Microbial bioprocess for the remediation of the hazardous di(2-ethylhexyl)phthalate

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Di(2-ethylhexyl)phthalate (DEHP) is the predominant plasticizer being blended in polyvinyl chloride (PVC) plastics to increase its flexibility, extensibility and workability. Since DEHP is only physically bound to the polymer network of PVC, it easily migrates into the surrounding environments, which in humans shown to cause many health problems, such as sterility, endocrine disruption, various cancers. We isolated and characterized several fungi and bacteria from heavily plastic contaminated soils in Kerala, viz., Aspergillus japonicas, A. parasiticus, Penicillium brocae, P. funiculosum, Fusarium subglutinans, Purpureocillium lilacinum, Achromobacter denitrificans, etc. We used PVC blood storage bag as a model for the bioremediation DEHP, which contained ~35% (w/w) DEHP as the plasticizer. Employing a batch process, the fungi listed above could completely remediate the DEHP bound to PVC blood bag by both in situ and ex situ techniques in a simple salt medium and the fungal biomass so obtained could be used as feed to biogas plant, and subsequently to organic manure; thus the carbon in DEHP is efficiently mineralized. Furthermore, the DEHP biodegradation pathway by A. denitrificans was analyzed and the crucial enzyme, esterase involved in the pathway studied in detail with its characteristics. Interestingly, A. denitrificans could remediate DEHP into a pharmaceutically active novel 25-Cprodigiosin analogue. In silico molecular docking studies performed to assess the binding affinities of this prodigiosin to various human targets showed that this novel prodigiosin is a potent drug interacting with human targets. In addition to this, in silico evidences for the toxicity of common phthalates and their metabolites on human molecular targets (steroid hormone receptors, PPAR-RXR subtypes, etc.) are also described.

Effect of explant source, nutrient medium, phytohormones and elicitation treatment on in-vitro callus culture of Curcuma longa and expression of secondary metabolites

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Curcuma longa (Zingiberaceae), beauty of ‘Indian Ayurveda’ commonly known as ‘Indian Saffron’ and ‘Haldi’ in the Indian system of Medicines, is an erect perennial herb and grows as an annual crop. In tribal medicine, it has great importance as an anti-inflammatory, analgesic, antioxidant, anti-diabetic, anticancer, antimarial, anthelmintic, carminative, antiarthritic and many more which is proved by scientific evidences. Present research work deals with the development of in-vitro callus culture of such medicinally important plant and to find out the effect of explant source, age of explant, nutrient medium, various phytohormones and elicitation treatment on expression of secondary metabolites from callus. C. longa is propagated vegetatively in department’s research field and leaf sheath, leaf lamina, leaf base, lateral and apical buds of rhizome were used as explant for the present study. Explants were aseptically cultured on Murashige and Scoog (MS) medium, Gamborg (BS) medium, Whites medium and Woody plant medium supplemented with different concentrations of auxins and cytokinins like 2, 4-Dichlorophenoxacyclic Acid (2,4-D), Indole Acetic Acid (IAA), Naphthalene Acetic Acid (NAA), 6-Benzyl Adenine (6-BA) and Kinetin, individually as well as in combinations. The cultures were maintained at 25±2°C temperature and 16hrs photoperiod. Induced calli were then sub-cultured maintained on the same medium. Calli were also subjected to elicitation treatment. After sufficient sub-culturing when no further growth of callus has seen, it is subjected to extraction and phytochemical screening.