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Biotransformation of Reactive Red X-GRL 41; Reactive Red 196; Reactive Red 141 and Reactive Red 120 dyes using *Saccharomyces Cerevisiae*

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ABSTRACT

Saccharomyces cerevisiae (baker's yeast) is one of the most important industrial microorganisms. The of This study aims to study the bioconversion potential of commonly available Saccharomyces cerevisiae for the four textile dyes of Reactive Red X-GRL 41; Reactive Red 196; Reactive Red 141 and Reactive Red 120. Reaction mixtures for the biotransformation of dyes included 25 mg/l dyes and 1% dried harvested cells of S. cerevisiae (bread's yeast) were well-tried. The survey results show that harvested cells of Saccharomyces cerevisiae can bioconvert these dyes. Biotransformation happened more than 99% for Reactive Red X-GRL 41 and Reactive Red 120. Reactive Red 141 and Reactive Red 196 were decolorized with 96% and 93 %, respectively at the room temperature after 72 hours. We hope these data can be used in chemical, pharmaceutical and biotechnological industries.
KEYWORDS: *Saccharomyces Cerevisiae, Biotransformation, Reactive Red X-GRL 41, Reactive Red 120, Reactive Red 141, Reactive Red 196, Biotechnology*

INTRODUCTION

A majority of synthetic dyes currently used are highly water soluble azo reactive dyes. The existence of nitrogen characterizes azo reactive dye–nitrogen double bonds, and the appear of light color leads to these azo bonds and associated chromospheres. Even dyes at very low concentrations (less than 1 mg/l) in the effluent are highly visible and are considered undesirable, especially the red color. These reactive dyes are the most problematic compared to other forms of dyes and must be disconnected from the wastewater all over. However, removal of these colors from wastewater is a major environmental challenge, and there is a constant need to have an effective process that can efficiently remove these dyes economically. Reactive dye wastewater has limited biodegradability in an aerobic environment, and many azo dyes may decompose under anaerobic conditions into potential carcinogenic aromatic [1]. This contaminated sewerage that, on the whole, are from painting and terminative product, are associated with the water contamination. Wastewater resulting from these shows improper impacts in terms of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Organic Carbon (TOC), suspended solids, color, affect on pH and the organic compounds, [2]-[4]. Azo dyes may be as toxic and carcinogenic [5]. Synthetic dyes cannot be efficiently decolorized by traditional biological processes [6]. Likewise, some biological and chemical methods have been developed for the efficient removal of industrial azo dyes [7] [8]. Azo dyes are electron-deficient xenobiotic components because of their azo linkage, and also other electron withdrawing groups, that produce an electron deficiency and make the dye less susceptible to biodegradation [9] [10]. Therefore under the suitable conditions, they can be degraded by reductases [11]-[13]. Azoreductases work only in the presence of reducing equivalents, e.g., FADH, NADH and NADPH [14] [15]. The available evidence demonstrates that azoreductase activity can be associated with more than one reductase [16]. Azoreductases are willing in microorganisms, as bacteria [17]-[19], algae [20] and yeast [21]. Usage of microorganisms for the biodegradation of dyes is one of the noteworthy alternatives to the extension of bioremediation procedures for the cure of tissue waste water. Biological techniques are a friendly environment, generate fewer sludges than physically and chemically methods, and are relatively inexpensive, as the running cost is low. Microbial discoloration can occur via biosorption, enzymatic degradation or a combination of both [22]. Yeast has long been known to be able of bioaccumulation of heavy metal from the solution and recently some reports for the accumulation of dyes [23]-[33]. Reactive dyes are problematic compounds and widely used in the textile industry. High temperatures and alkaline conditions require for dying of the fibers, but they are hydrolysed under these conditions. Hydrolysed dyes do not

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bind to fibres Cationic Red X-GRL is selected because it is hardly biodegradable by the conventional biological process, but widely used in the textile, color solvent, ink, paint, varnish, paper, and plastic industries.[24]
On the other hand, little experiment has been carried out investigating the capability of yeast to act as a biocatalyst for textile dyes especially using harvested cells. The aim of this study the bioconversion potential of commonly available S. cerevisiae yeast for the four textile dyes of Reactive Red X-GRL 41 and Reactive Red 196 & Reactive Red 141 & Reactive Red 120 dyes at batch-scale level.

