

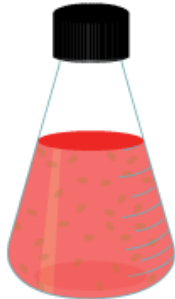
Liquid Injection System (LIS)

AUTOMATED FEEDING OF LIQUIDS IN SHAKE FLASKS



Currently, automated feeding experiments cannot be performed in shake flasks, limiting their use for bioprocess development.

Problem: Lack of feeding technologies for shake flask cultures

	Microtiter Plate	Shake Flask	Bioreactor
			
Automated Feeding Availability	✓	✗	✓
Feeding Applications	Fed-batch, pH control, automated induction	✗	Fed-batch, pH control, addition of antifoam, automated induction

LIS is the first technology allowing for automated feeding of liquids into shake flask cultures.

Liquid Injection System (LIS)



The LIS Drive and the LIS Cartridge are the two key components that allow for feeding of liquids into shake flasks.

Components of the LIS System (1/2)



The LIS Software and Coordinator enable you to set up, control and monitor LIS experiments wirelessly.

Components of the LIS System (2/2)

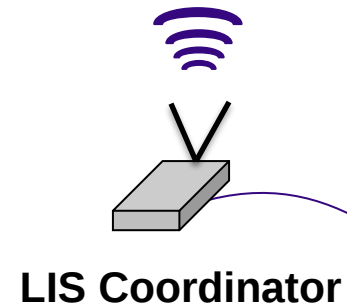
