ISSN 2664-4169 (Print) & ISSN 2664-7923 (Online)
South Asian Research Journal of Biology and Applied Biosciences
Abbreviated Key Title: South Asian Res J Bio Appl Biosci

| Volume-8 | Issue-1 | Jan-Feb -2026 | **DOI: https://doi.org/10.36346/sarjbab.2026.v08i01.005**

Original Research Article

Effect of Nickel Chloride on Physiological State of the Aquatic Plant *Lemna minor*

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Article History
Received: 03.12.2025
Accepted: 28.01.2026
Published: 02.02.2026

Abstract: The aim of study was to determine effects of nickel chloride on the physiology of *Lemna minor* through used three different concentrations of nickel chloride (10, 20, 30 ppm) for a month in order to measure the amount of total chlorophyll and its protein content. The results of the investigation showed that exposure to nickel chloride causes several effects on the physiology of *Lemna minor* through reduced biomass, slowed leaf growth at high nickel concentrations, decreased protein levels, reduced chlorophyll content, and impaired photosynthesis. It also causes oxidative stress by increasing MDA levels, altering antioxidant enzyme activity, and affecting nickel uptake from water. However, high levels of nickel are toxic. Symptoms of nickel-induced stress include yellowing of leaves, tissue death, and metabolic disturbances.

Keywords: Nickel Chloride, Physiological, *Lemna Minor*.

INTRODUCTION

Nickel at environmental or elevated concentrations acts as a toxic heavy metal stressor for *Lemna minor*. It affects growth, at low Ni levels (e.g., ~0.5 mg/L), L. minor may initially show stimulated growth, but at higher concentrations, growth inhibition becomes clear [1]. The concentration that reduces growth by 50 % (EC50) for Ni in *Lemna minor* was observed around 1.29 mg/L in one study. At high Ni concentrations, duckweed shows reduced biomass, inhibited frond expansion, chlorosis (yellowing), and potential necrosis [2]. Photosynthesis, Exposure to Ni causes significant declines in chlorophyll a and b content in Lemna species, decreasing the plant's ability to capture light and perform effective photosynthesis [3].

Related structural changes in chloroplasts include transition to altered plastid forms and accumulation of starch due to impaired carbohydrate export [4]. Lemna minor bio-accumulates Ni from water, sometimes with high bio-concentration factors, making it useful as a phytoremediation of Ni-contaminated water [5]. Despite accumulation capacity, physiological damage can accompany heavy Ni uptake, limiting long-term survival at very high levels. Although L. minor can accumulate Ni and thus has potential in phytoremediation, physiological stress and declining health occur at higher Ni loads [6].

Ni induces reactive oxygen species (ROS) formation and alters cellular processes like photosynthesis, respiration, and membrane integrity. Beyond Lemna specifically, studies in other species show Ni can affect auxin transport and cell wall functions, further inhibiting growth and root/shoot development [7].

High Ni exposure leads to Oxidative stress in the plant by elevated malondialdehyde (MDA) levels in duckweed, indicating lipid peroxidation and cell membrane damage from oxidative stress [8]. Plants respond by altering activities of catalase and other antioxidant enzymes as part of stress defense, but prolonged or excessive Ni still overwhelms defenses

[9]. Soluble protein content tends to decrease significantly, reflecting disrupted metabolism and stress responses [10]. The aim of study was to knowledge effects of nickel chloride on the physiology of *Lemna minor*.

Materials and Methods

The research study was designed to knowledge effects of nickel chloride on the physiology of *Lemna minor* by used weight of 500 grams and they were grown individually in plastic containers with a capacity of 15 liters. Each container contained 10 liters of water contaminated with three different concentrations (10, 20, 30) mg/liter of heavy metal salts, which are nickel chloride [11]. Plant samples were collected from the ponds for the purpose of estimating the concentrations of heavy metals and the amount of chlorophyll and protein. The protein level in plant tissues was determined using the Bradford method [12], and the total chlorophyll content in aquatic plant tissues was estimated using the chlorophyll meter [13].

Results and Discussion

The results of the study showed an increase in the concentration of heavy elements in the studied aquatic plant *Lemna minor* at the end of the experiment. Figure (1) shown accumulation of nickel chloride in the aquatic plant *Lemna minor* tissues (3.543, 4.244, 5.231) compared with the control (1.152) respectively. Figure (2) shown effect three different concentrations of nickel chloride on chlorophyll in *Lemna minor* tissues (0.234, 0.243, 0.223) compared with the control (0.212). Figure (3) shown effect three different concentrations of nickel chloride on the protein content in *Lemna minor* tissue (2.128, 2.631, 2.711) compared with the control (2.702). The effects of increased chlorophyll concentration in aquatic plants, capable of accumulating in plant tissues, led to chlorophyll degradation in experimental plants [14]. It became unavailable for lanophilic activity due to the activity of its precursors, such as oleofilicon amino acid dehydrate and porphobilinogen dehydrate, which form porphyrins [15]. The stereogenic design of carotenoids, successful in creating cinematic models and synthesizing other pigments like opium and carotenoids, all acquired the characteristic "pincer" effect [16]. The protein content in all plants, which reduces the protein content in their tissues, is attributed to the vital activities or metabolic processes occurring within them to counteract the concentration of elements [18]. This percentage varies over time until the end of the experiment [19].

