



Metagenomics and Digital Cell Modeling Facilitate Targeted High-Throughput Sorting of Anaerobic Hydrogen-Producing Microorganisms

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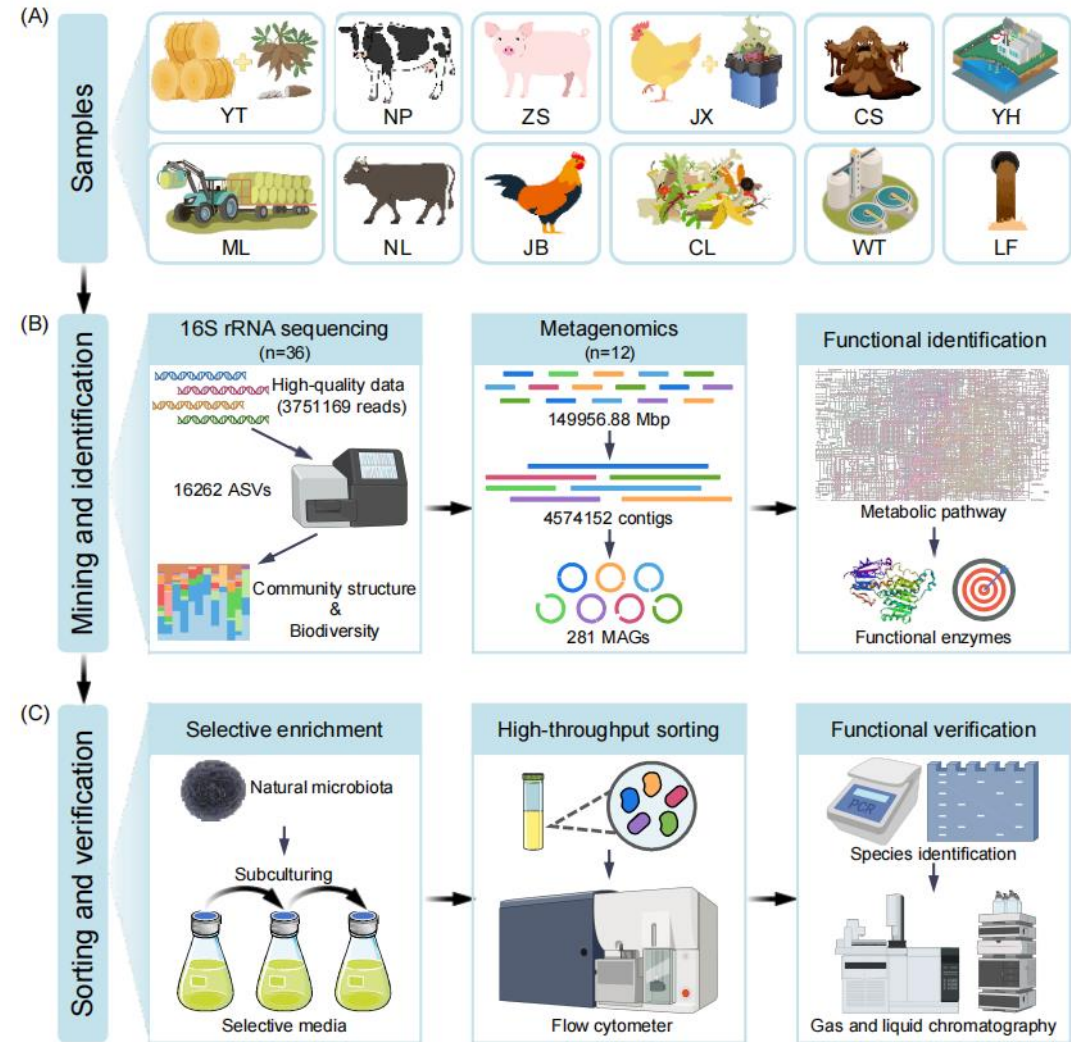
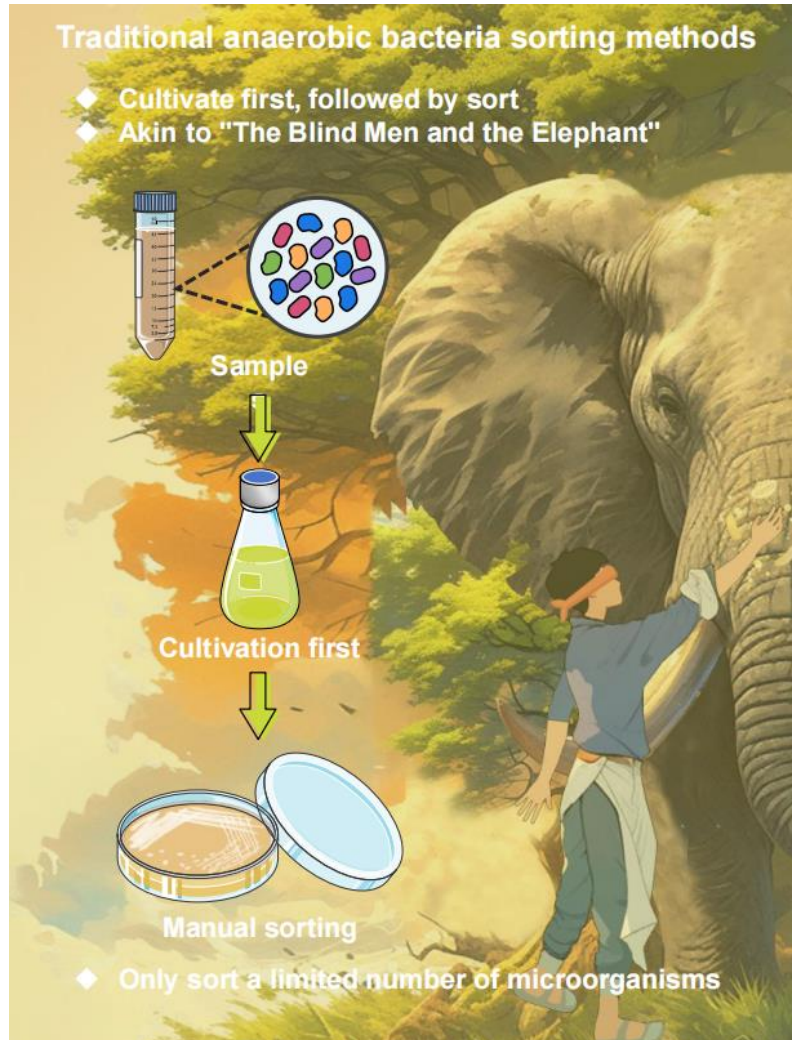
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Introduction

