MOLECULAR DEVICES

Optimize your

HIGH-VALUE CELL LINES

Accelerate cell line development for recombinant proteins and monoclonal antibody production

Contents

Introduction

The production of monoclonal antibodies (mAbs) and recombinant proteins using mammalian cells has revolutionized the biotherapeutics market.

In 2022, recombinant cell lines held the highest market share of 31.79%. Currently valued at more than $5 billion USD globally, the cell line development market is expected to grow at a compound annual growth rate (CAGR) of 9.81%, reaching a revenue forecast of more than $10 billion USD by 2030[1].

This growth is driven by the increased demand for biologics, including monoclonal antibodies. Additionally, the hybridomas segment is also expected to grow at a CAGR of 10% through 2030[1]. This is due to its several advantages: its ability to grow continuously, combination of two different cell types, and production of pure antibodies on a large scale.

In this eBook, we present an overview of the cell line development workflow, plus high-throughput solutions for accelerating the process, enabling easier and faster selection of high-producing mammalian cell lines.

Cell Line Development Workflow

In order to generate high yields of recombinant protein products, cell lines such as CHO, Hybridoma or HEK 293 are typical platforms of choice. The process of developing stable cell lines starts with transfecting host cells (CHO or HEK 293) with recombinant plasmids or cell fusion for hybridomas. After transfection or cell fusion, large numbers of clones are screened and selected on the basis of expression of protein of interest (therapeutic biologics). Once candidate clones are identified, each "hit" is confirmed, validated, and characterized using DNA sequencing and a variety of downstream analytical assays. Upon completion, the lead clones are expanded and scaled up where bioprocesses occur.

Cell Line Development for Recombinant Proteins

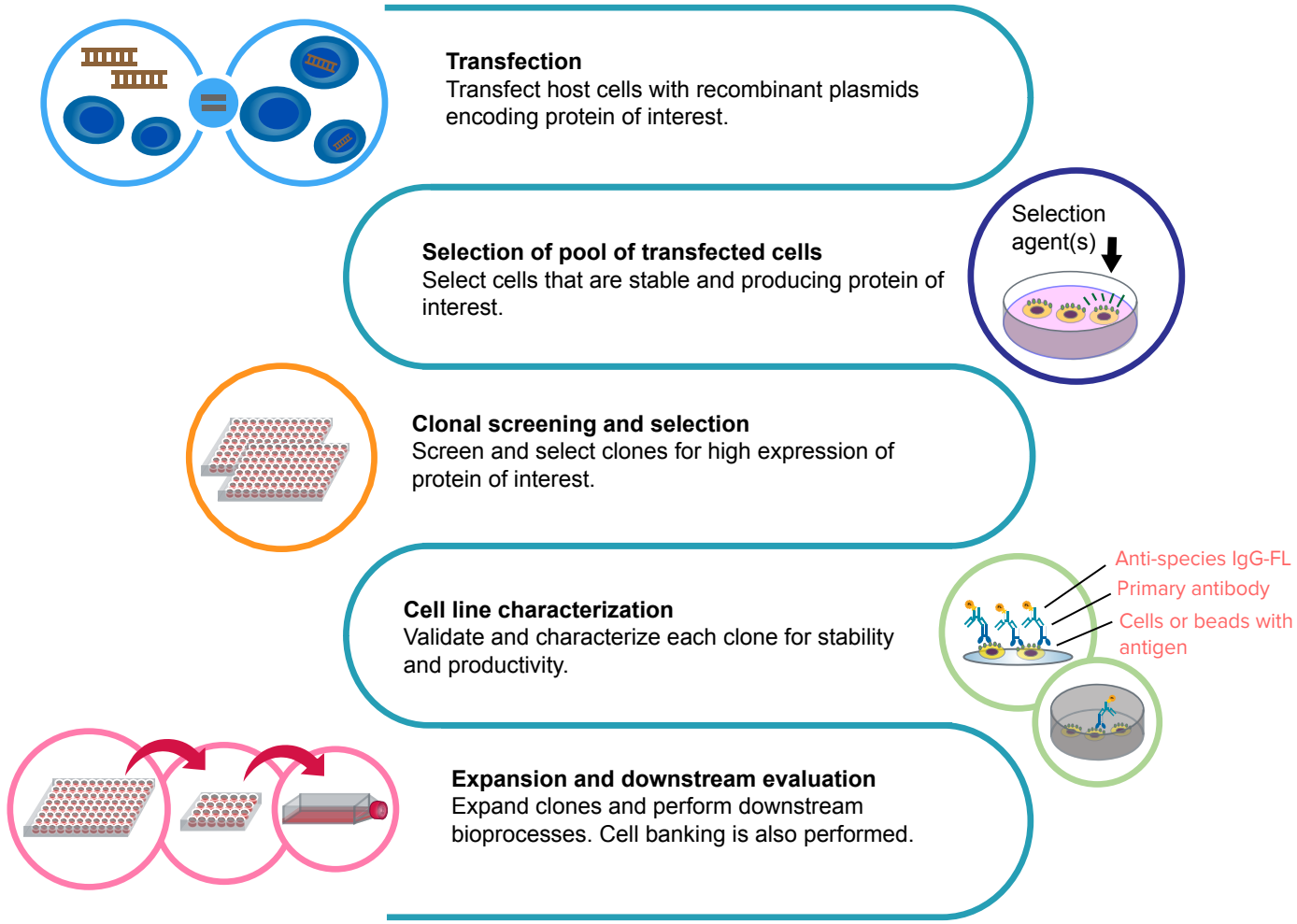


Figure 1. *Workflow for generating recombinant proteins.*

Overview of Cell Line Development

Cell line development is crucial in generating high yields of recombinant protein products. Common platforms include CHO, Hybridoma, and HEK 293 cell lines. The process involves transfecting host cells with recombinant plasmids or cell fusion for hybridomas, screening numerous clones, and selecting those expressing the desired protein. Confirmed clones undergo DNA sequencing and various analytical assays before being expanded and scaled up for bioprocesses.

Importance in Biotechnology and Pharmaceuticals

Cell line development is foundational in biotechnology and pharmaceuticals, underpinning the production of mAbs and recombinant proteins essential for disease prevention, diagnosis, and treatment. High-quality cell lines ensure the consistent production of therapeutic proteins, meeting stringent regulatory standards and supporting the advancement of innovative treatments.

Goals & Objectives of Cell Line Development

1. **Cost reduction**
2. **Accelerating timelines**
3. **Enhance the selection process for high-producing clones**

Achieving these objectives ensures the timely delivery of safe and effective biotherapeutics to the market, ultimately improving patient outcomes.

Cell Line Development for Hybridomas

Hybridoma technology is a method for mass-producing antibodies in a hybrid cell line generated from the fusion of antibody-producing B-cells with an immortalized myeloma cell line, now called a hybridoma cell. Because every B-cell produces a unique antibody, single-cell cloning of hybridomas can be used to generate a diverse library of unique monoclonal antibodies at a large scale, which are very frequently used in the prevention, diagnosis, and treatment of disease.

