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AGARICUS BISPORUS: A POTENT CLEAN BIOACCUMULATION TECHNOLOGY FOR A HEALTHIER AND SUSTAINABLE ENVIRONMENT.

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ABSTRACT

The presence of heavy metals in water, air, soil and other living substance is a crucial health concern for public and its harmful effect on environment and on humans as well, their elimination is significantly vital for healthier and sustainable environmental health. The heavy metals are not safe while getting degraded in environment and pose a health risk unlike much other organic waste Therefore a study was carried out to use (Agaricus bisporus) mushroom to remove heavy metals from fortified soil with heavy metals. Agaricus bisporus were cultured in the laboratory for the evaluation on bioaccumulation of heavy metals, viz. Copper, Zinc, Cadmium, Nickel and lead from fortified soil and woodhusk, Saw dust, grains husk as a substrate in soil. The bioaccumulation conditions were studied for each metal. The pH of the soil was found to be 6.0 for the absorption of heavy metals. The absorbent dosage and contact time is found to increase bioaccumulation of heavy metals. Agaricus bisporus exhibited maximum absorption for lead. The data proves that mushrooms may be used as efficient biosorbent for the removal of heavy metals viz. Copper, Zinc, Cadmium and lead.

KEYWORDS: *Agaricus bisporus mushroom, bioaccumulation, Copper, Zinc, Cadmium lead.*

INTRODUCTION

The determination of metals in soil samples is very important in monitoring environmental pollution. Therefore, considerable attention has been applied to reducing metal pollution of the soil through bioaccumulation in edible mushrooms (fruiting bodies) (Aruguete DM, Aldstadt III JH, Mueller GM, 1998, Işiloglu M, Yilmaz F, Merdivan M, 2001, Sarikurkcu C, Copur M, Yildiz D, Akata I, 2011). One aspect of biotechnology involves the use of bacteria, fungi, yeasts, algae and other organisms for biosorption, an alternative process for removing metals, These biosorbents have the property of isolating (sequestering) the metal and can be used to decrease the concentration of heavy metal ions in solution to the ppb to ppm level these microorganisms isolate metal ions dissolved in complex dilute solutions with high efficiency (Wang J, Chen C 2009) Conventional methods like chemical precipitation, adsorption, ion exchange, reverse osmosis and electro-dialysis, to get rid of heavy metal burden of the environment, have their own shortcomings. These methods offer limitations like slow metal precipitation and incomplete removal (Aziz et al. 2015). Concentrations of heavy metals have been observed in the fruiting bodies of mushrooms collected adjacent to heavy metal smelters (Kalac et. al. 1996) and landfills of sewage sludge emission areas (Cibulka et. al. 1996). Some species of mushrooms uniquely grow on mounds of harvester and ant hills. Mushrooms, compared to green plants, are capable of bio-accumulating more heavy metals in their fruit bodies since some of these heavy metals are natural components of the earth's crust, It has been found that mushrooms can bio-accumulate many molecules because of the mycelia stalk structures they posses (Demirbas 2000). Mushrooms have been used as biomarkers to determine the heavy metal pollution. Compared with green plants, fungi can accumulate high concentrations of some heavy-metals, such as P, Cd and Hg (Tüzen M, 2003, Işiloglu M, Yilmaz F, Merdivan M, 2001). Fungi are able to accumulate high concentrations of heavy metals (Dhawale SS et al, 1996, Melgar MJ, 1998, Cihangir N, Saglam N, 1999). *Agaricus bisporus*, This mushroom is reported to be very susceptible to increasing content of mercury and too lesser extent of cadmium in substrate and bio accumulate both the metals and leads in its fruiting bodies (Tuzen et al, 1998). Isildak et al (2004) reported that this mushroom could absorb heavy metals like copper cadmium, lead, zinc, manganese, iron, chromium and nickel. The level of copper was quiet high as compared to other metal ions. According to Kalac et al (2004) cultivated A. *Bisporus* absorb less amount of cadmium compare to plants growing in wild. Similar reports on biosorption of heavy metals was also published by Demirbas (2001) and Sesli and Tuzen (1999).

MATERIALS AND METHODS

Preparations of Copper, Zinc, Cadmium, Nickel and lead solutions

Stock solutions of Copper, Zinc, Cadmium, Nickel and lead is prepared by dissolving 2.5 g of Copper sulphate, 2.5 g of Zinc chloride, 2.5 g of cadmium chloride, 2.5 g of Lead nitrate and 2.5 g of Nickel chloride in 1 L distilled water. For standard solutions, Initial stock solution having concentration 1000 mg/L was later diluted with suitable amount of distilled water.