LIS Drive & Cartridge on Flask



Wireless
Communication



LIS Software & Coordinator



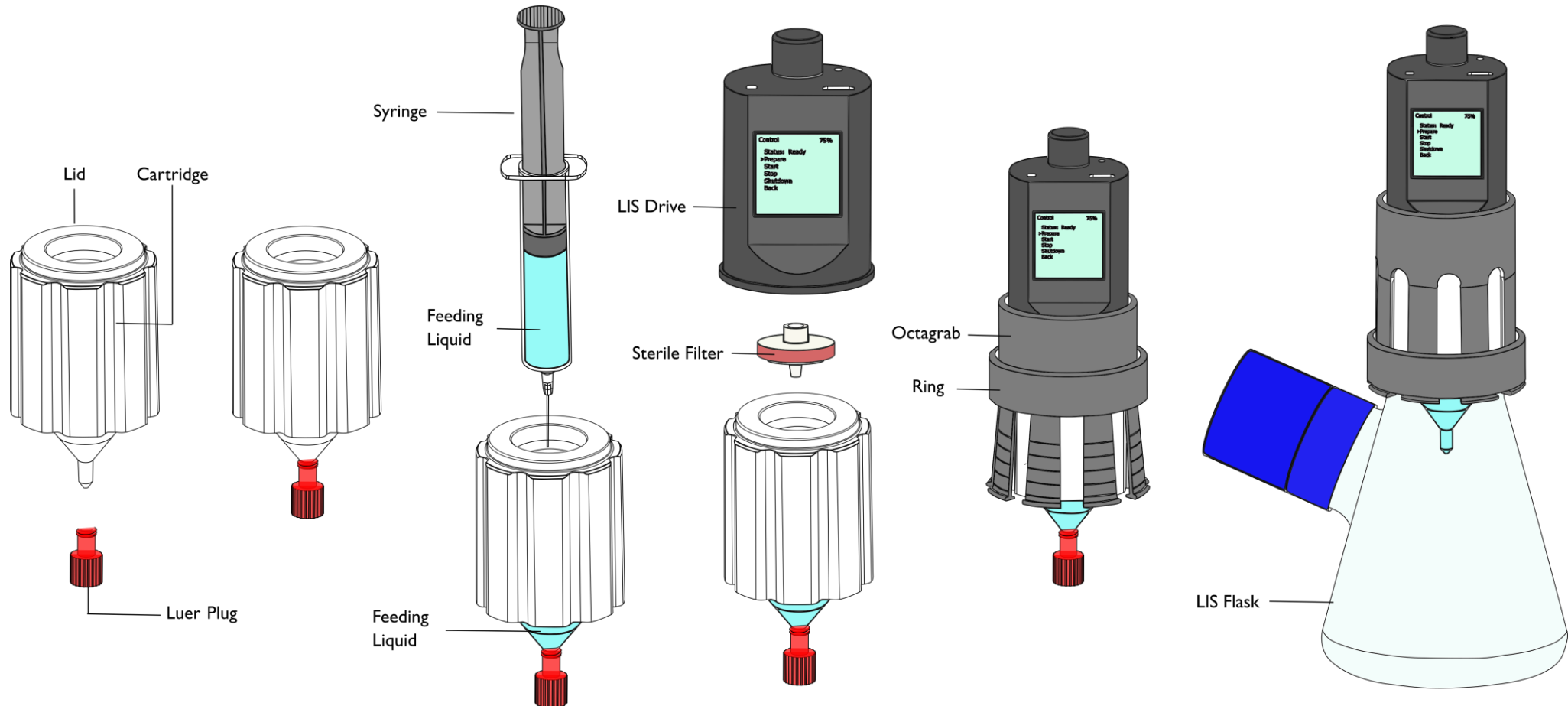
LIS Coordinator



LIS Software

LIS is easy to assemble: fill the cartridge with the feeding liquid, connect the LIS drive to the cartridge and start feeding.

LIS Assembly



LIS creates significant value enabling scientists to perform feeding experiments on a shake flask level.

LIS Key Facts



Key Facts

Wireless control and monitoring

Control and monitor your feeding experiments wirelessly with the LIS software

Compatible with various substances

Sugars (e.g., 50% glucose), alcohols (e.g., 75% methanol), glycerol, acids, bases,...

Create any feeding profile you want

Single or multi shot, exponential or constant feeding and many more

Easy to install and use

Fill the sterile cartridge, program the LIS drive and start feeding your culture

Flexible feeding rates

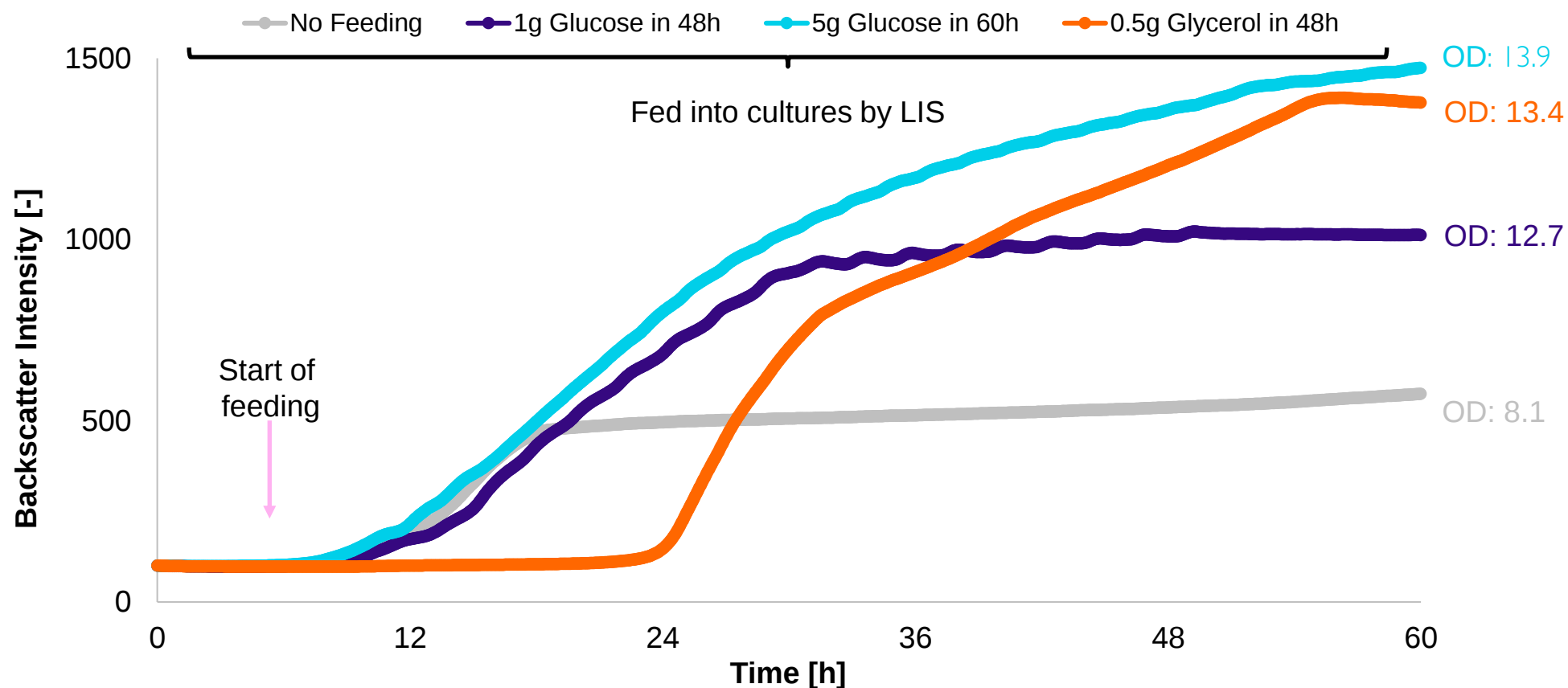
From 100µl droplets to 1mL / min feeding rate