Cell Line Development for Hybridomas

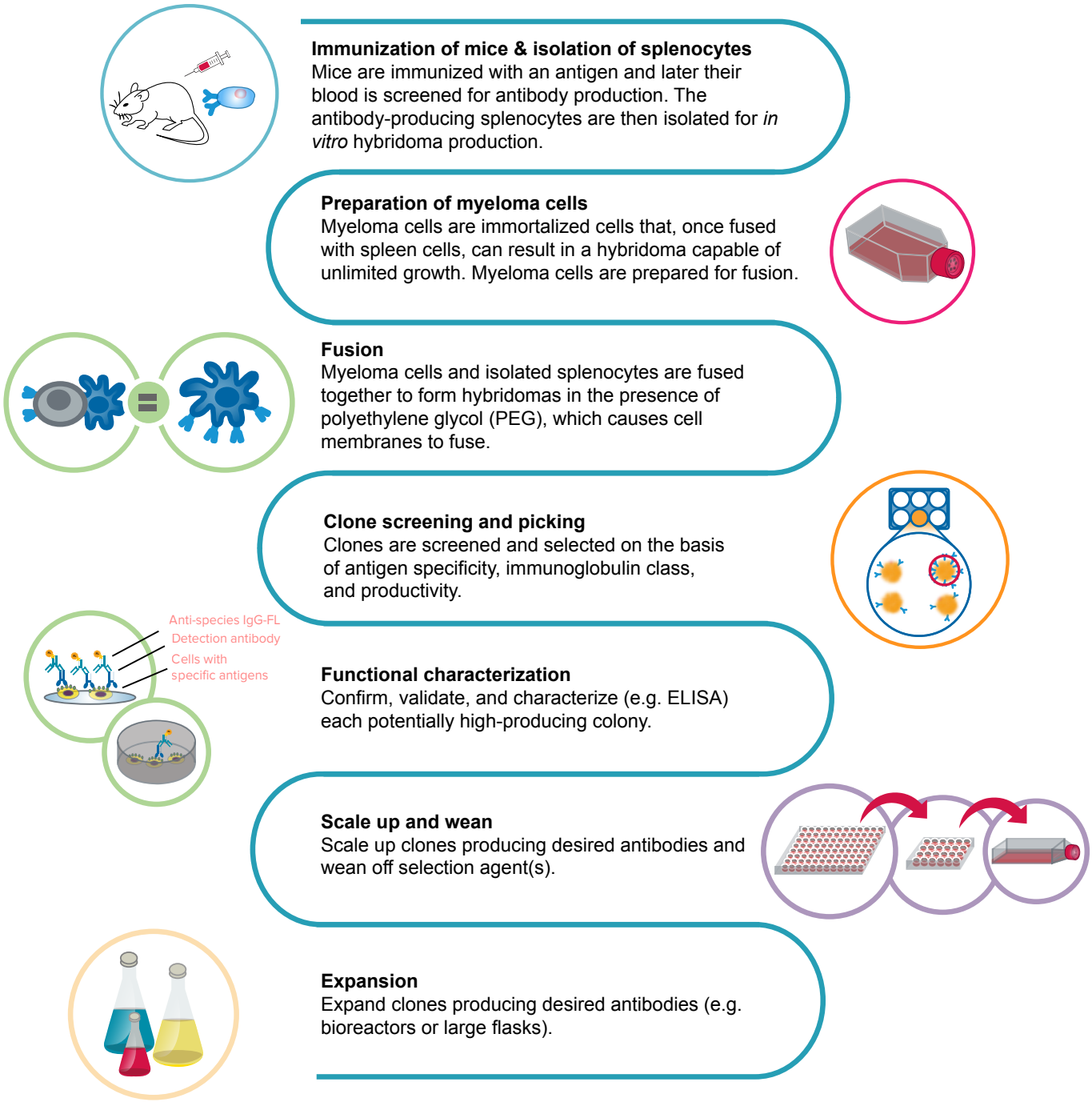


Figure 2. *Workflow for generating hybridoma cell lines.*

Types of Cell Lines and Applications

Primary Cell Lines Versus Immortalized Cell Lines

Primary cell lines are derived directly from tissues and closely mimic the natural cellular environment, making them invaluable for studying cell biology and physiology. However, they have a limited lifespan and can undergo only a finite number of divisions. In contrast, immortalized cell lines are modified to proliferate indefinitely, providing a consistent and long-term resource for research. These cell lines are crucial for experiments that require extensive replication and are widely used in various applications, from basic research to drug development.

Commonly Used Cell Lines

Several cell lines have become workhorses in the field of biotechnology due to their reliability and versatility:

- **Chinese Hamster Ovary (CHO) Cells**
  Renowned for their use in the production of recombinant proteins and therapeutic antibodies, CHO cells are a cornerstone in biopharmaceutical manufacturing.
- **Human Embryonic Kidney 293 (HEK293) Cells**
  These cells are widely utilized for gene expression studies, viral vector production, and the development of gene therapies due to their high transfection efficiency.
- **Hybridomas**
  Created by fusing B-cells with myeloma cells, hybridomas are essential for the production of monoclonal antibodies, which are used extensively in research, diagnostics, and treatments for various diseases.

Applications

RESEARCH

They serve as model systems to study cellular processes, gene function, and disease mechanisms. This understanding is foundational for advancing scientific knowledge and developing new treatments.

THERAPEUTICS

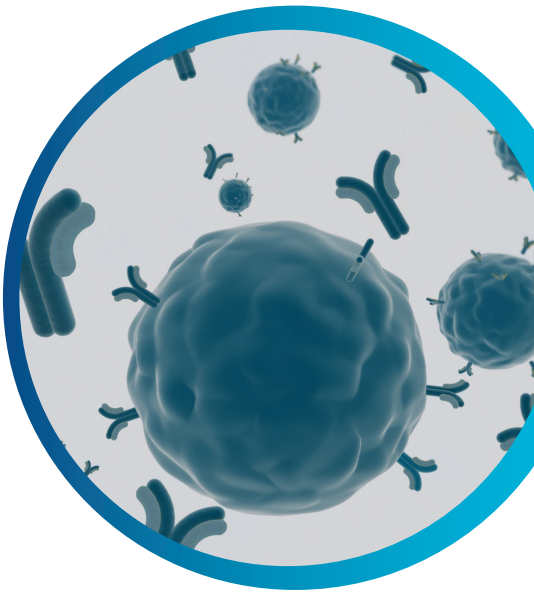
Immortalized cell lines, such as CHO cells, are employed in the large-scale production of biotherapeutics, including vaccines, hormones, and monoclonal antibodies, providing effective treatments for a variety of conditions.

DIAGNOSTICS

Monoclonal antibodies produced by hybridomas are critical for the development of diagnostic tests that detect pathogens, biomarkers, and other indicators of disease.

Applications in Biotherapeutics

Production of Monoclonal Antibodies



Monoclonal antibodies (mAbs) have transformed medical treatment, providing precise and effective therapies for diseases such as cancer, autoimmune disorders, and infections. Utilizing hybridoma cell lines or recombinant DNA technology in mammalian cells like CHO and HEK293, the production process involves:

- **Hybridoma Technology**
  Fusion of B-cells with myeloma cells to produce hybrid cells that generate large quantities of specific antibodies.
- **Recombinant DNA Technology**
  Genetic engineering of cells to express the desired antibody, enabling high-yield production.

These antibodies work by neutralizing pathogens, blocking cellular receptors, or delivering cytotoxic agents to target diseased cells, making them invaluable in both treatment and diagnosis.

Development of Recombinant Proteins

Recombinant proteins play a critical role in treating various medical conditions, including diabetes, hemophilia, and hormone deficiencies. The development process involves:

- **Gene Insertion**
  Introducing the gene encoding the protein into mammalian cells like CHO or HEK293.
- **Cultivation and Expression**
  Growing the cells to express the protein in large quantities.
- **Purification**
  Isolating the functional protein for therapeutic use.

These proteins, produced through advanced biotechnological methods, ensure functionality and biological activity, essential for their therapeutic efficacy.

