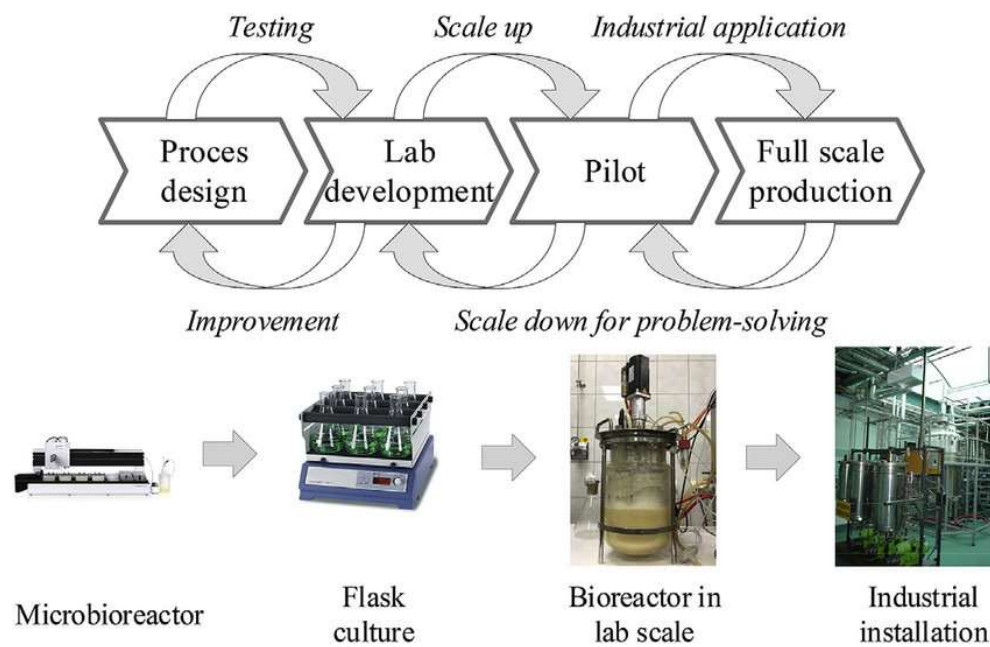




Sable Fermentation, Inc.

Bringing cutting-edge science to scale

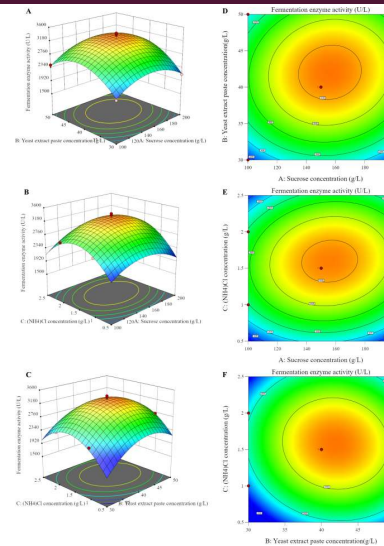
WHAT IS SCALE-UP?



- Bench scale
 - Less than 1 mL to 20L
- Pilot scale
 - 20L to 10,000L
- Manufacturing scale
 - 10,000L to 200,000L
- DSP and Formulation must also be scaled-up!
- Gradients, mixing and hydrostatic pressure become more important as volumes increase

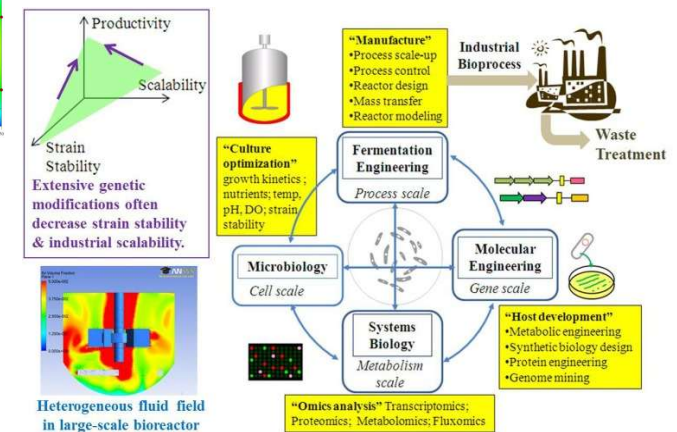
SCALE UP AFFECTS PRODUCT PERFORMANCE

- Processes can be optimized using statistical DOE
- Design-Engineering-Analysis incorporates optimization data

