Advanced Cell Culture Media Optimization Training Course

Professional Development Training Course Outline

Category	Biotechnology and Pharmaceutical Development	**Duration**	10 Days
Base Fee	$4,000 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

The transition from empirical media development to Rational Design and High-Throughput Screening (HTS) is essential for modern biomanufacturing. This course is a deep dive into the state-of-the-art strategies required to develop and optimize Chemically Defined (CD) media and Feed Systems for superior bioproduct yields and enhanced Critical Quality Attributes (CQAs). With industry pressure to lower Cost of Goods Sold (CoGS) and accelerate Time-to-Market, mastery of Metabolic Engineering and advanced analytical techniques like Multi-Omics is non-negotiable. Advanced Cell Culture Media Optimization Training Course bridges the gap between theoretical cell biology and industrial Process Intensification, ensuring participants can design robust, scalable, and GMP-compliant media workflows.

This intensive program emphasizes practical application, moving beyond basic batch culture to focus on Fed-Batch and Perfusion Bioreactor media strategies. We will explore the integration of Design of Experiments (DoE) and Machine Learning (ML) for predictive modeling and rapid media component identification. By analyzing Spent Media and leveraging Process Analytical Technology (PAT), attendees will gain the skills to diagnose, troubleshoot, and mitigate common issues like Lactate Accumulation and Ammonia Toxicity. The ultimate goal is to empower R&D and Process Development teams to drive productivity improvements, achieve unparalleled Process Robustness, and secure a significant competitive advantage in the Biologics and Cell & Gene Therapy (CGT) sectors.

Programme Curriculum

Advanced Cell Culture Media Optimization Training Course

Introduction

The transition from empirical media development to Rational Design and High-Throughput Screening (HTS) is essential for modern biomanufacturing. This course is a deep dive into the state-of-the-art strategies required to develop and optimize Chemically Defined (CD) media and Feed Systems for superior bioproduct yields and enhanced Critical Quality Attributes (CQAs). With industry pressure to lower Cost of Goods Sold (CoGS) and accelerate Time-to-Market, mastery of Metabolic Engineering and advanced analytical techniques like Multi-Omics is non-negotiable. Advanced Cell Culture Media Optimization Training Course bridges the gap between theoretical cell biology and industrial Process Intensification, ensuring participants can design robust, scalable, and GMP-compliant media workflows.

This intensive program emphasizes practical application, moving beyond basic batch culture to focus on Fed-Batch and Perfusion Bioreactor media strategies. We will explore the integration of Design of Experiments (DoE) and Machine Learning (ML) for predictive modeling and rapid media component identification. By analyzing Spent Media and leveraging Process Analytical Technology (PAT), attendees will gain the skills to diagnose, troubleshoot, and mitigate common issues like Lactate Accumulation and Ammonia Toxicity. The ultimate goal is to empower R&D and Process Development teams to drive productivity improvements, achieve unparalleled Process Robustness, and secure a significant competitive advantage in the Biologics and Cell & Gene Therapy (CGT) sectors.

Course Duration

10 days

Course Objectives

Upon completion of this course, participants will be able to:

1. Rationally Design high-performance Chemically Defined (CD) Media formulations for specific cell lines
2. Implement Design of Experiments (DoE) methodologies for efficient multi-factor media screening.
3. Apply principles of Cellular Metabolism and Metabolic Engineering to identify nutrient bottlenecks and minimize toxic by-products
4. Develop dynamic Nutrient Feeding Strategies for Fed-Batch processes to maximize Titer and Peak Viable Cell Density (PVCD).
5. Formulate specialized media and concentrates for Perfusion Culture to support extreme cell densities and continuous processing.
6. Utilize Spent Media Analysis and Metabolomics to accurately profile nutrient consumption and waste generation in real-time.
7. Integrate Process Analytical Technology (PAT) for real-time, non-invasive monitoring of critical media components.
8. Optimize media components to enhance Critical Quality Attributes (CQAs) such as Glycosylation, charge variant profile, and protein aggregation.
9. Employ Machine Learning (ML) and Explainable AI (XAI) frameworks for Predictive Modeling of media performance and component effects.
10. Design a Scalable and Process-Robust media workflow, minimizing Raw Material Variability and ensuring GMP Compliance.
11. Troubleshoot common media-related process deviations, including productivity decline and low cell viability, via Root Cause Analysis.
12. Reduce the Cost of Goods Sold (CoGS) associated with media by strategic sourcing and component concentration optimization.
13. Adapt media formulations to support novel cell therapies, including Viral Vector production and T-cell Expansion for CGT applications.

