Azoreductase Activity: Bioremediation for Treatment of Synthetic Diazo Dyes in Polluted Water

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Azo dyes, which are characterized by one or more azo bonds, are a predominant class of colorants used in tattooing, cosmetics, foods, and consumer products. Synthetic dye pollution is a serious environmental problem and a public health concern. Toxic effluents containing azo dyes are discharged from various industries and they adversely affect water resources, soil fertility, aquatic life, and ecosystem integrity. These dyes when released into the environment untreated, result in both pollution of surface and ground waters in the region. They are not readily degradable under natural conditions and are typically not removed by conventional waste water treatment systems. A naturally occurring enzyme called azoreductase, is known to catalyze the reductive cleavage of the azo bond of the azo dyes into smaller potentially harmless colorless aromatic amines that can be further metabolized by microorganisms. This project utilizes the azoreductase enzymatic activity of microorganisms for bio-degradation of textile effluent synthetic azo dyes. The design of the experiment is to ultimately test the efficacy and feasibility of the use of the azoreductase enzyme to treat water polluted with synthetic dyes through bioremediation. The studies used four different microorganisms and 12 different synthetic azo dyes, including mono- and diazo compounds. A mathematical model was developed by measuring the change in color spectrophotometrically to assess the efficiency of each bacterial enzyme on azo dye decomposition. Overall, the experiments demonstrated that all the microorganisms tested have azoreductase activtity and effectively breakdown the synthetic azo dyes.