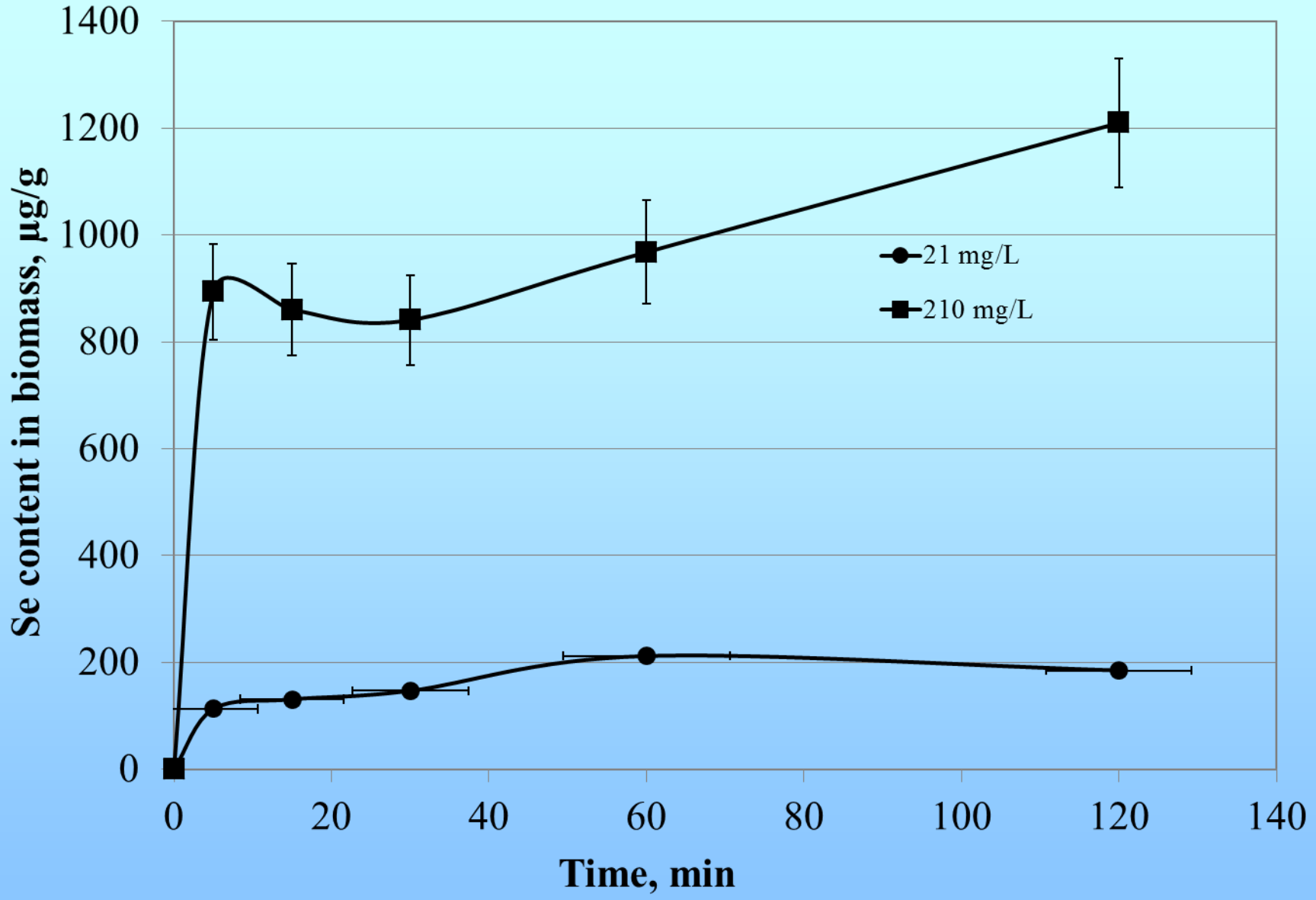


Fig. 2. Selenium adsorption by *Spirulina platensis* cells: (a) 21 mg/L; (b) 210 mg/L.

Table 1. Na, Mg, K, Co, As, and Br content in spirulina biomass after its interaction with cobalt selenite solution.

