

## CHAPTER VII

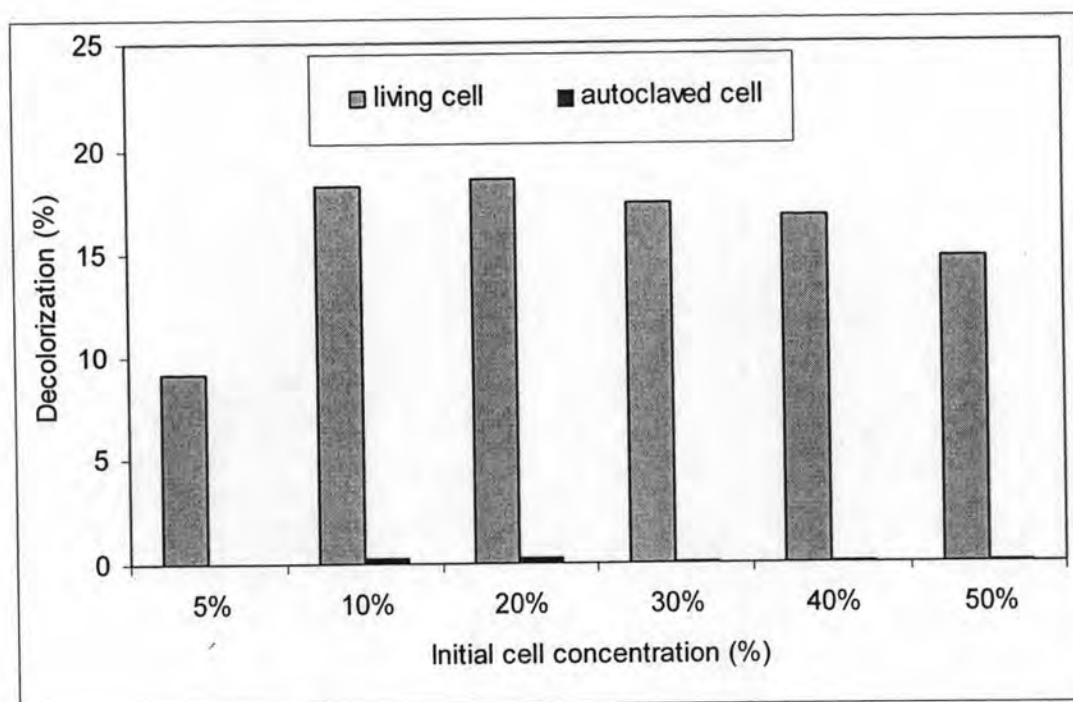
### COMPARATIVE STUDY FOR THE REMOVAL OF MELANOIDINS VIA BACTERIAL ADSORPTION AND DEGRADATION

Adsorption has been reported as an efficient method for the removal of different toxic pollutants and organic compounds in wastewater. Among various kinds of adsorbents, bacterial cells are widely used as powerful adsorbents for most pollutants in wastewater. It is also used as an adsorbent to remove color from the clarified juice in sugar refineries (Ruiz and Rolz 1971). These higher adsorption capacities were correlated to the surface nature of bacterial cells which are enriched in functional groups that act as adsorption sites for a variety of aqueous chemical species, including melanoidins (Beveridge 2005; Hass 2004). Because of their high adsorption capacities and low production costs, viable and dead bacterial biomasses have also drawn the attention of specialists in the field of water treatment (Sirianuntapiboon et al., 2004). Furthermore, only few studies have systematically compared the adsorptive properties of viable and dead bacterial cells for melanoidins-containing wastewaters.

Hence, this chapter describes the decolorization of the synthetic melanoidins-containing wastewater medium using viable and autoclaved cell of the constructed bacterial consortium MMP1.

#### 7.1 Decolorization by living and autoclaved cells

This study was carried out to check whether the decolorization observed was due to biological or non-biological activity (abiotic decolorization). Living and autoclaved cells of bacterial consortium with different cells concentrations at 5–50% (v/v) were added into 250 ml Erlenmeyer flask, each containing 50 ml of synthetic melanoidins-containing wastewater medium. The flasks were placed on rotary shaker (200 rpm) at room temperature of 48 h. Samples were taken at regular time and then centrifuged at 10,000 rpm for 10 min. The supernatants were read at OD equal to 475 nm using a spectrophotometer. The summarized results of decolorization of the synthetic melanoidins-containing wastewater by living and autoclaved bacterial cells after incubation under aerobic conditions for 48 h are shown in Figure 7.1. It showed that the experiment with the different initial cells concentrations (5–50% v/v) of autoclaved cell from consortium MMP1, exhibited no melanoidins decolorization after incubation for 48 h. On the contrary, the melanoidins decolorization was observed with living cell of MMP1.