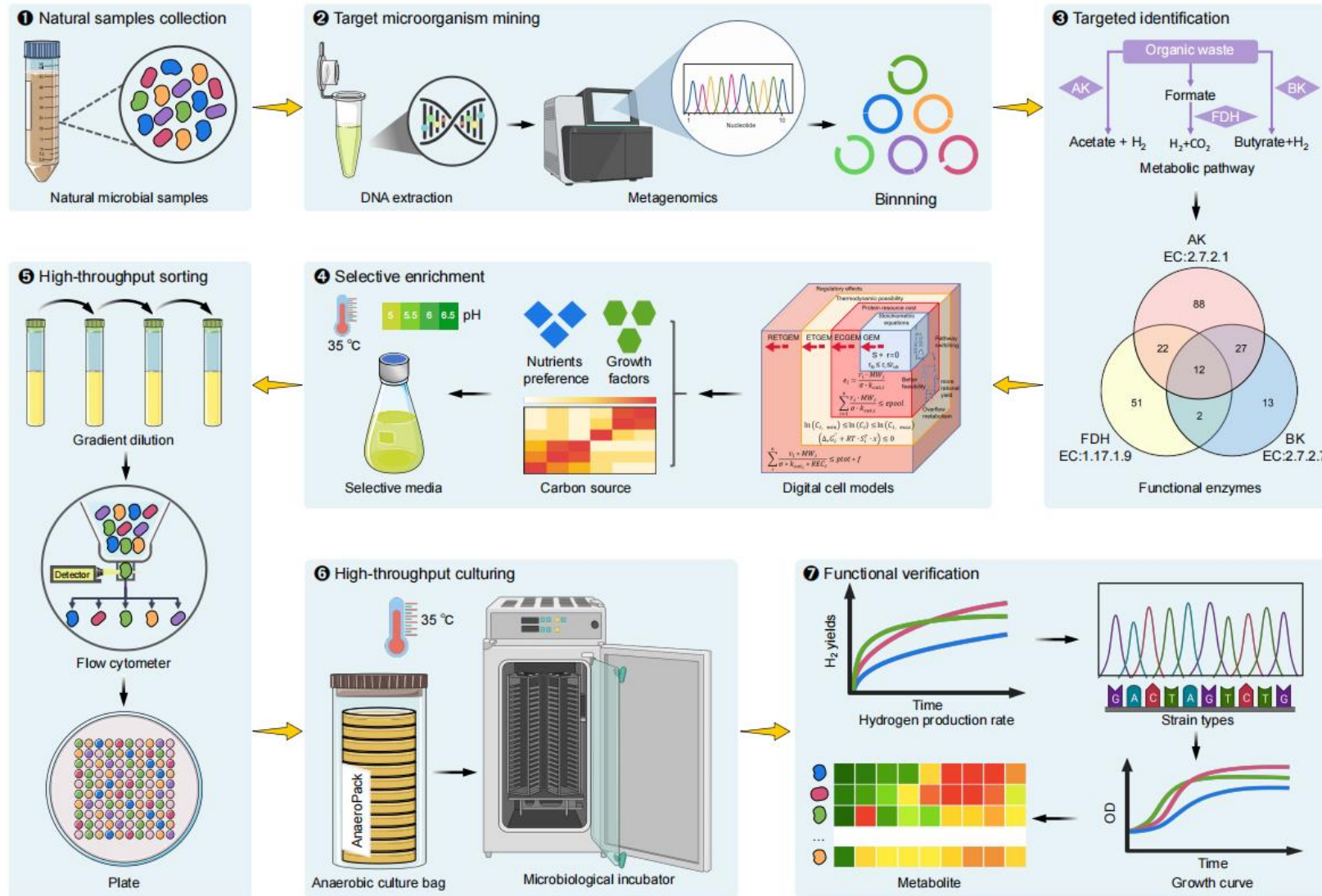


In traditional anaerobe sorting, a “cultivate first, followed by sort” strategy is often likened to “The Blind Men and the Elephant”.