Time, min	Element, μg/g					
	Na	Mg	K	Co	As	Br
Control	10600±420	5380±320	18600±950	0.12±0.001	0.44±0.01	1.9±0.2
5	2210±90	436±70	14600±200	543±44	0.42±0.01	1.4±0.16
15	2100±80	492±60	14300±190	536±302	0.42±0.01	1.4±0.16
30	1980±80	529±60	14300±180	634±40	0.44±0.01	1.5±0.18
60	2390±90	522±70	14200±210	609±45	0.44±0.01	1.6±0.2
120	1890±80	342±60	13300±170	573±40	0.43±0.01	1.6±0.2

Experimental scheme

III experiment

To study formation of selenium nanoparticles the biomass resuspended in 250 ml Erlenmeyer flasks with 100 mL of 100 mg/L aqueous cobalt selenite solution for different periods of time (24-72 hours) at the constant stirring.

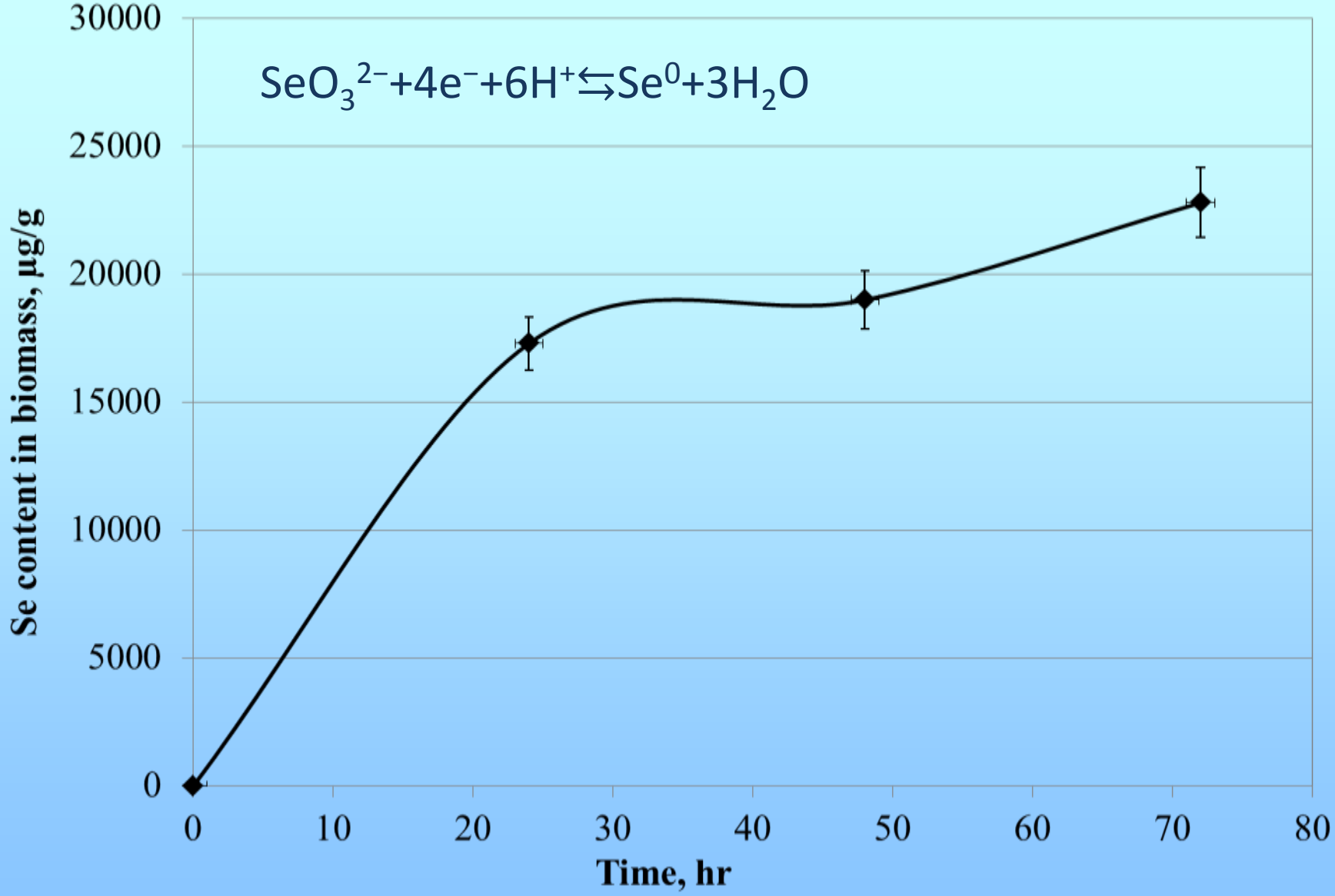


Fig. 3. Total selenium concentration in biomass of *Spirulina platensis* determined by NAA