Other Therapeutic Applications

Cell lines are pivotal in innovative therapeutic areas, particularly gene therapy and regenerative medicine. Key applications include:

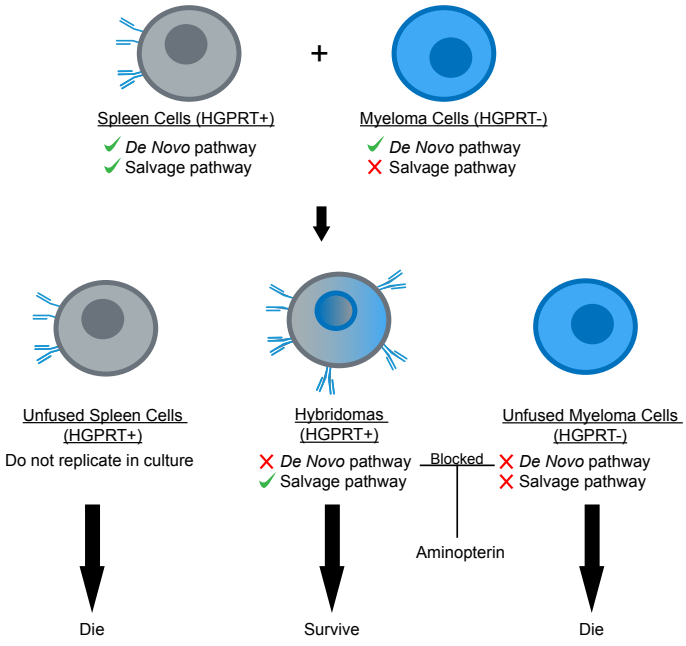
- **Gene Therapy**
  Using HEK293 cells to produce viral vectors that deliver therapeutic genes to patients' cells, aiming to treat genetic disorders by correcting or replacing faulty genes.
- **Regenerative Medicine**
  Employing specialized cell lines to develop stem cell therapies that can regenerate damaged tissues and organs, offering potential cures for degenerative diseases and injuries.

By harnessing the unique capabilities of various cell lines, these biotherapeutic applications not only address complex health challenges but also pave the way for groundbreaking treatments that improve patient outcomes and quality of life.

Hybridoma selection using HAT

Hybridomas are a specialized cell line created *in vitro* by the fusion of myeloma and spleen cells for the purpose of producing antibodies. The rationale behind fusing these two cell types together is that spleen cells produce the antibodies of interest but cannot replicate in culture. Thus, it is difficult to harvest antibodies from them. Myelomas, on the other hand, do not produce antibodies but do replicate in culture quite easily. Hybridomas take advantage of the properties of both cell types to mass produce antibodies of interest. During the fusion process, it is important to select for hybridomas over unfused cells in order to maximize antibody yield.

Spleen cells are easily selected against since they do not replicate in culture. Myelomas are more challenging to select against, but it can be accomplished through the use of media containing hypoxanthine, aminopterin, and thymidine (HAT). In order to understand the rationale behind this approach, it is important to note that mammalian cells can synthesize DNA nucleotides using two different pathways: the de novo and salvage pathways. Under physiological conditions, mammalian cells will use the de novo pathway to replicate. When the de novo pathway is blocked, cells will then utilize the salvage pathway (only if hypoxanthine and thymidine are present) as an alternative means to replicate.



The key to this approach is to use myeloma cells that are deficient in an enzyme (HGPRT) required for the salvage pathway. In this scenario, myelomas are unable to replicate because the de novo pathway is blocked by aminopterin and the salvage pathway is blocked by a deficiency in HGPRT. Hybridomas are able to replicate under HAT selection because they inherited a functioning HGPRT enzyme from the spleen cells. Following selection for hybridoma cells, aminopterin is no longer required as a selection agent. As cells recover from the selection pressures of aminopterin, they will still utilize the salvage pathway as a means to replicate. HT (hypoxanthine and thymidine) are maintained in the media until the hybridomas are fully recovered.

VIDEO

Enhancing Hybridoma Workflows: A Comprehensive Guide

Discover our solutions for a hybridoma workflow, detailing steps from fusion to binding affinity and internalization. Gain insights into generating and screening antibody libraries using hybridomas.

Monoclonal Antibodies

Monoclonal antibodies continue to enjoy intense interest as potential therapeutics. However, a major bottleneck in hybridoma cell line development is screening large heterogeneous populations of cells to find candidates yielding the highest amount of mAbs. This challenge can be overcome with automated technologies such as the ClonePix system, which enables *in situ* detection of secreted antibodies.

Here, we present a case study in which a hybridoma cell line has been optimized to produce and secrete a highly specific, non-cross reactive monoclonal antibody against a double-stranded DNA (dsDNA) virus.

Goal: To identify an optimal cell line that secretes a highly specific, non-cross-reactive monoclonal antibody to be used in biotherapeutic development against dsDNA viruses.

Background: Parental line was generated using limiting dilution method. Historical yield was less than 3mg/L of mAb, and quality of purified mAb was never uniform with varying amounts of aggregation observed in the preps.

Method: Parental hybridoma clones were expanded, followed by analysis and picking of the desired clones on the ClonePix system. A total of 480 clones were picked from source plate and imaged with the CloneSelect™ Imager for five days to determine cell growth. 146 top growers were isolated and screened for specificity.

Results: Two novel sub-clones showing optimal binding also showed a dramatic improvement in IgG production (17–25 mg/L) over historic yields of the parent clones (~1 mg/L). Hybridoma screening time was reduced by up to 50%.

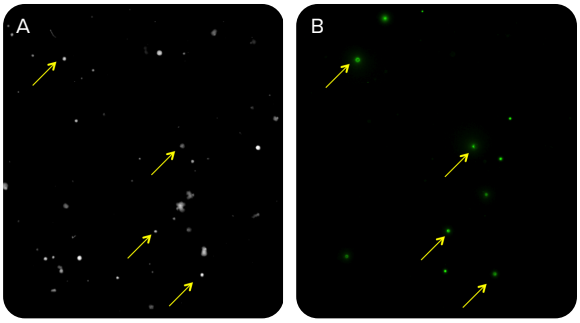


Figure 3. *Visualization of IgG secretion in parental hybridoma cell line suggests only a small set (~7%) is producing dsDNA virus-specific antibodies. Hybridoma cells were plated in CloneMedia semi-solid medium. Fluorescently-conjugated CloneDetect agent (green) was added to enable in situ detection of secreted IgG. (A) To visualize all colonies in a single view, colonies were imaged on a ClonePix system in white light at 150 ms. (B) Colonies were imaged in fluorescence at 500 ms in order to determine which ones secrete higher amounts of IgG. Variability of FITC signal as quantitated by Interior Mean Intensity and Exterior Mean Intensity indicate an unstable, non-monoclonal hybridoma cell line.*

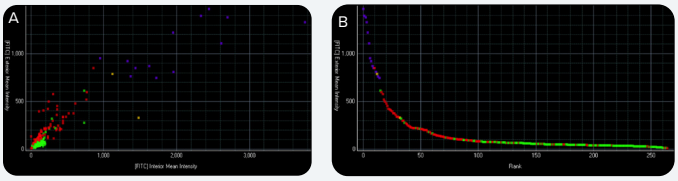


Figure 4. *Viable, high-secreting colonies are detected and selected using ClonePix Imager software analysis. (A) Scatter plot shows a linear correlation between Exterior and Interior Mean Intensity suggesting that the IgG is being secreted properly (otherwise immobilized on the cell surface with high Interior and low Exterior). The clones with low IGg yield are due to a heterogeneous population of variable secretors (i.e. only a few hybridomas, 5–6% of the total population, are producing IgGs, while the majority of clones are growing without IgG expression). (B) Ranking plot shows clones selected and picked for further characterization in purple.*

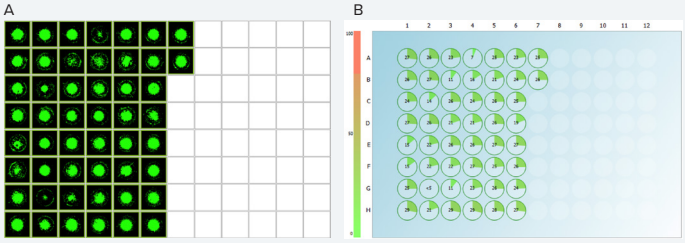


Figure 5. *CloneSelect Imager software analysis enables identification of optimally growing clones. Clones were selected and picked using the ClonePix system and deposited into a 96-well plate. Cell growth was then assessed over a period of seven days with the CloneSelect Imager. (A) Image analysis performed with the CloneSelect Imager software on a subset of the selected clones. Total well coverage from day seven is displayed in green. (B) Colony growth is tracked using pie charts, which indicate cell confluency in each well on day seven.*

