Characterisation of Ender pump pressure fluctuations against 3 commercial pumps

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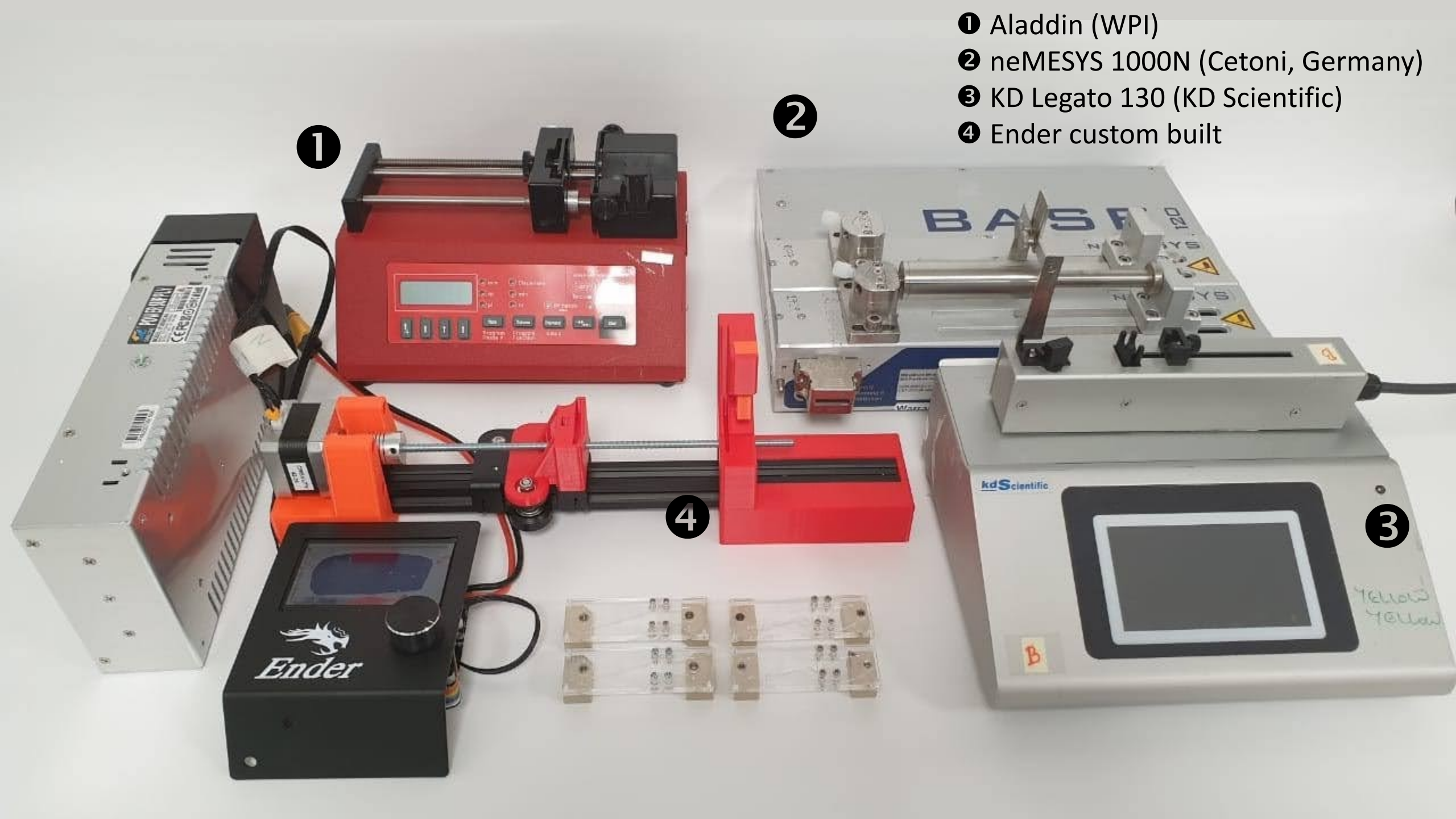
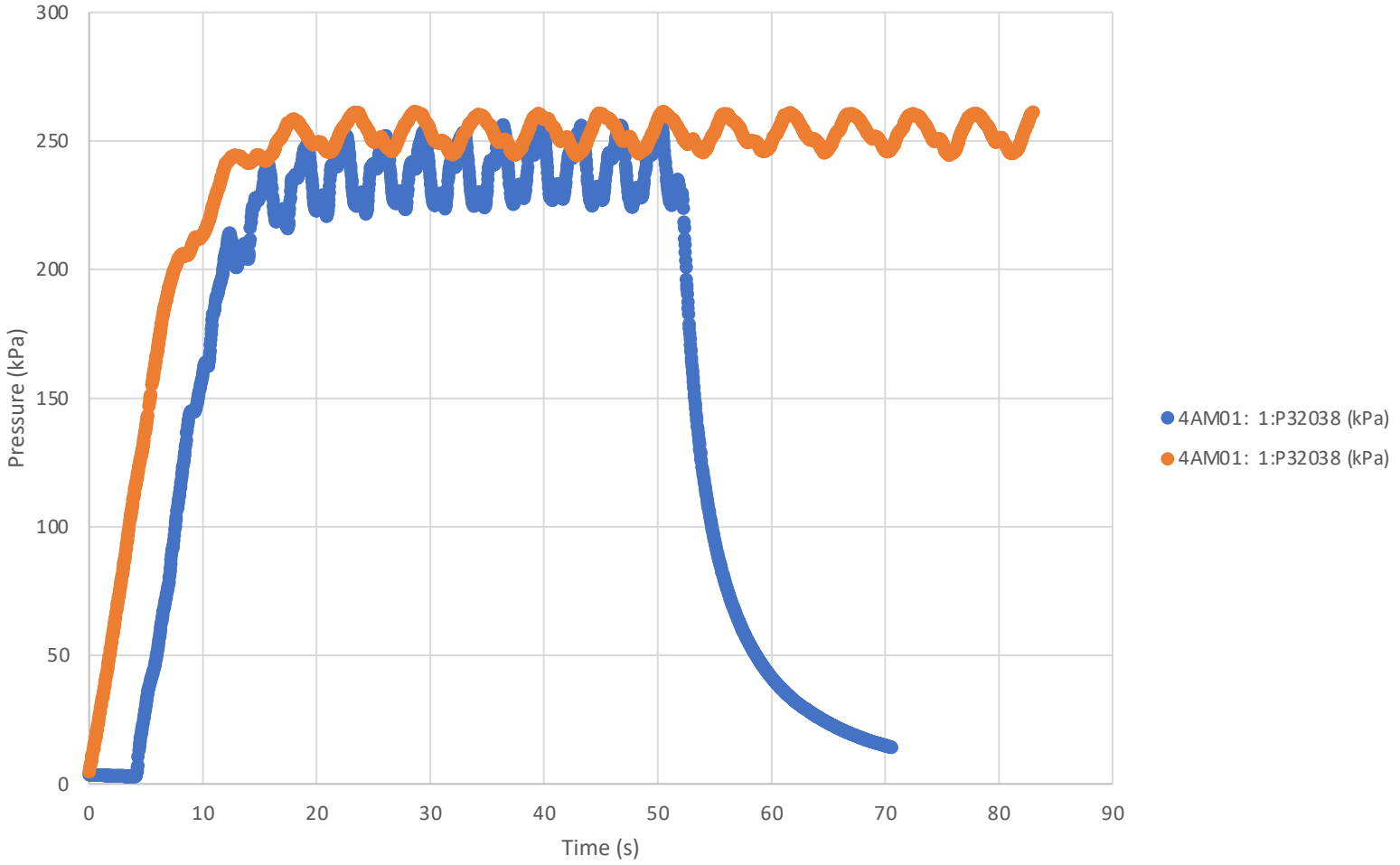
