RAMA UNIVERSITY

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FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

SINGLE CELL PROTEIN

- Single-cell proteins (SCP) refers to edible unicellular microorganisms.

- The biomass or protein extract from pure or mixed cultures of algae, yeasts, fungi or bacteria

- It is used as an ingredient or a substitute for protein-rich foods.

- It is suitable for human & animal feeds.

- Agricultural waste are used as starter/media for microbial growth.

- Max Delbrück and his colleagues found out the high value of surplus brewer's yeast as a feeding supplement for animals

PRODUCTION PROCESS

•Single-cell proteins develop when microbes ferment waste materials. E.g - wood, straw, cannery, and food processing wastes, residues from alcohol production, hydrocarbons, or human and animal excreta

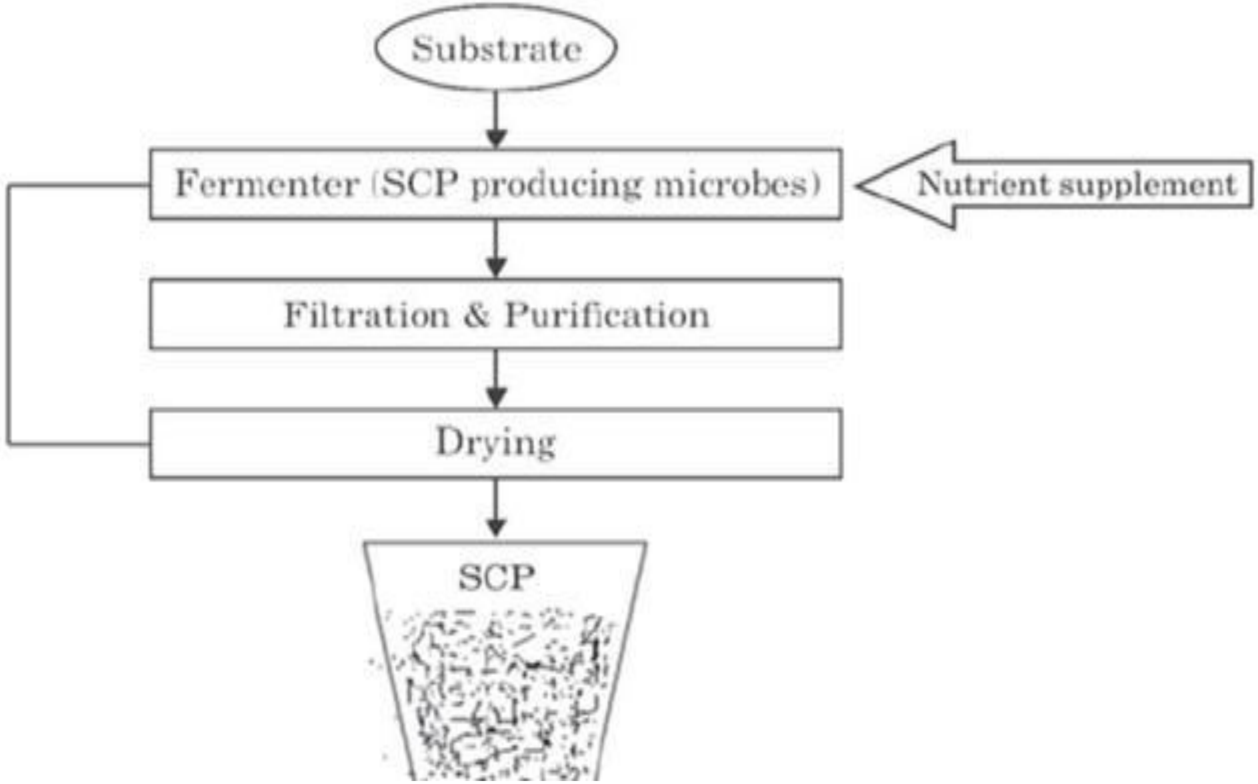
• The problem with extracting single-cell proteins from the wastes is the dilution and cost. They are found in very low concentrations, usually less than 5%.

• Engineers have developed ways to increase the concentrations including centrifugation, flotation, precipitation, coagulation, and filtration, or the use of semi-permeable membranes

•The single-cell protein must be dehydrated to approximately 10% moisture content and/or acidified to aid in storage and prevent spoilage.

•The methods to increase the concentrations to adequate levels and the dewatering process require equipment that is expensive and not always suitable for small-scale operations.

•It is economically prudent to feed the product locally and soon after it is produced