MATERIALS AND METHODS

All chemicals used in the experiments were reagent grade. All solutions were prepared with distilled water. Reactive Red X-GRL 41 and Reactive Red 196 & Reactive Red 141 & Reactive Red 120 dyes were obtained from a local company of AlvanSabet, Tehran Iran.

Harvested cells of S. cerevisiae or baker's yeast were purchased from Razavi Yeast Company (1392), Mashhad, Iran. In this experiment, yeast was prepared at a concentration of 1%. For this purpose, 1 g of yeast was suspended in 100 ml of substance solution.[2]

100 ml reaction mixtures were prepared by mixture of dyes and 1 grams Harvested cells of S. cerevisiae. The experiments were performed at room temperature (22˚C ± 2˚C).(2)

10 ml of sample was taken from each beaker at definite time intervals. Samples were centrifuged to remove suspended biomass and the concentration of dye in the supernatant was determined by reading absorbance at 530 nm for Reactive Red 196 and X-GRL 41 and 544 nm for Reactive red 141 and 535 nm for Reactive red 120. Absorbance measurements were carried out by using a PG Instruments, T80+UV/VIS model spectrometer.

RESULTS

Harvested cells of *S. cerevisiae*were investigated in the reaction mixtures to study the ability for biotransformation of four synthetic dyes. A few dye bioconversions have been reported by this yeast. The results are givenasthe units of percentage of biotransformation in Table 1.

Table 1: Percent of the dye Bioconversion using *S. cerevisiae*at the different time. Values are the mean of three experiments ±SD.

Time	1Hour	2 Hours	3 Hours	One Day	Three Days
X-GRL 41	19.43 ±0.6	12.5 ±0.44	7.63 ±0.29	0.73±0.61	0.041±0.011
Reactive red 141	21.5 ±0.58	14.33 ±0.88	11.43 ±0.88	5.62 ±0.88	0.011±0.004
Reactive red 120	24.13 ±1.04	19.5 ±0.69	15.7 ±1.2	3.45 ±0.34	0.047±0.01
Reactive Red 196	24.69 ±0.98	18.77 ±0.59	16.33 ±1.33	6.93 ±0.59	0.0281±0.012

Figure 1, shows the decolorization of dyes by *S. cerevisiae* and **Figure 2,**show the decolorization of X-GRL41 by *S. cerevisiae*.

