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Original Research Article

Effects of Cobalt on Aquatic Plant *Lemina minor*

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Abstract: In this work, aquatic plants Lemina minor were exposed to varying concentrations of cobalt [10, 20, and 30 mg/L] for a month in order to measure the amount of total chlorophyll and its protein content. This was done to evaluate the effects of various salt concentrations on the physiological states of the plants. The investigation's conclusions showed that the amounts of the components in the water plants used for the research rose in a different way than in the control sample as the study came to an end. We examined the levels of protein and chlorophyll in water plants exposed to heavy metals.

Keywords: *Lemina Minor*, Chlorophyll and Protein and Cobalt.

INTRODUCTION

Cobalt is a transition metal located in the fourth row of the periodic table and is a neighbor of iron and nickel [1]. It has been considered an essential element for prokaryotes, human beings, and other mammals, but its essentiality for plants remains obscure [2]. In this article, we proposed that cobalt (Co) is a potentially essential micronutrient of plants [3].

Co is essential for the growth of many lower plants, such as marine algal species including diatoms, chrysophytes, and dinoflagellates, as well as for higher plants in the family *Fabaceae* or *Leguminosae* [4]. The essentiality to leguminous plants is attributed to its role in nitrogen (N) fixation by symbiotic microbes, primarily rhizobia [5].

Co is an integral component of cobalamin or vitamin B_{12}, which is required by several enzymes involved in N_2 fixation. In addition to symbiosis, a group of N_2 fixing bacteria known as diazotrophs is able to situate in plant tissue as endophytes or closely associated with roots of plants including economically important crops, such as barley, corn, rice, sugarcane, and wheat [6].

Their action in N_2 fixation provides crops with the macronutrient of N. Co is a component of several enzymes and proteins, participating in plant metabolism. Plants may exhibit Co deficiency if there is a severe limitation in Co supply [7]. Conversely, Co is toxic to plants at higher concentrations. High levels of Co result in pale-colored leaves, discolored veins, and the loss of leaves and can also cause iron deficiency in plants [8].

It is anticipated that with the advance of omics, Co as a constitute of enzymes and proteins and its specific role in plant metabolism will be exclusively revealed [9]. The confirmation of Co as an essential micronutrient will enrich our understanding of plant mineral nutrition and improve our practice in crop production [10].

Cobalt has a dual effect on plants: It is essential for growth, particularly in nitrogen fixation in legumes (as a component of vitamin B12), which promotes plant growth and chlorophyll formation. However, high concentrations of cobalt are toxic, causing iron deficiency, yellowing of leaves, leaf drop, and stunted plant growth [11].

Beneficial effects of cobalt: Nitrogen fixation: Cobalt is essential for the biological process of nitrogen fixation carried out by certain bacteria such as Rhizobium, which provides nitrogen to plants, especially legumes. Vitamin B12 component: Cobalt is part of the structure of vitamin B12, a vitamin essential for the growth of organisms, including plants [12].

Promoting growth and development: Cobalt helps improve plant growth through its role in auxin metabolism. Increasing stress resistance: Cobalt increases plants' tolerance to environmental stress and pathogens [13].

Toxic effects of cobalt: Plant toxicity: High concentrations of cobalt in soil lead to phytotoxicity. Iron deficiency: Cobalt accumulation in some plants can lead to iron deficiency, which stunts plant growth. Leaf deterioration: Cobalt toxicity manifests as yellowing of leaves, discoloration, premature leaf closure, leaf drop, and decreased weight. Effect on photosynthesis: Iron deficiency resulting from cobalt toxicity negatively impacts photosynthesis [14].

MATERIALS AND METHODS

In this experiment, ten plastic pots containing ten litres of water were used to plant fifty grammes of Lemna minor. There are seven litres of chlorine-free pond water in each jar. Weekly samples of plants were collected from the ponds to measure the levels of heavy metals, protein, and chlorophyll in accordance with the required test. Sampling and growth were carried out for five weeks. Furthermore, the study used three distinct cobalt concentrations (10, 20, and 30 mg/L) [15]. Protein content in aquatic plant tissues was measured using the Bradford method, and total chlorophyll content was measured using a chlorophyll meter [16].

