*DOI: http://doi.org/10.21698/simi.2021.ab54*

# THE INFLUENCE OF TEMPERATURE ON THE ACCUMULATION CAPACITY OF ZINC IN THE PLANT *SALVINIA NATANS* (L.) ALL.

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**Keywords***: Salvinia natans, temperature, zinc*

## *Introduction*

Heavy metal pollution of the aquatic environment is an increasingly acute environmental problem globally. These toxic metals are a major problem because they are persistent in nature, are not biodegradable and bioaccumulate in animals and plants, and can reach the human body through them. Activities such as the mining industry, the metallurgical industry, car manufacturing, the chemical industry, the electronics industry, etc., generate large quantities of wastewater containing heavy metals each year, some of which is discharged into surface waters without proper treatment, leading to pollution of the aquatic environment.

Aquatic plants, as the main producers in the food chain of the aquatic ecosystem, are the first point of entry for pollutants. *Salvinia natans* (L.) All., is an annual floating fern of the class Polypodiopsida, being characterized by rapid growth, wide distribution, ability to grow in sewage, high tolerance to pollutants and convenient harvesting. Previous studies have shown that *S. natans* can not only effectively eliminate heavy metal pollution and eutrophication in water, but can also be used as an indicator for various pollutants in the aquatic environment.

Although in the literature there are many studies performed on aquatic plants and especially on the species *S. natans*, few of them have focused on the influence of temperature on the degree of tolerance and accumulation of heavy metals of this species. The purpose of this paper was to address this topic in more depth.

## *Materials and methods*

### *Plant material*

The experiments were performed on plant material (*Salvinia natans* (L.) All.), harvested from the natural environment and acclimatized in laboratory conditions for seven days. The test solutions in which the plants were introduced were zinc-enriched surface waters (surface waters had an imperceptible load of heavy metals) to reach the desired concentrations. The reagents used for this were of superior quality, purchased from specialized companies in the field.

### *Experimental conditions*

Approximately 10 grams of plant material, representing 6 individuals with 5-6 nodules each, were placed in transparent plastic containers with a diameter of 8 cm

containing 300 mL of enriched surface water up to concentrations of 1, 2 and 4 mg Zn/L. The amount of metal was determined both initially and after 24, 72 and 120 experimental hours during which time the plants remained in the incubator at different temperature ranges (15° C, 25° C, 35° C ± 0.5° C) with a 16/8 day/night cycle.

*Methods of analysis*
After various drying, calcination and digestion processes, the plant material was brought to liquid state, and the determination of the metals in the samples was performed with an Avanta GBC AAS spectrophotometer in accordance with existing standards.

***Results and conclusions***
The table below shows the amount of zinc accumulated in the body of the plant depending on the incubation temperature and the exposure time.

**Table 1.** The degree of accumulation of zinc ions in the body of the plant. Values are expressed in mg/kg D.M. and represents the average of three samples

| **Pollutant** | **Incubation temperature and exposure time** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15° C | | | | 25° C | | | | 35° C | | | |
| | 0h | 24h | 72h | 120h | 0h | 24h | 72h | 120h | 0h | 24h | 72h | 120h |
| **1 mg Zn/L** | 630 | 1641 | 3025 | 3664 | 630 | 4726 | 5458 | 4523 | 630 | 3631 | 5613 | 6163 |
| **2 mg Zn/L** | 630 | 2982 | 6450 | 5909 | 630 | 9103 | 18417 | 10583 | 630 | 9552 | 11705 | 13037 |
| **4 mg Zn/L** | 630 | 4019 | 9127 | 9344 | 630 | 9750 | 14754 | 15314 | 630 | 13353 | 16782 | 11785 |

At a temperature of 15° C the highest accumulation of metal in the plant (9344 mg/kg D.M.) was observed after 120h in the experimental variant with 4 mg Zn/L, however the difference between 120h and 72h is insignificant.
At a temperature of 25° C, the highest accumulation of metal in the plant (18417 mg/kg D.M.), was observed after 72h in the experimental variant with 2 mg Zn/L. After 120h it is interesting that the amount of metal in the plant decreases quite a bit compared to the previous time interval, to the value of 10583 mg/kg D.M., which indicates a saturation of the cells in zinc ions, and metal are elimination back into the aquatic environment.
At a temperature of 35°C, the highest accumulation of metal in the plant (16782 mg/kg D.M.) was observed after 72 hours at an initial concentration of 4 mg Zn/L. Comparison of the related results for 72h and 120h, at the same initial concentration of 4 mg Zn/L, indicates a fairly large decrease in metal (from 16782 mg/kg D.M. after 72h, to 11785 mg/kg D.M. after 120h) and as in the case of the temperature of 25° C, this can be attributed to the saturation in zinc ions of the tissues of *Salvinia natans*.
Summarizing the data presented above, a brief conclusion can be drawn from which it results that the maximum efficiency of the plant in terms of zinc bioaccumulation processes is about at the same level at both 25° C and 35° C.