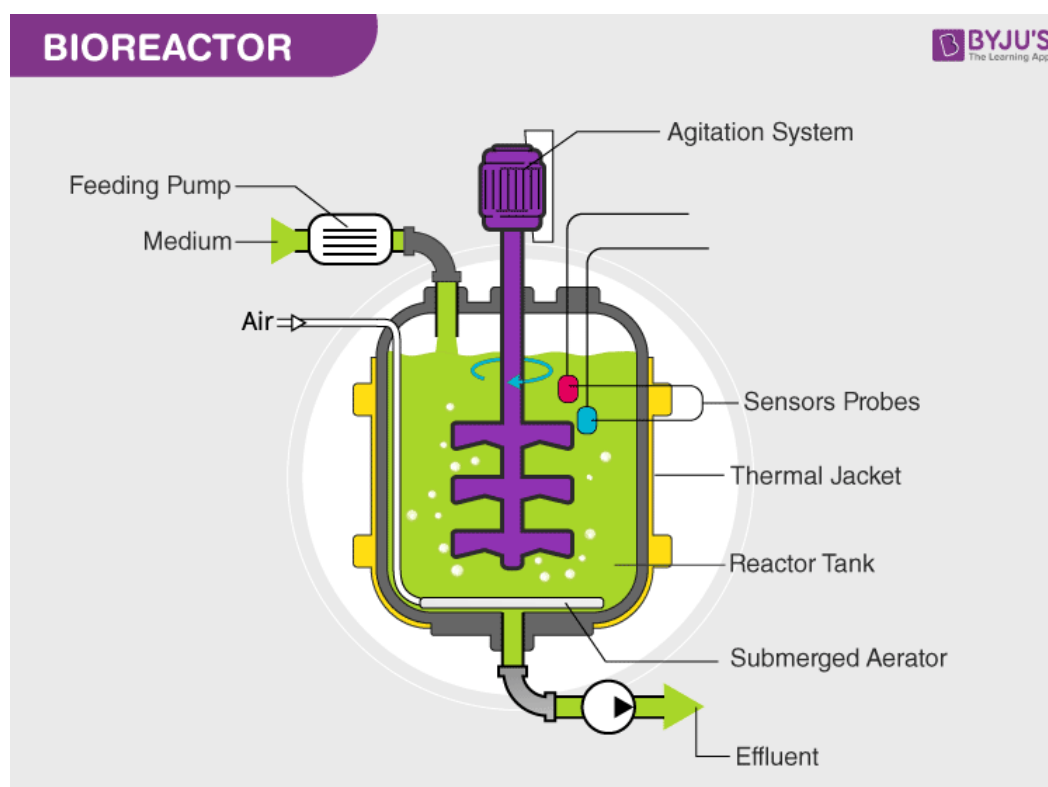


## BIOREACTORS

Bioreactors are **vessels or tanks in which whole cells or cell-free enzymes transform raw materials into biochemical products and/or less undesirable by-products.**

The microbial cell is a **miniature bioreactor**; other examples include shake flasks, Petri dishes, and industrial fermentors.

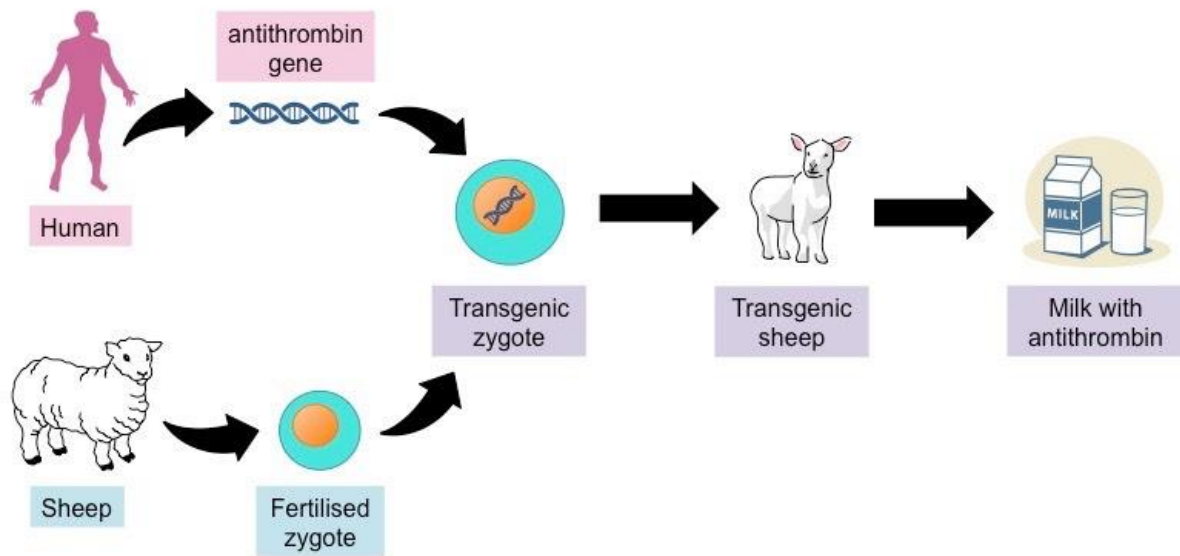
A bioreactor helps to produce a large volume of culture. The bioreactor is a large vessel where the different cells such as human or plant, or animal cells can be cultured to obtain new biological products. It provides optimum conditions like temperature, pH, substrate, oxygen, etc required for the culturing of cells producing desired products. Simple stirred-tank bioreactor and sparged stirred-tank bioreactor are the two types of bioreactors used for this purpose.



