Effect of rhizospheric microorganisms inoculum on sweet pepper quality

F. Rosso[1,*], F. Zoppellari[1], G. Sala[1], B. Bergesio[2], E. Malusà[1], L. Bardi[1]

[1] *C.R.A. Centro di Ricerca per lo Studio delle Relazioni tra Pianta e Suolo GR Torino, Italy*
[2] *Az. Agr. Sperimentale Agrinatura Roero, Pocapaglia, Italy*
Keywords: arbuscolar mycorrhizal fungi; PGPR; sweet pepper; quality

The effect of the interaction among rhizospheric microorganisms and plant roots on plant physiology has been largely investigated and it is well known that they can improve plant nutrition, water efficiency, bioprotection against pathogens, and crop productivity. Several inocula composed of arbuscular mycorrhizal fungi and Plant Growth Promoting Rhizobacteria (PGPR) are commercially available. Most literature focused on the effects of commercial inocula on the productivity of maize and cereals; less abundant are studies on the quality of fruits and vegetables, such as apple, tomato, strawberry. Sweet pepper is an important horticultural crop in the world; it is as an important source of nutrients in the human diet and of antioxidant compounds, useful for prevention of health disease. We investigated the effects of a commercial rhizospheric inoculum on the productivity and on the quality of sweet pepper. Morphometric parameters, flavour profile, amount of vitamins, carotenoids and sugars were analysed in fruits. Plants of two local varieties (*cv. Corno* and *cv. Cuneo*) of sweet pepper, largely widespread in Italy, were cultivated in mesocosms. The addition to soil of a commercial inoculum containing mycorrhizal fungi and PGPR was compared to the traditional cultivation without inoculum; the yield and the quality of fruits were analysed.

Several significant effects of the inoculum in particular on fruit quality parameters were observed. The thickness of the pericarp was higher due to the inoculum in all varieties.

The ascorbic acid content variation due to the inoculum was related to fruit colour (red or yellow) but not to the variety. Sugar content (wet weight) decreased in fruits of inoculated plants. The pH was also influenced by the inoculum.

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[P-E.164]

Bioremoval of hexavalent chromium by *a. viscosus* supported on y and zsm5 zeolites

B. Silva*, I.C. Neves, T. Tavares

University of Minho, Portugal
Keywords: Chromium; Biosorption; Zeolites

The increasing awareness of water pollution with heavy metals, such as Cr(VI), and its long term effects has encouraged intensive efforts towards pollution abatement. The removal of Cr(VI) by a system that combines biosorption by a bacterium with the ion exchange properties of a zeolite was evaluated. The aim of this work was the assessment of the effect of sodium content in Y and ZSM5 zeolites on the removal of chromium. The zeolites NaY, HY and HZSM5 were used as the starting materials. The modified zeolites H(Na)Y and H(Na)ZSM5 were obtained by an ion exchange treatment with $NaNO_3$ solution. Batch biosorption assays were performed using an initial Cr(VI) concentration of 100 mg/L and a biomass concentration of 5 g/L, at pH 4. During the biosorption process, *Arthrobacter viscosus* bacterium supported on zeolite performed the reduction of Cr(VI) to Cr(III), which was retained in the zeolite by ion exchange (Silva et al., 2008). After the biosorption assays, the zeolites loaded with chromium were analysed by bulk chemical analysis. The results presented in Table 1 revealed that the initial sodium content in the zeolite had an effect on the removal of chromium. For the Y structure, the starting zeolite that had the lowest sodium content, HY, achieved the highest chromium retention. For the ZSM5 zeolite it was observed that the increase of sodium in the structure led to a significant drop of chromium percentage in the zeolite. In fact, the ion exchange of a small cation, such as H^+, is easier in comparison to Na^+, and the reduction of Cr(VI) by the bacterium is enhanced with a higher concentration of protons.

