# Comparison of Thomson Optimum Growth® 7L Flasks vs Ambr® 250 Bioreactor Systems Using Stable CHO Cells

Data provided by Amanda Smith, Matt Kane, Patricia McNeill, Barbara Bengtsson, Shaun Barnett, & Rodney Peterson at Lundbeck.

Authored by Thomson Team: Alberto Estevez, Sam Ellis, & other contributors.

## Abstract

Thomson's Optimum Growth® 7L Flask system provides a cost-effective alternative to conventional bioreactor platforms for large-scale cell culture applications. This application note directly compares Thomson Optimum Growth® 7L Flasks and industry-standard Ambr® 250 bioreactors with pH control, evaluating their performance with stable CHO cell lines. The study assessed cell growth, viability, and protein titer production over a 14-day expression run. Results demonstrate that the 7L flask system not only matches but exceeds the Ambr® 250 performance in key metrics, offering researchers a more accessible and efficient solution for mid-scale bioprocessing and bioproduction while maintaining high-quality experimental outcomes.

## Introduction

The Thomson Optimum Growth® 7L Flask has emerged as a promising method for large-scale screening or as a viable alternative to more expensive bioreactor setups. The use of Ambr® 250 bioreactors is an established approach to monitoring and understanding critical parameters at the 250mL scale before initiating large-scale production of stable CHO cells. However, Ambr® systems require substantial investment in equipment, expertise, and resources to yield valuable data.

With increasing pressure to optimize efficiency in bioprocessing workflows, developing methods that require fewer resources while maintaining or improving outcomes has become essential. This study evaluated the benefits of the Thomson Optimum Growth® 7L Flask by running parallel experiments against three Ambr® 250 expressions controlled at different pH levels. Throughout the 14-day experiment, culture metrics and titer yields were assessed to determine the utility of the 7L format for rapid and efficient scale-up of stable cell lines.

| Flask | P/N | Fill Volume | RPM in 1" \| 2" |
|---|---|---|---|
| Optimum Growth® 7L Flask | 931117 | 2.8-5L | 140-150 \| 110 |

## Materials

- Thomson Optimum Growth® 7L Flask *(pn# 931117)*
- Ambr® 250 High Throughput Generation 2 with FLEX2 analyzer
- Vi-CELL BLU cell counter
- Stable CHO cell line
- Cell culture media and supplements

## Methods

A selected stable CHO cell line was thawed and expanded. During the expansion phase, cells were maintained at 150 rpm (25 mm throw), 6% $CO_2$, and 80% humidity. Shake flasks starting with 30 mL in a 125 mL flask and passaged every three days. Target seed density was between 0.3E6 and 0.8E6 viable cells/mL.

### Thomson Optimum Growth® 7L Flask Cell Culture

Two Thomson Optimum Growth® 7L Flasks were seeded at a cell density of $0.6\times10^6$ cells/mL with an initial volume of 3.2L. Cultures were supplemented with fresh media on feeding days. Feed volumes were 5% of start volume for nutrient feed A and 0.5% start volume nutrient feed B (Ingredients are proprietary, but similar to ActiPro™ Cell Boost™ A/B) on days 3, 5, 7, 9, 11, and 13. On sample days 3, 5, 7, 9, 11 and 13 glucose were replaced up to 10 g/L. The cultures reached a final volume of approximately 5L at harvest after 14 days.

### Ambr® 250 Bioreactor Cell Culture

Three Ambr® 250 bioreactors were seeded at $0.9\times10^6$ cells/mL with an initial fill volume of 250mL. Each bioreactor was operated with different pH setpoints: high, medium, and low. The Ambr® system's integrated pH control managed conditions throughout the 14-day run, with automated feeding and sampling performed via the FLEX2 analyzer. Ambr® runs were also fed 5%/0.5% feed A/B on day 3, 5, 7, 9, 11, and 13. Glucose was replaced daily starting day 3 to 7 g/L. The FLEX2 was hooked up to the Ambr® and the robot took the sample and presented to FLEX2 – 0.675 mL.

### Sampling and Analysis

Culture metrics for viable cell density and viability were collected at various time points for all five vessels. Ambr® metrics were collected using the integrated FLEX2 system, while Thomson flask samples were manually drawn and analyzed on a Vi-CELL BLU cell counter. On Day 14, all conditions were harvested, and the final data was analyzed. Titers were determined using Bio HT IgG assay.

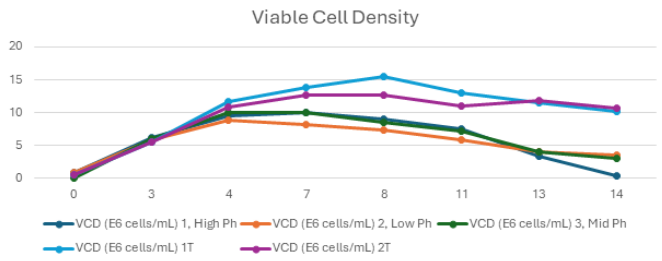
## Results

### Cell Density and Growth

Cell growth was similar in all conditions for the initial 3 days after seeding. By day 4, the Thomson flasks demonstrated superior cell growth, exceeding the highest count for the Ambr® conditions by $1\times10^6$ cells/mL.