DIFFERENT PROCESSING TECHNIQUE

PRUTEEN PROCESS AND SYMBA PROCESS

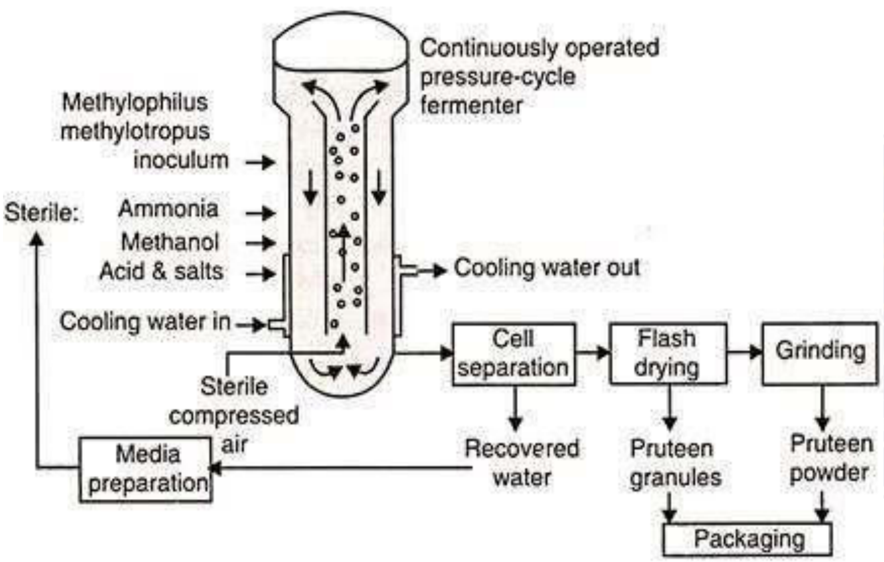


Fig. 16.4: The SCP production through pruteen process

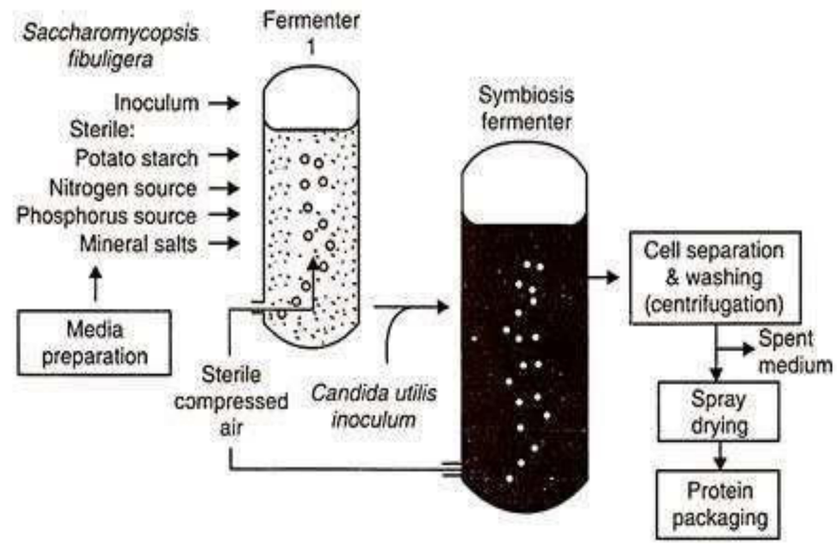


Fig. 16.5: The symba process

[SOURCE – INDUSTRIALBIOTECHNOLOGY]

PRUTEEN PROCESS

- Attempts to develop methanol based processes were made in Europe, the former society union, Japan and the USA.

- They involved bacterial species (Hyphomicrobium, Methylococcus, Methylophilus and Methylotrophus),

- yeasts (Candida boidinii, Pichia angusta and P.pastorn)

- filamentous fungi (Gliocladium deliquescans, paecilomyces variotii and Trichoderma linganus)

SYMBA PROCESS

•The symba process was developed in Sweden to produce SCP for animal feed from potato processing wastes to make it more attractive and economical.

•The process was developed with two microorganisms that grow in symbiotic association.

• The yeast (Saccharomycosis fibuligera) which produces copious amount of amylases necessary for starch degradation, while Candida utilis utilizes resultant sugars.

•The process is operated in two stages.

• In the first stage S. fibuligera is grown in a small reactor on the sterilized waste supplemented with a nitrogen source and phosphate. At this point starch is hydrolysed.

• The resulting broth is then pumped into second larger fermenter of 300 m capacity where both organisms are present. However, C.utilis dominates and constitutes 90% of the final product.

• Resultant protein rich biomass (45% protein) is concentrated by centrifugation and finally spray or drum dried MICROORGANISMS INVOLVED

MICROORGANISMS INVOLVED

Yeast	*Saccharomyces cerevisiae* *Pichia pastoris* *Candida utilis* *Torulopsis* *Geotrichum candidum*
Fungi	*Aspergillus oryzae,* *Fusarium venenatum* *Sclerotium rolfsii* *Polyporus* *Trichoderma* *Scytalidium acidophilum*
Bacteria	*Rhodobacter capsulatus*
Algae	*spirulina (dietary supplement)*

ADVANTAGES

- Large scale production of microbial biomass has many advantages over the traditional methods for producing proteins for food or feed.
- Microorganisms have a much higher growth rate (Algae ; 2-6 hours, Yeast ; 1-3 hours, Bacteria ; 0.5-2 hours)
- Can grow in agricultural waste products
- 30-70% protein content in dry mass; higher than vegetables.
- Can build vitamins & other nutrients.
- No photoinhibition & efficiently use CO2 (10 times than plants)
- Low water use for production.
- No requirement of fertile soil.

DISADVANTAGES

- Ingestion of purine compounds arising from RNA breakdown leads to increase plasma levels of uricacid which can cause gout and kidney stone.

- Algae and yeast contain nondigestable cellulose cellwall; thus it should be broken up in order to liberate the cell interior and allow complete digestion.

- Some exhibits unpleasant colour and flavors.

- Some yeast and fungal proteins tend to be defficient in methionine.

References

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