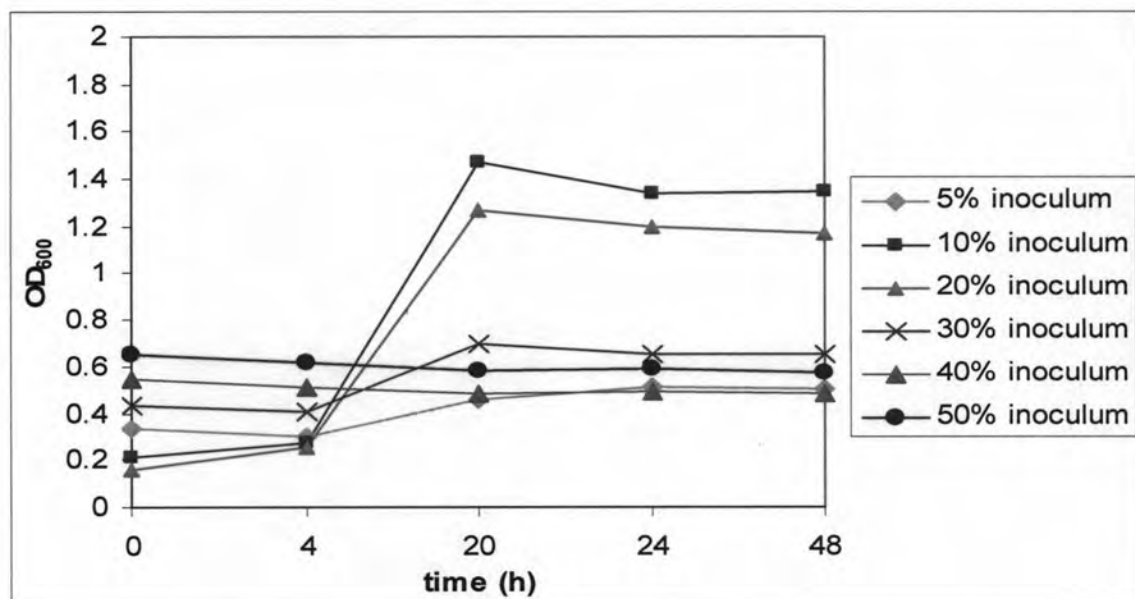


**Figure 7.1** Decolorization assays of synthetic melanoidins-containing wastewater with different initial concentration using either viable cells or autoclaved cells of the constructed bacterial consortium MMP1. The data were averaged from three independent experiments.

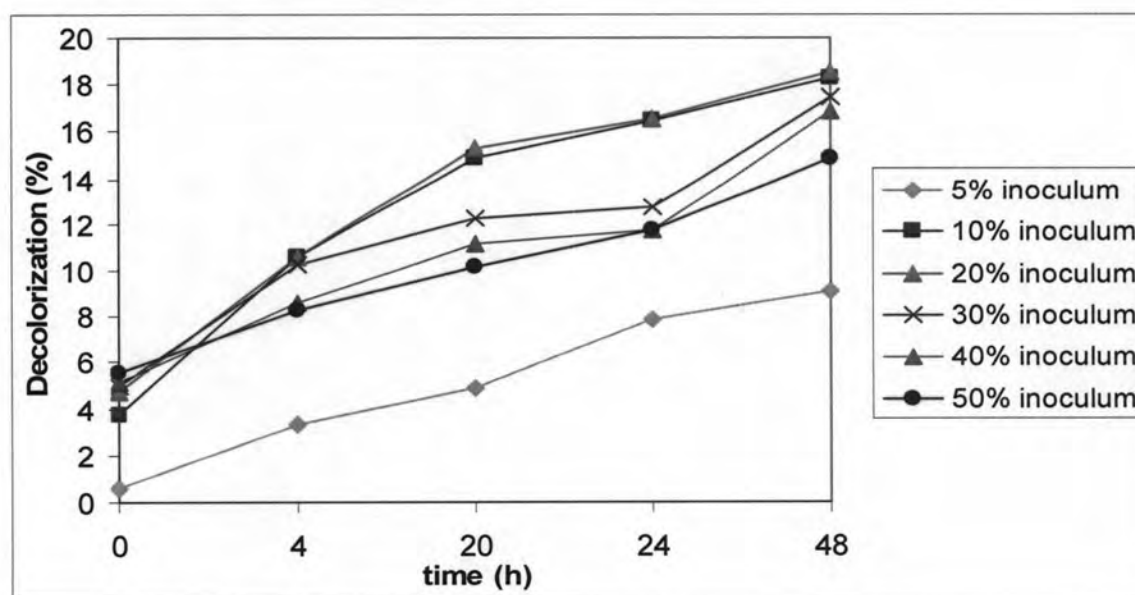
The effect of different concentrations of inoculum on decolorization and growth of constructed bacterial consortium MMP1 are shown in Figures 7.2 – 7.3, respectively. It shows the percentage of decolorization corresponding to the initial concentration of bacterial cells. The results in Figure 7.3 indicate that the decolorization varied markedly with the initial bacterial concentration, in the range of 9-18% after aerobic incubation for 48 h. Individually, initial bacterial concentration at 5%, 10%, 20%, 30%, 40% and 50% could decolorize melanoidins-containing wastewater up to 9.1%, 18.2%, 18.5%, 17.4%, 16.8% and 14.8%, respectively after aerobic incubation for 48 h (Figure. 7.3). The results show that the initial cells concentration at 10% and 20% accounted for the majority of decolorization of synthetic melanoidins-containing wastewater. The lowest decolorization was observed when the initial 5% cells concentration was used.

