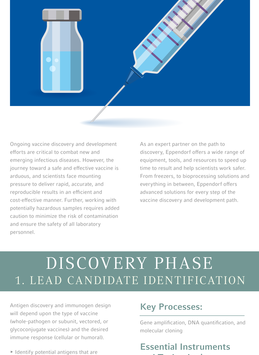
eppendorf

Advanced Solutions for Vaccine Discovery and Development

The right partner and technologies can help overcome common challenges



Ongoing vaccine discovery and development efforts are critical to combat new and emerging infectious diseases. However, the journey towards a safe and effective vaccine is arduous, and scientists face mounting pressure to deliver rapid, accurate, and reproducible results in an efficient and cost-effective manner. Further, working with potentially hazardous samples requires added caution to minimize the risk of contamination and ensure the safety of all laboratory personnel.

As an expert partner on the path to discovery, Eppendorf offers a wide range of equipment, tools, and resources to speed up time to result and help scientists work safer. From freezers, to bioprocessing solutions and everything in between, Eppendorf offers advanced solutions for every step of the vaccine discovery and development path.

DISCOVERY PHASE

1. LEAD CANDIDATE IDENTIFICATION

Antigen discovery and immunogen design will depend upon the type of vaccine: whole-organism or subunit, vectored, or glycoconjugate vaccines and the desired immune response (cellular or humoral).

- Identify potential antigens that are conserved across all strains, and those essential for pathogenicity
- Antigen-purification: express antigen as a protein or in a viral vector
- Quality control to confirm antigen conformation
- Compare potential antigens in appropriate model systems

Key Processes:

Gene amplification, DNA quantification, and molecular cloning

Essential Instruments and Technologies:

Thermal cyclers, spectrophotometers, heating/cooling/mixing platforms

CHALLENGE:

PCR is an essential technique for antigen expression and purification. Slow speed and low throughput can create bottlenecks in the discovery process.

SOLUTION:

Fast-ramping thermal cyclers can accelerate heating and cooling for a faster time to result. For example, a faster ramp rate of 10°C/s can reduce runtime to under 40 minutes.

DEVELOPMENT PHASE

2. LEAD DEVELOPMENT

Lead candidates are refined to induce optimal responses in subsequent in vivo and in vitro assays.

- Re-cloning to ensure it is appropriate for host inoculation
- Strain development to ensure it can be produced optimally in vitro and for the study of antigen presentation
- Determination of critical quality attributes (CQAs) including physical, chemical, biological, or microbiological properties
- Determination of chemical and thermostability, potential interaction between preservatives and antigen, and adjuvantation

Key Processes:

Molecular cloning, storage (bacteria, plasmid, genetic material, virus, and reagent), transformation, transfection and cell growth, and quality analysis

Essential Instruments and Technologies:

Thermal cyclers, ultra-low temperature freezers, shakers and evaporators, bioreactors and bioprocess equipment

CHALLENGE:

An incubator must maintain uniform temperature and atmospheric conditions, and minimize vibration and turbulence to protect sensitive cells.

SOLUTION:

CO_2 incubators equipped with multiple temperature sensors, and rapid temperature and CO_2 recovery capabilities ensure stable conditions. A fan-less design can reduce vibration and turbulence.

CHALLENGE:

An incubated lab shaker is necessary when the growth atmosphere needs to be maintained at medium or high throughput, but must be flexible to adapt to changing needs.

SOLUTION:

A shaker with a wide range of accessories and platforms, including tricky pads, clamps, and test tube and microplate racks is easily configured for any application.

3. IN VITRO AND IN VIVO STUDIES

These studies are designed to assess the ability of the candidate antigen/vaccine to induce a protective immune response without adverse effects.

- Candidate antigen/vaccine administration followed by monitoring for signs of reactogenicity
- Assess serum and/or peripheral blood mononuclear cells for antibodies, number and function of T cells
- Assess safety and toxicity in target organs and determine appropriate dose (often performed in a rodent and non-rodent species)

Key Processes:

Antibody analysis, hematology testing, histopathological evaluation, clinical chemistry

Essential Instruments and Technologies:

Ultra-low temperature freezers, centrifuges, thermal cyclers

CHALLENGE:

Ultra-low temperature storage (-80°C) is important to preserve sample integrity, especially for long-term storage. Many ultra-low temperature (ULT) freezers are inefficient, and have high operating costs.

SOLUTION:

Energy-efficient ULTs are designed with superior polyurethane and vacuum insulation panels, and use environmentally friendly cooling liquids to provide superior temperature stability and significantly lower operating costs.

CHALLENGE:

Refrigerated centrifuges protect temperature-sensitive samples, but the time required to cool from room temperature to a set temperature can create inefficiencies during analysis.

SOLUTION:

A centrifuge with rapid pre-cooling capabilities can cool from +21°C to 4°C in only 8 minutes.

LEAD CANDIDATES IDENTIFIED

4. PROCESS DEVELOPMENT

Process development begins to create a scalable manufacturing process.

- Upstream and downstream processes are designed
- If relocation is required, essential materials, SOPs, product and process characterization/validation assays must be transferred to the manufacturer
- Analytical data obtained for process controls, product and impurities characterization and release assays
- Pilot scale-up studies

Key Processes:

Bioprocessing

Essential Instruments and Technologies:

Bioreactors

CHALLENGE:

Running large scale processes during development is costly. Modernizing production processes to run at a smaller scale makes it possible to run multiple conditions in parallel and reduces the cost of development.

SOLUTION:

A miniature bioreactor system with multiple blocks is ideal for parallel processing and experimental design.

5.PROCESS VALIDATION

Process validation is the collection and evaluation of data that establishes scientific evidence that a manufacturing process will consistently deliver quality products.

- Quality control and stability testing
- Engineering batches are produced to finalize processes prior to the GMP campaign
- Animal toxicology (reproductive) study data to determine potential effects on male and female reproduction, and developmental toxicity

Key Processes:

Bioprocessing

Essential Instruments and Technologies:

Bioreactors and bioprocess control systems

CHALLENGE:

Bioprocess systems control parameters such as pH, dissolved oxygen, temperature, and agitation. These systems must be flexible and scalable to meet changing needs including scale up and scale down, and batch or fed-batch processes.

SOLUTION:

A flexible, universal platform can support the operation of multiple bioreactors (in any combination of vessel types) in parallel, and is capable of operating at processes at different scales.

6. MANUFACTURE

- GMP manufacture (bulk): multiple batches (or lots) of antigen are produced and undergo quality control tests
- GMP manufacture (fill/finish): the bulk product is diluted to produce the desired concentration of antigen, packaged in vials or syringes, and labeled. A number of these undergo testing to confirm sterility, protein concentration, and safety.
- Prepare clinical trial application

Key Processes:

Bulk manufacture

Essential Instruments and Technologies:

Fermenters

CHALLENGE:

Downstream processing is required to produce large volumes of highly concentrated, biologically active components. Batch processing requires additional time for start-up and turnaround, and can create bottlenecks in production.

SOLUTION:

Fermentors equipped with specially designed impellers can facilitate continuous and perfusion processes, and reduce production downtime.

CLINICAL DEVELOPMENT

Clinical trial applications are prepared for entry into clinical development phase.

eppendorf

To learn more about Eppendorf solutions for vaccine discovery and development, visit: www.eppendorf.com/vaccines

Lab Manager

*This infographic was created in cooperation with Lab Manager