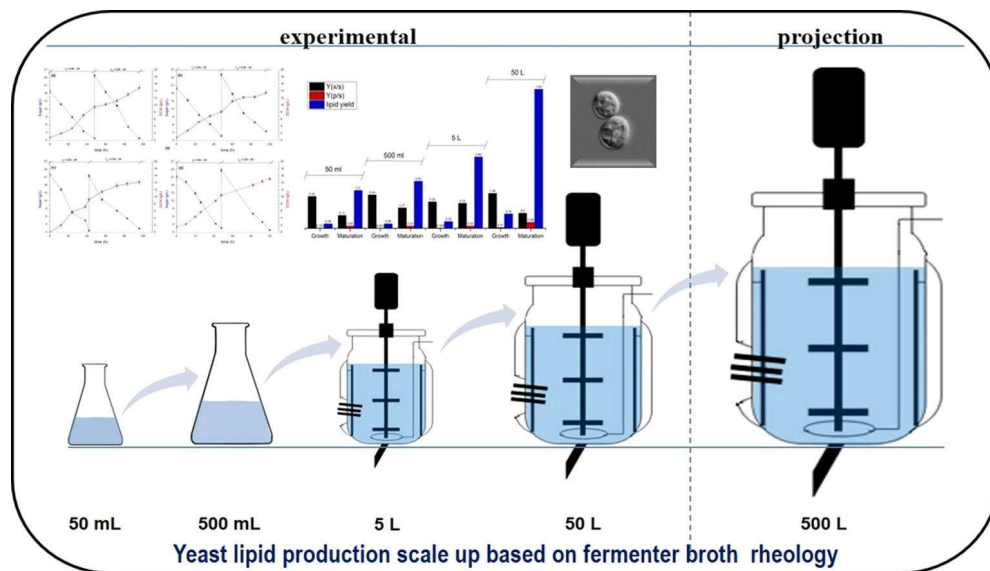


Wu, Y., Zhang, Y., Zhong, X. *et al.* Optimization of the fermentation process for fructosyltransferase production by *Aspergillus niger* FS054. *Microb Cell Fact* 24, 173 (2025)

Hollinshead, Whitney & He, Lian & Tang, Yinjie. (2014). Biofuel production: An odyssey from metabolic engineering to fermentation scale-up. *Frontiers in microbiology*. 5. 344. 10.3389/fmicb.2014.00344.



EFFECT OF SCALE ON GROWTH AND PRODUCTIVITY



Corrigendum to "Scale-up strategy for yeast single cell oil production for *Rhodotorula mucilagenosa* IIP132 from corn cob derived pentosane" [Bioresour.Technol.309 (2020) 123329–123337]

Bioresource Technology, Volume 359, September 2022, Pages 127508

Ayan Banerjee, Tripti Sharma, Abhilek K. Nautiyal, Diptarka Dasgupta, Saugata Hazra, Thallada Bhaskar, Debashish Ghosh

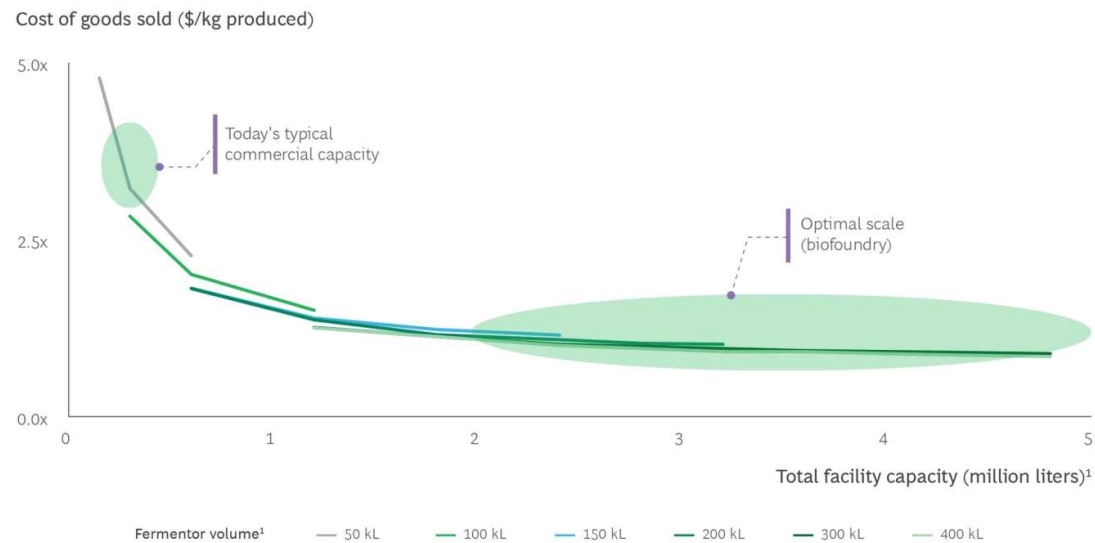
Significant gradients in temperature, O₂, CO₂ and pH can occur in larger fermenters

Hydrodynamic models predict effects on productivity at larger scale

Similar strategies are employed for downstream processing and formulation

ECONOMY OF SCALE IS CRITICAL TO REDUCING PRODUCT COST

Exhibit 3 - Optimized Biofoundries with a Minimum Working Capacity of 2 Million Liters Can Cut Costs by About 50%



Sources: BCG analysis; Synonym analysis.

¹Working volume.

<https://www.bcg.com/publications/2024/breaking-the-cost-barrier-on-biomanufacturing>

SCALE-UP IS NOT A CHECKLIST

Predictive modeling
Troubleshooting
Process Development
Downstream Processing
Formulation
Feedback and analysis