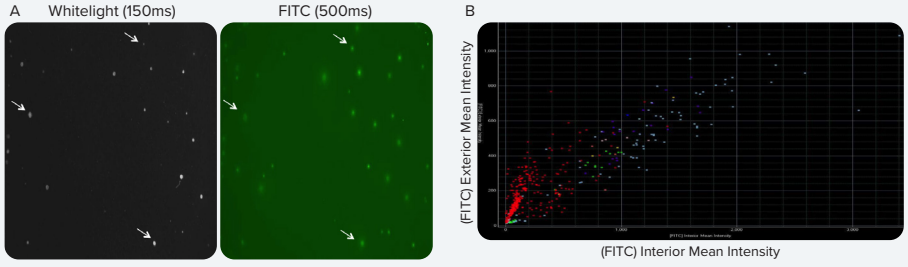


Figure 6. *Sub-cloning of parental hybridoma with the ClonePix system results in uniform IgG secretion at higher yields. Subset data for one sub-clone is shown. (A) A significant improvement in percentage FITC-positive colonies as a result of sub-cloning is observed as compared to the parental clone (Fig. 6 A, B). IgG secretion was detected at seven days growth by 100 U/mL of CloneDetect reagent. (B) Scatter plot shows a linear correlation between FITC exterior and Interior Mean Intensity; the slope is shifted towards the Y-axis indicating greater uniformity, while more clones in the upper quadrants indicates the presence of high-expressing FITC-positive clones.*

GPCRs

G protein-coupled receptors (GPCRs) are popular targets in drug discovery. However, the endogenous expression of GPCRs in mammalian cells is typically very low, with no more than 3,000 copies per cell. These levels are sufficient to maintain proper receptor function but present a challenge for GPCR drug discovery screening efforts. Most screening assays require a much higher concentration of functional GPCRs presented on the cell surface. Attempts to create expression systems in simple organisms have met with limited success due to inefficient folding (bacteria), low yield (yeast), or incorrect post-translation modification (baculovirus). These challenges fuel the market need for mammalian expression systems capable of providing elevated GPCR expression levels required to support drug discovery efforts.

The ClonePix system helps tackle the challenge of locating and isolating rare clones from large heterogeneous pools of transfected cells. Utilizing both white and fluorescence imaging *in situ*, the system can quantitatively detect endogenous and cell surface protein expression levels of respective GPCRs.

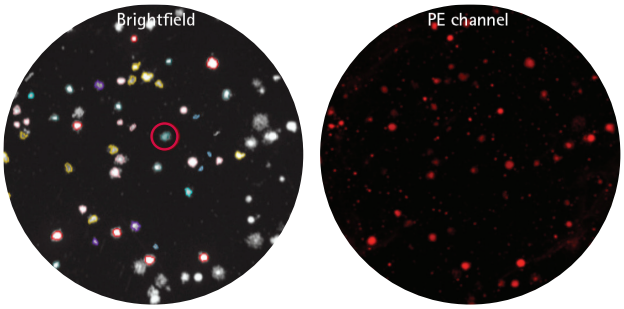


Figure 7. *Detection of CHO-M1 cells on ClonePix system. A transfected CHO-M1 cell line expressing endogenous G-protein coupled muscarinic acetylcholine receptor M1 (GPCR-M1) was chosen to demonstrate the feasibility of using the ClonePix system to detect cell surface proteins. CHO-M1 expressing clones were screened using anti-M1 antibody conjugated with PE (Phycoerythrin), selected based on fluorescence intensity, and picked using the ClonePix system. The system reveals diverse levels of fluorescent intensity with CHO-M1 cell line, demonstrating it can distinguish between various levels of expression of GPCR-M1 protein. Colonies recognized by the software are outlined in color under the brightfield channel. Fluorescence intensity is calculated based on the physical location of colonies.*

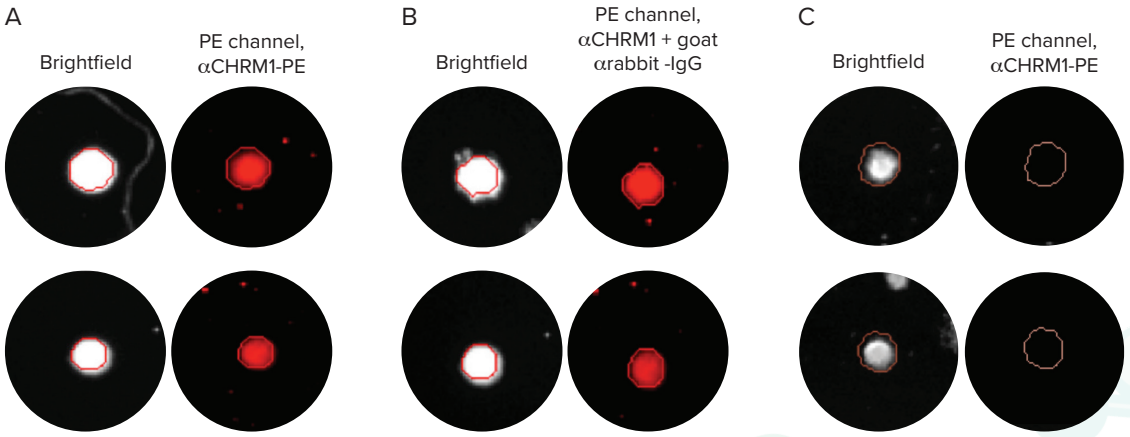


Figure 8. *Selection of GPCR M1-expressing clones with both direct labeled antibody (A) and dual-labeled antibodies (B) approach are shown (brightfield and fluorescence images). The fluorescent intensity is proportional to M1 expression in the positive clones. (C) The negative control, CHO-K1 cell line demonstrates no fluorescence in the PE channel.*

Other Proteins

The underlying technology in the ClonePix system allows the system to screen and select high value cell lines beyond mAbs and GPCRs, such as tagged or untagged recombinant proteins and cell-surface proteins. Using target-protein specific, fluorescent-labeled antibodies combined with imaging and robotic processing/picking techniques, the ClonePix system can significantly improve efficiency while generating optimal cell lines that secrete the highest levels of the desired proteins. Some examples are shown below.

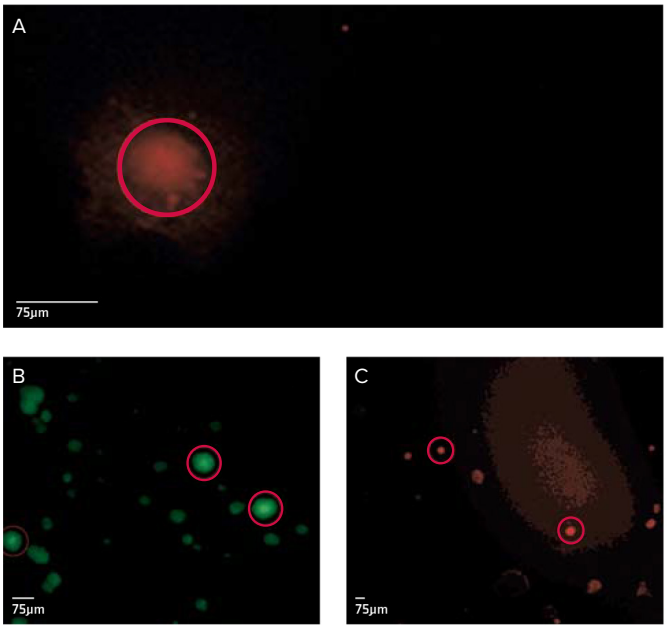


Figure 9. *Selection of transfected, exogenous cell surface proteins. Detection and selection of colonies of cells expressing endogenous receptors (examples of selected colonies indicated with red circles); colorized images from the ClonePix system. (A) Jurkat cells grown in semi-solid medium with Red-Phycoerythrin (RPE) labeled antibody to the T-cell receptor CD3 at day 12 and the cells imaged and picked on day 14. (B) HEK 293 cells grown in semi-solid medium with FITC-labeled antibody to the ICAM-1 adhesion molecular added at day 12. The cells imaged and picked on day 14. (C) CGR8 mouse embryonic stem cells grown in semi-solid medium with RPE-labeled antibody to the pluripotency marker SSEA-1 added at day 9. The cells imaged and picked on day 10.*

