

- Batch cultivation is closed system where there is no interaction between the system and the surrounding during the process. Except air during the aerobic cultivation.
- In Batch cultivation we prepare medium, sterilize it and inoculate the culture into the bioreactor.
- Allow the cells to grow and produce the product.
- Once the product formation reaches maximum harvest the fermentation broth.

How cells grow during Batch cultivation

After inoculating the medium and start measuring the biomass at different time intervals, you may find six different phases. They are

1. **Lag phase**
2. **Accelerated growth phase**
3. **Exponential growth phase**
4. **Decelerated growth phase**
5. **Stationary phase**
6. **Death phase**

Environmental conditions affecting cell growth

- **Substrate concentration**
- **Temperature**
- **pH**
- **Dissolved oxygen**
- **Others**

Substrate concentration

The effect of substrate concentration on the Specific growth rate is represented by monod equation

$$\mu = \mu_{\max} \frac{S}{K_s + S}$$

μ - Specific growth rate

μ_{\max} - Maximum specific growth rate

S - Residual substrate concentration

K_s - Substrate saturation constant

Medium optimization by continuous cultivation

- First construct x-D diagram
- Pulse various compounds to the medium during steady state and identify the positive nutrients.
- Shift the inlet medium with positive nutrients.
- Continue this process till you have completed with all the positive nutrients
- Final x-D diagram and evaluate kinetic constants

Why continuous cultivation is not used in the industries

- Secondary metabolites are produced only during the stationary phase. Hence the continuous cultivation is not suitable for them.
- Maintenance of sterility is very difficult.
- High infrastructure cost is required.

Fed Batch cultivation

- Batch cultivation have low productivity
- Though continuous cultivation productivity is higher it cannot be used for secondary metabolites
- Fed batch cultivation is semi open system
- Here nutrients are fed slowly into medium either continuously or discontinuously in stages.