Target Audience

1. Process Development (PD) Scientists/Engineers
2. Cell Culture/Upstream Bioprocessing Specialists
3. Research & Development (R&D) Biologists/Chemists
4. Manufacturing & Tech Transfer Associates
5. Quality by Design (QbD) and Analytical Scientists
6. Formulation Scientists in Biologics
7. Managers overseeing Bioprocess Optimization
8. Academic Researchers focusing on Cell Line Development

Course Modules

Module 1: Foundational Principles of Advanced CD Media

- The evolution from serum-supplemented to Chemically Defined (CD) Media and ADCF systems.
- Detailed review of media components.
- Defining and controlling Raw Material Variability and its impact on process performance.
- Calculations: Osmolality, buffering capacity, and ionic strength optimization.
- Case Study: Transitioning a legacy hybridoma process to a high-titer, serum-free CD medium, eliminating contamination risk.

Module 2: Cellular Metabolism and Nutrient Bottlenecks

- In-depth analysis of CHO cell central carbon metabolism.
- Mechanisms of Lactate and Ammonia formation and strategies for their metabolic mitigation.
- The role of specific amino acids and glucose in biomass and protein synthesis.
- Introduction to metabolic flux analysis for identifying media component deficiencies.
- Case Study: Using a Glutamine Synthetase (GS) expression system model to design a media supplement blend that bypasses the need for high-glutamine feeding.

Module 3: Fundamentals of Design of Experiments (DoE) in Media

- Selecting appropriate DoE strategies
- Defining factor ranges, responses, and setting up experimental matrices.
- Interpreting DoE results.
- Introduction to multivariate data analysis (MVDA) tools for process understanding.
- Case Study: Applying a Fractional Factorial DoE to identify the three most influential trace elements on monoclonal antibody titer, reducing a 20-factor problem to 8 experiments.

Module 4: High-Throughput Screening (HTS) and Automation

- Implementation of Micro-Bioreactor platforms for rapid, small-scale media screening.
- Principles of automated liquid handling and robotic integration for media preparation and sampling.
- Scaling-down process parameters from production bioreactors to HTS systems for accurate prediction.
- Data management and statistical analysis of large HTS datasets.
- Case Study: A pharmaceutical company's high-throughput screen of 96 media formulations to rapidly identify a lead candidate for a novel fusion protein within 6 weeks.

Module 5: Advanced Spent Media and Metabolomics

- Techniques for collecting, quenching, and preparing spent media samples for analysis.

- Applying analytical methods for quantifying small molecule metabolites.
- Interpreting Metabolomics data to understand metabolic shifts and nutrient depletion dynamics.
- Using data to design precise, on-demand, or dynamic Nutrient Feeding Strategies.
- Case Study: Employing UPLC-MS to profile consumption rates of vitamins and non-essential components, leading to a 30% reduction in feed volume and CoGS.

Module 6: Fed-Batch Media Optimization and Strategy

- Design principles for concentrated, chemically compatible Feed Solutions
- Developing and controlling bolus vs. continuous vs. variable rate feeding protocols.
- Monitoring residual concentrations to prevent nutrient accumulation or starvation.
- Mass balance calculations for predicting and achieving target cell density and productivity.
- Case Study: Optimizing a two-part feed system to increase a therapeutic antibody's final titer from 5 g/L to 10 g/L over a 14-day run.

Module 7: Media for Perfusion Culture and Intensification

- Unique media and feed requirements for high-density, long-duration Perfusion Bioreactor systems.
- Design of highly concentrated, low-osmolality perfusion media to minimize dilution.
- Strategies for maximizing Cell Specific Productivity (Qp) in a continuous process.
- Integration of Cell Retention Devices and managing media exchange rates.
- Case Study: Developing a perfusion medium that supports Very High Cell Density, significantly reducing required bioreactor volume.

Module 8: Optimizing Media for Critical Quality Attributes (CQAs)

- The direct link between media components and protein Glycosylation profiles.
- Controlling media pH, buffer systems, and metal ion concentrations to manage protein aggregation and charge variants.
- Strategies for media supplementation to enhance product stability and reduce degradation.
- Analytical methods for CQA monitoring: IEX-HPLC for charge variants, CE-SDS for fragmentation.
- Case Study: Tuning trace element concentrations in a CD medium to shift the Glycan Profile of an IgG, meeting strict biosimilarity requirements.

