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Chitin deacetylase for improved production of chitosan with bio adsorption efficiency for agricultural sustainability

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Abstract:

Chitosan is a deacetylate product of chitin, which is an abundant natural biopolymer having immense potential in various field of applied science including waste water treatment (heavy metal ions, radioisotopes, extracellular polymeric substances, poly chloro biphenyls, dyes, solid materials from food processing waste), agricultural fields (fungicide, feed additive and seed coating), medical and pharmaceuticals (artificial skin, contact lenses, antitumor, media etc due to the characters like having defined chemical structure, biodegradable and biocompatible with many organs, tissues and cells. It can be chemically and enzymatically modified to flakes, fine powders, membranes, sponges and gels. In agricultural fields chitosan act as an elicitor by inducing accumulation of lignin, callose, phytoalexin which help in plant defence mechanism. It also promotes plant growth, resistance against biotic and abiotic stress. Chitosan is extensively used as a seed coating element due to its antimicrobial activity and ability to change the permeability of seed plasma membrane. It can be considered as a potent bio pesticide. The cationic nature of chitosan is considered as one of the most promising bio adsorbents for extensive application in waste water treatment. The protonated NH2 and OH group present facilitates the electrostatic interaction between polymers and negatively charged contaminants. It can effectively bio adsorb heavy metals like (Cu(II), Cd(II), Pb(II), Fe(III), Zn(II), Cr(III), Poly chloro biphenyls (PCBs), Extracellular polymeric substances (EPS) including the proteins lipids and carbohydrates promoting bioremediation and sludge treatment. Commercialized chitosan is manufactured from chitin suffered disadvantages viz., grievous, thermochemical process, multistep chemical procedure, requirement of high alkali and high temperature, environmentally unsafe, leading to a broad and heterogeneous range of products. Employing a novel chitin deacetylase (CDA) from microbial source enzymatically deacetylase the chitin into chitosan addressing bioadsorption of heavy metals and pollutants. Bio derived chitosan is more efficient than the chemically derived. The major hurdle in this approach is to improve the chitosan yield and solubility which can be achieved by increasing CDA activity.

Key words: Chitin, Chitosan, Chitin deacetylase (CDA), polychlorinated biphenyls (PCBs), extracellular polymer substance (EPS).