For a broad range of applications

Fed-batch, gene induction, pH regulation, automated inoculation, toxicity assay,...

LIS can be used to create fed-batch conditions for microbial shake flask cultures and increase biomass and product titers.

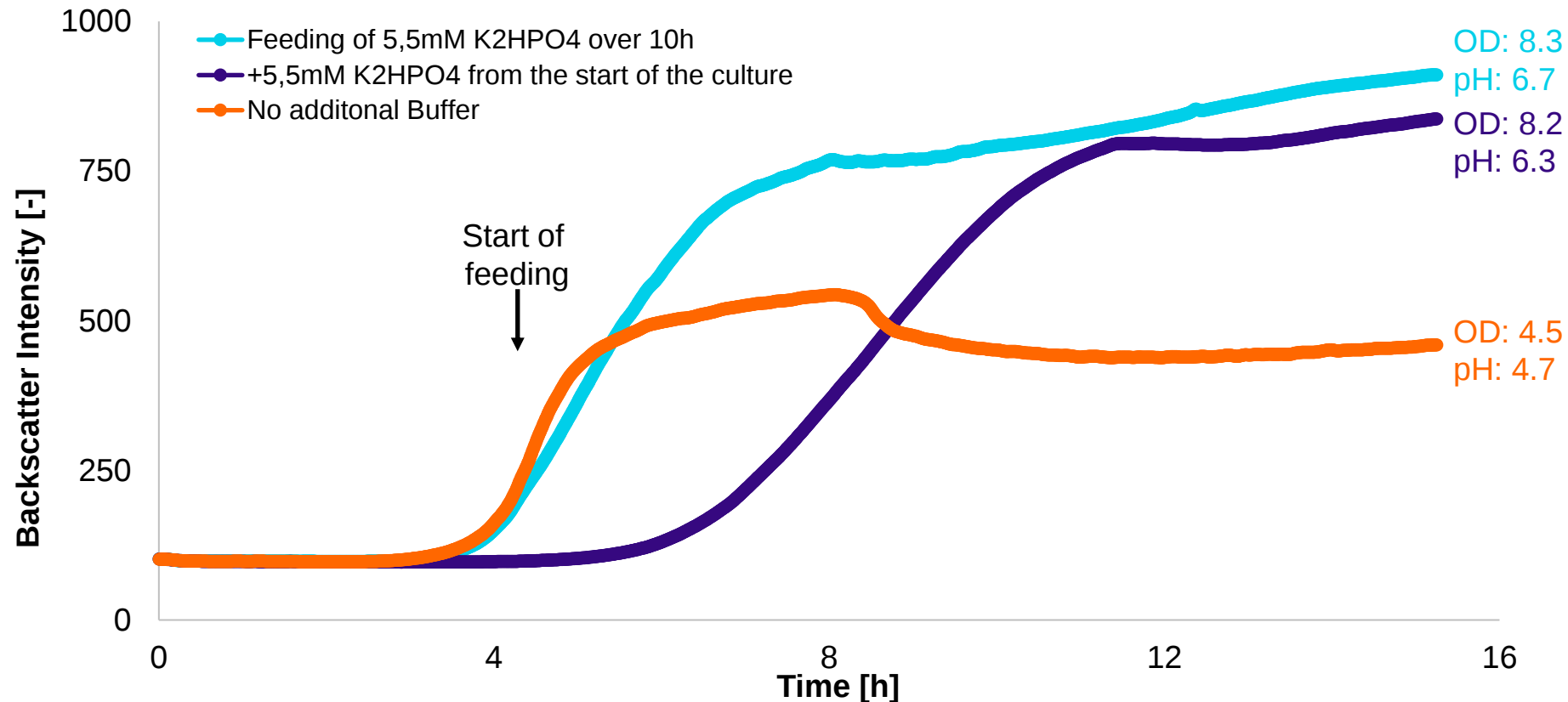
Example Use Case (1/2): Fed-Batch



Saccharomyces cerevisiae, 25 mL YPD Media, 250 mL Shake Flasks, 30 °C, 250 rpm; growth curves monitored with the CGQ

LIS can be used to control pH drifts of *Escherichia coli* shake flask cultures by automatically feeding buffer to the culture.