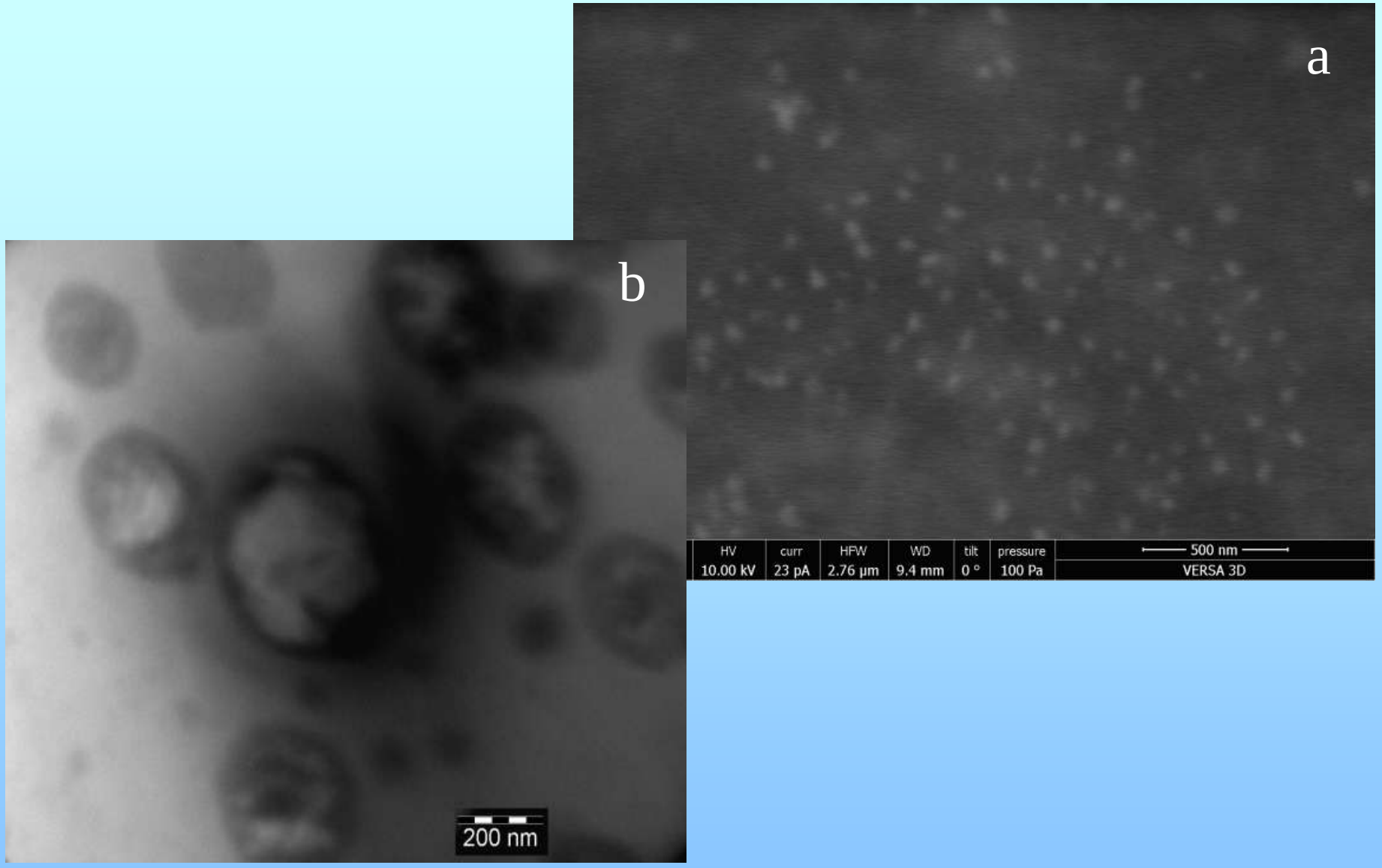


Fig. 4. SEM (a) and TEM (b) micrographs of *Spirulina platensis* cells with selenium nanoparticles

