Culture

Tech Bulletin

High-Density TFF Perfusion on the Stratyx™ 250 Platform Outperforms Fed-Batch Across Every Productivity Metric

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13X	3.3X	29X	35
Volumetric Productivity mg/L/day	Specific Productivity (Qp) pg/cell/day	Total IgG Mass Produced vs. fed-batch	Days at High VCD & Viability days run duration

Advantage of TFF Perfusion over Fed-Batch Control, same cell line, same Stratyx platform, same inoculum

Overview

Fed-batch bioprocessing is well-established, but biologically constrained: as cells grow, metabolic waste accumulates, nutrient supply falls, and culture health deteriorates, capping both run duration and yield. Tangential Flow Filtration (TFF) perfusion removes this ceiling by continuously exchanging spent media for fresh, enabling sustained high cell density and a stable culture environment over extended campaigns.

This technical bulleting presents data from a controlled study in which CHO cells expressing an IgG antibody were cultured in parallel in two 250 mL Stratyx bioreactors, one fed-batch, one TFF perfusion, both inoculated from the same seed train under identical setpoints. The perfusion run, utilizing the MidiKros Hollow Fiber Filter from Repligen, delivered a 13× advantage in volumetric productivity, 29× more total IgG mass, and maintained >90% cell viability through a 35-day campaign. The results demonstrate what becomes possible when a development team can access high-density perfusion with the same operational simplicity as fed-batch.

1: Culture Biosciences,

Results

Cell growth & longevity. Both conditions showed comparable early growth kinetics through Day 6. From Day 9, the trajectories diverged sharply. The fed-batch peaked at 21 × 10^6 cells/mL, then declined as waste accumulated, viability fell from >98% to 81% by run termination at Day 14. The perfusion run reached 68 × 10^6 cells/mL peak VCD, stabilized into a quasi-steady state at 53 ± 7 × 10^6 cells/mL from Day 19 onward, and terminated at Day 35 with 92% viability.

Metabolic environment. Continuous media exchange kept osmolality stable at 267 mOsm/kg throughout steady state, 94 mOsm/kg lower than the fed-batch at run end (361 mOsm/kg). Ammonium declined to a steady-state mean of 4.7 mmol/L vs. 6.3 mmol/L at fed-batch termination. Lactate was maintained at 0.50 g/L steady state. Dissolved CO_2 was elevated (85 mmHg vs. 44 mmHg in fed-batch), a predictable consequence of high cell density currently under active mitigation.

IgG productivity. Because perfusion continuously removes product in the perfusate, in-vessel titer (107 mg/L) understates true production. A full mass balance, perfusate harvest (698 mg) + vessel at run end (19 mg) + cell bleed (129 mg), gives 847 mg total IgG produced, vs. 29 mg in the fed-batch. Volumetric productivity was 131 vs. 10 mg/L/day. Cell-specific productivity (Qp) was 3.7 ± 1.5 vs. 1.1 ± 1.0 pg/cell/day, reflecting not just more cells, but individually more productive cells sustained in a nutrient-replenished, waste-cleared environment.