Cultivation of Mushroom *Agaricus bisporus*

Three tub of 18x24-inch about 9 inches deep is selected for the cultivation of *Agaricus bisporus* Mushrooms. The tub is filled with the soil fortified with aqueous solutions of Copper, Zinc, Cadmium, Nickel and lead, mushroom compost material with the substrate such as sawdust, grain, wooden plugs, straw, wood chips and inoculated with spores and covered with potting soil the tub is covered with a transparent plastic sheet so as to easily provide water every day and to observe growth and kept in dark cool moist place. After 3rd week mycelium starts to appear after full maturation button mushroom was harvested. The harvested mushroom fruiting bodies are used for the determination of the heavy metals. In the resultant concentration of Copper, Zinc, Cadmium, Nickel and lead ions in the bio accumulation experiment in mushroom was determined using Atomic Absorption Spectrometer (iCE 3400 AAS).

RESULTS AND DISCUSSION

Table 1: (Control) Mean concentrations (mg/kg) of heavy metals in *Agaricus bisporus.*

Mushroom Species	Cu	Zn	Cd	Ni	Pb
Agaricus bisporus	0.0001	-	-	0.01	0.002

Table 2: (Test 1) Mean concentrations (mg/kg) of heavy metals in *Agaricus bisporus.*

Mushroom Species	Cu	Zn	Cd	Ni	Pb
Agaricus bisporus	1.5	0.42	8.5	0.65	15

Table 3: (Test 2) Mean concentrations (mg/kg) of heavy metals in *Agaricus bisporus.*

Mushroom Species	Cu	Zn	Cd	Ni	Pb
Agaricus bisporus	1.8	0.40	7.5	0.75	13.9

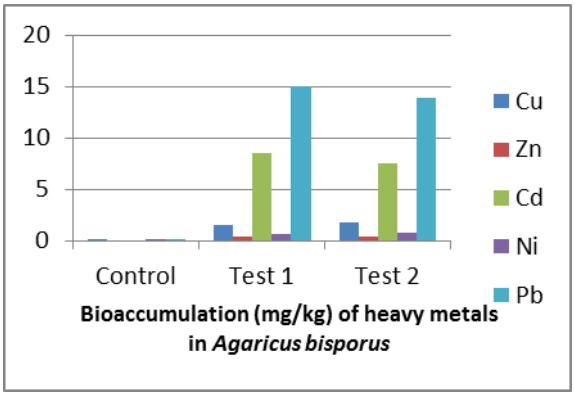

Fig. 1: Multiple bar showing mean bioaccumulation (mg/kg) of heavy metals in *Agaricus bisporus.*

DISCUSSION

From the results in Table 2 and 3, it is clear that Agaricus *bisporus* has the concentration of all the heavy metals. Pb has the highest bioaccumulation of 15 and 13.9 respectively. The order of concentrations of heavy metals in *Agaricus bisporus was found to be Pb*>Cd> Cu>Ni>Zn. Lead (Pb) as observed in *Agaricus bisporus* was higher in concentration According to European commission, 2001 in cultivated mushrooms maximum permitted level for lead is 0.3 mg/kg wet weight. Sources of lead are pesticides car batteries, plastics alloys, fumes of car. It accumulates in human blood, kidneys and bones can lead to lead poisoning. Tuzen et. al. (1998) detected a range of 0.75 – 7.77 mg/kg. Sources of cadmium is due to impurity in products insecticides, it's a very toxic metal and causes damage too human also. Thus, cadmium seems to be the most deleterious among heavy metals in mushrooms (Pavel et. al 2004). The copper concentration is 1.5 mg/kg and 1.8 mg/kg in table 2 and table 3 respectively whereas Nickel concentration is 0.65 mg/kg and 0.75 mg/kg and the Zinc concentration is 0.42 mg/kg and 0.40 mg/kg in table 2 and table 3 respectively. Sources of these heavy metals are fertilizers, manmade weathering, pesticides, Biosolids, manure, wastewater, metal mining, various air borne sources.

CONCLUSION

Several strategies have been employed over years to remediate soil and to remove heavy metals. The mycoremediation using Mushroom is a cost effective, reliable and recyclable method for the bio accumulation and biosorption of heavy metal. The present results indicate that the *Agaricus bisporus* has the potential to be used in the bio accumulation of metal in the fruiting bodies and mycelia of mushroom and it has a promising future for absorption and accumulation of metals from soil and wastewater. Mushrooms with heavy metals pose a health risk to human and proper screening of mushrooms has to be assessed and cultivation site should be chosen after proper evaluation. These results also indicate that mycoremediation can be done of the degraded sites for the healthier and sustainable environment.

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