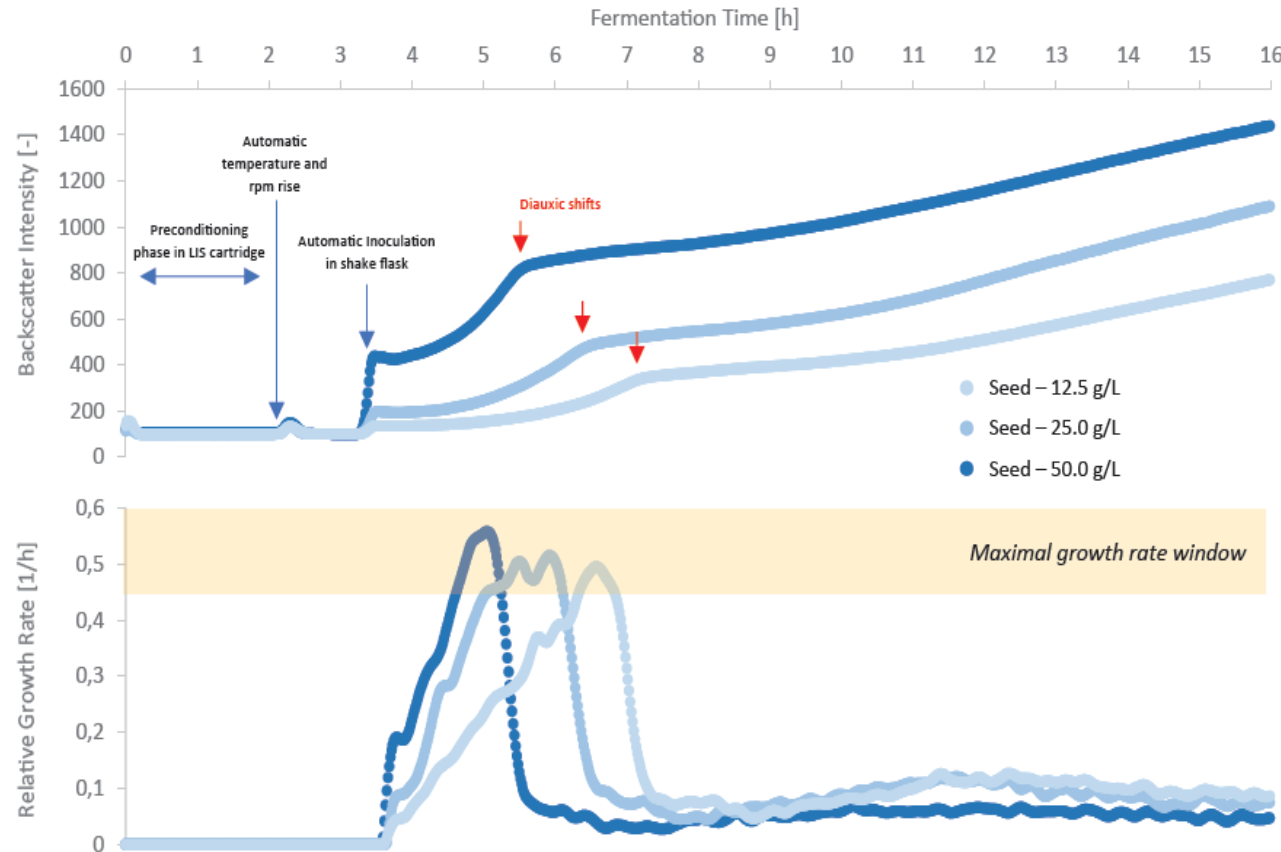
Example Use Case (2/2): pH Regulation



Escherichia coli, 25 mL LB Media + 2 % Glucose, 250 mL Shake Flask, 37°C, 250 rpm growth curves monitored with the CGQ

LIS and CGQ (biomass monitoring) enable bioreactor-type experiments in shake flasks.

