Sustainable biocatalytic synthesis of β-hydroxyl-α-amino acids on an industrial scale

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The development and commercialization of sustainable enzymatic and microbial catalysis technologies is gaining increasing priority to reduce the environmental impact of chemical and related industries.

Enzymes offer, as common platform, significant opportunities for innovations to enhance production capabilities to meet these new reduced impact demands, whilst retaining product quality and keeping costs down. To enable cost efficient biocatalytic processes, however, high selectivity, high activity, high substrate loadings and tolerance to organic solvents are required. This is in general not sufficiently displayed by natural enzymes, despite providing high selectivity and activity on native substrates under physiological conditions. As a solution, enzyme engineering allows us to optimize any enzyme to a powerful catalyst that overcomes these boundaries and can be conveniently applied under industrial conditions.

As an industrial example, we will discuss the synthesis of β-hydroxyl-α-amino acids, important chiral building blocks in pharmaceutical and fine chemical industry. Current chemical synthesis protocols employ hazardous and environmentally unfriendly methods, thus, a replacement by safe and green biocatalysis is desired.
However, wild type aldolases do not meet the anticipated target criteria for selectivity, activity and solvent tolerance under process conditions. Nonetheless, smart bioinformatics guided directed evolution, enabled us to develop an enzyme variant which meets the industrial target for the sustainable Chloromycin production at multi ton scale.