Studies on the bioremediation of some heavy metals using some fungi

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The objective of the present investigation was to isolate some metalresistant fungal strains from soil and evaluated their bioremediationabilities of Cd2+ , Cu2+ , Pb2+ and As5+ ions and then studied the suitableconditions under whish they could remove these metal ions moreefficiently. A comparison between the bioaccumulation and biosorptionof these metal ions by the tested fungi was achieved along the thesis.Also, the physiological effects of these heavy metals on the fungal cell(represented by S. cerevisiae cell) were studied. This can be summarizedas follow:1. Twelve fungal species were isolated from soil as well as thestrain S. cerevisiae was obtained from the effluent of foodfactory (Holw Elsham Company).Then the effect of differentmetal concentrations on the viability and growth of theseisolates were tested.2. These isolates were classified into four groups according totheir viability: Group A represents the completely inhibitedisolates while group D represent the high resistance isolates. Inbetween, (group B and C) represent the isolates that depend onmetal type and its concentration.3. The eight isolates (groups: B, C, and D) were then tested fortheir ability to remove of Cd2 +, Cu2+ , Pb2+ and As5+ either fromliquid growth media (bioaccumulation) or from aqueous metalsolution (biosorption).Summary3024. In bioaccumulation study; All tested fungi able to grow andtolerate 100 mg/l Cd2 +, Cu2+ , Pb2+ and As5+ ions in growthmedia except S. brevicaulis that was inhibited by 100 mg/l Pb2+and As5+. This tolerance was varied among tested fungi and thisreflected on their bioaccumulation capacity, where the hightolerance accompanied by high bioaccumulation capacity.5. Better Cd2 +, Cu2+ bioaccumulation was done by A. niger whilelead and arsenate showed high bioaccumulation results by S.cerevisiae and P. chrysogenum, respectively. Thebioaccumulation of metals reached 70.74%, 84.3%, 73.98%and 61.89% removal for Cd2 +, Cu2+ , Pb2+ and As5+, respectivelyat fourteen days of incubation (saturation done during the firstfour days).6. In biosorption study; dried and killed biomasses were used. A.niger and A. terreus were the best microorganisms in removalof all metals except Pb2+ that was removed better by dried formof S. cerevisiae; also Cd2 + and Cu2+ were removed better bykilled form of P. chrysogenum. The highest metal uptakevalues by dried biomasses were 6.49, 7.17, 7.43 and 5.58 whileby killed biomasses were 6.4, 7.51, 6.2 and 4.67 mg/g at pH 5for Cd2 +, Cu2+ , Pb2+ and As5+, respectively during the 96 h.7. The factor of time was not essential with the same degree as inthe bioaccumulation process for most

tested fungi because thisSummary302process is non-metabolism dependant, and faster thanbioaccumulation process. Saturation of fungi with metals variedaccording to the individual fungus and the type of metal ions.For most fungi, saturation not requires long time but it takesplace during the first 4-6 hours.8. All tested fungi able to adsorb an amount of Cd2 +, Cu2+ , Pb2+and As5+ ions. This amount (q) was varied among tested fungiaccording to the type of metal ions, the main composition ofcell wall.9. S. cerevisiae was selected among other tested fungi for furtherstudies as it performed well in both bioaccumulation andbiosorption study. In addition, it is easy to cultivate at large scale,its biomass can be obtained from various food and beverageindustries and it was accepted by the public when appliedpractically. Finally it is an ideal model organism to identify themechanism of biosorption in metal ion removal, especially toinvestigate the interactions of metal–microbe at molecular level forfuture studies.10. In bioaccumulation study; the type of nutrient medium, pH,incubation periods and initial metal concentration were theculture conditions that affected on the S. cerevisiae growth aswell as its metal bioaccumulation capacity. Maximum growthof S. cerevisiae was achieved when the organism was cultivatedon glucose-peptone broth, at pH 5 for four days incubation atSummary30227 C in absence or presence of metal ions. On the other hand,by increasing metal ion concentration, the growth and alsobioaccumulation capacity of S. cerevisiae decrease.11. In biosorption study; The yeast cells were treated physicallyand chemically for increasing their biosorption capacity, sincethe highest metal uptake values (6.78, 8, 7.54 and 6.12 mg/g forCd2 +, Cu2+ , Pb2+ and As5+ respectively at pH 5) were obtainedby ethanol treated yeast cells for Cd2 +, Pb2+ and As5+, butNaOH treated yeast cells for Cu2+ . The optimum pH value thatachieves best biosorption capacity was 5 for all metal ionsexcept Cd2 +, where its uptake value increased at pH 6 andbecome 7.87 mg/g.12. Increasing of Cd2 +, Cu2+ , Pb2+ and As5+ concentrations in theiraqueous solutions containing suitable form of S. cerevisiae ,was accompanied by increasing their biosorption process. Wenoted that the biosorption was very fast for all metal ionsduring the first 2 h but, in the remaining period, final metalconcentrations in the liquid reached an equilibriumconcentration value.13. In addition, metal ions adsorbed by the biomass could beeluted effectively with HNO3. Regeneration of the biomasswith NaOH enhanced the biosorption capacity even after fivecycles of adsorption–elution–regeneration.Summary30214. The effect of Cu2+ , As5+, Pb2+ and Cd2+ ions with differentconcentrations on growth phases of S. cerevisiae showedinhibition of the yeast cell reproduction. This inhibition differsfrom metal to another according to the degree of metal toxicity.With increasing metals concentration, the metal uptakegradually decreased and the curves were flatter and flatter.15. By increasing the concentration of Cd2+ , Cu2+ , Pb2+ or As5+ions, the total S. cerevisiae DNA, protein, carbohydrates andlipids decreased. The degree of these negative effects wasvaried according to the type of metal species and the target