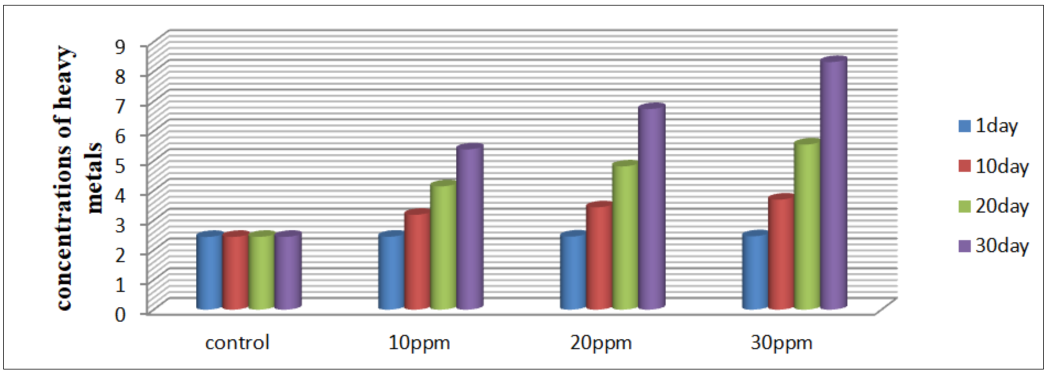

Figure 1: Three different concentrations of Cobalt during the experiment period in *Lemina minor* tissue

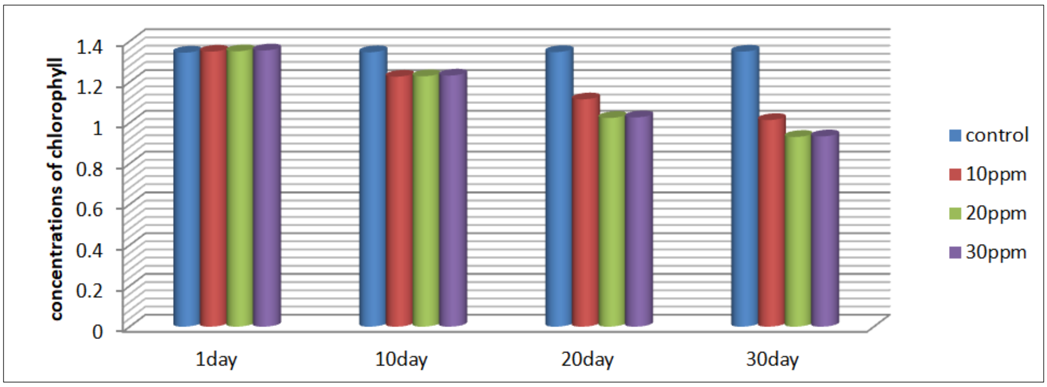

Figure 2: Effect concentrations of Cobalt on chlorophyll in *Lemina minor* tissue

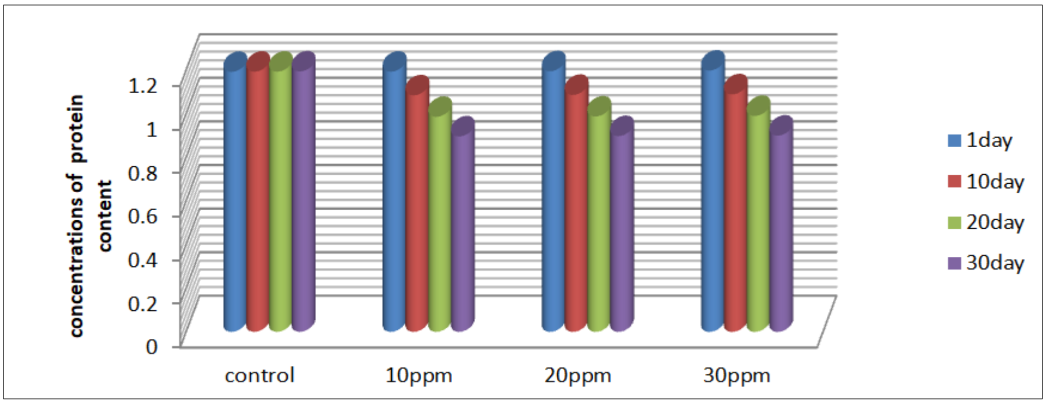

Figure 3: Effect concentrations of Cobalt on protein content in *Lemina minor* tissue

RESULTS AND DISCUSSION

The results of the study showed that as the experiment came to an end, the levels of heavy metals in the aquatic plants under examination rose. Figure 1 shows the accumulation of cobalt in the aquatic plant Lemina minor relative to the control. This indicates that the studied aquatic plants are able to collect this element in their tissues, have a special defence mechanism against high concentrations of the element, or absorb high levels of cobalt and transform them into inactive forms of holes [17]. Variations in the amount of cobalt deposited in plant bodies may be influenced by species, physiological condition, and elemental sensitivity [18].

Figure (2) shows how much chlorophyll is present in the aquatic plant Lemina minor compared to the control. At the end of the trial, the total amount of chlorophyll in the aquatic plant had decreased, according to the study's findings. Chlorophyll levels in the experimental plants have dropped as a result of the presence of these particularly toxic substances, which can accumulate in plant tissue [19].

Figure (3) showed Because the protein in Lemina minor plants' tissues is used up during vital processes or metabolic activities that take place in order to withstand the concentration of cobalt, the percentage of protein content in their tissues decreases, which is the cause of the decline in protein content [20]. This percentage decreases with increasing exposure duration until End of Experience is achieved [21].

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