Extracellular enzyme production and phylogenetic distribution of yeasts in wastewater treatment systems

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HIGHLIGHTS

- We isolated 257 yeasts from five different wastewater treatment systems.
- The abilities of the yeasts to produce extracellular enzymes were detected.
- The yeasts mainly produced lipase, protease, MnP and LiP.
- The enzyme producing yeasts had diverse phylogenetic distribution.
- The types of enzymes produced by yeasts were related with isolation sources.

GRAPHICAL ABSTRACT

Colony characteristics of yeast isolates that could produce extracellular enzymes (A, producing lipase; B, producing protease)

ABSTRACT

The abilities of yeasts to produce different extracellular enzymes and their distribution characteristics were studied in municipal, inosine fermentation, papermaking, antibiotic fermentation, and printing and dyeing wastewater treatment systems. The results indicated that of the 257 yeasts, 16, 14, 55, and 11 produced lipase, protease, manganese dependant peroxidase (MnP), and lignin peroxidase (LiP), respectively. They were distributed in 12 identified and four unidentified genera, in which Candida rugosa (AA-M17) and an unidentified Saccharomycetales (AA-Y5), Pseudozyma sp. (PH-M15), Candida sp. (MO-Y11), and Trichosporon montevideense (MO-M16) were shown to have the highest activity of lipase, protease, MnP, and LiP, respectively. No yeast had amylase, cellulase, phytase, or laccase activity. Although only 60 isolates produced ligninolytic enzymes, 249 of the 257 yeasts could decolorize different dyes through the mechanism of biodegradation (222 isolates) or bio-sorption. The types of extracellular enzymes that the yeasts produced were significantly shaped by the types of wastewater treated.

1. Introduction

Yeasts, as a group of single-celled fungi, have been unequivocally recognized as having important roles in biotechnological applications such as fermentation, food, pharmacy, and fine chemicals (Kurtzman et al., 2011). The potential application of yeasts in wastewater treatment was suggested about 15 years ago by some Japanese scientists (Chigusa et al., 1996). More recently, some yeasts were revealed to be capable of producing lipase or of degrading phenol compounds, and thus have potential value in treating wastewater from oil manufacturing (Zheng et al., 2001), olive mill wastewater (Goncalves et al., 2009) or reclaiming oil-contaminated sites (Hesham et al., 2006). Our previous studies also demonstrated...