Figure1A-1C. Experimental design and workflow



Highlights



We propose a novel strategy, “prioritizing functional recognition, followed by targeted high-throughput sorting”, for comprehensive, rapid, and efficient acquisition of target microorganisms.



Mining of hydrogen-producing microorganisms

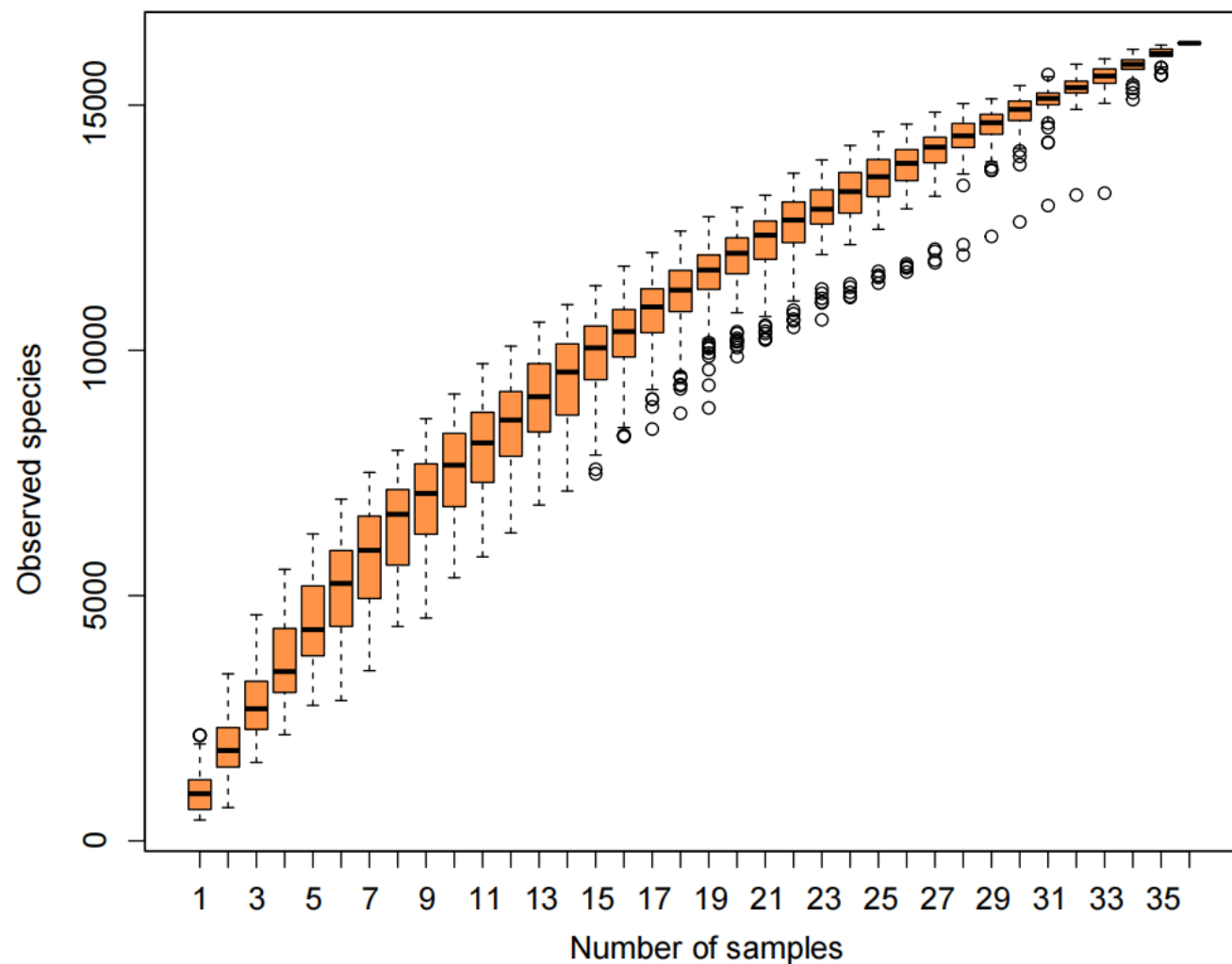


Figure S1. A total of 16,262 amplicon sequence variants (ASVs)