CGQ and LIS for Seed Train Applications



Key Facts

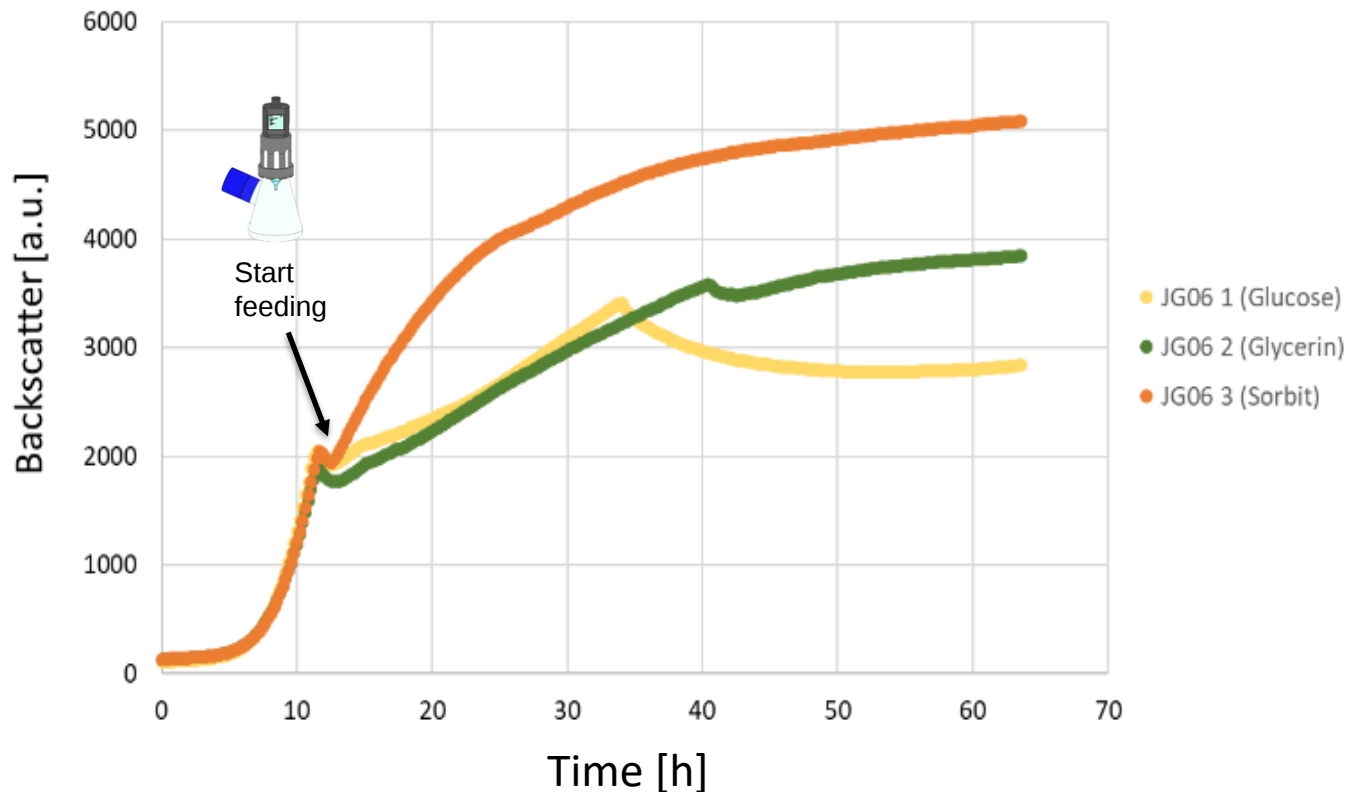
- Data from Eppendorf Application Note
- CGQ (biomass monitoring) and LIS (feeding) work together to prepare the perfect culture in the shortest time
- No interaction required
- No risk of contamination, no interruption of the process, better results

eppendorf

S. cerevisiae grown on YPD + 20 g/L Glc. Shaking speed: 100 – 210 rpm, 50 mm throw, temperature 10-30°C. Feeding: Yeast with 12.5g/L – 50 g/L Glc

LIS and CGQ (biomass monitoring) enable bioreactor-type experiments in shake flasks.

Closed Loop Control – Biomass-based Feeding



H. polymorpha grown on mineral medium, 180 rpm, 30°C. Feeding rate: 2.5 g/L*h

Key Facts

- Preliminary data from application note
- LIS started feeding when the CGQ (biomass monitoring) detected the end of the batch phase
- Different sugars fed
- No risk of contamination, no interruption of the process, perfect time to feed without the need to be in the lab

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