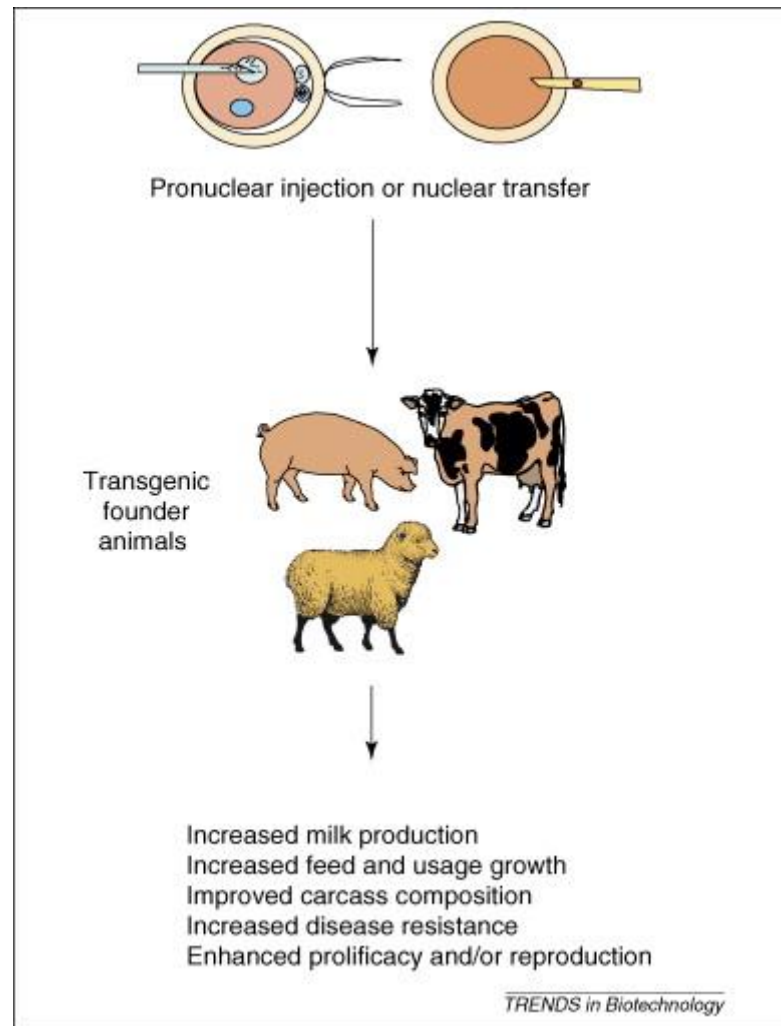
## Downstream Processing

Downstream processing is a sequential step in which the isolation, purification and preservation of final products are done before it is marketed. In this stage, the final product is formulated with additives like preservatives, colours, etc., followed by clinical trials.

## BIOPHARMING



Biopharming is **the production and use of transgenic plants and animals genetically engineered to produce pharmaceutical substances for use in humans or animals**. It often involves the insertion of gene constructs derived from humans.



