My research is divided into three major groups as shown below.

1) Screening and characterization of novel enzymes
2) Function modification of enzyme
3) Biocatalytic synthesis of useful compounds

Among our research topics, I would like to introduce about microbial hydroxylation of adamantane and its derivatives, and chiral cyclic amine synthesis from cyclic imine by enantioselective imine reductases in the system coupled to regeneration of NADPH.

Hydroxylated adamantane derivatives are useful as pharmaceutical intermediates, polymers and electronic industry materials. For example, acrylic esters of 1-adamantanol and 1,3-adamantanediol are promising uses as photo-resist materials.
We have surveyed hydroxylation activity for adamantane (ad), 1-adamantanol (1-adOH), 1,3-adamantanediol (1,3-ad$(OH)_2$) in soil isolates and stocked strains of our laboratory. *Streptomyces griseoplanus* AC122, *Streptomyces* sp. SA8 and *Kitasatospora* sp. GF12 were selected as strains with highest activities and regioselectivity for ad, 1-adOH and 1,3-ad$(OH)_2$, respectively. Under optimized conditions, production of hydroxylated adamantanes was achieved (Fig. 1).

Enzymatic imine reduction is a promising method for the synthesis of chiral amine. In 2009, no information about imine reductase acting on unnatural imine has been reported yet. This might be attributable to the remarkable instability of most of imines, which are easily decomposed into carbonyl compound and amine in water. We thus focused on water-stable cyclic imine, 2-methyl-1-pyrroline (2-MPN). We surveyed imine-reducing activity using water-stable cyclic imine, 2-methyl-1-pyroline (2-MPN) among soil isolates and laboratory collections and found *Streptomyces* sp. GF3587 and 3546 with high (*R*)-and (*S*)-selective imine reductase activity, respectively. We have purified and characterized (*R*)-imine reductase (RIR) from GF3587 and (*S*)-imine reductase (SIR) from GF3546, respectively. In the reaction system coupled to regeneration of NADPH, (*R*)- and (*S*)-2-MP were synthesized in high optical purity and conversion (Fig. 2).