	Na (%) [a]	Cr (%) [b]
NaY	7.76	0.90
H(Na)Y	2.50	1.10
HY	1.95	1.20
HZSM5	0.082	0.93
H(Na)ZSM5	1.10	0.60

[a] Sodium content for the starting zeolites
[b] Chromium content after the biosorption process

Reference

Silva, B., Figueiredo, H., Quintelas, C., Neves, I.C., Tavares, T., 2008. Zeolites as supports for the biorecovery of hexavalent and trivalent chromium. Microporous and Mesoporous Materials 116, 555–560.

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[P-E.165]

Influence of sunflower oil on the biodegradation of creosote-pahs by *mycobacterium* sp. strain cp1

Sara Gallego[1,*], Marta Jorba[1], Joaquim Vila[1], Jose-Julio Ortega-Calvo[2], Magdalena Grifoll[1]

[1] *Universidad de Barcelona, Spain*
[2] *Instituto de Recursos Naturales y Agrobiológicos, Spain*
Keywords: sunflower oil; creosote; Mycobacterium; biodegradation

PAHs are pollutants of concern due to their toxicity and environmental persistence, thus developed countries have adopted specific regulations to reinforce the prevention of soil contamination and the remediation of existing polluted sites. Efficacy of bioremediation technologies is usually limited by the low bioavailability of PAHs. Vegetable oils have been proved to be effective to treat PAH-polluted soils when used as cleaning agents (Gong et al., 2005). In addition, it has been demonstrated that they increase PAH bioavailability (Pannu et al., 2003).

The aim of this work was to evaluate the applicability of sunflower oil as a natural, cost -effective and non-toxic agent to promote PAH biodegradation. For this purpose, we used soil:water slurry microcosms artificially polluted with creosote-PAHs and inoculated with the pyrene-degrading strain *Mycobacterium* sp. CP1, which ability to act on 2- to 4-ring PAHs in a creosote mixture had been previously demonstrated (López et al., 2008). The effects of the oil in PAH biodegradation were monitored by determining the disappearance of parent PAHs by GC-MS analysis, metabolite production, and mineralization of pyrene as target compound. For the latter, a series of microcosm were spiked with this hydrocarbon labelled with ^{14}C.

At the end of incubation, strain CP1 had significantly depleted phenanthrene (80%), anthracene (50%), fluoranthene (59%) and

pyrene (67%) from the non-treated microcosms. In amended microcosms, sunflower oil clearly stimulated PAH biodegradation, showing an especial effect on the four-ring compounds fluoranthene and pyrene (81% and 87%, respectively). In agreement with the biodegradation results, the addition of sunflower oil resulted in increased mineralization rates of pyrene compared with inoculated controls without oil addition.

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[P-E.166]

Enhanced production of fungal enzymes for effective decolorization of a reactive dye, Acid Blue 350

J. Lee[1], M. Lee[1,2], C. Park[2], D. Lee[1], J. Cho[1], S. Kim[1,*]

[1] *Korea Institute of Industrial Technology, Republic of Korea*
[2] *Kwangwoon University, Republic of Korea*

Due to the low biodegradability of industrial dyes, the conventional biological technologies are not efficient in the treatment of dye wastewater. An enzymatic decolorization of the dye has been attempted to overcome this problem. White-rot fungi are known to produce a group of lignolytic enzymes including laccase which has potential as a dye degrader. In our previous studies, we have found that decolorization ability of *Funalia trogii* ATCC200800 was excellent compared to those of other fungi tested in the treatment of dye wastewater due to the higher production of laccase. After preliminary studies on the relationship between the fungal growth and the enzyme production of *F. trogii*, several inducers like guaiacol, xylidine, $CuSO_4$, $MnSO_4$, $ZnSO_4$, and alcohols were tested for their ability to boost the enzyme production. As a result, $CuSO_4$ was found most effective in stimulating the laccase production (22.8 units at 0.5 mM $CuSO_4$). The enzyme was produced and secreted into the growth media enabling the purification by ultrafiltration and gel permeable chromatography (GPC). The purified enzyme was immobilized by entrapment in alginate and was successfully used to degrade a model dye, Acid Blue 350. Furthermore, the resulting immobilized enzyme exhibited better stability and activity during reaction compared to the free enzyme, and maintained 57% of its initial activity after 7-time reuse. It is expected that the advantages of this method like facilitated degradation of the dye, stability and reusability of the enzyme could be fully utilized in the real textile wastewater treatment processes.