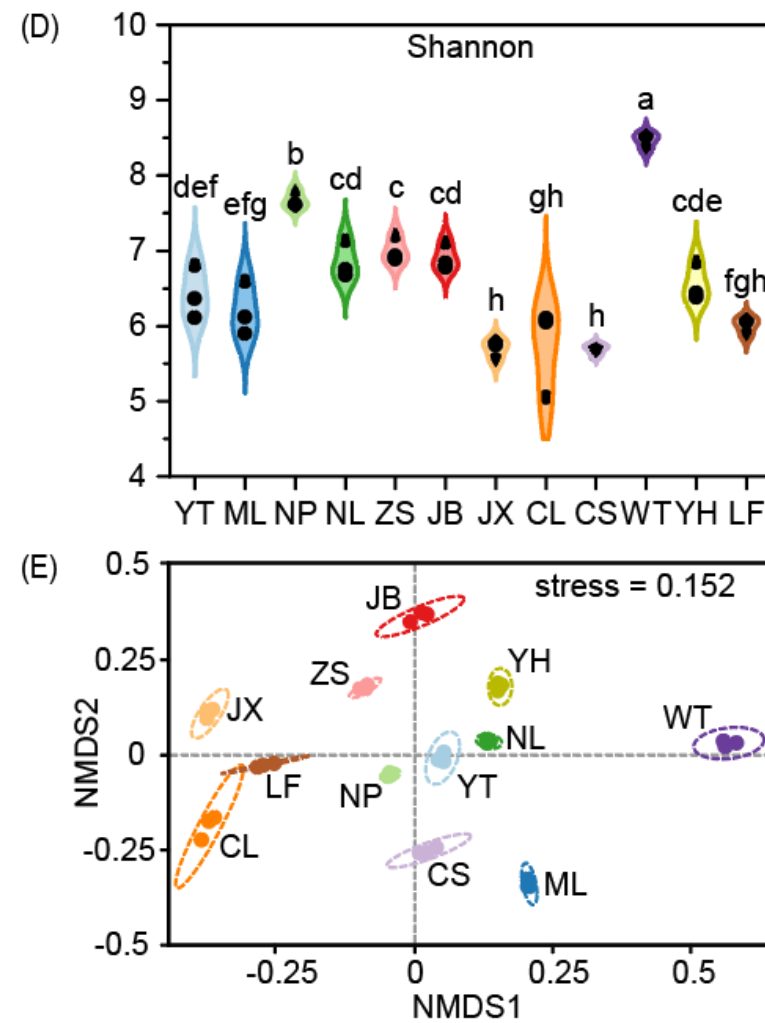


Figure 1D and 1E. Alpha diversity and Beta diversity of the microbial communities



