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Research Article

Studies on hyper accumulation of Mercury by *Jussiaea repens* under laboratory condition

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Abstract

Phytoremediation ability of plants has been a well known fact in the field of environmental toxicology. The present investigation reports the hyperaccumulating ability of aquatic plant *Jussiaea repens* under laboratory condition. Initiation of growth of roots of the plants in mercury contaminated water is a good morphological indication of the utilization of the mercury salt by the plant for its growth. To test the purifying potentiality of *Jussiaea repens*, mercury contaminated water and treated mercury contaminated water with *Jussiaea repens* were separately checked by *in vitro* pollen grain germination test. It was found that *Jussiaea* treated mercury-contaminated water significantly gives the higher percentage of pollen grain germination in comparison to pure mercury-contaminated water of the same concentration. Hence, *Jussiaea repens* can be effectively utilized for detoxification of heavy metals.

Keywords: Phytoremediation, In vitro pollen grain germination, detoxification, heavy metals.

1. Introduction

Mercury is a toxic metal. Mercury toxicity came to limelight after the incidence of Minamata diseases in 1953-60 in Japan. The Minamata incident was followed by a more tragic report of mercury poisoning from Iraq in 1972 where 450 villagers died after eating wheat which had been dusted with a mercury containing pesticide. [1] Now toxicity of mercury has become crystal clear. Mercury enters the environment mainly through human activities. Sewage effluent, Mining discharges, Industrial effluent, different pesticides etc. contain surprising amount of mercury. Anthropogenic releases of mercury to water are likely to be at least 1000 tonnes per year [2]. Once mercury is absorbed on sediments of water bodies, it is slowly released into the water and constitutes a reservoir which is likely to cause chronic pollution long after the original source of mercury is removed. [1] It is super-toxic to biota.

Mercury toxicity is dangerous for health. It creates different health hazards. Mercury toxicity is concerned with tremors, ataxia, paresthesia, sensory disturbances, cardiovascular collapse, severe gastrointestinal damage, irreversible damage to the brain, kidneys, and developing fetuses, and even death [3].

So, removal of mercury from water bodies is a problematic issue when mercury contamination of water contributes to countless cases of chronic poisoning. Phytoremediation of heavy metals is now well established. Phytoremediation is a green technology and if implemented properly it is environment friendly and aesthetically pleasing to the public [3]. Different plants hyperaccumulate mercury very slowly by small uptake over an extended period of time and a large quantity of the mercury is sequestered into the roots, shoots and other parts. Different plant species differ in terms of ability to accumulate heavy metals [4].

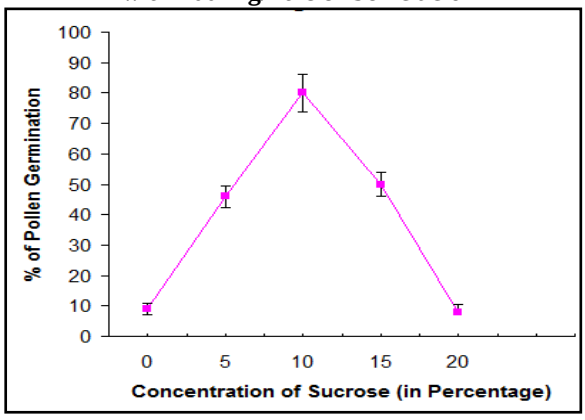
In the present investigation, *Jussiaea repens*, an aquatic angiosperm was tested to remediate mercury from contaminated water and a satisfactory result was obtained. The objective of this study was to find out the efficiency of *Jussiaea repens*, an aquatic angiosperm to absorb mercury from water. This strategy of phytoremediation can easily be implied to purify mercury contaminated surface water in the developing countries.

2. Materials and Methods

During the present investigation the hyper accumulating potentiality of *Jussiaea repens* were assessed under laboratory condition. The herbaceous plant, *Jussiaea repens* were collected from its natural habitat like pond which is a reservoir of domestic sewage. 1.5 mg of fresh apical portion of plant twigs with roots was taken for experiment. 5 mg l^{-1} and 10 mg l^{-1} of mercuric chloride solution were prepared. 40 ml of 5 mg l^{-1} mercuric chloride solution was taken in each of two petridishes separately. One was treated with *Jussiaea repens* and another remained blank. The same actions were repeated for 10 mg l^{-1} of mercury solution. 40 ml of 0 mg l^{-1} solution (Pure water) was taken in a Petridish. Three replicas were made for each concentration of the solution. 48 hours treatments were followed for the experiment.

