Underground metabolism: network-level perspective and biotechnological potential

A key challenge in molecular systems biology is understanding how new pathways arise during evolution and how to exploit them for biotechnological applications. New pathways in metabolic networks often evolve by recruiting weak promiscuous activities of pre-existing enzymes. Here we describe recent systems biology advances to map such ‘underground’ activities and to predict and analyze their contribution to new metabolic functions. Underground activities are prevalent in cellular metabolism and can form novel pathways that either enable evolutionary adaptation to new environments or provide bypass to genetic lesions. We also illustrate the potential of integrating computational models of underground metabolism and experimental approaches to study the evolution of novel metabolic phenotypes and advance the field of biotechnology.

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