Electronic Supplementary Material (ESI) for Lab on a Chip.

Electronic Supplementary Information (ESI)

Low-cost microphysiological systems: Feasibility study of a tape-based barrier-on-chip for small intestine modeling

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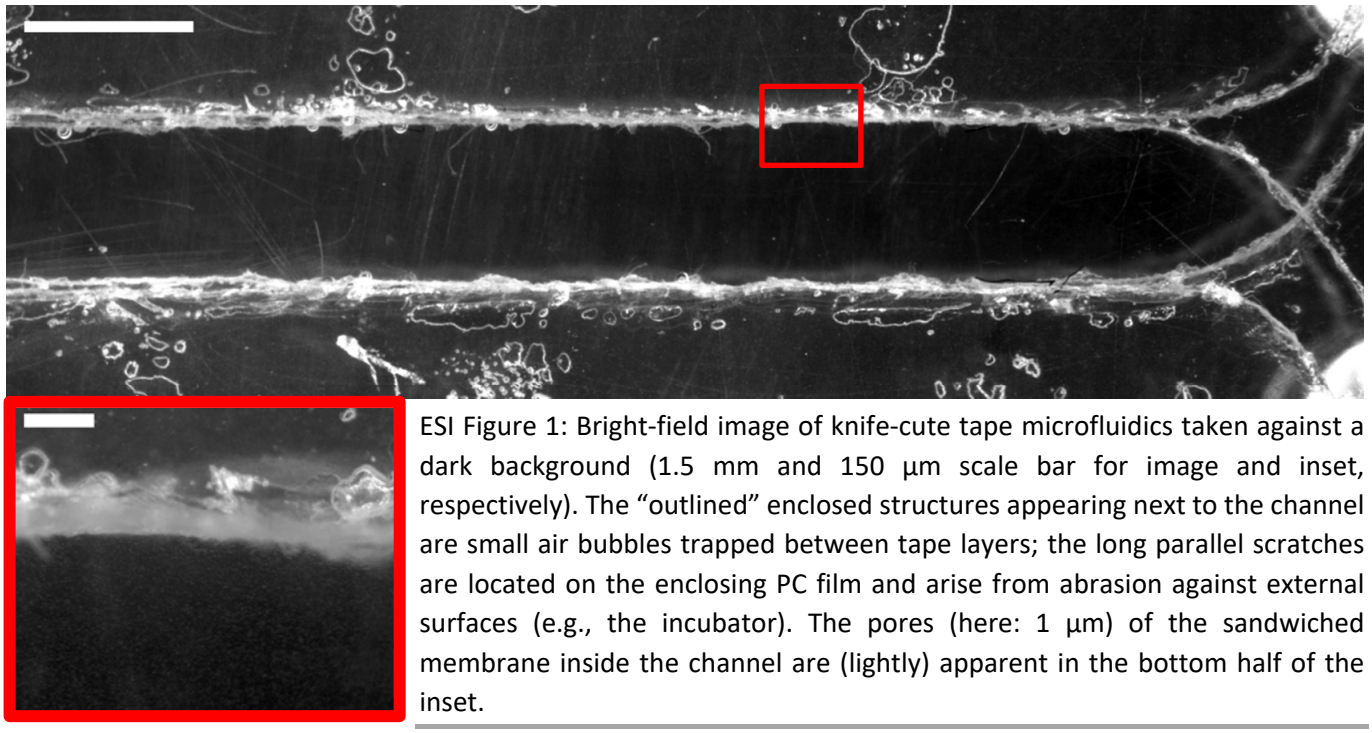
ESI Table 1: Non-exhaustive list of commercial platforms for barriers-on-chips. Companies mentioned in a published industry overview[1] were assessed for suitability to barrier-on-chip models, and per-"organ" costs in the European market determined where possible.

Dominant Material	Type of Membrane[2]	Company	Cost	Comments[3]
PDMS	Porous PDMS	Emulate (USA)	> € 100/"organ"	
	Lateral filtration	SynVivo (USA)	€ 135/"organ"	
Thermoplastic	Hydrogel	AIM biotech (SG)	€ 7/"organ"	3 "organs" per slide
		Mimetas (NL)	€ 9/"organ"	40 "organs" per plate; gravity perfusion only
		Ibidi (DE)	€ 35/"organ"	3 "organs" per slide; not intended for perfusion
	Transwell insert	CN bio (UK)	€ 35/"organ"	12 "organs" per plate; proprietary perfusion system
		TissUse (DE)	unknown	proprietary perfusion system
	Track-etched	Micronit (NL)	€ 230/"organ"	proprietary holder required
		Aline (USA)	> € 200/"organ"	custom design service
		Hesperos (USA)	unknown	gravity perfusion only
		Draper (USA)	unknown	96 "organs" per plate; proprietary perfusion system

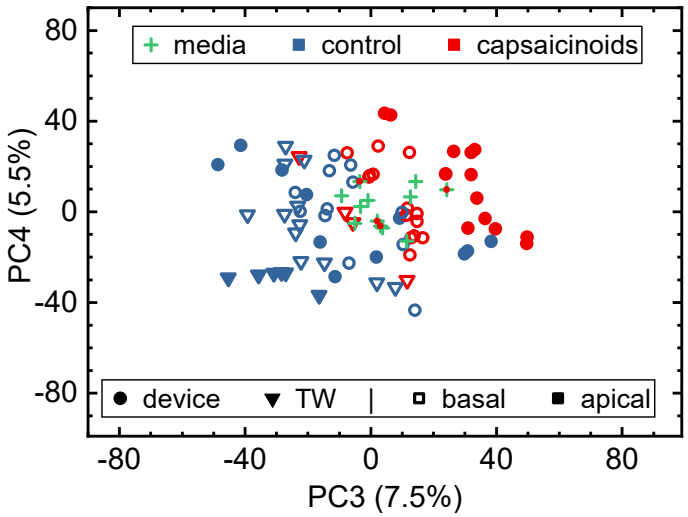
1 M. Mastrangeli, S. Millet, The ORCHID Partners, and J. van den Eijnden-van Raaij, *ALTEX - Alternatives to animal experimentation*, 2019, **36**, 650–668.