As observed in Figures 7.4 - 7.5, the adsorption capacities of autoclaved cells from the constructed bacterial consortium MMP1 constituted of *Klebsiella oxytoca*, *Serratia mercrescens*, and the unknown bacterium DQ817737 for melanoidins were markedly lower compared to those of viable cells. The decolorization of autoclaved cells at all different initial cells concentrations was limited to 0.9% by adsorption of the bacterial cells (Figure 7.5).

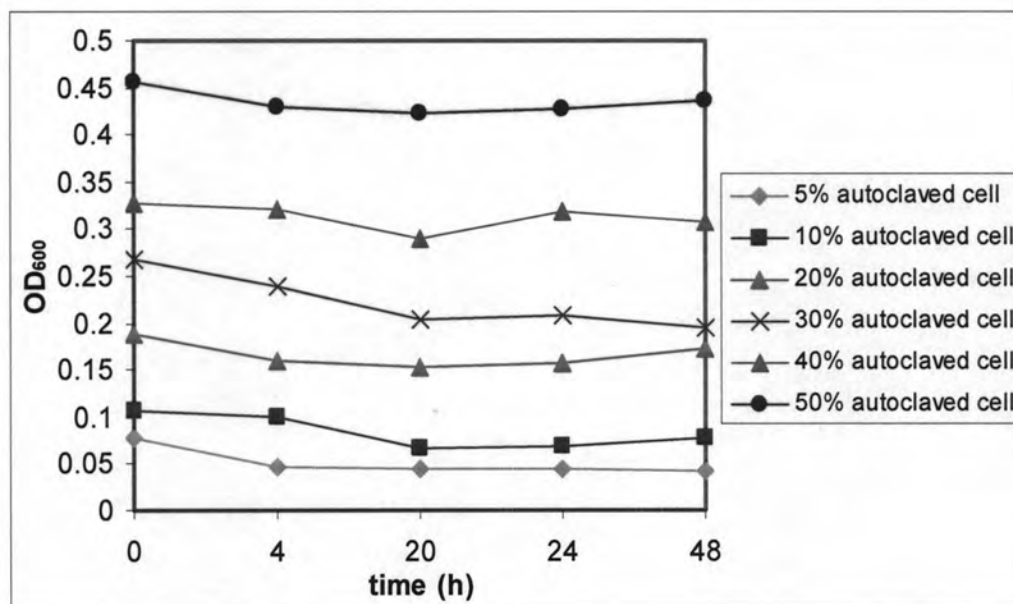
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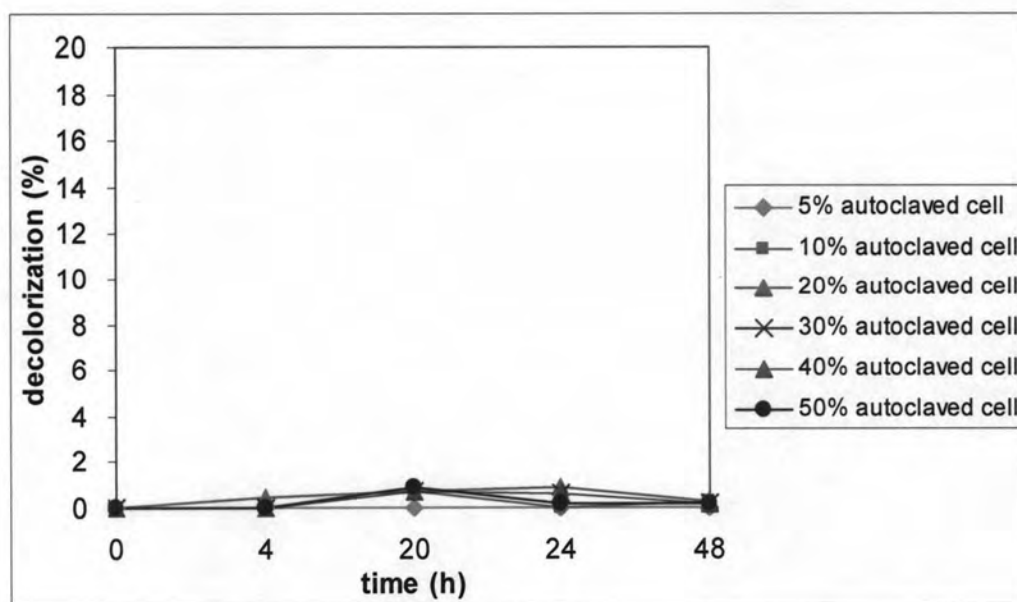
**Figure 7.2** Effect of different initial concentrations of seed inoculum on the growth of the constructed bacterial consortium MMP1.