## RISKS OF BIOPHARMING

Critics of biopharming involves plants process proteins differently than animals or humans, **the body might recognize a “human” protein produced in plants as foreign, triggering an allergic reaction.**

## RECOMBINANT VACCINES

A recombinant vaccine is a vaccine produced through **recombinant DNA technology**. This involves inserting the **DNA encoding an antigen** (such as a **bacterial surface protein**) that stimulates an immune response into bacterial or mammalian cells, expressing the antigen in these cells and then purifying it from them

The recombinant vaccines may be broadly categorized into three groups:

**Subunit recombinant vaccines:**

- These are the components of the pathogenic organisms. Subunit vaccines include proteins, peptides and DNA.

**Attenuated recombinant vaccines:**

- These are the genetically modified pathogenic organisms (bacteria or viruses) that are made non-pathogenic and used as vaccines.

**Vector recombinant vaccines:**

- These are the genetically modified **viral vectors** that can be used as vaccines against certain pathogens.

**ANIMAL CLONING**

Cloning is a process that produces **genetically identical genes, cells, tissues and organisms**.

Some plants and bacteria produce clones through asexual reproduction.

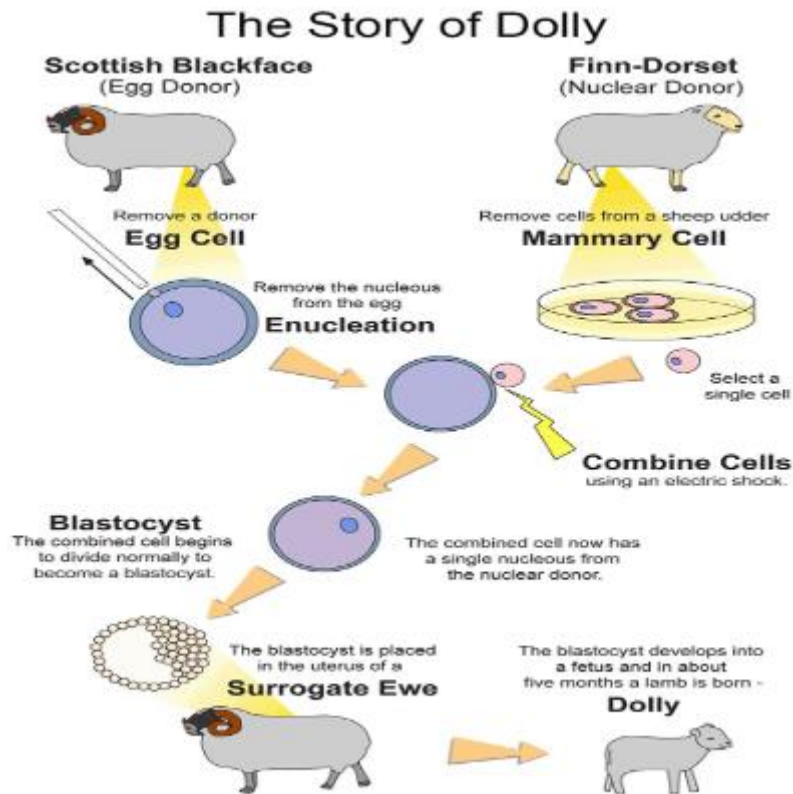
- Natural **human clones** are known as **identical twins**.
- The twins are produced when as **embryo splits**, creating two or more embryos that have almost identical DNA

**Types of Artificial cloning**

- Gene cloning-Produces copies of genes or **segments of DNA**
- **Reproductive cloning** produces copies of whole animals
- **Therapeutic cloning** produces stem cells for experiments aimed at creating new tissues to replace injured or diseased tissues

**Procedure**

- Scientists remove a cell (like a skin cell) from the animal they want to copy
- They remove the nucleus of an egg cell from the surrogate mother (the female who will grow and birth the clone)
- They put the DNA from the skin cell into the egg cell of the surrogate mother
- A few months later, the clone is born (a baby)



## Transgenic microbes

The microorganisms which carry **foreign genes** are called **transgenic microbes**. A number of microbes (e.g., *Lactobacillus*, *Leuconostoc*, *Bacillus*, *Streptomyces*, *Yeast*, *Rhizopus*, *Penicillium*, *Aspergillus*) are employed commercially in preparation of Yoghurt, cheese, alcoholic drinks, vinegar, lactic acid, enzymes, vitamins and antibiotics.