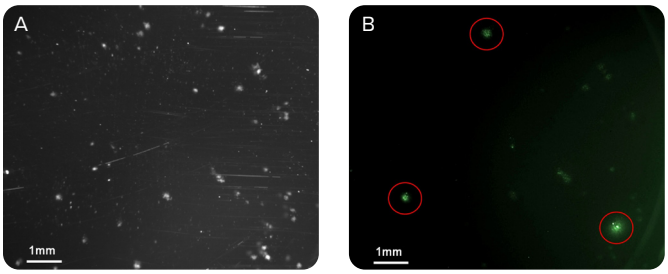


Figure 10. *Detection and picking of cells producing tagged, non-mAb proteins. Tagged recombinant proteins can be detected by probing with fluorescently-conjugated antibody against tags. CHO cells were transfected with a construct encoding the protein of interest with the His6- and FLAG-tag sequences at the C-terminus of the protein and detected using a mix of anti-His and anti-FLAG antibodies. (A). White light image of adherent CHO colonies. (B) Fluorescent image of the colonies. They were grown as suspension in CloneMatrix-based semi-solid medium. Imaged with antibodies to His6 and FLAG, of which the anti-His6 antibody was conjugated to FITC to allow fluorescent visualization of the secreted protein.*

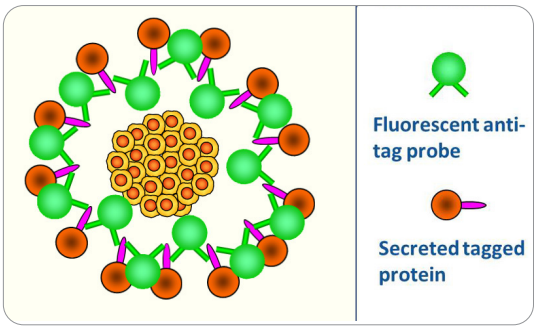


Figure 11. *Principle for detecting tagged recombinant proteins. Principle of the technology in the ClonePix system for detecting tagged recombinant proteins. The secreted tagged protein is trapped in the vicinity of the colony and visualized using fluorescently-conjugated anti-tag antibody.*

Automating Cell Line Development

Role of Automation in Enhancing Productivity

Automation plays a pivotal role in modern cell line development, significantly enhancing productivity and efficiency. By automating routine and complex tasks, laboratories can achieve higher throughput, reduced human error, and greater consistency. Automation streamlines processes such as cell culture maintenance, media preparation, screening, and selection, allowing researchers to focus on more critical and innovative aspects of their work. This leads to faster development timelines, improved reproducibility of results, and ultimately, quicker progression from research to clinical applications.

