

• Biomass Based products:

- Biomass based products are products made from living cells (microorganisms) like yeast & bacteria.
- In biomass production, the cells
- Biomass = total mass of living cells.
- microorganism itself is product not chemical it produces.
eg ① when penicillin produced penicillin is product
② when yeast cells produced yeast cells are product.
- Biomass based products are industrial products where microbial cells are grown in large quantity & used directly.

* Uses of Biomass -

① Starter culture -

- living organisms added to start fermentation.
eg ① yeast in bread dough
② Lactobacillus in curd.

② Protein Source -

- microbial cells are rich in protein & used as nutritional supplement & animal feed.
eg. Yeast tablets used as protein supplement.

③ Animal feed -

- Dried yeast biomass added to poultry feed to increase protein.

* Yeast —

- unicellular fungus
- most imp. *Saccharomyces cerevisiae*

Importance of *S. cerevisiae* ↓

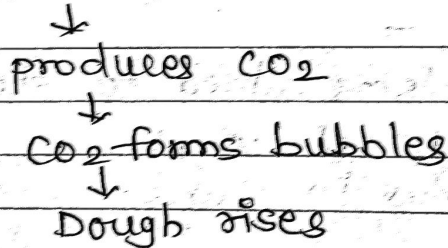
- ① Grows fast
- ② ferments sugar efficiently
- ③ produces CO_2 & ethanol
- ④ Safe for food use.

* Types of yeast products —

- ① Active yeast (for fermentation)
- ② Compressed yeast (blocks)
- ③ Active dry yeast (powder)
- ④ Inactive yeast (nutritional)
- ⑤ Yeast extract (flavour enhancers)

eg. Bred production

- Yeast consumes maltose sugar



- Ethanol evaporates during baking.

* Production of Baker's yeast —

- produced using fed-batch fermentation.
- Nutrients added gradually during fermentation

- why uses fed-batch fer?:

↳ If too much sugar is added & yeast switches to alcohol production instead of cell growth
we want maximum yeast cells → so use FRF

Date: _____

* fermentation process —

- ① Raw materials → Molasses (sucrose sugar)
— sucrose broken into glucose & fructose by Invertase enzyme.



step ② supplementation —

- molasses lacks some nutrients, so we add:

Ammonium sulfate → N_2

Phosphate → Energy

Magnesium → Enzyme activation

Biotin → Growth factor.



step ③ sterilization — To maintain pure culture.



step ④ Inoculum preparation —



step ⑤ aeration high, temp — $30^{\circ}C$, pH — 4-4.5

- foam controlled — Antifoam agents (polyethylene glycol) (low pH prevents contamination)



step ⑥ Maturation — complete division stops



step ⑦ separation — centrifugation



step ⑧ pressing & Drying

- filter press — Yeast cake

- spray drying — Active dry yeast.

* Distillers yeast —

- for maximum alcohol production
- used in → Brewery
Winery
Distillery.

- produced under anaerobic conditions.

- Glucose → Ethanol + CO_2 .
- maximum ethanol want not biomass.

* Probiotics —

- According to WHO & FAO (Food & Agriculture organization)

probiotics are living microorganisms which, when used in adequate amounts gives health benefits on host.

- probiotics are beneficial live microbes.
- Improves gut health
 - maintain intestinal microflora balance.
 - prevent growth of harmful bacteria
 - support immunity.

- Source: Yogurt, Curd, Buttermilk, fermented food, probiotic capsule.

* Growth Media —

- Basal media must be soluble & homogeneous
- complex media like milk/whey cannot be sterilized by normal heat:
because protein denatures.
- Avoid precipitation
- Must support high biomass production.
- Used for lactic acid growth.

- Ingredients of media must dissolve properly.
- overheating destroys growth-promoting factors.
- media use UHT pasteurization.

* Probiotics — (Lactobacillus sporogenes)

- Live microorganisms which when administered in adequate amounts confer health benefits to host.

* Common probiotic organism —

- ① Lactobacillus sp.
- ② Bifidobacterium sp.
- ③ Propionibacterium sp.
- ④ Streptococcus sp.
- ⑤ Saccharomyces sp.

- spore-forming bacteria are more stable, Better survival & having longer shelf life: spore-forming bacteria use as probiotics.

* Bacillus coagulans (Lactobacillus sporogenes) as probiotics —

- Is spore-forming
 - Lactic acid producing
 - Catalase positive
 - facultative anaerobe.
 - optimum temp. $\rightarrow 35 - 50^{\circ}\text{C}$
 - pH $\rightarrow \sim 6$
 - Growth factors required $\rightarrow$ Biotin, Thiamine.
 - ferments sugars $\rightarrow$ Glucose, Sucrose, Maltose, Mannitol.
 - produces Lactic acid.

* Fermentation —

(Starter Culture production.

- Large-scale starter cultures are prepared in modified dairy fermenters.
- Growth medium is sterilized by Ultra High temperature (UHT) pasteurization.
- fermentation is done under controlled conditions of Temperature, PH, Agitation, Redox potential, Nutrient concentration.
- fermentation goal is maximum biomass production.
- Culture is rapidly cooled using heat exchanger.

* Concentration & Packaging of Biomass —

— After fermentation Bacteria are :

(i) Concentrated — By centrifugation.

- at industrial scale concentrated by ultracentrifugation

(ii) spray Drying —

- spray drying converts liquid culture into powder.
- Culture is sprayed into hot air. Before drying culture is mixed with Ascorbate & Glutamate which functions as antioxidants & protect cells.

(iii) Freeze Drying — (Lyophilization) —

- Removes water at low temperature.
- Used for starter cultures.
- Packed in aluminium cans (70-360 ml)