To test its purifying potentiality *Jussiaea repens* treated mercury-contaminated water as well as mercury contaminated water without Jussiaea-treatment was used for *in vitro* pollen grain germination test. The highest rates of germination were obtained at 10% sucrose solution with 100mgl^{-1} boric acid for *Impatiens balsamina* followed by *in vitro* pollen grain germination of it. Therefore, *in vitro* germination rate of pollen grain of *Impatiens balsamina* in 10% sucrose solution with 100mgl^{-1} boric acid along with different concentrations of mercury solution were determined.

Figure 1: Germination of pollen of Impatiens balsamina in different concentrations of sucrose with 100 mg/litre of boric acid

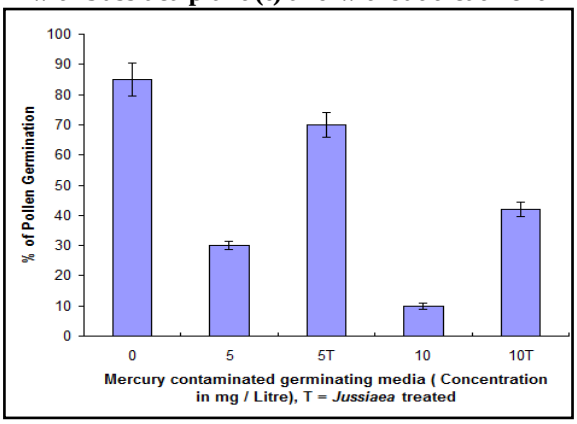


3. Result and Discussion

The highest rate of *in vitro* pollen grain germination of *Impatiens balsamina* is obtained at 10% sucrose solution with 100mgl^{-1} boric acid and it is about 80%-90% .When that germination were carried out with 5 mg l^{-1} and 10 mg l^{-1} of mercury solutions along with 10% of sucrose solution with 100mgl^{-1} boric acid the rate of *in vitro* pollen grain germination were reduced to 32% and 16% respectively. This reduction in pollen grains germination might be due to heavy metal stress. According to Gür Nazmi [5] heavy metals like mercury is responsible for a decrease in the pollen germination.

The rates of germination of pollen grains increased from 32% to 71% and from 16% to 47% respectively when 5mgl^{-1} and 10 mgl^{-1} of mercury solution were treated with *Jussiaea repens*. This therefore suggests that *Jussiaea repens* treated mercury solutions did not inhibit the rate of pollen grain germination. This might be due to accumulation of soluble mercury in the vegetative part of *Jussiaea repens.*

Figure 1: In vitro pollen germination of Impatiens balsamina in the media contaminated with 5 mg / Litre and 10 mg /Litre of Mercury after treatment with Jussiaea plant (t) and without treatment



The plants in 5mgl^{-1} and 10mgl^{-1} of mercury solution developed new roots. Percentage of newly developed roots at Control set was about 12% where as Percentage of newly developed roots at 5mgl^{-1} and 10mgl^{-1} mercury solution were 36% and 33% respectively. The increased number of new roots in turn increased the number of root hairs thereby causing the increase in absorbance capacity. The root system provides an enormous surface area that absorbs and accumulates water and nutrients essential for growth along with other non-essential contaminants [3]. This increased absorbance capacity was induced by the presence of mercury in water. Thus, it may be presumed that the plant prefers to absorb mercury from water.

Thus, the results suggest that the phytoremediation through the macrophyte *Jussiaea repens* effectively absorbs mercury from contaminated water. This practice is convenient to use by the general people and has a long term impacts. Phytoremediation as an emerging technology should be considered for remediation of contaminated sites because of its cost effectiveness, aesthetic advantages and long term applicability [6] Therefore, application of *Jussiaea repens* might give the remedial measures to subside those problems.

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