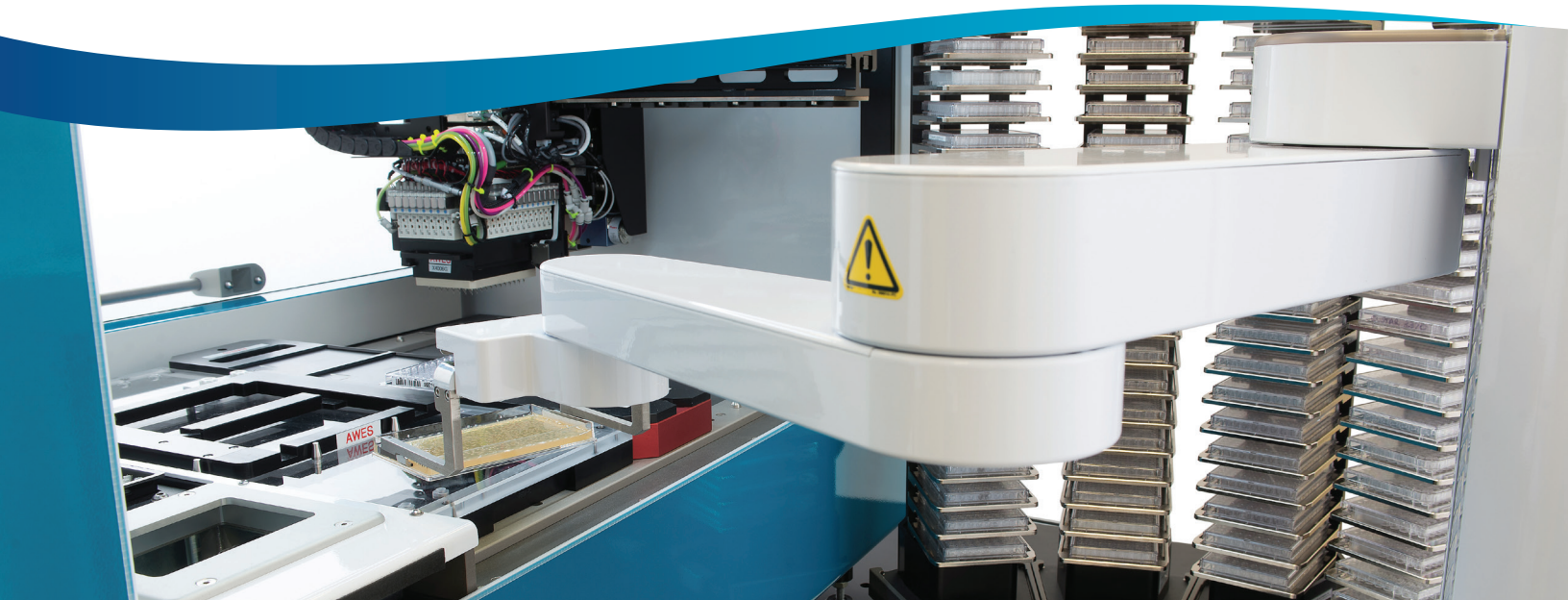
Benefits and Challenges of Automation

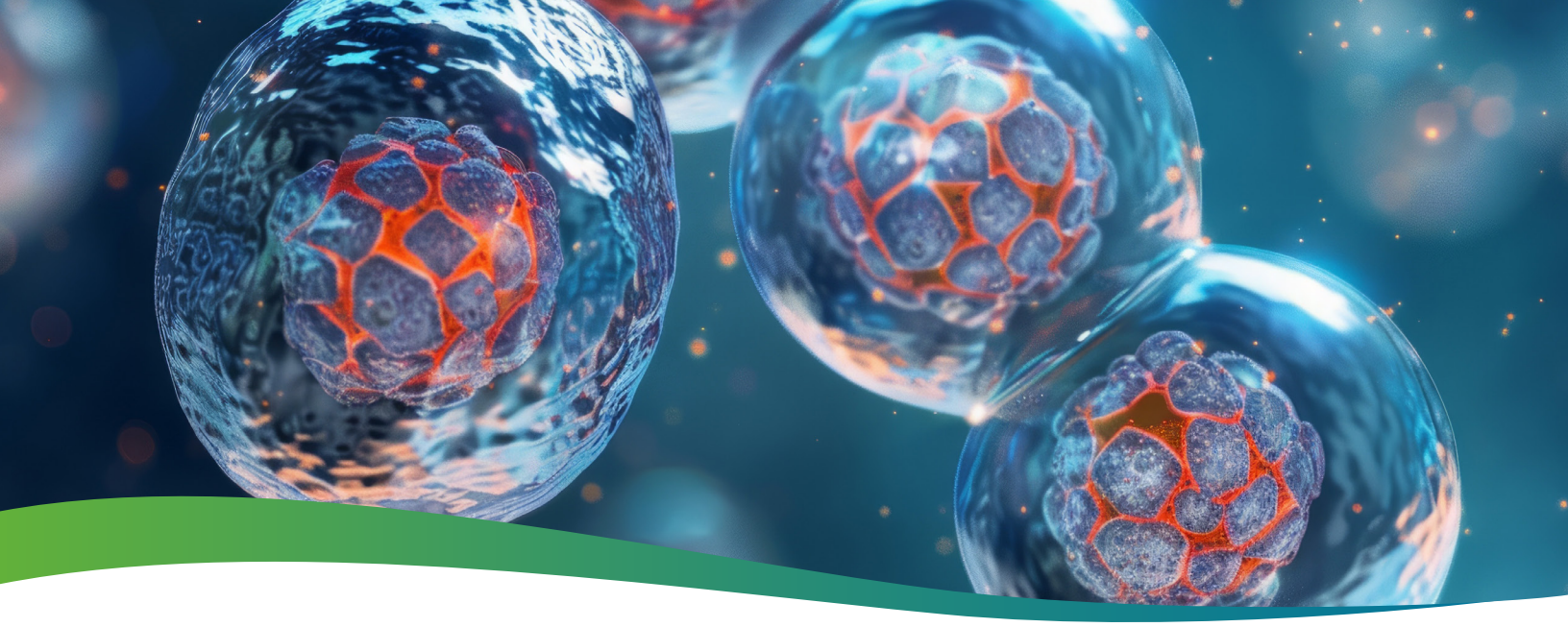
Benefits

- **Increased Throughput**
  Automation enables the processing of large sample volumes, accelerating the pace of research and development.
- **Enhanced Accuracy and Reproducibility**
  Automated systems reduce human error and provide consistent results, crucial for reliable data and reproducibility.
- **Time Efficiency**
  By automating routine tasks, researchers can devote more time to critical analysis and innovation, speeding up project timelines.
- **Scalability**
  Automated systems can easily scale up processes, facilitating the transition from small-scale research to large-scale production.

Challenges

- **Initial Investment**
  The cost of acquiring and implementing automated systems can be high, requiring significant initial investment.
- **Technical Expertise**
  Operating and maintaining automated systems necessitates specialized technical skills and training.
- **Integration**
  Integrating new automation technologies with existing laboratory workflows can be complex and may require workflow adjustments.
- **Maintenance and Downtime**
  Automated systems require regular maintenance, and any downtime can disrupt the research process.





Cell Culture Conditions and Optimization

Media Formulation and Supplements

The success of cell culture depends on the precise formulation of growth media and essential supplements. Media must provide nutrients like amino acids, vitamins, and growth factors. Common supplements include serum and specific growth factors tailored to the cell type. Optimizing media composition is crucial for maintaining cell health and maximizing productivity.

Optimization of Culture Conditions for High Yield

High yields in cell culture require optimizing conditions such as temperature, pH, oxygen levels, and nutrient supply. Factors like cell density and agitation speed in bioreactors are critical for growth. Regular monitoring ensures cells remain in their ideal environment, leading to enhanced production of proteins or antibodies. Automated systems can refine these conditions for consistent outcomes.

Scale-Up Strategies for Large-Scale Production

Scaling up from lab cultures to large-scale production involves strategic adjustments in bioreactor design, aeration, and nutrient distribution. Robust protocols maintain cell viability and productivity. Techniques like fed-batch and perfusion culture enhance cell density and yield, meeting commercial demands.

High-Throughput Screening Techniques

High-throughput screening (HTS) techniques are essential for identifying high-producing clones quickly and efficiently. These methods allow researchers to process thousands of samples simultaneously, significantly reducing the time required to find optimal clones. HTS utilizes automated systems to handle large volumes of data, ensuring accuracy and reproducibility in clone selection.

Automate Fast, Robust Clone Screening

Researchers are moving away from limiting dilution because it significantly prolongs the time to antibody discovery. Automation is needed to scale productivity, throughput, and reduce development time. One solution is to use the ClonePix 2 system, an automated colony picker capable of screening large numbers of clones from heterogeneous populations. The system requires mammalian cell lines to be cultured in semi-solid media (e.g. CloneMedia), enabling formation of discrete colonies, each originating from a single parent cell. Individual isolation of these discrete colonies with the system ensures high probability of monoclonality in a single step. In addition, reagents (e.g. CloneDetect) can be added directly into the semi-solid media to measure total protein secretion over time, or *in situ* antigen specificity. Heterogeneous populations of cells can then be rapidly screened using white light to detect colonies based on morphology and size (indicators of monoclonality and growth rates, respectively). Multiple fluorescent wavelengths can be used to quantify secreted proteins, cell surface protein expression, or *in situ* antigen specificity. The instrument's software also allows automatic colony ranking based on user-defined criteria such as fluorescence intensity, which is typically used to benchmark protein titer such as in a typical CHO cell line development process or target binding such as in hybridoma research workflow. The instrument can then accurately pick high-ranking colonies, eliminating errors associated with limiting dilution.

Select and pick with more accuracy and confidence

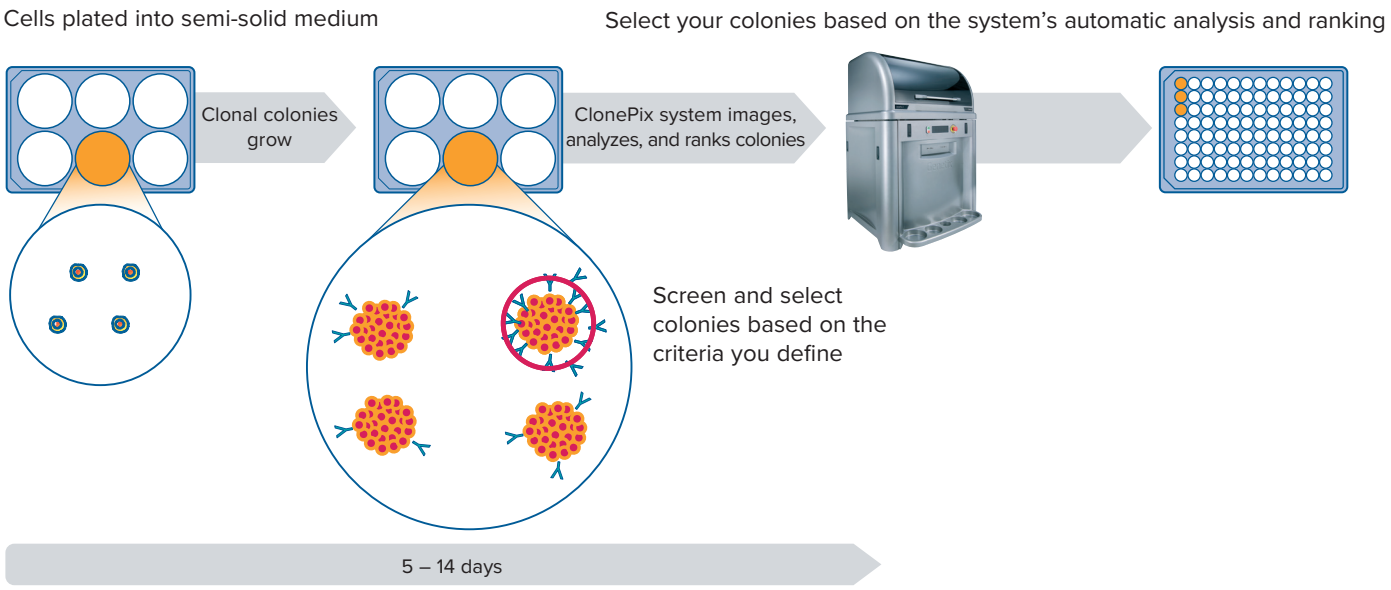


Figure 12. *ClonePix system workflow. Cells are grown in semi-solid medium, forming discrete clonal colonies. Next, these colonies are screened based on morphology, size, and secretion level using label-free detection of secreted antibodies (such as CloneDetect) or tagged recombinant proteins and expression markers. Finally, these clones are ranked and accurately picked, thus eliminating errors associated with limiting dilution.*