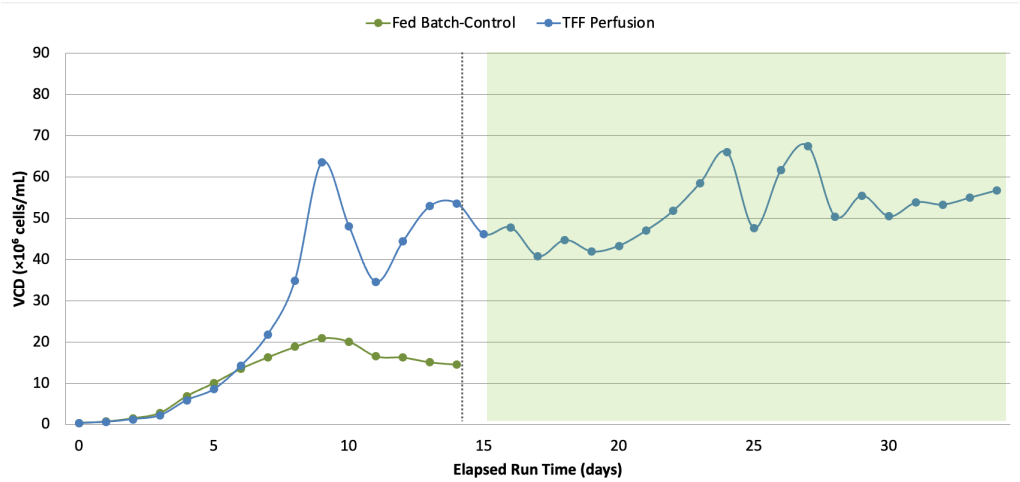

Figure 1: Viable Cell Density Over Time

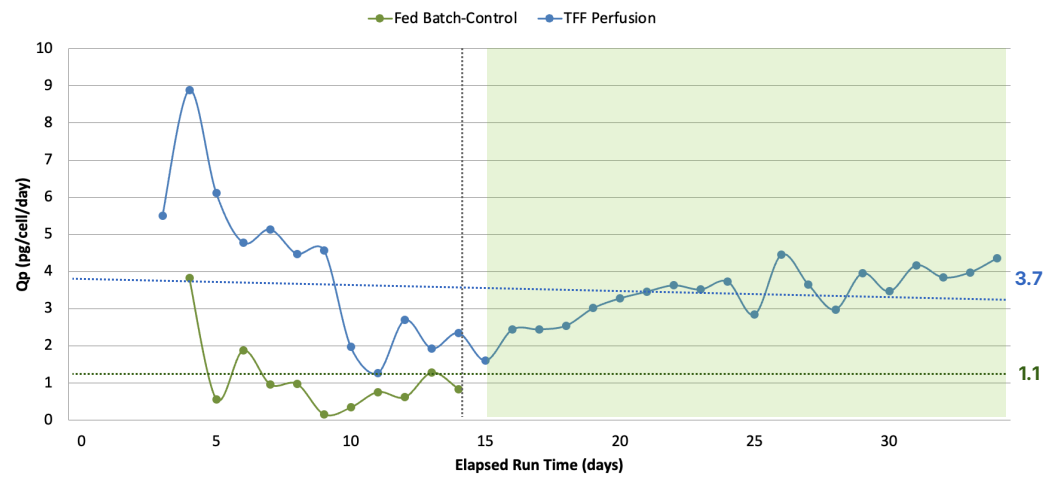

Figure 2: Specific productivity (Qp) over time

Results

Table 1: Key performance metrics , Fed-Batch Control vs. TFF Perfusion on the Stratyx platform

Performance Metric	Fed-Batch Control	TFF Perfusion (Stratyx)
Run Duration	14 days	35 days
Peak VCD (× 10^6 cells/mL)	21	68
Final viability (%)	81	92
Total IgG produced (mg)	28.8	846.5 ★
Volumetric productivity (mg/L/day)	10.3	131.1 ★
Specific productivity Qp (pg/cell/day)	1.1 ± 1.0	3.7 ± 1.5 ★
Space-time yield — vessel-based (mg/L/day)	10.3	131.1 ★
Osmolality at run end (mOsm/kg)	36.1	263
$NH4^+$ — steady state (mmol/L)	6.3	4.7 ± 1.5
pCO2 (mmHg)	44	85 ‡

★ Key perfusion advantages. ‡ Elevated pCO_2 is a predictable consequence of high cell density; sparge optimization under evaluation.
† In-vessel perfusion titer (107 mg/L) understates total production; product is continuously harvested in the perfusate

847 mg total IgG from a single 35-day Stratyx perfusion run — equivalent to approximately 29 sequential fed-batch campaigns from the same 250 mL vessel.