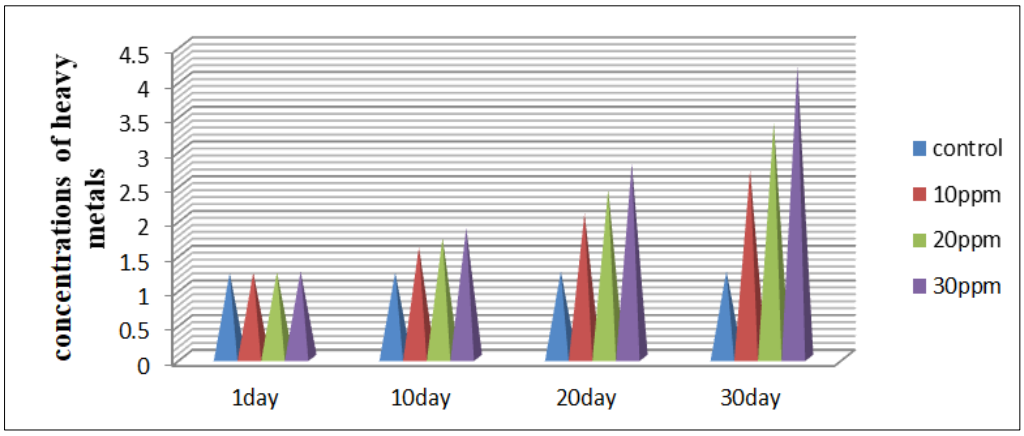

Figure 1: Effect concentrations of nickel chloride in Lemna minor

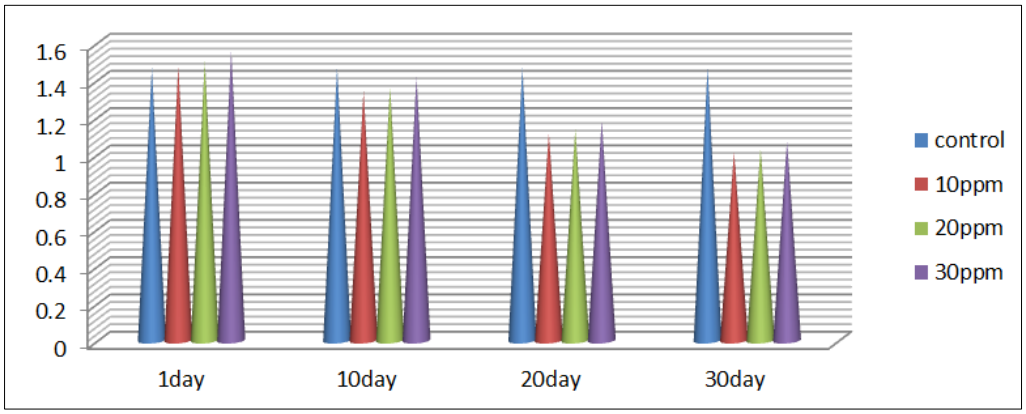

Figure 2: Effect concentrations of nickel chloride on chlorophyll in Lemna minor tissue

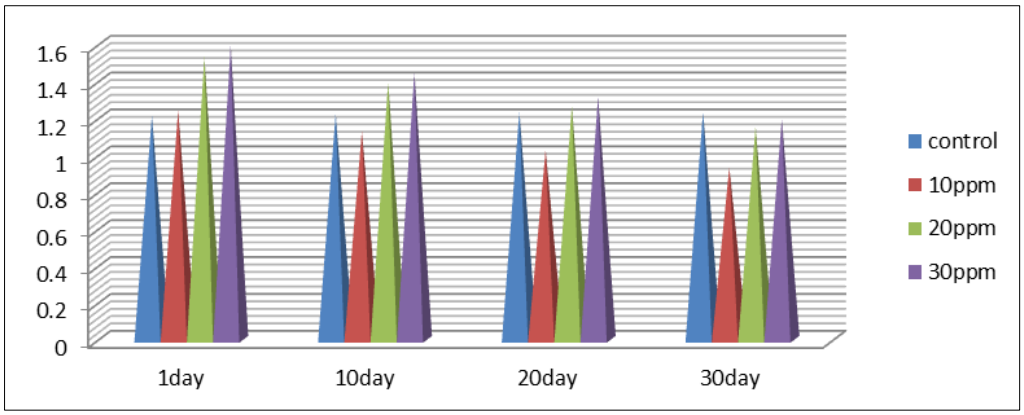

Figure 3: Effect concentrations of nickel chloride on protein content in Lemna minor tissue

CONCLUSION AND RECOMMENDATIONS

The harmful effects of nickel chloride lead to decreased chlorophyll and protein levels in aquatic plants.

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