High-Throughput Screening Techniques

Select and pick with more accuracy and confidence

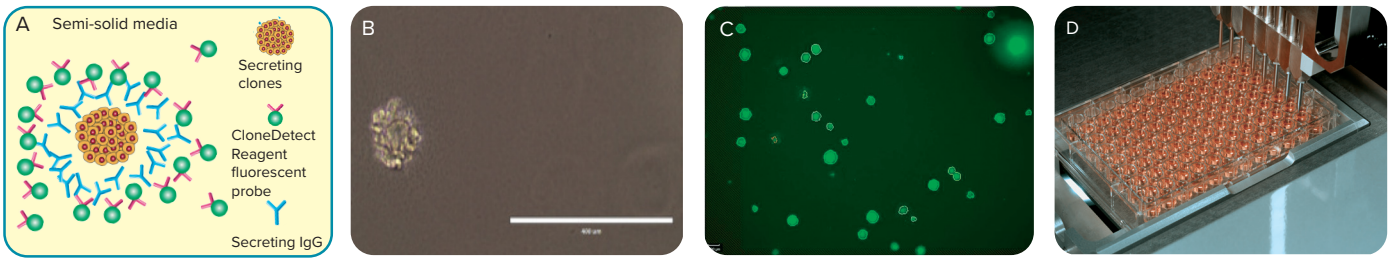
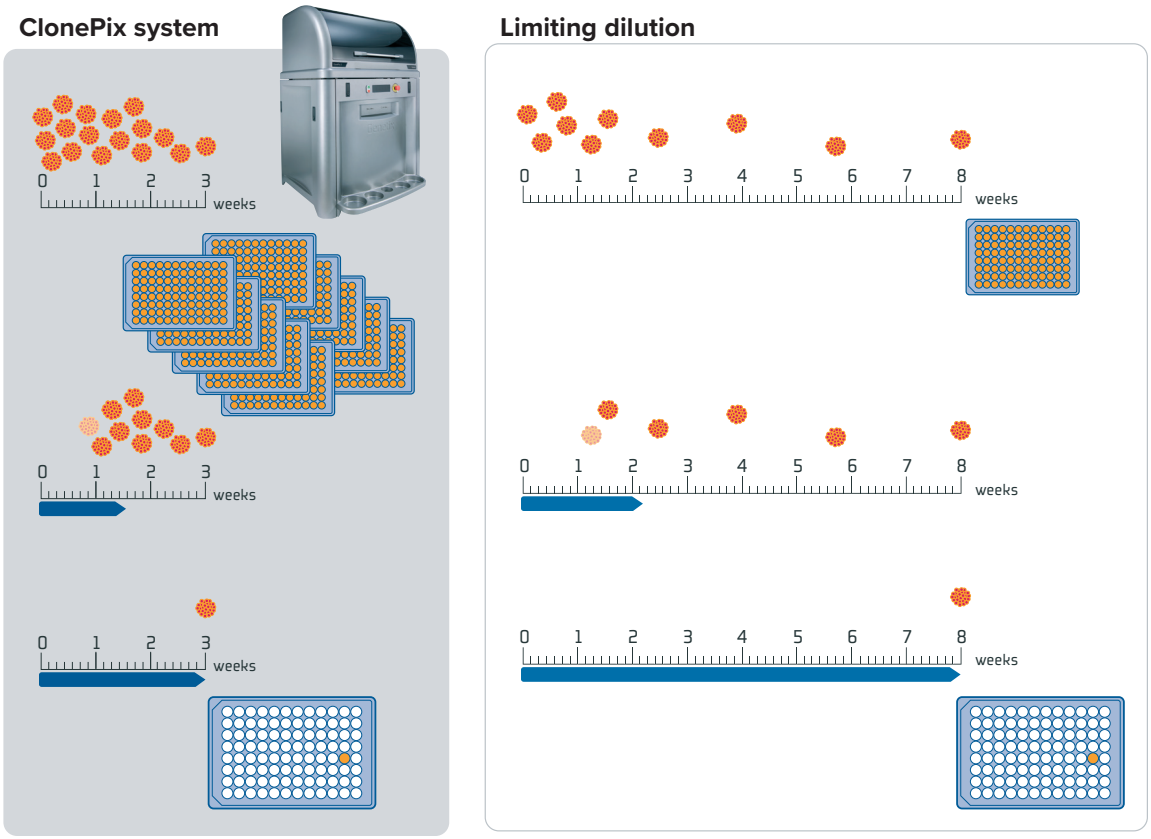


Figure 13. *The principle of ClonePix technology. (A) Conceptual overview of secreted protein detection from individual clones grown suspended in a methycellulose matrix. (B) White light image of a clonal colony (in this case, antibody surrounding a growing hybridoma clone). Note the optical clarity of the image and spherical formation of the clonal colony (important for colony integrity) produced using CloneMedia medium. (C) Fluorescence image of secreted antibodies imaged on the ClonePix system. (D) After automated picking of clones, the ClonePix system transfers the isolated target clones to destination plates.*

ClonePix system vs. limiting dilution



...screens 10,000 clones in three weeks **...screens 1,000 clones in eight weeks**

Figure 14. *ClonePix system can shorten colony screening time significantly over traditional methods such as serial limiting dilutions. Cells are sequentially diluted into well plates at the concentration of less than one cell per well in the serial limiting dilution approach. Typically this method takes months to screen the desired colonies (e.g. only ~1,000 clones are screened in eight weeks). The ClonePix system, however, can shorten the time significantly (~10,000 clones in three weeks).*

Monoclonality Assurance

When developing cell lines for biotherapeutics, it is crucial from a quality and regulatory perspective to ensure that the cell line originates from a single progenitor and is therefore monoclonal. Traditional cloning methods (e.g. limiting dilution and FACS) use statistical analysis to determine a confidence level for monoclonality. However, the documentation of monoclonality (a regulatory metric for biological cell lines) has driven the need for more robust technologies and methodologies in bioprocessing. Many researchers now routinely use imaging systems, such as the CloneSelect Imager coupled with DispenCell for single-cell dispensing technology, to verify monoclonality and monitor cell growth in cell culture media.

