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Fast method of azo dye decolorization by anaerobic bacteria: A green method

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Abstract
Azo dyes are the largest class of commercial synthetic dyes and have found wide applications in various industry. As they are not readily degraded by conventional treatment this class of dyes result a significant environment problem.
The bacteria *Serratia marcescens* shows positive result for the decolourisation of the two azo dyes Biebrich Scarlet (BS) and Direct Blue 71 (DB) under anaerobic condition. Here we report within 24 hours that can be a boon to the colour industry and to have the sustainable water effluent from the industry.

Keywords: Azo dye, anaerobic bacteria, green method

Introduction
Dyes are severe organic contaminants from textile and paper manufacturing industries [1]. Azo dyes are the most widely used dyes in the Industrial sector [2]. Approx 80% of all reactive dyes are based on Azo chromogen. Azo dyes are characterized by the nitrogen double bond (-N=N-) which together with other chromophore is responsible for the dye [3]. The functional group associated with the azo dye makes up a complex composition and influences capabilities of the bacteria. Therefore, choosing the best azo dye decolorizing bacteria is critical. The majority of isolated bacteria require anerobic growing conditions to degrade azo dye [4] Azo dyes have wide applications in textile, food, cosmetics, plastic, laboratories, leather, paper printing, colour photography, pharmaceutical and toy industries.
More than 50% of these generally used Azo dyes are recognized as non-biodegradable compounds [5].
Azo dyes are not readily degraded in conventional aerobic treatment system make this class a significant environmental problem. Textile industries consume large amounts of water for dyeing and finishing processes, the colored nature of textile waste water causes major environmental problem [6]. For dye decolorization and degradation, several methods such as coagulation/adsorption, electrolysis, ozonation, chemical oxidation and ultrafiltration have generally been used. However these methods have limited applicability due to their inefficiency, higher budget and toxic intermediate [7]. As a viable alternative, biological processes have received increasing interest owing to their cost-effectiveness [8].
Over the past decades many microorganisms have been reported that are capable of degrading azo dyes, including bacteria [9, 10, 11].
The anaerobic reductive cleavage of Azo bonds is often always preferred over the aerobic conditions as oxygen molecule will compete with the azo group for electrons in the oxidation of reduced electron carrier i.e. NADH [9]. Many bacteria have been reported to decolorize azo dyes under anaerobic conditions e.g. *Bacteroides* sp. Eubacterium sp. Clostridium sp., Proteus vulgaris and *Streptococcus faecalis*. [12].
A simple stab culture method for the culture storage of bacterial have reported here using this method results can be obtained in 25 hours.

Methods
The bacterial sample *Serratia marcescens* gathered from Paliwal pathology, Kanpur was inoculated via stab inoculation into loosely capped microbiological test tubes semisolidified with 5.0 gl^{-1} of agar and the bacterial sample was tested for the ability to decolorize two azo dyes, Biebrich scarlet (BS) and Direct blue 71(DB) in 0.10gl^{-1} concentration. The color change was observed qualitatively.

Result and Discussion

The two azo dyes BS and DB 71 were observe to get decolorized over control using stab culture method after 24 hrs. of inoculation of the bacterium *S. marcescens* at room temperature. The selective advantage of low oxygen tension environment of the azo dyes decolorization as observed was probably due to the electron with drawing properties of the azo bond itself that produces electron deficiency at the site of cleavage and could only thus be cleaved in the presence of reducing agents, generated during anaerobic metabolism on static incubation [13].

The clear zone observed at the bottom of the test tube suggests that the degradation of Biebrich Scarlet and Direct blue 71 occurs under anaerobic conditions.

The overall methods is green simple yet effective to combat with environmental problem of waste water pollution.

Conclusions

Many small scale factories were built years ago without proper waste management systems in place[14]. Lack of awareness and proactive action towards textile waste water may cause significant problems to the environment. Textile waste water could be mutagenic, carcinogenic and very toxic towards aquatic life [15, 16, 17].

This process can be utilize to treat waste, water containing dyes such as BS and DB 71 and is very effective and less expensive than conventional processes.

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