

Review

Microbial production of farnesol (FOH): Current states and beyond

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ABSTRACT

Farnesol (FOH) recently has been paid close attention because of its intrinsic properties as a cosmetic, pharmaceutical and industrial material. However, extraction from natural sources and chemical synthesis often suffer from the low yield and purity. Metabolic engineering of microorganisms for FOH production is an alternative way to meet the ever-growing demands. Several efforts have been done to make it possible to produce FOH from microorganisms including *S. cerevisiae* and *E. coli*. With developments of systems biology and synthetic biology, an optimal industrial microorganism can be expected to produce FOH cost-effectively. This review aims to give an update on the various facets of FOH synthesis pathway including the features of involved genes and enzymes, and recent progresses on FOH production. Combining traditional metabolic engineering with these new fascinating molecular, systems biology and synthetic biology tools will provide a better understanding of FOH biosynthesis and a great potential of microbial production.

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1. Introduction

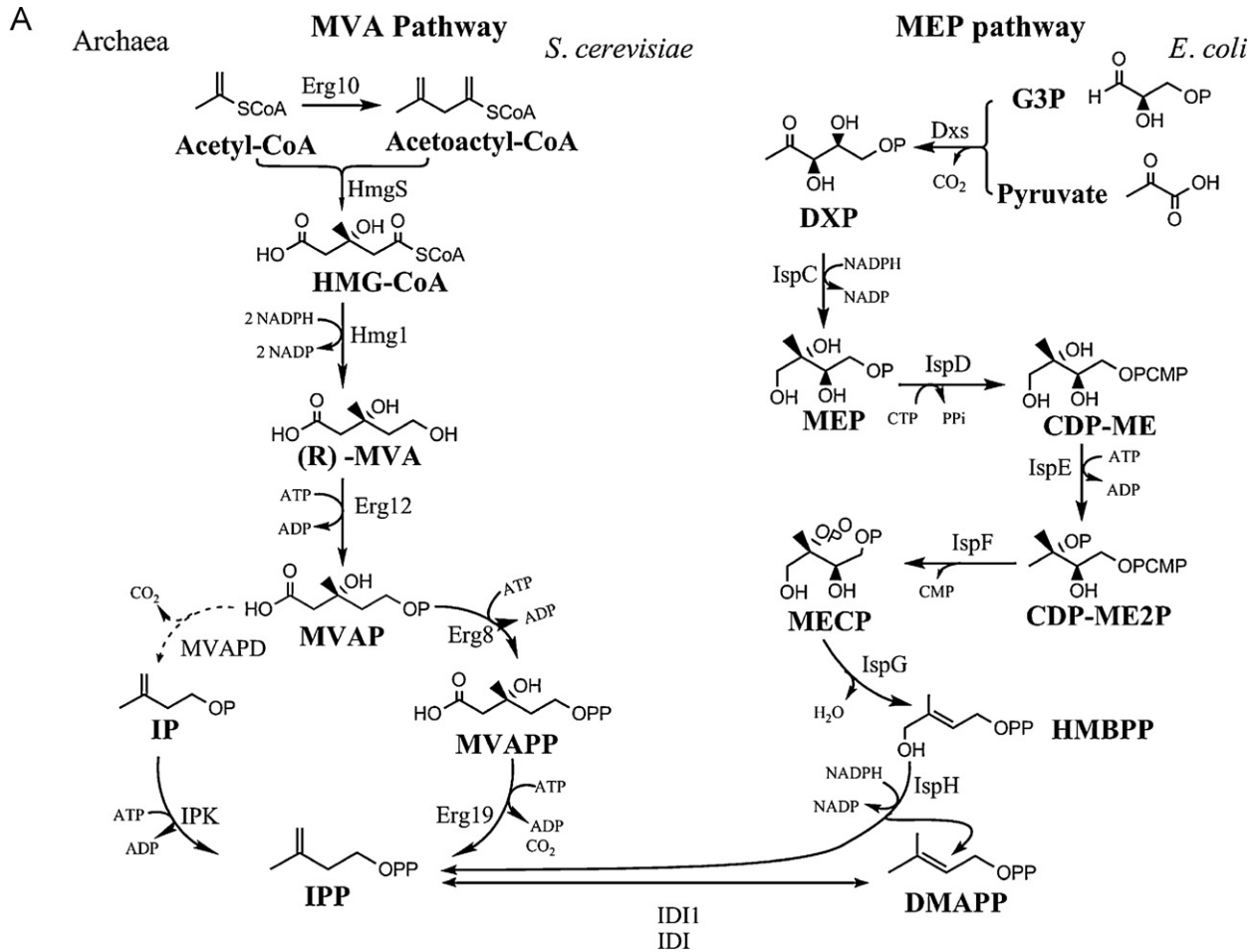
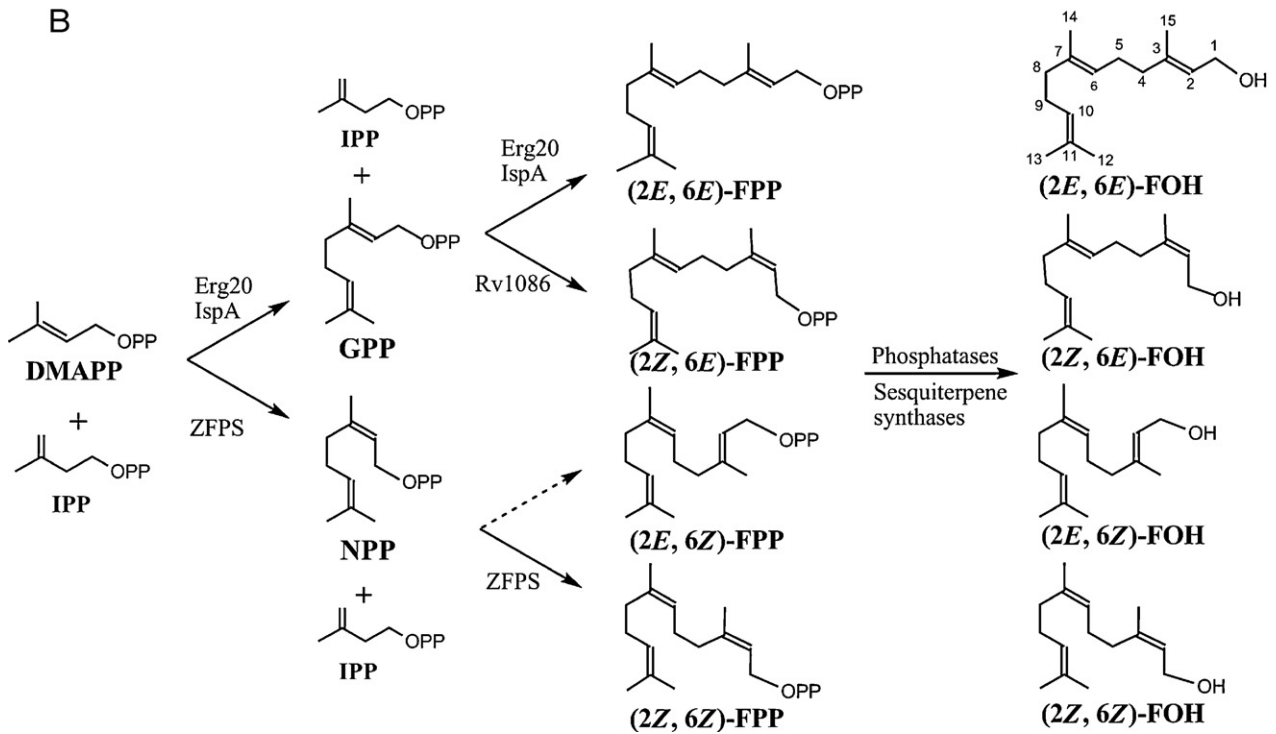
Sesquiterpenes are a large and diverse family of natural compounds with important medical and industrial properties [1]. Farnesol (FOH, C₁₅H₂₆O), an acyclic sesquiterpene alcohol with

sweet-oily odor, is widely distributed in many essential oils such as citronella, neroli, lemon grass, rose, musk, and balsam [2,3]. It also exists in animals and microbes, and plays essential roles such as signal transduction [4,5], quorum-sensing [6–8], and apoptosis induction [9–11]. Hence, FOH has been used as a fragrance ingredient of cosmetics, a natural pesticide to mites and starting material for anticancer pharmaceuticals [2,12]. This C₁₅ branched-chain alcohol has been also considered as a diesel or jet fuel substitute due to its low water solubility and high energy content [13]. Unfortunately, FOH is naturally produced in a trace amount, which makes it difficult to mass produce FOH in high purity. It also causes a high

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