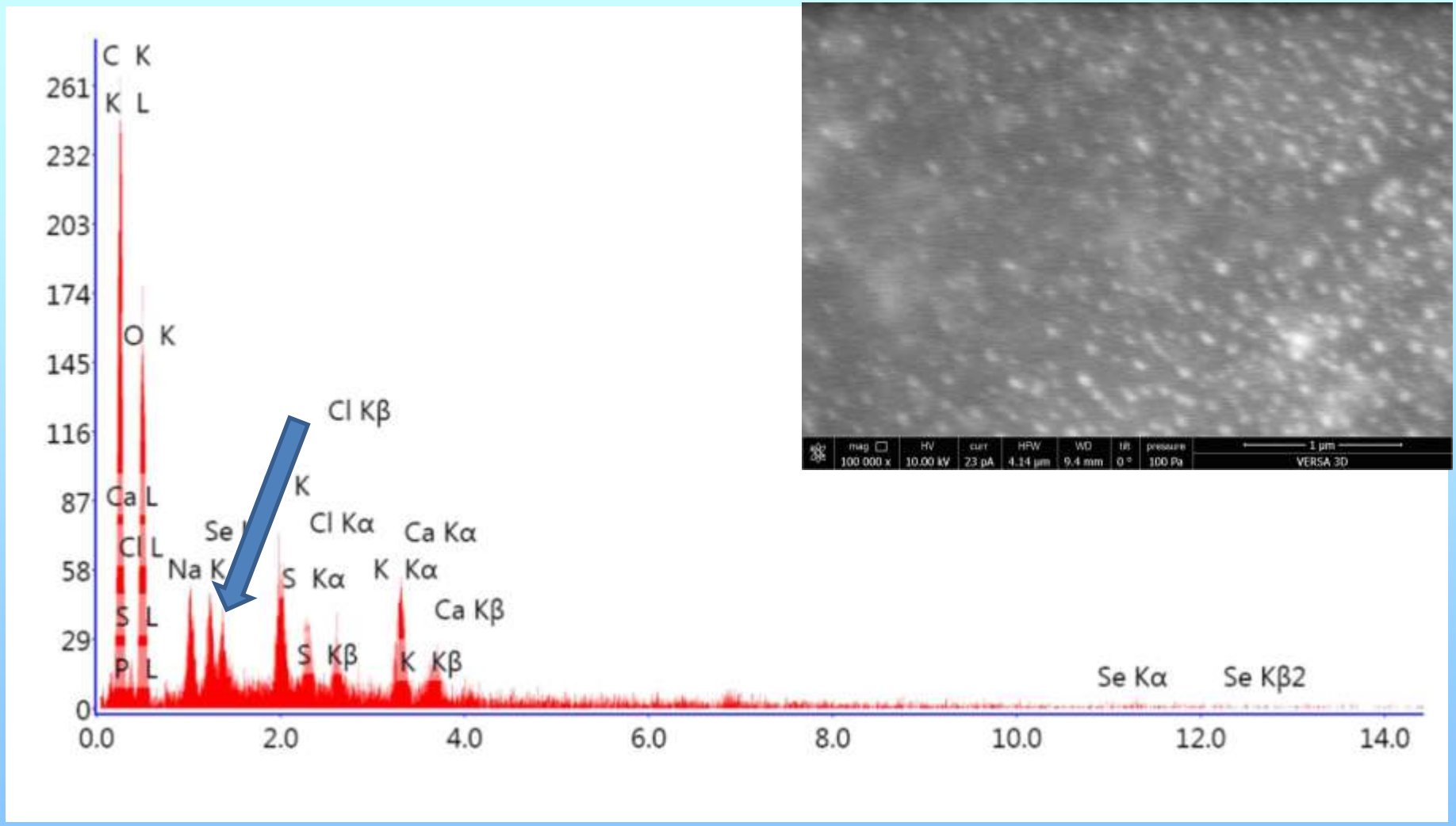
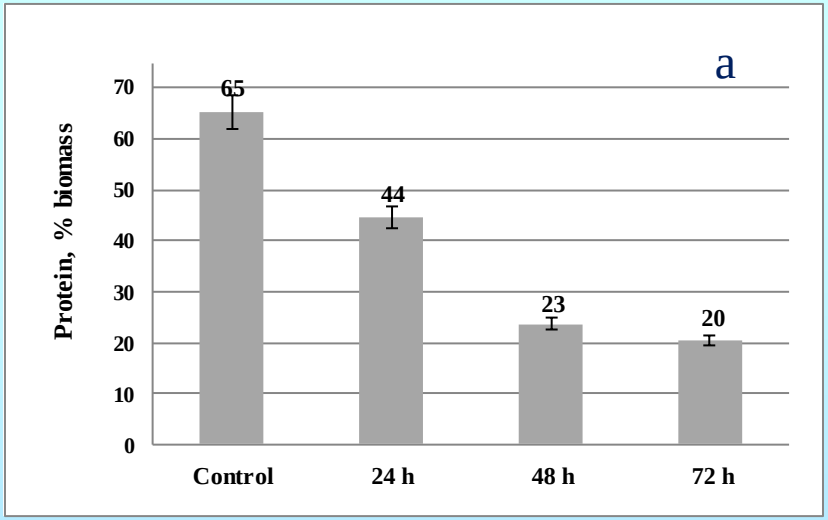
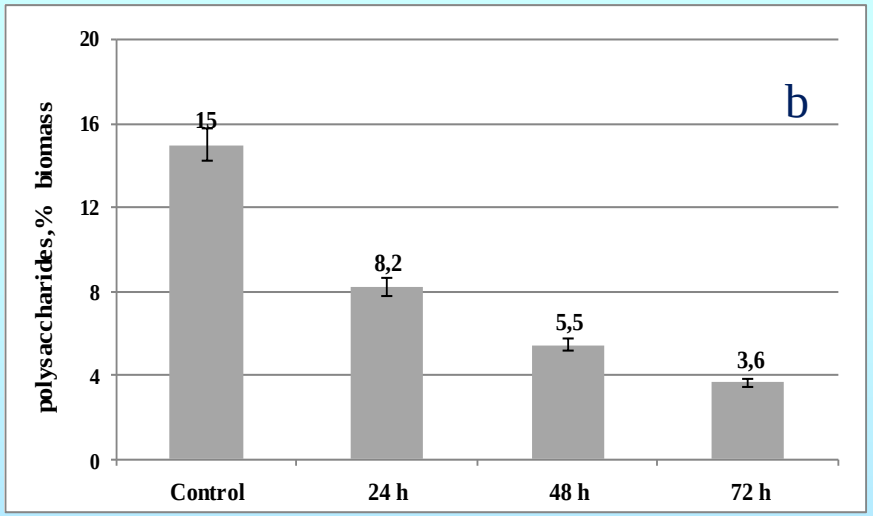