Mining of hydrogen-producing microorganisms

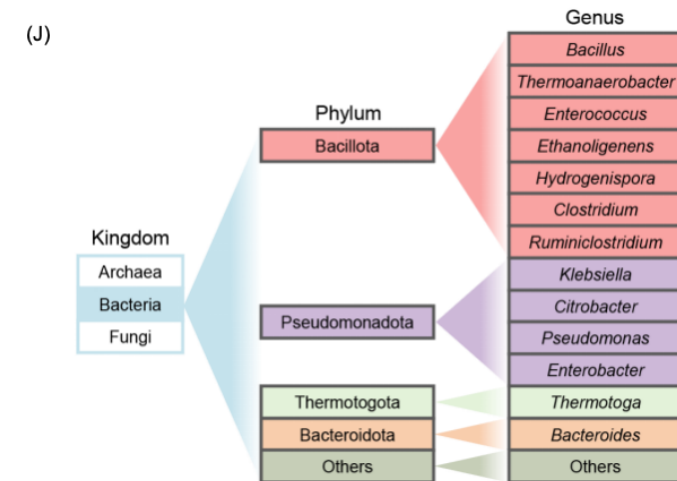
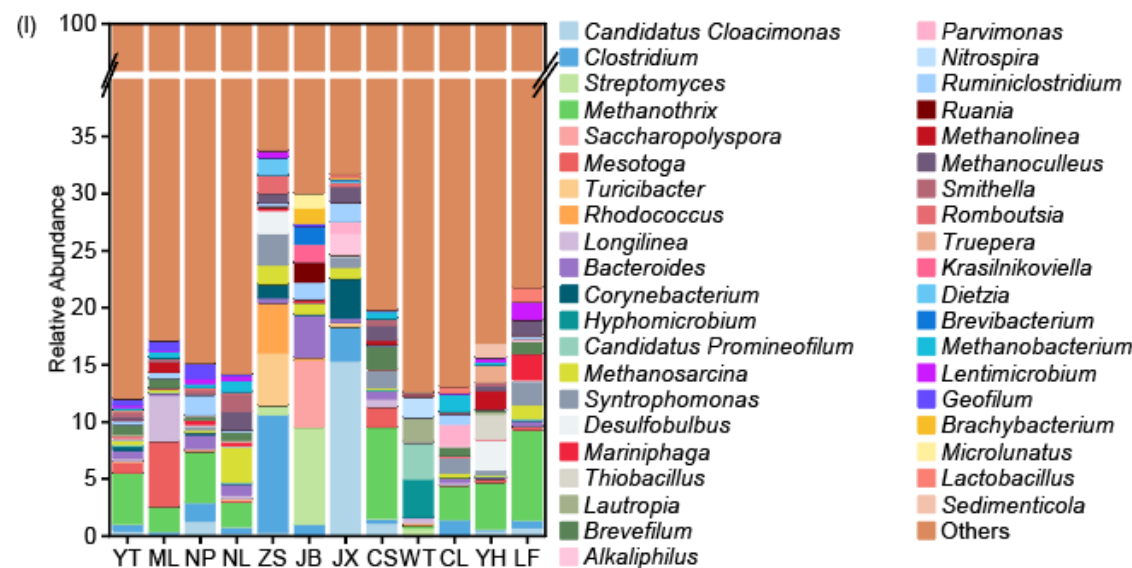
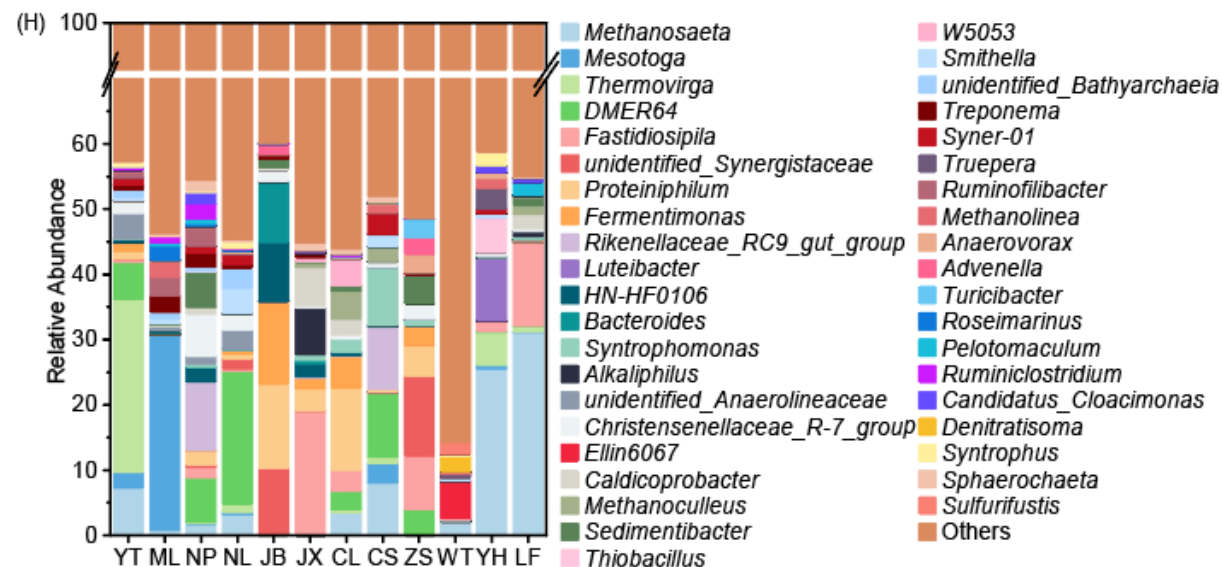
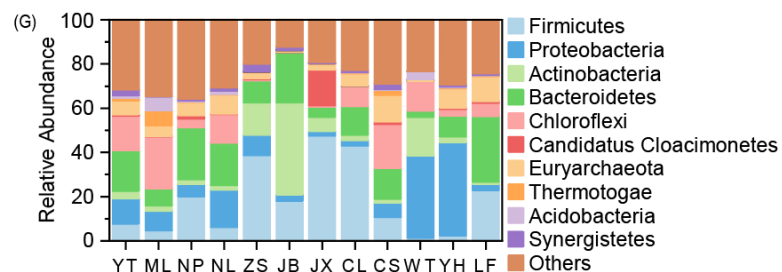
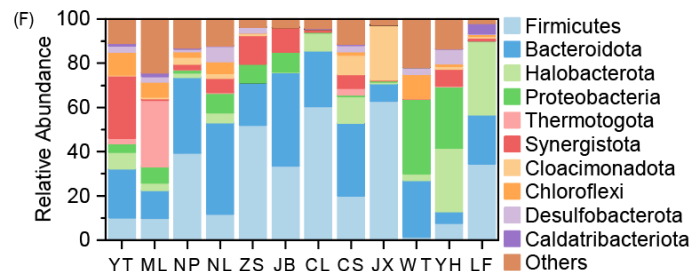


