Science of Biosimilars

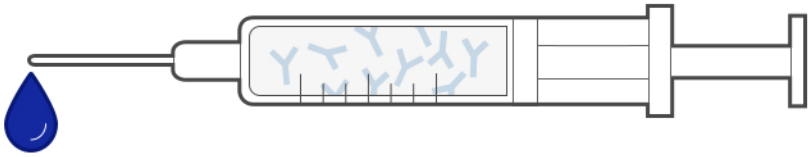
Biosimilars are biologic medicines which are far more complex to develop compared to generic chemical drugs.

The Development and Manufacturing of Biosimilars

01. Characterization of the Reference Biologic

Biosimilar development begins with a characterization of the reference biologic by analyzing and identifying its quality attributes, such as the molecule's physicochemical properties, immunochemical properties, biological activities and quantity and types of impurities. The data collected is used to define the Critical Quality Attributes (CQA) of a biosimilar.

Reference Biologic

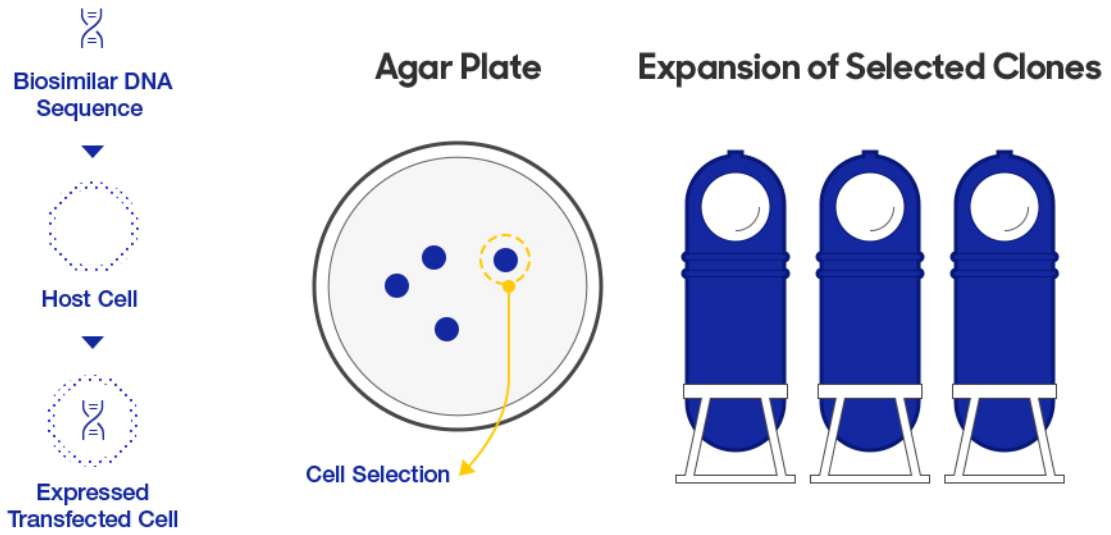


Analytical Consideration

- Biological Activity
- Purity and Impurity
- Physicochemical Properties
- Immunological Properties
- Quantity

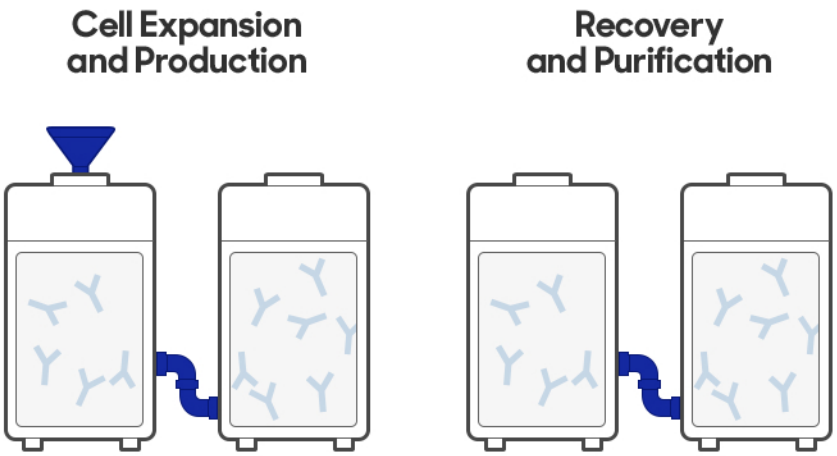
02. Cell Line Development

To generate a cell line, the DNA sequence encoding the target product is incorporated into an expression vector, which is then transfected into a host cell for stable expression of the biosimilar drug. Typically, more than 15,000 single clones are screened for generation of a lead cell line that will ultimately become the production source for the biosimilar drug.



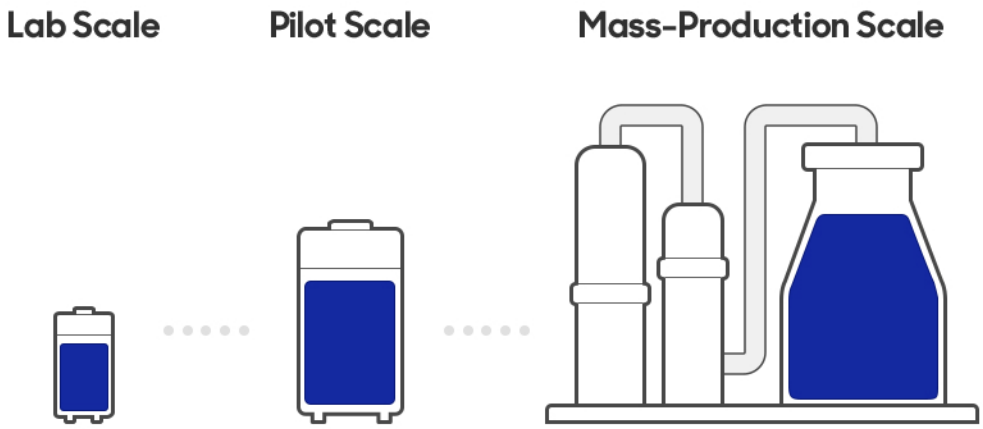
03. Manufacturing Process Development

The lead cell line is subjected to manufacturing process development at lab scale, in order to meet biosimilarity requirements. The cell culture conditions are refined to improve yield and reduce impurities. Hundreds of cell culture experiments are conducted to develop a process that maintains optimal growth conditions. Hundreds of purification experiments are performed for each product to effectively remove impurities and to help achieve consistency and quality.



04. Scale-Up

Pilot scale studies entail extensive quality assessments, including real-time monitoring and product quality control. Cultures often behave differently at large scale than at lab scale, and a careful monitoring of the essential quality attributes is required. At the mass-production scale, control strategies are put in place to maintain the quality of the biosimilar product.



05. Final Product

The formulation of the final product can also affect quality. Final drug products are manufactured under current good manufacturing practice (cGMP) regulations, following a manufacturing process that has been validated to meet the requirements of various regulatory agencies. The final form can be a vial, pre-filled syringe or auto-injector.