Fig. 5. EDAX spectrum recorded from *Spirulina platensis* cells after formation of selenium nanoparticles





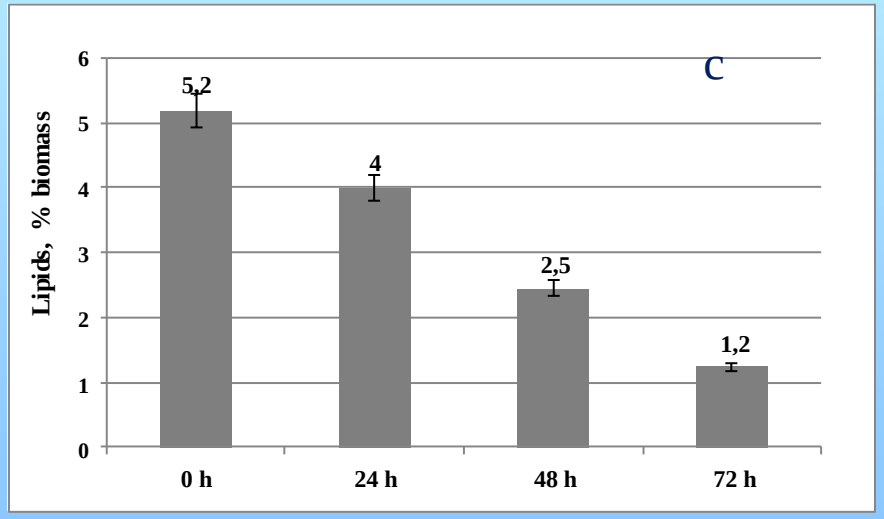


Fig. 6. Change of protein (a), polysaccharides (b) and lipids (c) content in *Spirulina platensis* biomass during selenium nanoparticles synthesis

Conclusions

- *Spirulina platensis* native biomass can be efficiently applied for selenium-enriched pharmaceuticals production and wastewater post-treatment.
- Production of selenium nanoparticles by *Spirulina platensis* proceeds extra- and intracellularly. The optimal time for nanoparticles production is 24 hr.

Thank you for attention!