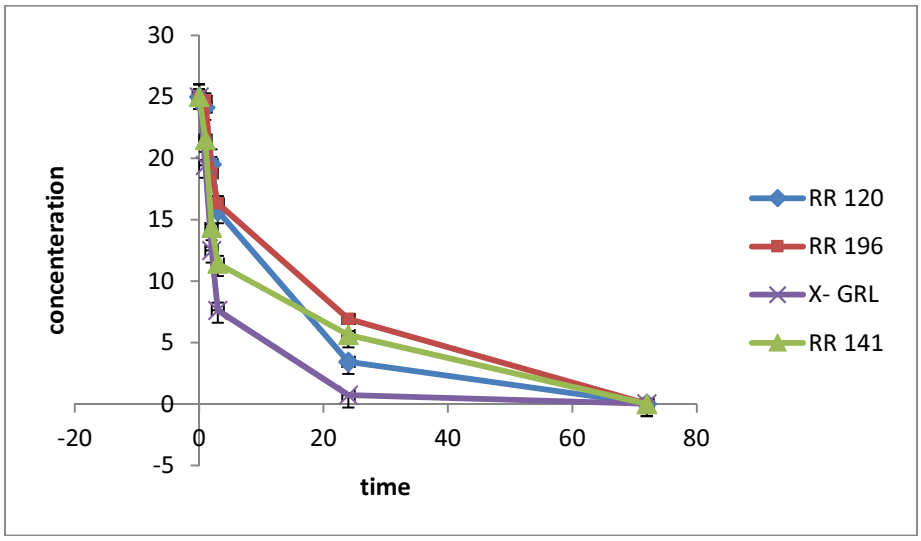

Fig.1: Bioconversion of dyes (25 mg/l) by *S. cerevisiae* (1%) during 72 hours. Values are the mean of three experiments ± SD.

Fig.2: Biotransformation of X-GRL 41 using wet cells of *S. cerevisiae* (1%) with concentration of dye 25 mg/l.

Figure 3, shows biotransformation of dyes (25 mg/l) using *S. cerevisiae* (1%) during 72 hours. Values are the mean of three experiments ± SD.

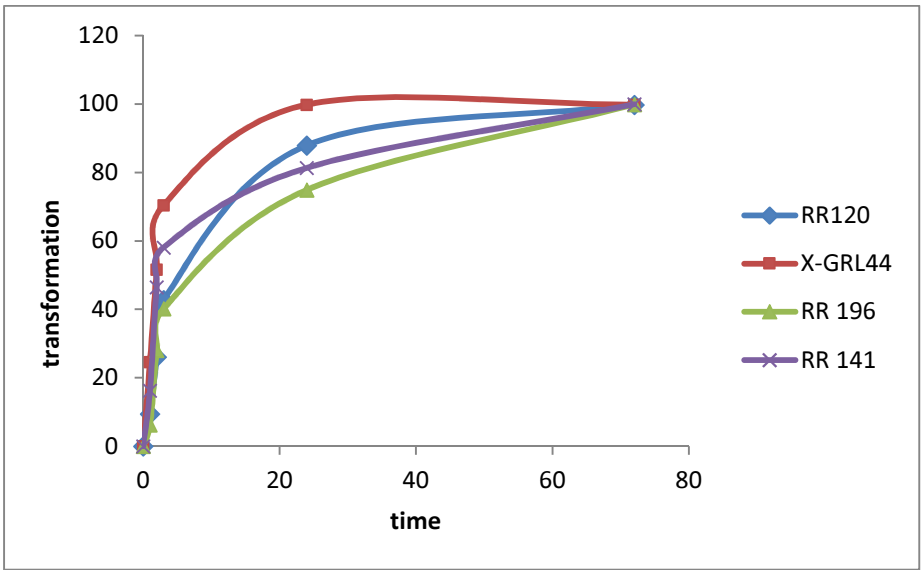

Fig.3: Biotransformation dyes (25mg/l) using *S. cerevisiae* (1%)

Decline in the absorption indicates that decolourization of this dye occurred by degradation. X-GRL 41 and red reactive 120 are degraded by biotransformation 100% and reactive red 196, and reactive red are degraded by biotransformation >93 % within 72 hours in water at the room temperature. Saccharomyces cerevisiae is able of operating a diversity of carbon and nitrogen sources. In the absence of natural condition sources of nitrogen and carbon, the yeast can use another synthetic chemicals. In this research, an experiment protocol was designed and used to check the ability of Saccharomyces cerevisiae to utilize two textile dyes at batch-scale level. Microscopic and macroscopic observations showed that the dye decolourization are due to microbial biotransformation and not due to biosorption.

DISCUSSION

Although some information have mentioned that S. cerevisiae in cultures can stack and store some paint in many days. Biotransformation of these paint in this survey, demonstrate that the harvested cells of the Saccharomyces cerevisiae capable be promised to other surveys and practical usage in the field of dye biotransformation for instance in biological sciences, chemical and industries. As well hold promise in providing a lower cost and more efficiency product to treat the textile sewage.

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