2 Hydrogel-based systems may be more in-vivo-like due to their biophysical and biochemical cues. However, systems based on porous membranes are generally easier to handle, since seeding of barrier-forming cells can rely on gravity-driven cell sedimentation on top of the support in the standard/upright device orientation. Hydrogel- and lateral filtration-based systems, on the other hand, generally feature lateral geometries, meaning barrier formation has to rely on (time-consuming) cell growth/migration around the entire channel circumference after seeding in upright orientation, or the device needs to be oriented such that the barrier-supporting surface faces up (often presenting practical challenges with liquids in the system).

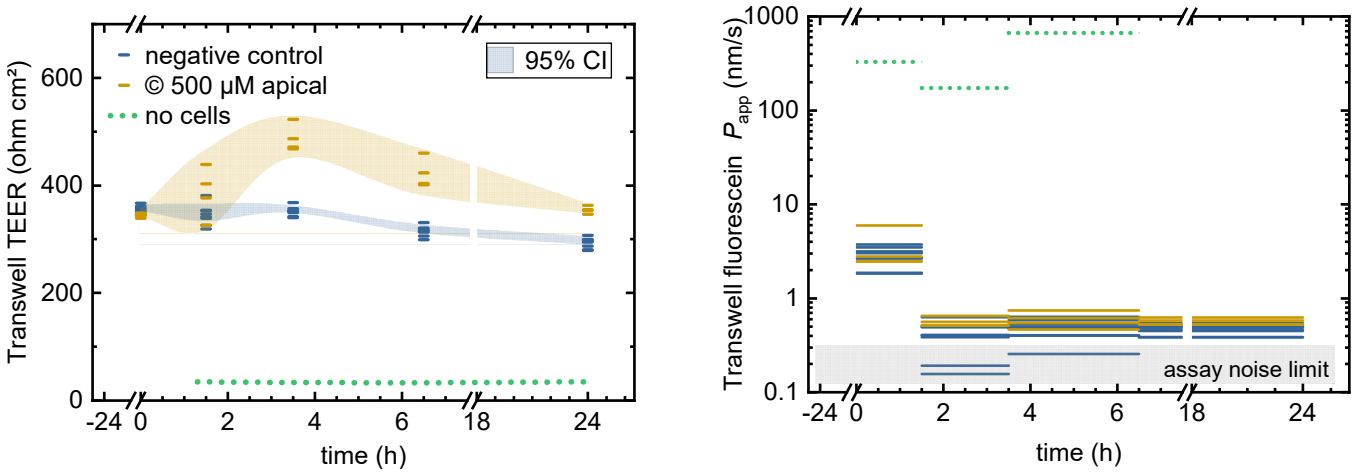
3 High numbers of "organs" per plate/slide are more suitable to high-throughput screening environments rather than academic research, since only a smaller number of "organs" may actually be needed, potentially driving up costs. Gravity perfusion is more affordable than continuous perfusion in terms of required equipment, but also less flexible, as compounds accumulate in the respective compartments over time until media is exchanged at a given time. This can be achieved in a continuous perfusion system by recirculation, but such a system likewise enables continuous media exchange, pulsatile flow, etc., enabling higher control over culture as well as assay kinetics.



ESI Figure 1: Bright-field image of knife-cute tape microfluidics taken against a dark background (1.5 mm and 150 µm scale bar for image and inset, respectively). The "outlined" enclosed structures appearing next to the channel are small air bubbles trapped between tape layers; the long parallel scratches are located on the enclosing PC film and arise from abrasion against external surfaces (e.g., the incubator). The pores (here: 1 µm) of the sandwiched membrane inside the channel are (lightly) apparent in the bottom half of the inset.



ESI Figure 2: Higher-order PCA of metabolomic data. Components 3 and 4 contain capsaicinoid effects independent of culture platform, with treated barriers scoring more positive in both components compared to negative controls.



ESI Figure 3: Independent Transwell experiment of capsaicinoid (yellow) effects compared to negative controls (blue) on TEER (left) and permeability (right). As in the main paper, capsaicinoid-treated epithelial barriers show higher TEER combined with higher tracer permeability at 2+ hours. Compared to the results presented in the main body of the paper, the TEER sampling intervals here miss out on the initial barrier disruption from the media change disturbance (evident in tracer permeability). The increase in tracer dye permeability for capsaicinoid-treated barriers is furthermore less pronounced, likely due to the different tracer characteristics (LY vs. fluorescein here). The experimental parameters were otherwise largely similar to those described in the main manuscript, except that media was used without ITS supplementation (i.e., 10% FBS only; likely contributing to lower TEER values at the start and in negative controls), and that a lower capsaicinoid dose was used as indicated.