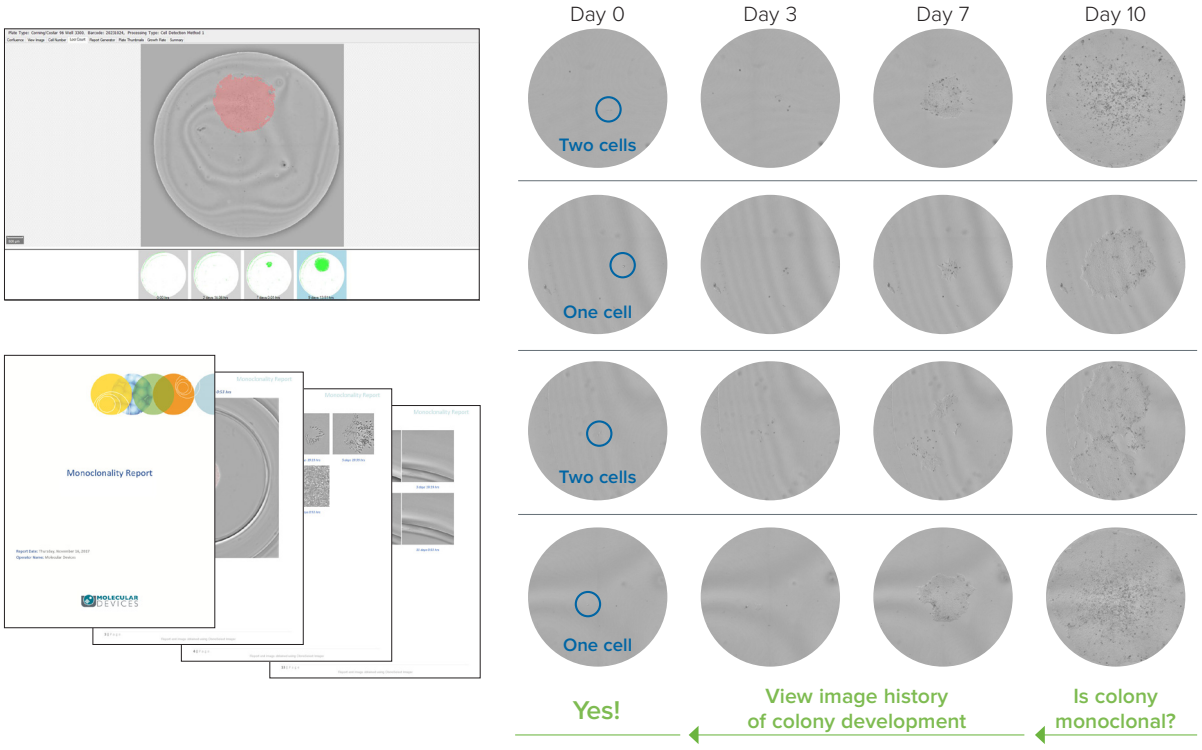
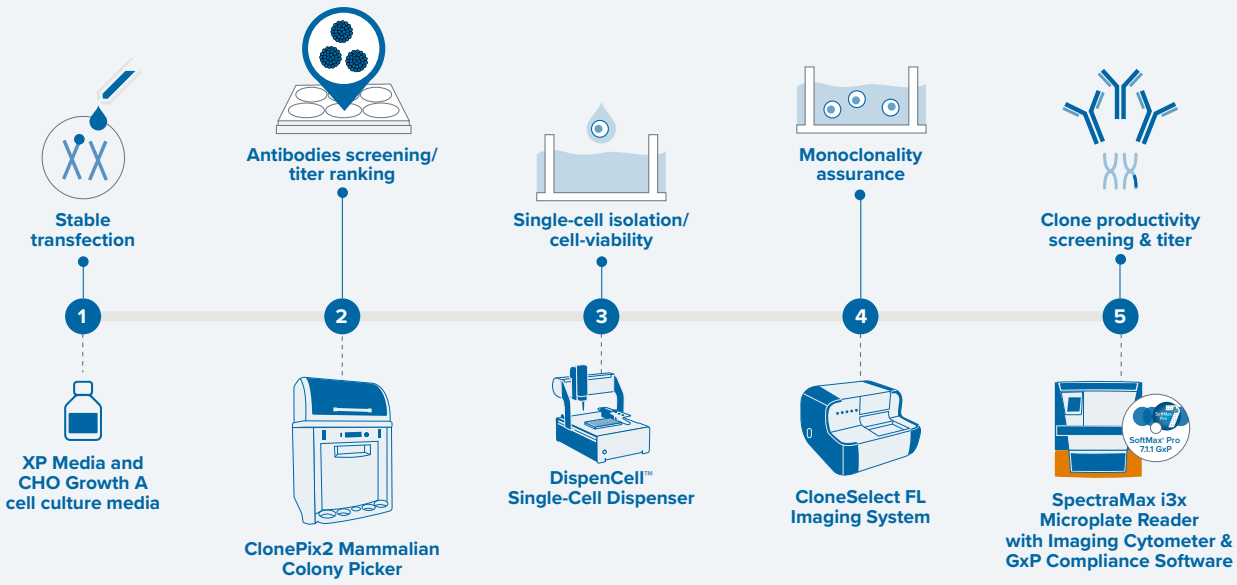


Figure 15. *The CloneSelect Imager FL software allows you to toggle between images at different time points. This is an example of how the instrument helps differentiate and assure (Day 0 assurance) the presence of a cell versus multiple cells or debri on Day 0.*



Use of Imaging and Fluorescence Technologies

Imaging and fluorescence technologies are critical for advanced screening and selection processes. These methods enable the visualization and quantification of protein expression, cellular interactions, and other vital parameters in real-time. Fluorescence-based assays, in particular, allow for the precise detection of specific biomarkers, aiding in the identification of high-producing clones.

ImageXpress® Micro Confocal High-Content Imaging System

The ImageXpress® Micro Confocal system offers high-resolution imaging capabilities, allowing for detailed analysis of cellular and subcellular structures. It supports various applications, including high-content screening, and 2D cell models, and live-cell imaging.

SpectraMax® iD5 Multi-Mode Microplate Reader

The SpectraMax® iD5 reader integrates multiple detection modes, including absorbance, fluorescence, and luminescence. It provides flexibility and sensitivity for a wide range of applications, enhancing the screening and selection of optimal clones.

PRODUCT SPOTLIGHT

CellXpress.ai™ Automated Cell Culture System

The CellXpress.ai™ Automated Cell Culture System automates the entire cell culture process, improving workflows and making assays more reliable. This AI-driven hub provides control over feeding and passaging schedules, eliminating constant lab presence and maintaining 24/7 operation for multiple cell lines, spheroids, or organoids.

- **Automate Cell Culture Processes**
  Control feeding and passaging schedules, reducing hands-on time.
- **Improve Screening Workflows**
  Around-the-clock operation for efficient growth and scaling of multiple cell types.
- **Develop Reliable Assays**
  Machine learning standardizes processes, delivering consistent results at scale.

Cell Line Development Solutions

DispenCell™ Single-Cell Dispenser

Compact, automated cell dispenser for fast, easy and gentle single-cell isolation

The DispenCell Single-Cell Dispenser is an automated benchtop solution designed for fast, easy and gentle single-cell isolation. DispenCell integrates seamlessly into your laboratory workflow, with a plug-and-play approach. Flexible and effortless, DispenCell operates equally under sterile conditions in a culture hood, or on a simple benchtop.

- Immediate and traceable proof of clonality
- As gentle as manual pipetting
- Compact to fit perfectly into any laboratory setting
- Proof of clonality, high-cloning efficiency, and contamination-free

ClonePix® 2 Enhanced for Monoclonality Verification

Cell line development solutions with automated clone screening

Screen more clones in less time with monoclonality verification on day zero, then screen and identify for highest producers in weeks, not months.

- Screen 10X more clones than limiting dilution
- Increase probability of identifying high-value clones
- Condense the workflow into a singular solution from single cell isolation to titer
- Eliminate or recover unstable clones early

CloneSelect® Imager and CloneSelect Imager FL

Verify monoclonality confidently

Add high-contrast multichannel fluorescent technology in addition to the standard white light imaging that allows for accurate single-cell detection and proof of monoclonality at day 0. Streamline your workflow with comparative confluence assays to identify and verify gene edits.

- Document evidence of single cells and confluency digitally for auditing and submission to regulatory authorities
- Image cells non invasively at multiple time points to monitor colony formation
- Screen using high resolution white light imaging
- Deliver real-time results with on-the-fly analysis
- Automation and integration ready

SpectraMax® iD3/iD5 and i3x Multi-Mode Microplate Readers

Multi-user microplate readers with a large touchscreen and NFC functionality*

The SpectraMax iD3, iD5, and i3x Multi-Mode Microplate Readers measure absorbance, fluorescence, and luminescence. In addition, the SpectraMax iD5 and i3x readers measure TRF and FP and can be expanded to include TR-FRET, HTRF®, BRET, and western blot detection. All of these readers are can be equipped with dual injectors. The SpectraMax i3x reader is field-upgradable to include the SpectraMax MiniMax 300 Imaging Cytometer, enabling a wealth of cell-based applications.

With optimized reagents, option to operate the readers using the touchscreen or a computer, and industry-leading SoftMax® Pro Software, the readers provide an all access pass for breakthrough research.

- Personalize workflows
- Simplify tasks
- Western blot analysis and imaging

*iD3 and iD5 only

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Contact Us

Phone: +1.800.635.5577
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