Figure 1J. Taxonomic classification of reported hydrogen-producing strains

Figure 1H and 1I. Community composition at the genus level

Identification of hydrogen-producing microorganisms

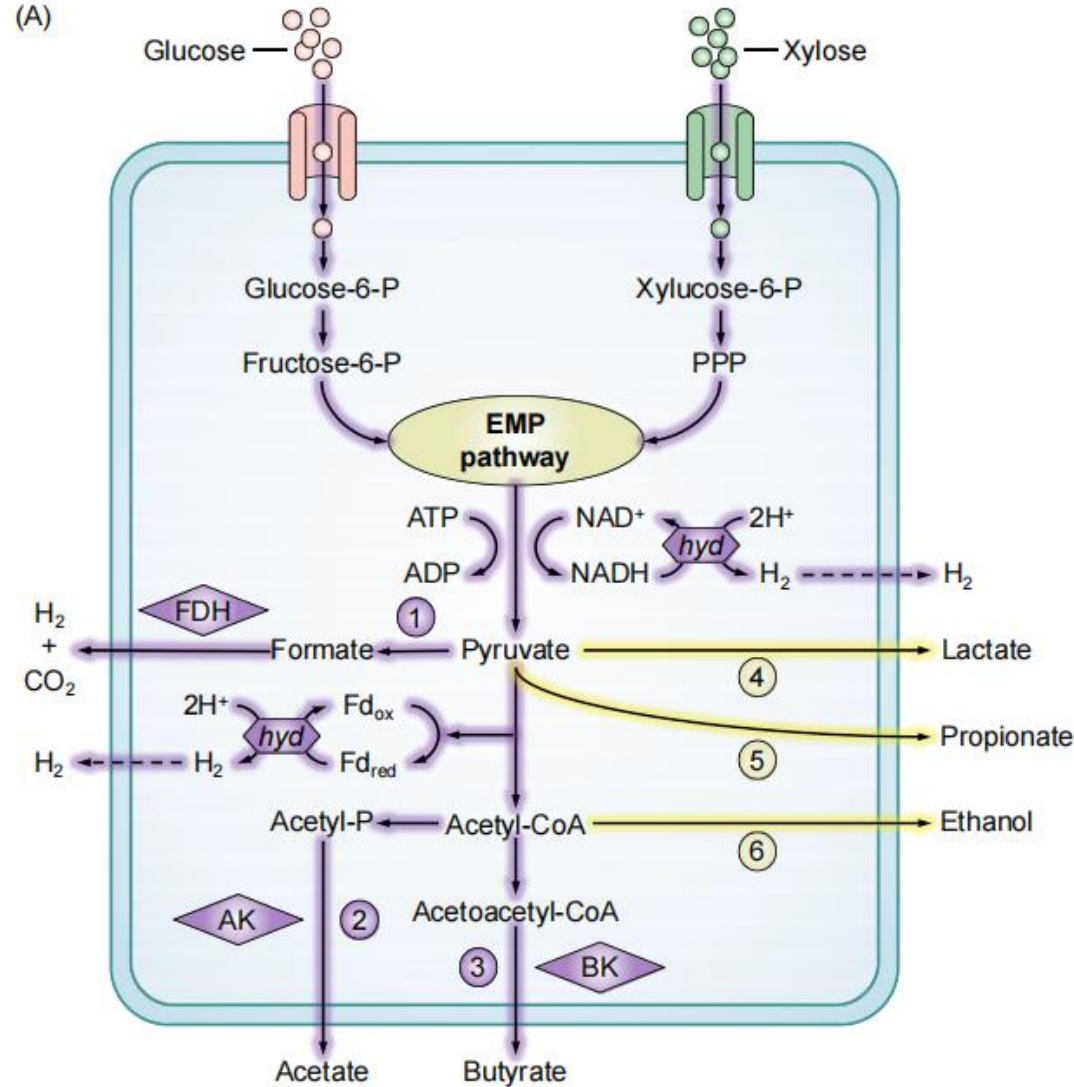


Figure 2A. The core metabolic pathways involved in anaerobic fermentation and hydrogen production

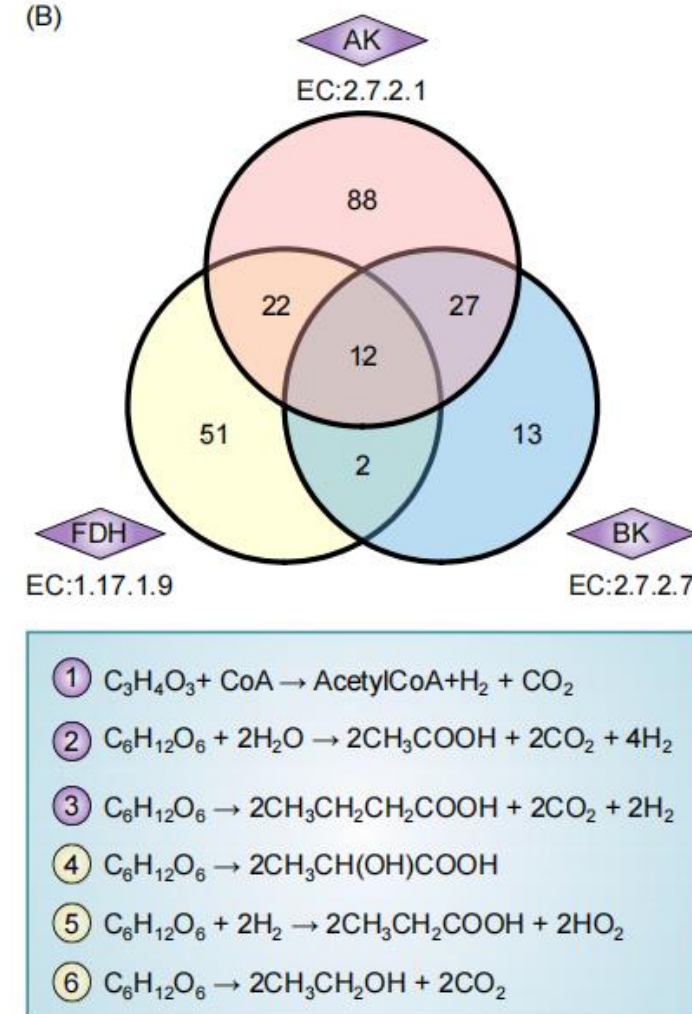


Figure 2B. Functional identification of potential anaerobic hydrogen-producing microorganisms