The Stratyx Platform

These results were not generated with bespoke perfusion infrastructure. They were produced on the same Stratyx automated bioreactor platform used for routine fed-batch development, both runs, in parallel, on the same day. Stratyx makes high-density perfusion operationally accessible through:

- Automated process control: pH, DO, temperature, and all perfusion flow rates managed continuously without manual intervention.
- Cloud monitoring: real-time visibility and automated alerting across multi-week campaigns without continuous on-site presence.
- Parallel bioreactors: matched head-to-head comparisons like this study, the same statistical rigor applied to fed-batch DoE.
- Unified data environment: all online and offline measurements captured together, enabling the rigorous productivity analyses demonstrated here.

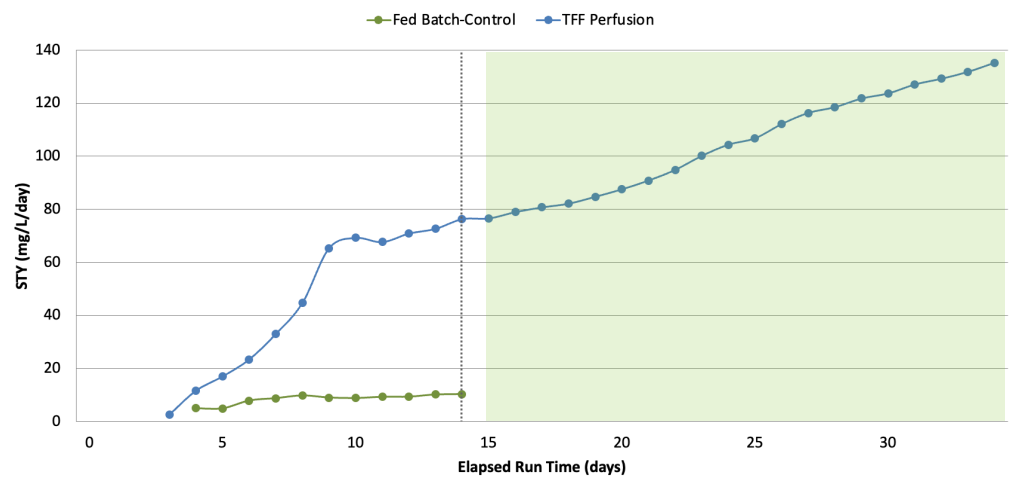

Figure 3: Space-time yield (STY) over elapsed run time. The perfusion STY was still rising at run termination, indicating unrealized productivity potential.

Conclusions

TFF perfusion on the Stratyx platform delivers measurable, reproducible productivity gains across every dimension of bioprocess performance, from cell density and culture health to total product mass and cell-specific efficiency. For development teams evaluating perfusion as a route to higher yields, faster timelines, or reduced manufacturing cost of goods, these results establish that Stratyx can deliver that potential at development scale, with the operational simplicity and data fidelity needed to support process characterization and regulatory submissions.

Perfusion on Stratyx is not a specialized manufacturing technique. It is a development tool — ready to run alongside the fed-batch workflows your team already uses, from the same platform, on the same day.

Methods

Cell line: CHO (Agarabi, ATCC), IgG-expressing.
Platform: Stratyx 250 mL single-use (Culture Biosciences).
Cell Retention Hollow Fiber Filter: MidiKros 20cm 0.2um PES 1mm (Repligen)
Cell counting: ViCell Blu (Beckman Coulter).
Metabolites: Flex2 whole-broth (Nova Biomedical). IgG: Supernatant ELISA/CEDEX (Roche).
Total IgG (perfusion): perfusate harvest + vessel at run end + bleed (vessel IgG × bleed volume).
Qp: interval mass balance at each offline timepoint. STY: cumulative IgG yield / vessel volume / elapsed time.
iVCD: trapezoidal integration of VCD-time curve.

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