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Biodegradation of aniline in an alkaline environment by a novel strain of the halophilic bacterium, *Dietzia natronolimnaea* JQ-AN

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HIGHLIGHTS

- *Dietzia natronolimnaea* JQ-AN was isolated for aniline biodegradation.
- Highest degradation occurred at pH 8.0 and 3% NaCl (w/v).
- Sodium acetate had a stimulating effect on aniline degradation.
- Removal of aniline was 72–100% at 7 d HRT in a bioreactor, respectively.
- Aniline was degraded as an *ortho*-cleavage pathway of the catechol intermediate.

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ABSTRACT

Dietzia natronolimnaea JQ-AN was isolated from industrial wastewater containing aniline. Under aerobic conditions, the JQ-AN strain degraded 87% of the aniline in a 300 mg L^{-1} aniline solution after 120 h of shake flask incubation in a medium containing sodium acetate. This strain had an unusually high salinity tolerance in minimal medium (0–6% NaCl, w/v). The optimal pH for microbial growth and aniline biodegradation was pH 8.0. Two liters of simulated aniline wastewater was created in a reactor at pH 8.0 and 3% NaCl (w/v), and biodegradation of aniline was tested over 7 days at 30 °C. For the initial concentrations of 100, 300, and 500 mg L^{-1}, 100%, 80.5% and 72% of the aniline was degraded, respectively. Strain JQ-AN may use an *ortho*-cleavage pathway for dissimilation of the catechol intermediate.

1. Introduction

Aniline is an important raw material used in dye, medicine, pesticides, explosives, perfume, rubber, and in other industries (O'Neill et al., 2000). Aniline is highly toxic, readily absorbed through the skin, and potentially fatal if swallowed or if the vapors are inhaled (Emtiazi et al., 2001). This chemical is released into the environment through industrial wastewaters and through its direct application to soil, resulting in the introduction of carcinogenic and mutagenic chemicals to the environment. Considered an environmental hazard, aniline is subject to legislatively control by the European Economic Community (EEC) directive and in the Priority Pollutant List of the U.S. Environmental Protection Agency (Zhang et al., 2008).

Several physical and chemical methods, e.g. sorption, oxidation by ozonation, and electrochemical treatment, have been used to treat aniline-containing wastewaters. The development of a viable alternative biological process has received increasing interest owing to its cost effectiveness and environmental benefit. While not as easily biodegraded as phenol or benzoate (Wyndham, 1986), aniline is biodegradable as has been reported by several authors (Zhang et al., 2011, 2008). The bacterial species of *Pseudomonas* (Kahng et al., 2000; Tanaka et al., 2009), *Comamonas* (Boon et al., 2000), *Acinetobacter* (Wyndham, 1986), *Rhodococcus* (Zhuang et al., 2007), *Frateuria* (Murakami et al., 2003), *Moraxella* (Zeyer et al., 1985), *Delftia* (Kahng et al., 2000; Zhang et al., 2008) and *Nocardia* (Wang et al., 2006) have been shown to degrade aniline and/or its derivatives (Liu et al., 2002). These bacteria biodegraded aniline efficiently under neutral and moderate conditions. However aniline-containing wastewater frequently has elevated salinity and high pH, which could inhibit microbial growth and pose problems in biological treatment systems (Li et al., 2010; Zhang et al., 2006).

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