ABSTRACT

It is the industrial revolution that gave birth to environmental pollution. Kerala, the land of coconuts is well known as ‘Gods own land’, has the largest number of coir industries in India. Synthetic dyes with different chemical structure are used to colour the processed coir to make useful products. These dyes are highly toxic pollutants which reaches the aquatic environment as effluent discharges from the coir industries. Most of the coir industries in Kerala are in small scale sector and do not have a proper effluent treatment system. An abundance of physico-chemical methods are in use worldwide, however, there is increasing concern about their impact in effectively treating dye effluents as they introduce secondary pollutants during the ‘remediation’ process which are quite costly to run, maintain and clean up. Research on biological treatment has offered simple and cost effective ways of remediating these effluents. An effective system for the biodegradation or amelioration of the toxic dyes is the need of the hour. So, this project was taken up as a topic of research to educate the industrialists about the pollution and hazardous effect of these dyes which could guide them to provide an eco-friendly system of treatment.

In the present study, the most commonly used dyes used in coir industry are selected and the toxicological effects of these dyes have been studied in fish models. The analysis of marker enzymes like Alkaline and Acid phosphatase, alanine and aspartate aminotransferase and histopathological studies of different tissues of fish, revealed the severe toxicity of these dyes.

The major task of the project was to develop an eco-friendly method of biodegradation of these toxic dyes. In this aspect, we have selected various bacterial isolates from different polluted environments. We selected seven bacteria which could degrade the dyes in one way or other. Studies with these bacteria enabled us to select minimum suitable bacterium that could degrade the above dyes. Biochemical characteristics and molecular identification of better
degrading strains by 16S rDNA analysis showed that the organisms are *Bacillus amyloliquefaciens* (ABR1 and ABR3), *Bacillus subtilis*, *S. gallinarum*, *S. paucimobilis*, *A. genomospecies* and *B. multivorans*. The phylogenetic analysis of the selected isolates was also carried out. The detailed study on the biodegradation of commonly used dyes in coir industry, Acid Orange 7 and Direct Blue 6 were conducted in detail by using *S. gallinarum*, which showed maximum decolourization of these dyes and the optimum conditions for the biodegradation by this organism were studied.

Based on the preliminary studies and observations, a consortium of bacteria containing three bacteria namely *B. subtilis*, *S. gallinarum* and *B. multivorans* developed which was found to be very effective for degrading the selected dyes than with a single bacterium used separately. The degraded products of the dyes by using selected bacterium and bacterial consortium were identified separately by different techniques generally employed for this purpose namely UV-Vis, HPLC, FTIR and LC-MS. The phytotoxicity studies were also conducted with the biodegraded products and found that the degraded products are not toxic in nature.