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[P-E.167]

A novel alkaline phosphatase PhoK from *Sphingomonas* sp. strain BSAR-1 and its application in uranium bioremediation

K.S. Nilgiriwala, S.K. Apte*

Bhabha Atomic Research Centre, India
Keywords: *Sphingomonas*; alkaline phosphatase; PhoK; uranium bioremediation

Uranium extraction from natural ores is generally carried out either by acid or alkaline leaching process. When carbonate content of the ore is more than 2%, alkaline leaching is more effective and advantageous. In nature, uranium (VI) forms highly soluble carbonate complexes at alkaline pH. This increases the mobility and availability of uranium in groundwater and soil, from the dumped nuclear wastes, resulting in health hazards. Currently, there is no microbial remediation technology available for alkaline wastes containing uranium.

A high specific activity alkaline phosphatase overproducing *Sphingomonas* sp. strain BSAR-1 was isolated in our laboratory. The corresponding gene was cloned by Tn*5* mutagenesis and chromosome walking, and its protein product was overexpressed and purified. Bioinformatic analysis revealed N-terminal hydrophobicity, secretion signal peptide, metal binding sites, enzyme active site and presence of disulphide bonds and predicted it to be an extracellularly released metalloenzyme. Biochemical characterization revealed many novel features of the enzyme such as its optimum pH and temperature, high specific activity, a broad substrate range, metal co-factor (Ca^{+2}/Zn^{+2}) requirement, presence of disulphide bonds and multimeric nature. Based on its unique biochemical properties and evolutionary isolation, it was considered to be a distinct alkaline phosphatase and named as PhoK. We also succeeded in crystallizing the enzyme recently (Nilgiriwala *et al.*, 2009 *Acta Crystallogr Sect F Struct Biol Cryst Commun* 65, 917-919).

The strain BSAR-1 and PhoK overexpressing *E. coli* clone were successfully applied to bioprecipitate uranium from alkaline solutions in a batch process (Nilgiriwala *et al.*, 2008 *Appl Environ Microbiol* **74**, 5516-5523). A continuous process for uranium recovery was also developed. The bioprecipitation of uranium was monitored online by exploiting the fluorescence property of the precipitated uranyl phosphate species (meta autunite). The present study has revealed the potential and utility of this novel alkaline phosphatase (PhoK) from BSAR-1 in bioremediation of uranium from alkaline solutions.

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[P-E.168]

Sewage sludge reduction and recycling for biological denitrification using radiation technology

T.-H. Kim[1,*], C.H. Park[2], M.-J. Lee[1]

[1] *Korea Atomic Energy Research Institute, Korea, Republic of*
[2] *Kwangwoon University, Korea, Republic of*
Keywords: sewage sludge; gamma ray; carbon source; denitrification

A large quantity of sludge is produced from a conventional sewage treatment plant. Commonly used sludge disposal practices are incineration, landfilling and land application. Land application or agricultural use of sewage sludge is highly debated, and an incineration is quite expensive. Moreover the conventional disposal methods of landfilling or incineration cause secondary pollution problems. Therefore, several methods such as mechanical disruption, thermal hydrolysis, chemical hydrolysis and ultrasounds have been developed to reduce the sludge volume. Radiation processes such as electron beam and gamma-ray irradiation are considered as a promising technology for the treatment of wastewater or sludge.

In this study, sludge reduction by some techniques including alkaline hydrolysis, ozone oxidation, hydrogen peroxide oxidation, and radiation were investigated. The organic carbon source was recovered from the sewage sludge, and the feasibility of that recovered sludge carbon source for biological denitrification was investigated.

As results, hydrogen peroxide oxidation led to a strong decrease of total solid contents, apparent viscosity and particle size, and a