Identification of hydrogen-producing microorganisms

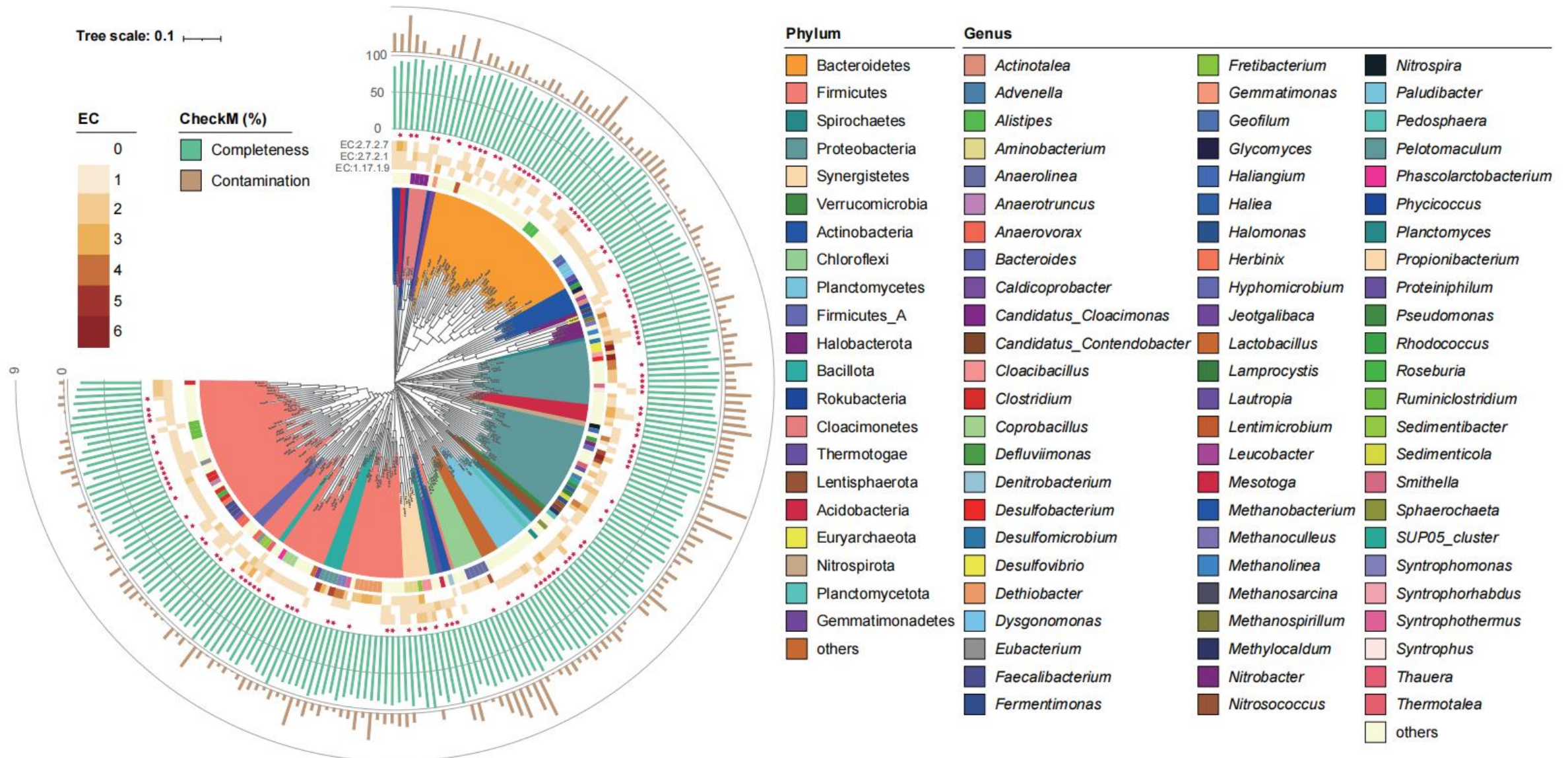


Figure 2C. Phylogenetic tree of 215 metagenome-assembled genomes (MAGs)



