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Application of magnetically immobilized edible fungus for the biotransformation of panax notoginseng saponin Rb1 to Rd and Rg3

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ABSTRACT

In this study, we developed a new magnetically immobilized edible fungus for the biotransformation of panax notoginseng saponins Rb1 to Rd and Rg3. The optimum biotransformation conditions were as follows: temperature 32 °C, pH 6.5, time 48 h and liquid–solid ratio 25:1 (mL/g). The yields of Rd and Rg3 reached 41.35 ± 0.12 mg/g and 6.35 ± 0.08 mg/g which increased 6.97-fold and 3.23-fold to that of untreated control, respectively. Additionally, SEM demonstrated that vestured pits and cell walls of samples were destroyed obviously which was beneficial to the Rb1 biotransformation and target Rd and Rg3 release. Meanwhile, the reusability of magnetically immobilized microorganism was tested and the activity of the magnetically immobilized microorganism remained 83.8% after 15 runs. The recycling experiments demonstrated that magnetically immobilized fungus exhibited higher efficiency than the non-magnetical one. These results proved that this new magnetically immobilized microorganism could be applied for industrial production and pharmaceutical industry with good efficiency.

1. Introduction

Panax Notoginseng (*P. notoginseng*), a well-known Traditional Chinese Medicine and healthy herb additive, is the dried roots of the member of the genus *Panax*, family *Araliaceae*. The phytochemical research showed that *P. notoginseng* are rich in different kinds of bioactive ingredients, such as panax notoginseng saponins (PNS), ginsenosides, acidic polysaccharides, phenolics, flavonoids, cyclopeptides, amino acids, fatty acids, inorganic elements and mineral salts [1–4]. Among these constituents, PNS is the main active components in *Panax Notoginseng* [5,6]. And it was composed of ginsenoside Rb1, Rb2, Rd and Rg3 et al. Among them, Rb1 (> 20%) is the most abundant compound than other ones [7] but its activity is poor. Although the contents of Rd (< 6%) and Rg3 (< 0.4%) of the total saponins are low, but they showed various bioactivities including the effects on the cardiovascular and the immune system, as well as anti-atherosclerotic activity, anticancer activities, hepatoprotective properties, hypoglycemic or antidiabetic activities, immunomodulatory properties and so on [8–11]. Moreover, Rd and Rg3 were extremely difficult to isolate from plant materials. This restricted their application for the healthy production or promising drugs [12].

Recently, many researchers focused on converting Rb1 into Rd and Rg3 by removing the glucose residues by mild acid, alkaline or enzyme hydrolysis [13,14]. But the disadvantages of these traditional methods were reaction violent, time-consuming, high costs, discontinuity activity and unfriendly to the environment [15–17]. Recently, microbial transformation has attracted more and more researcher's attention [18–20] because it possesses many advantages including good selectivity, high-level production, more economically and environmental compatibility [19,20]. However, there still existed low conversion yields, low reusability and high costs in conventional microbial transformation process. In this respect, magnetically immobilized microorganism can not only improve the biocatalyst stability and reusability, but also possess superparamagnetic ability with large surface area in substrate diffusion to the reaction system, which can reduce the mass transfer resistance in biotransformation processes with good efficiency [21–23]. Moreover, the immobilized microorganism can be facilely separated from the reaction mixture and can be reused for reducing cost from the perspective of industrial applications.

In this work, we firstly used magnetically immobilized

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