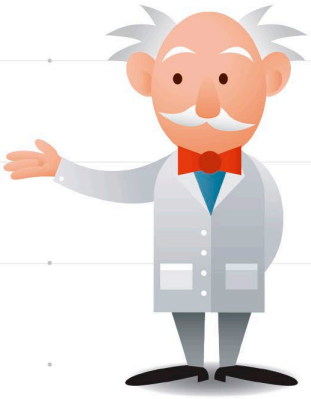
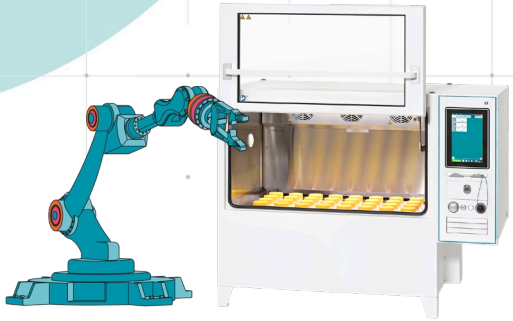
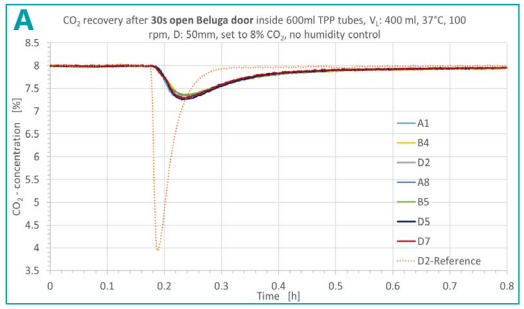
EquipNote by **Kuhner** shaker

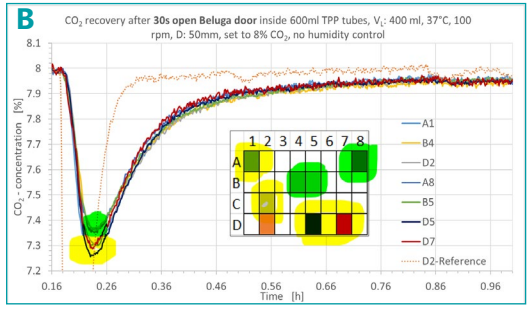
CO_2 stability inside the vessel
What happens when the Beluga door opens?

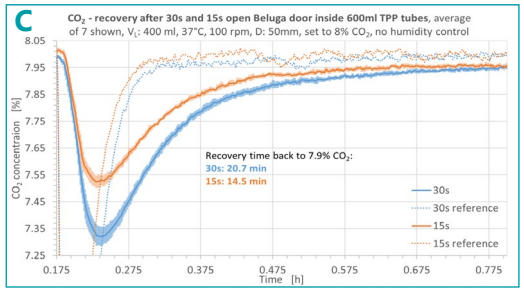


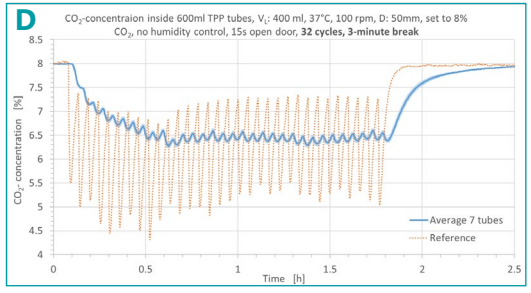


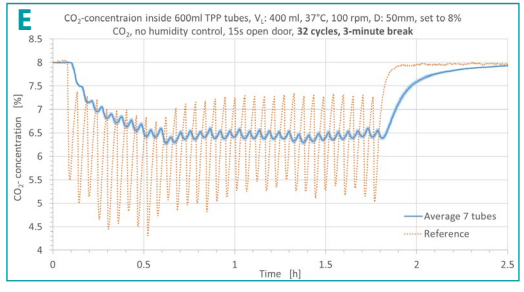
ISF1-Z Basic Beluga
Perfect fit for automation

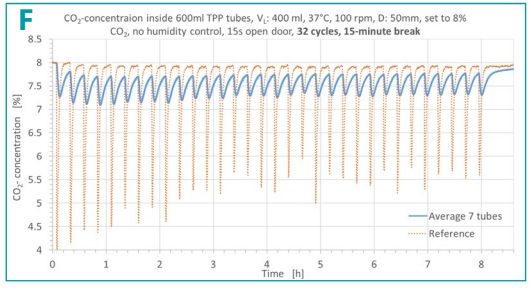












Why this matters

Researchers often worry that frequent door openings in CO_2-controlled incubator shakers will disturb pH-relevant CO_2 levels inside their cultures. While chamber CO_2 can change rapidly, the key question is: **What happens inside the cultivation vessel itself?**

Measurement approach

Using the **Kuhner TOM** off-gas analysis system, CO_2 was measured directly in the headspace of **600 mL TPP TubeSpin® bioreactors** during shaking via a bypass—without vessel-internal sensors or wires.

What actually happens when the door opens

Opening the Beluga door for 30 seconds cut the chamber CO_2 from 8% to ~4%. Inside the tubes, however, CO_2 decreased only **~10%**, stabilizing around 7.3% CO_2.
The response was **slow, modest, and nearly identical** across all vessel positions (B).
Shorter openings (15 s) caused even smaller changes (C).

Repeated door openings

Frequent openings led to a **stable oscillating equilibrium** inside the tubes (D+E+F)
3 - minute breaks → ~6.4% CO_2
8 - minute breaks → ~7.3% CO_2
15 - minute breaks → ~7.5% CO_2

Despite heavy disturbance of the chamber atmosphere, **in-vessel conditions remained stable and close to the setpoint**.

Take-home message

- The CO_2 inside shaken vessels is remarkably **robust** against door openings.
- Even large chamber fluctuations cause only **small, slow changes** inside the tubes.
- Repeated openings produce a predictable equilibrium — In this study between 0.5–1.6% below the setpoint.
- This effect is highly **reproducible**, and with an appropriately higher CO_2 setpoint (via software control), the **deviation can be eliminated**.

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Kuhner shaker