**Biosynthesis performance of phenyllactic acid during fermentation and whole-cell conversion with *Lactobacillus paracasei* strain**

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**Highlights**

* Effective strain of *L*actobacillus *paracasei* for the synthesis of phenyllactic acid
* Cell concentration of 3.2 g·L-1 in the fermentation
* Different biocatalytic properties of the cells obtained at different time in the logarithmic phase
* Concentrations of phenyllactic acid of 0.6-0.7 g·L-1 with the conversion ratio of 0.3-0.38

**1. Introduction**

Phenyllactic acid (PLA) is a kind of high-value organic acids with broad-spectrum antibacterial properties and could be used to synthesize the new bio-based materials of poly(phenyllactic acid)s [1-4]. The biosynthesis method for preparing PLA is a more sustainable method than chemical synthesis due to its advantages like more moderate reaction conditions and higher efficiency. In this work, the preparation of PLA by microbial synthesis was achieved via the highly efficient strain screening from Chinese traditional pickles, the microbial fermentation synthesis and whole-cell transformation synthesis process.

**2. Methods**

*L. paracasei* 16C3 strain was isolated from Chinese traditional pickles, identified by 16S rRNA gene sequence and deposited as the patent strain at the China Center for Type Culture Collection. The growth performance and fermentation production of PLA of this strain in the MRS medium with the static culture and the biosynthesis of PLA using this strain as the whole-cell biocatalyst and phenylalanine (Phe) as the precursor, were investigated experimentally.

The changing of pH was measured by a pH meter (FE20, Mettler-Toledo Ltd., Switzerland). Concentrations of PLA in the fermentation broth and bioconversion broth were analyzed by high performance liquid chromatography (HPLC) using Agilent 1260 infinity system equipped with DAD detector at the wavelength of 210 nm.

**3. Results and discussion**

The results showed that the maximum cell concentration of about 3.2 g·L-1 in the fermentation broth was achieved, as shown in Figure 1(a). The broth pH decreased with time increasing at the logarithmic phase (3 to 15h), indicating that the Intracellular metabolism was active, and some metabolites such as organic acids were produced into the broth. No significant decrease was observed in the stable phase (30 to 44h), indicating that the activity of cells and enzymes in the broth at this stage were stable.



(a) (b)

**Figure 1.** (a) Cell growth and pH change for *L. paracasei* 16C3 in MRS broth during fermentation process with 30 mL flasks at 35℃. (b) Concentrations of PLA and conversion ratios with cells at different culture time as the whole-cell biocatalysis compared with those obtained at the fermentation. Bioconversion conditions was 2 gꞏL-1 glucose, buffer pH 8.0, 2 gꞏL-1 Phe, 300 gꞏL-1 permeabilized cells and 35°C shaker temperature.

With the cells obtained at different time in the logarithmic phase as the whole-cell biocatalysts, the strain *L. paracasei* 16C3 has different biocatalytic properties, as shown in Figure 1(b). It was found that the bioconversion concentration of PLA was positively correlated with the culture time. The cells cultured about 12 h at the logarithmic phase displayed more effective biocatalytic capacity. The concentration of phenyllactic acid of 0.7 g·L-1 with the conversion ratio of 0.38 was achieved, which was high that that with the cells cultured about 9 h, i.e., 0.6 g·L-1 with the conversion ratio of 0.3. Moreover, the concentration of PLA with whole-cell biocatalysis from Phe was ten times that produced in the fermentation broth. At the same time, Phe could be the suitable substrates for PLA in bioconversion replaced phenylpyruvate due to the low-cost, stable and water-soluble advantages.

**4. Conclusions**

*L. paracasei* 16C3 is an interesting strain for the production of PLA by using Phe as the key substrate by whole-cell bioconversion. The culture time of the cells is one of important parameters influencing the whole-cell biocatalytic properties.

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