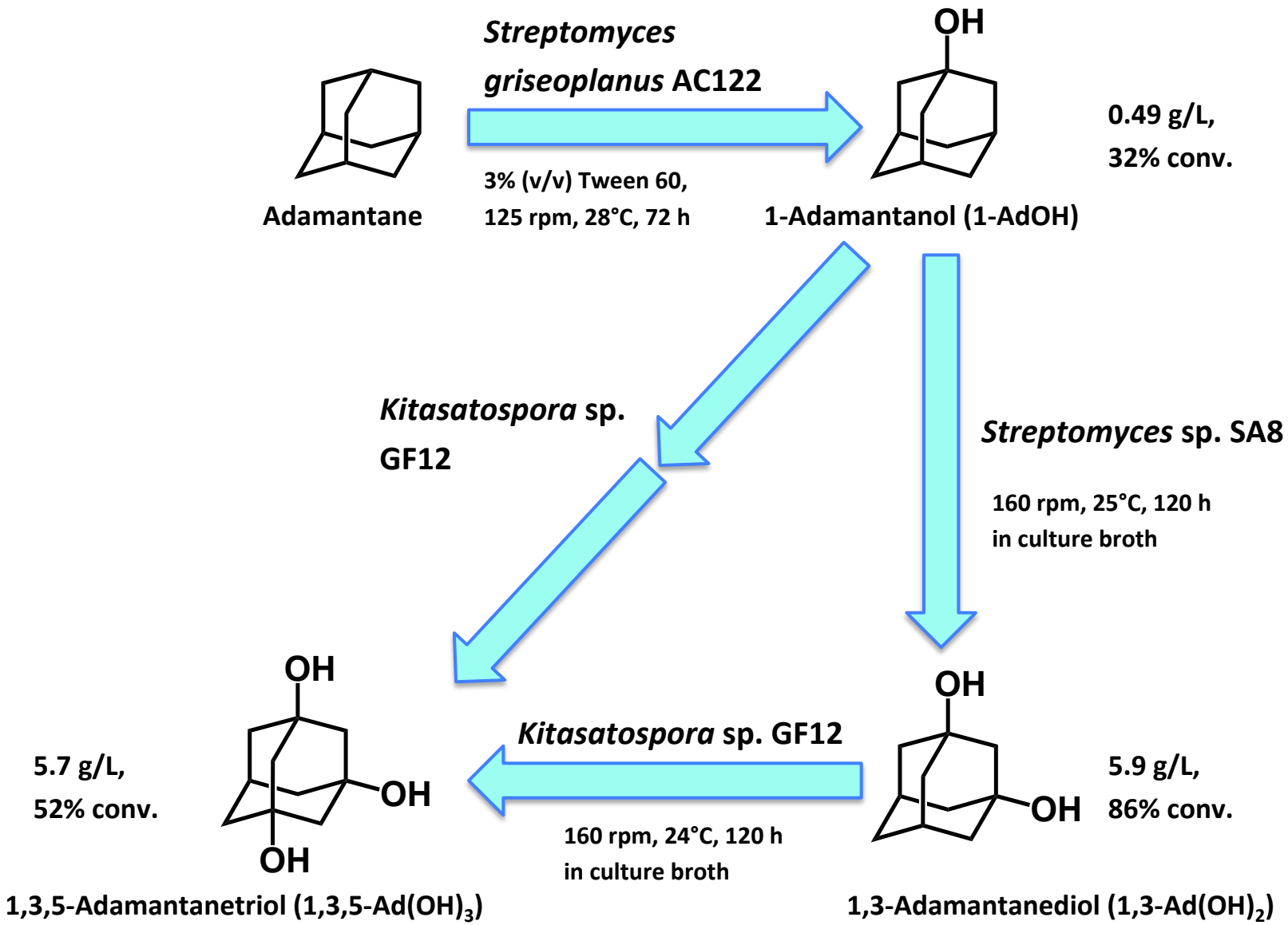

Fig. 1 Green Synthesis of Hydroxylated Adamantanes Using Whole-cell Catalyst

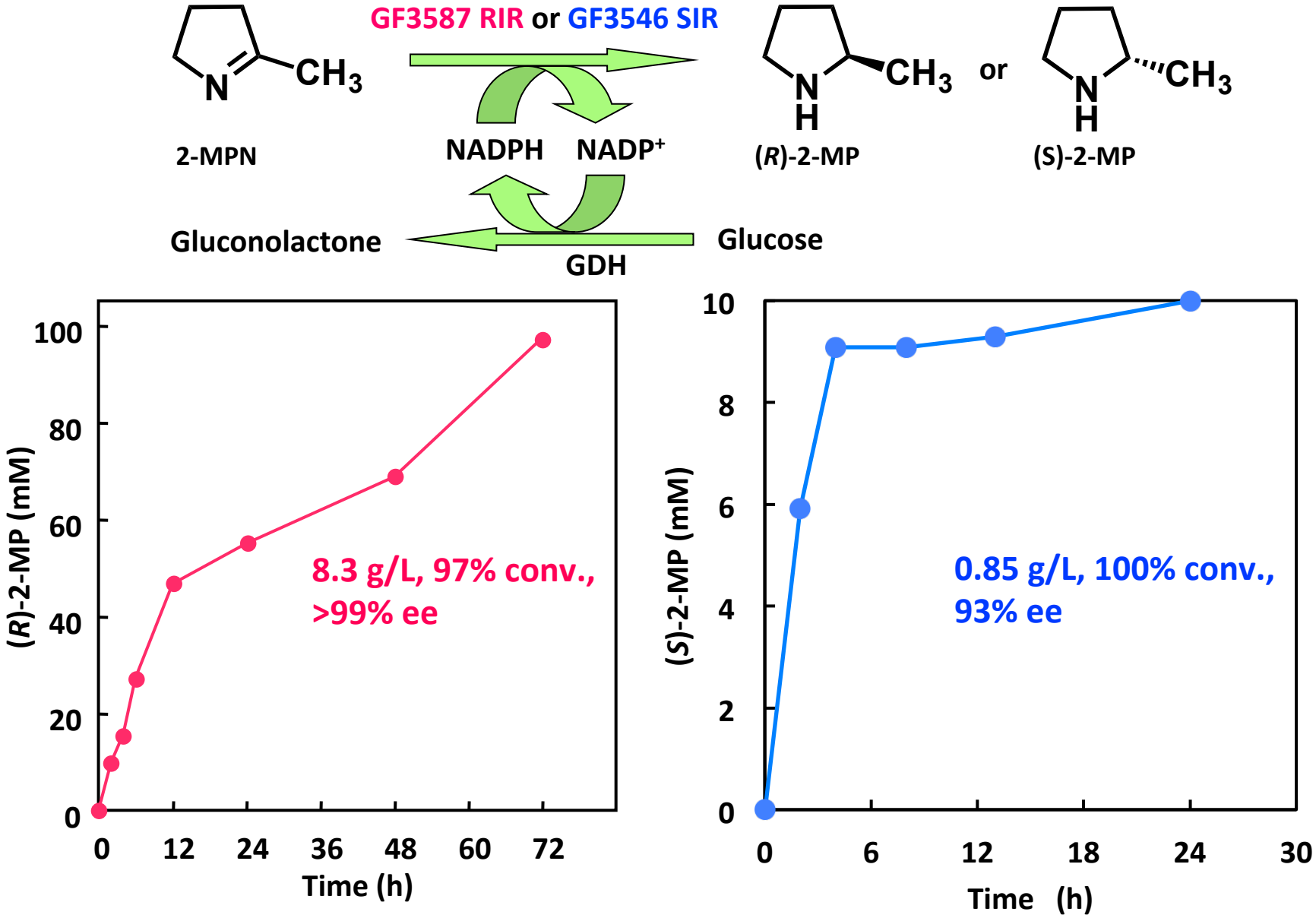

Fig. 2 Enzymatic Synthesis of (*R*)-and (*S*)-2-MP