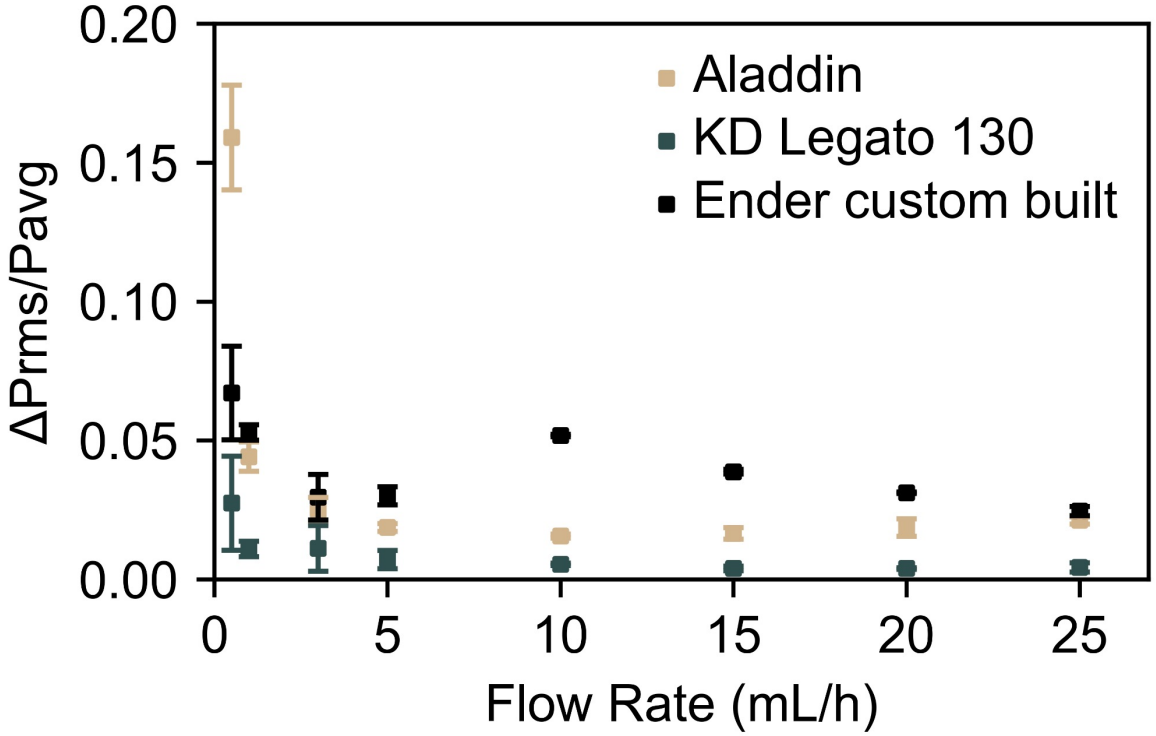
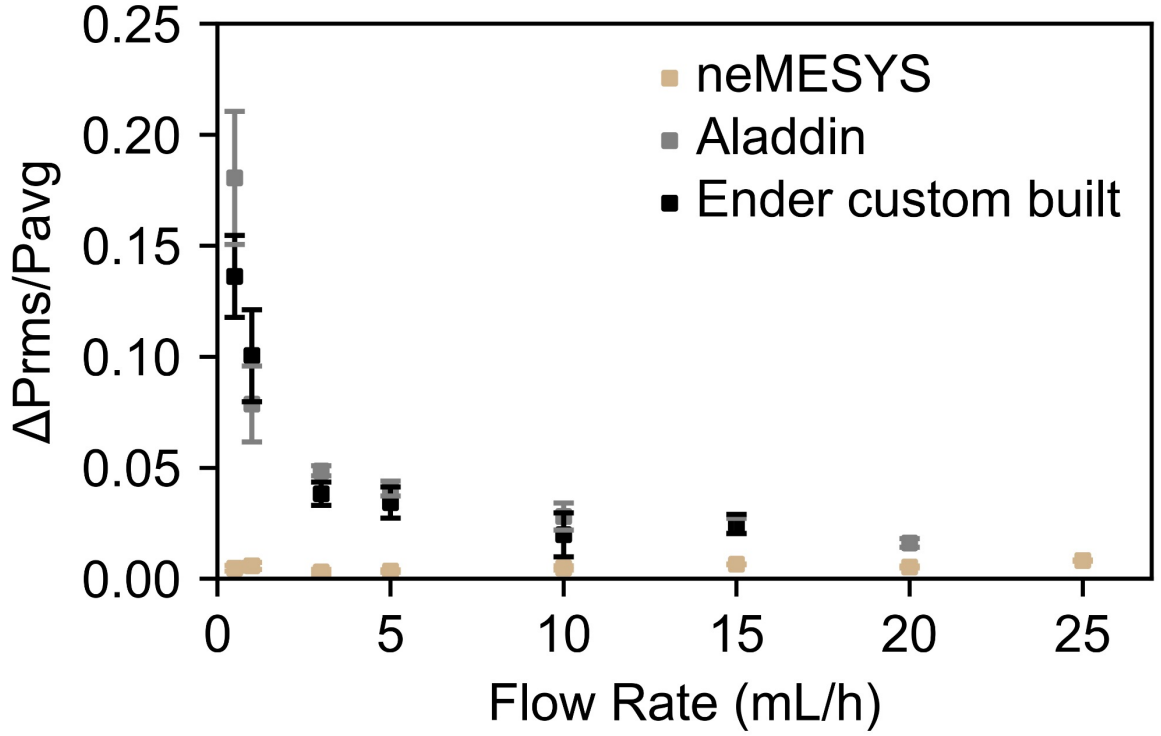