Module 9: Process Analytical Technology (PAT) in Media Monitoring

- Fundamentals of PAT and its application to real-time media and metabolic monitoring.
- Utilization of in-line sensors.
- Principles and application of Raman Spectroscopy for non-invasive, simultaneous measurement of glucose, lactate, and amino acids.
- Data integration and control loops.
- Case Study: Implementing a Raman PAT probe to dynamically control a glucose feed rate, resulting in reduced lactate levels and greater batch consistency.

Module 10: Machine Learning and Predictive Modeling

- Introduction to Machine Learning (ML) algorithms for bioprocess data.
- Training ML models using multi-parametric DoE and HTS data to predict optimal media formulations.
- Explainable AI (XAI).
- Developing in-silico models for "what-if" process simulation and risk assessment.

- Case Study: Utilizing a Random Forest ML model trained on five years of bioreactor data to predict media component adjustments needed to prevent future productivity decline.

Module 11: Media for Cell & Gene Therapy (CGT) Applications

- Unique and stringent media requirements for T-cell Expansion, Stem Cells, and primary cells
- Media development for Viral Vector production in adherent and suspension systems.
- The role of cytokines and specific growth factors in CGT media and their stability in culture.
- Addressing the high cost and complexity of CGT-grade raw materials and supply chain security.
- Case Study: Formulating a specialized, defined medium for large-scale clinical expansion of CAR T-cells, achieving high viability and specific transduction efficiency.

Module 12: Scaling and Tech Transfer of Optimized Media

- The engineering principles of Scale-Up from lab to pilot and commercial-scale bioreactors.
- Mass transfer, mixing, and gassing considerations in large-volume media preparation.
- Developing robust media preparation protocols for GMP manufacturing
- Strategies for successful Technology Transfer (TT) and process validation.
- Case Study: Successful tech transfer of an optimized concentrated feed to a 15,000L commercial bioreactor, requiring new powder-to-liquid mixing validation.

Module 13: Troubleshooting and Failure Investigation

- Structured methodology for Root Cause Analysis (RCA) of cell culture media failures
- Diagnosing non-nutrient media issues.
- Testing and mitigating the impact of potential contaminants and inhibitory raw materials.
- Best practices for a media component quality control program.
- Case Study: Investigating a facility-wide drop in productivity traced back to a single, newly-sourced raw material lot and implementing a corrective action plan.

Module 14: Economic and Regulatory Considerations

- Calculating the full Cost of Goods Sold (CoGS) impact of media and feed choices.
- Strategies for securing multiple, qualified Raw Material Suppliers and managing the supply chain risk.
- Regulatory expectations for chemically defined media and documentation in IND/BLA submissions.
- Establishing a Quality by Design (QbD) lifecycle for media development.
- Case Study: Performing an economic evaluation to justify the investment in a more expensive, high-performing CD media, showing a net annual CoGS saving due to increased titer.

Module 15: Future Trends: Synthetic Biology and In Silico Media

- The role of Synthetic Biology and engineered cell lines in simplifying media requirements.
- Acoustic Cell Retention and other next-generation cell retention technologies.
- Advanced In Silico models for de novo media formulation design.
- Applying Digital Biomanufacturing tools for end-to-end media and process data integration.
- Case Study: Reviewing an academic project that utilized Directed Evolution to generate a cell line capable of high productivity in a low-cost, minimal media formulation.

Training Methodology

The course employs a highly interactive and practical methodology designed for immediate application in the bioprocess lab:

1. Lectures & Interactive Discussions.
2. Software Workshops.
3. In-Silico Case Studies.
4. Process Flow Diagrams.
5. Troubleshooting Scenarios.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call +254769199797

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	04 Dec 2026	Online	$2,000
23 Nov 2026	04 Dec 2026	Physical	$3,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$12,000

Start Date	End Date	Location	Price
23 Nov 2026	04 Dec 2026	Physical	$9,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$12,000

Ready to enroll or request a customized program? Book online or contact us:

Register Online Now

Email: info@fineskilltrainingcenter.com | Website: www.fineskilltrainingcenter.com