Selective medium and High-throughput sorting

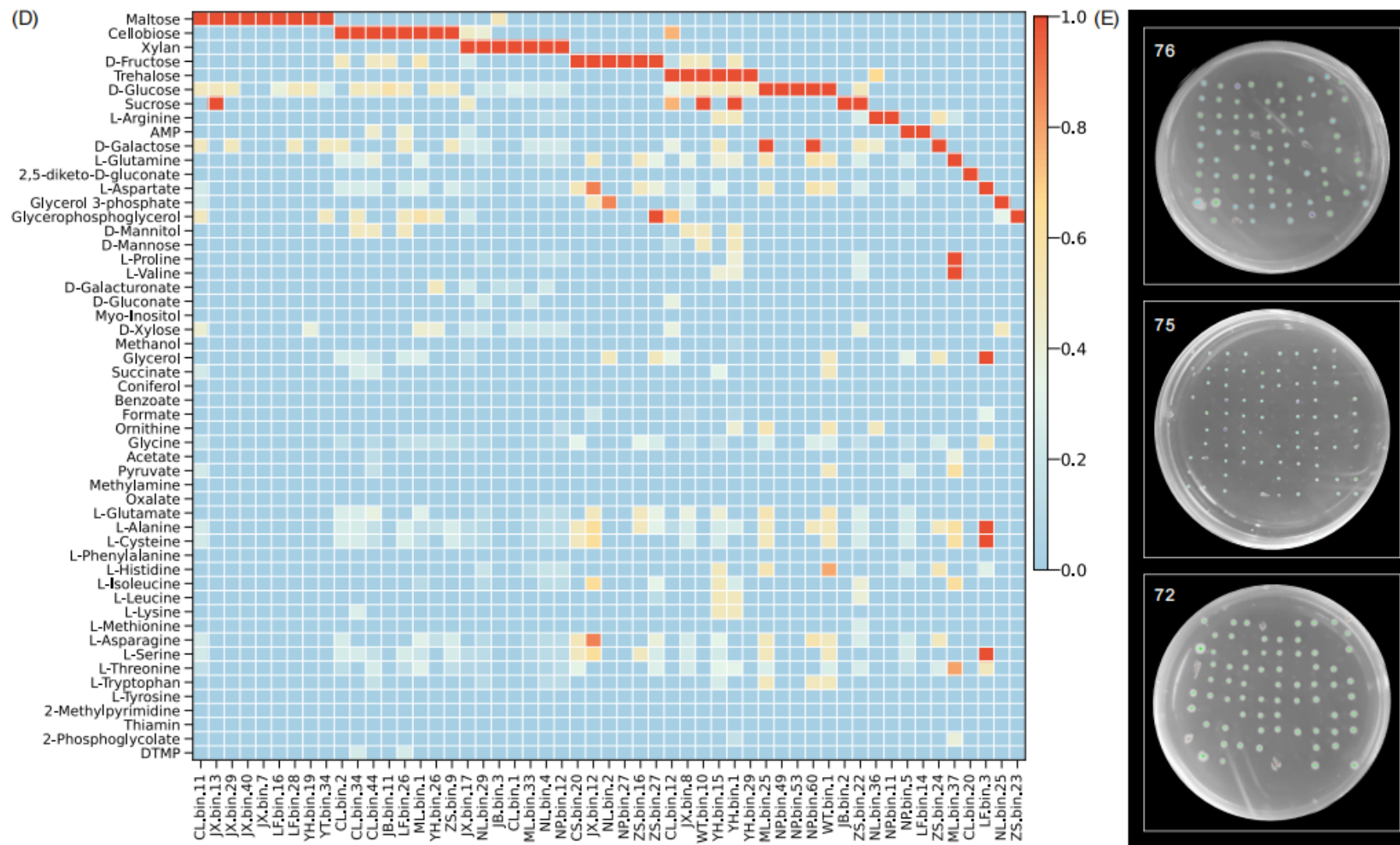


Figure 2D and 2E. Simulation prediction of digital cell model and high-throughput sorting of target strains



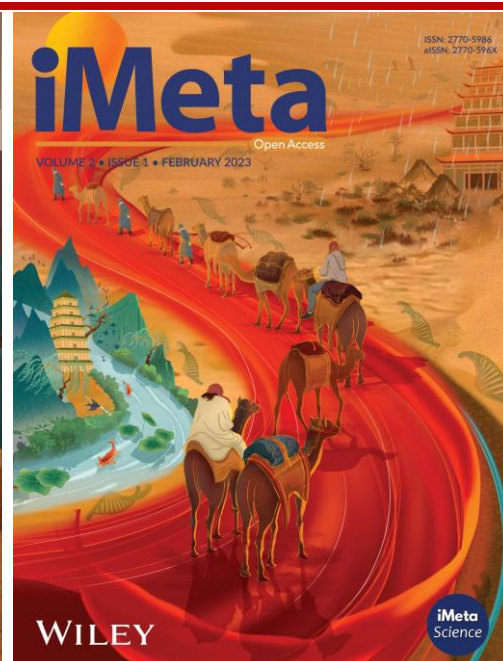
Summary

- ❑ We proposed a new strategy of "function recognition priority coupled with targeted high-throughput sorting", achieving a paradigm shift from experience-driven to data-driven approaches. This strategy demonstrates strong universality and broad application prospects.
- ❑ By constructing digital cell models based on metagenomic data, we accurately predicted the carbon source utilization profiles, nutritional requirements, and metabolic characteristics of target strains, providing a theoretical basis for the rational design of selective culture media.
- ❑ We established a comprehensive anaerobic microbial workflow encompassing high-throughput excavation, identification, cultivation, and sorting. The acquisition rate of target strains reached 37%, with a viability rate exceeding 70%. This achievement lays a critical foundation of key strains for the industrialization of synthetic microbiomes.

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