❶ Aladdin (WPI)
❷ neMESYS 1000N (Cetoni, Germany)
❸ KD Legato 130 (KD Scientific)
❹ Ender custom built
❶
❷
❸
❹
Ender
kdScientific



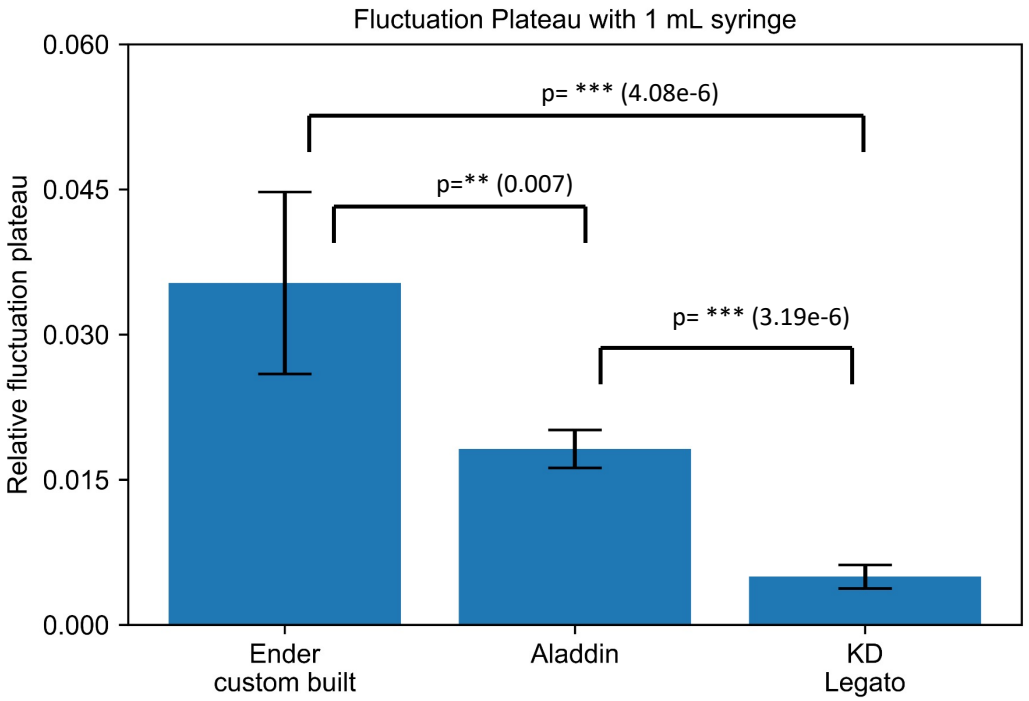
- Example of raw data
- 1mL syringe
- 15mL/h flow rate
- Blue: Ender
- Orange: WPI Alladdin