**Figure 7.3** Effect of different initial concentrations of seed inoculum on the decolorization of the synthetic melanoidins-containing wastewater.



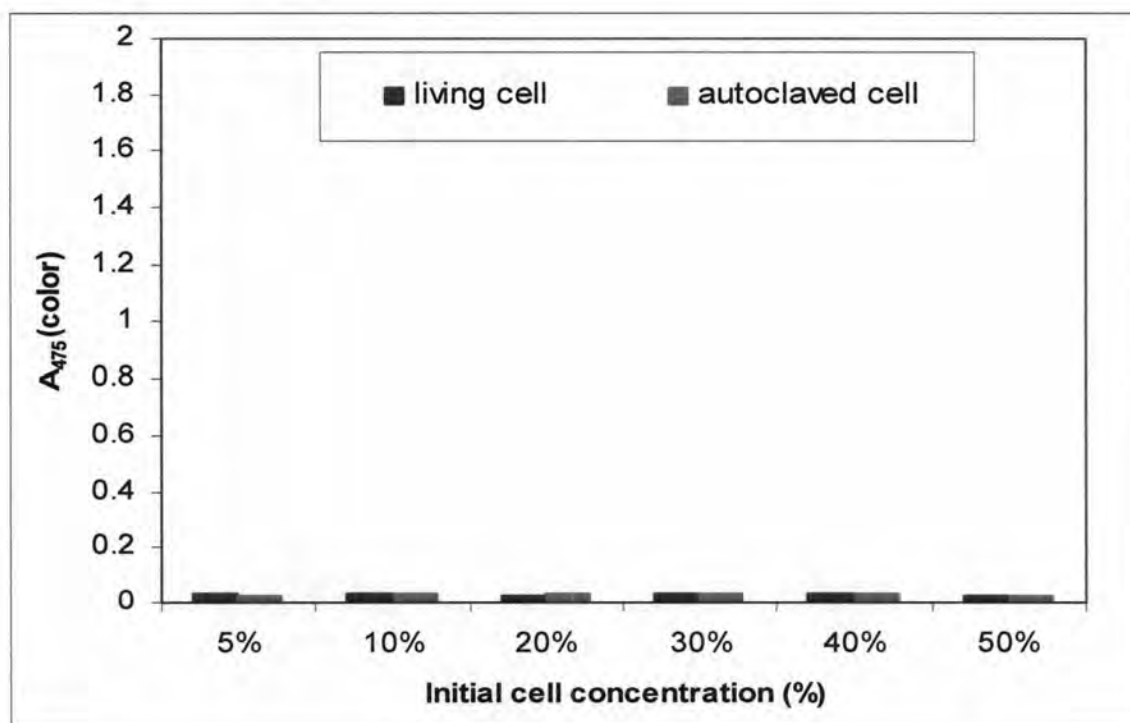
**Figure 7.4** Effect of different initial concentrations of autoclaved cells on biomass of the constructed bacterial consortium MMP1.



**Figure 7.5** Effect of different initial concentrations of autoclaved cells on the decolorization of the synthetic melanoidins-containing wastewater.

## 7.2 Elution of adsorbed-melanoidins from bacterial cells

Additionally, to confirm that the melanoidins decolorization occurred by biological activity but not by adsorption mechanism, NaOH extraction was applied (Sirianuntapiboon et al., 2004). The cell pellets of either living cells or autoclaved cells sampled in a given volume, were resuspended with in the equal volume of NaOH 0.1 M to extract color substances adsorbed on cells surface. The extracts were centrifuged and measured at OD equal to 475 nm. The figure 7.6 showed that the final fractions of NaOH-extractable color substances were negligible. These results clearly indicated that the decolorization of melanoidins by consortium MMP1 was mainly due to biological mechanisms.



**Figure 7.6** Release of melanoidins compounds from viable and autoclaved cells of constructed bacterial consortium MMP1 after extraction with 0.1M NaOH. The data were averaged from three independent experiments

The comparison of decolorization of consortium MMP1 with abiotic control has proved that the color removal for synthetic melanoidins-containing wastewater medium containing 2% (v/v) Viadox was due to the biotic activity of bacteria but not to the adsorption of color substances on the cells surface.