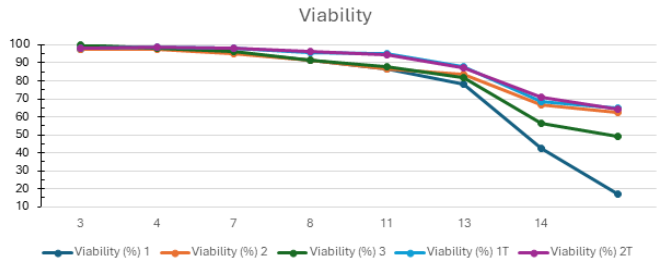
On day 8, Thomson flasks reached an average density of $14\times10^6$ cells/mL. In contrast, the maximum density achieved by any Ambr® condition was $10\times10^6$ cells/mL, recorded on

day 7 by the high pH condition.




## Cell Viability

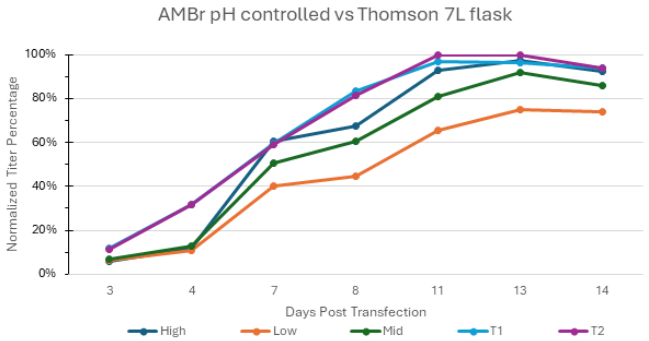
Both Thomson and Ambr® conditions showed expected high percentages of viable cells for the initial 7 days post-cell seeding. On day 8, a clear separation was observed in the viability profiles between the systems. While the Ambr® viabilities began to approach 90%, the Thomson flasks maintained high viability above 95%. Both Thomson flasks maintained a higher viability than all three conditions of the Ambr® run for the remainder of the experiment.




## Protein Titer Production

A normalization method was employed for titer measurements to facilitate direct comparison between the different culture systems. The day 14 average titer value of the Ambr® runs was set as the reference point (1.0 or 100%), and all other titer values were calculated as a percentage relative to this reference value. For example, if the average day 14 titer for the Ambr® runs was 5.0 g/L and a Thomson flask measurement on day 8 were 4.0 g/L, it would be represented as a normalized titer of 0.8 or 80%. This normalization approach allows for clear visualization of the relative production kinetics between the different culture systems, independent of absolute titer values.

The normalized titer data demonstrated that the Thomson Optimum Growth® 7L Flasks reached peak production levels earlier than the Ambr® conditions. By day 11, the Thomson flasks achieved 100% of the maximum titer value observed in the best Ambr® condition. This accelerated production timeline means the flasks had higher production output for at least 20% of the experimental duration.




Key observations from the titer analysis based on the provided graph:

- Thomson flasks (T1, T2) showed accelerated production starting from day 3
- By day 8, Thomson flasks reached approximately 80% of the maximum titer
- High pH Ambr® condition performed best among bioreactor setups
- Low pH Ambr® consistently showed the poorest performance
- The Thomson flasks reached maximum titer (100%) by day 11, while Ambr® conditions took longer to reach their peak values

## Discussion

The comparative analysis between Thomson Optimum Growth® 7L Flasks and Ambr® 250 bioreactors provides valuable insights into the capabilities of each system for CHO cell culture applications. The Thomson Optimum Growth® 7L Flask system demonstrated superior performance in several key areas:

**Enhanced Cell Growth:** The 7L flasks consistently supported higher cell densities than the Ambr® conditions.

**Sustained Cell Viability:** The extended high viability in the Thomson flasks suggests improved environmental conditions for maintaining cellular health throughout the production run.

**Accelerated Production:** The faster trajectory to maximum titer in the 7L flasks indicates the potential for shortened production timelines, which could significantly impact manufacturing efficiency.

**Operational Simplicity:** The 7L flask system achieves these superior results without the complexity of automated pH control or the specialized infrastructure required for bioreactor operation.

These findings suggest that the Thomson Optimum Growth® 7L Flask provides a highly effective platform for mid-scale bioproduction using stable CHO cell lines. The system combines operational simplicity with performance that meets or exceeds that of more complex and expensive bioreactor setups.

## Conclusion

The Thomson Optimum Growth® 7L Flask system represents a significant advancement in bioprocessing technology, offering researchers a cost-effective alternative to traditional bioreactor systems without compromising performance. The data presented in this application note demonstrates that the 7L flasks not only match but frequently surpass the capabilities of Ambr® 250 bioreactors in terms of cell growth, viability maintenance, and protein production.

For laboratories seeking to optimize their bioprocessing workflows, the Thomson Optimum Growth® 7L Flask provides an accessible solution that reduces equipment complexity and resource requirements while delivering excellent experimental results. This system is particularly valuable for organizations looking to scale up production efficiently or to conduct multiple parallel experiments without the substantial investment typically associated with bioreactor infrastructure.

The combination of higher cell densities, extended viability, and accelerated production timeline, which positions the Thomson Optimum Growth® 7L Flask as an ideal platform for mid-scale bioprocessing applications using stable CHO cell lines.