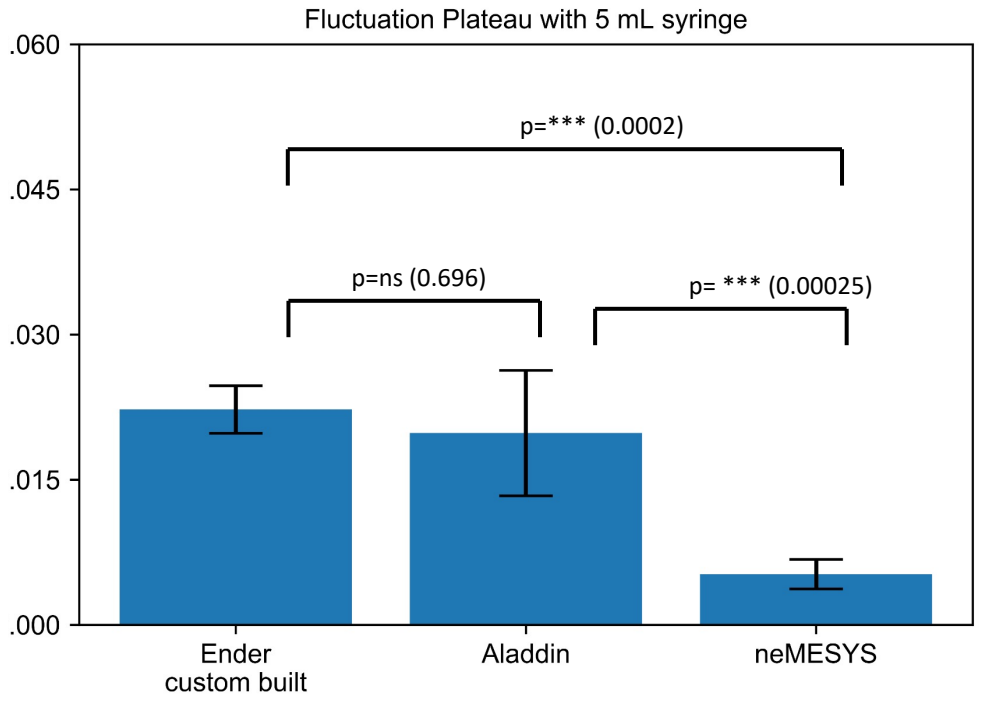


- Characterisation of pressure fluctuations of KD Legato, Aladdin and Ender custom built pumps using Feb16 B1 blood plasma separation device
- 1mL syringes
- N=3 for all points
- Note: only Ender ‘X pump’ was used



- Characterisation of pressure fluctuations of neMESYS, Aladdin and Ender custom built pumps using Feb16 B1 blood plasma separation device
- 5mL syringe
- N=3 for all points
- **Note 1**: neMESYS does not accept 1mL syringes, while KD Legato does not accept 5mL syringes
- **Note 2**: Only Ender 'Y pump' was used
- **Note 3**: Back pressure was too high for the Ender pump to pump at 20 or 25 mL/h (~400 KPa)





- Average relative fluctuations were compiled on the fluctuation plateau observed at higher flow rates (5-25mL/h)
- Statistics: Student t test, unpaired, n.s= not significant, ** and above, highly significant
- We saw a significant difference of about 1.5% in the relative fluctuation plateau between the Ender (>3%) and the Alladin (>1.5%) used with 1mL syringe.
- That effect disappeared for 5mL syringes
- KD Legato and Nemesys are both high-end pumps resulting in pressure fluctuations below 1%

Conclusions

- Pulseless neMESYS syringe pump (>£12K) has the lowest frequency and for the full range, the relative fluctuation is limited within 0.2 to 0.6%, unlike the stepper motor-based syringe pumps.
- The KD pump (~£3k) shows the lowest relative fluctuation among the stepper motor-based syringe pumps. Although it provides 0.5% relative fluctuation after reaching the plateau after 5 mL/h flow rate (corresponding frequency 0.12 Hz), at lower flow rates it can provide higher fluctuation(e.g., 3% fluctuation at 0.5 mL/hour).
- The widely used Aladdin syringe pump (~£500), which retails at 16% of the cost of the KD pump provides much more fluctuations than the KD syringe pump at plateau [~4.5 times].
- Overall, the open-source ENDER pump (£140) performs as well as* the Aladdin pump, at a fraction of the price, but is not suitable for precise operation. It is preferable to use to 5mL syringes or above, and avoid flow rates below 1mL/h

- Additional note: we noticed significant deviations on the Ender pump at lower flow rates, typically lower than 1mL/h. We cannot be more precise than this at this stage, we would need to invest more time to look into this. Would you be interested in this at all?