

Chapter 11

Beneficial Uses of Microorganisms

Objective

- Criteria for the microbes
- Classification of microbes, example, uses.

Introduction

- Is an applied microbiology, which involved in a large scale of microorganisms to produce valuable commercial products to carry out important chemical transformation.
- Generally the process that are involved in produce commercial products using microorganisms are:



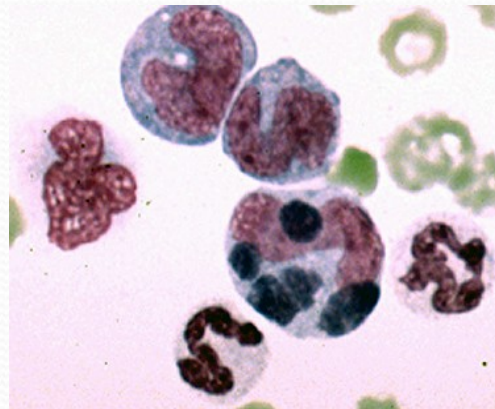
Screening & isolation of microorganisms of interest

- Example: searching for specific strains of microorganisms that will yield **sufficient quantities** of the desired product to permit commercial production on a commercial production on an economically favorable

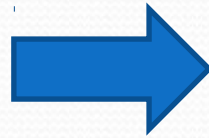


Strains improvement (Genetic manipulation)

- Example: improved the strains properties in order to achieve separation of the desired product from microbial cells, residual substrate and other metabolic products in most economical manner.



Formulation of media



Fermentation process



Packaging & marketing



Microorganisms in industry

Criteria of industrial microorganisms:

1. They should liberate a large amount of single product that can be efficiently isolated and purified
2. They should be easy to maintain and cultivate
3. They should have genetic stability with infrequent mutation
4. They are easily manipulated genetically

Criteria of industrial microorganisms-^{cont}

5. They can grow on an inexpensive, readily available medium. Example: capable to grow in a large scale culture
6. They are able to grow rapidly and produced the desired product in a relatively short of period of time.
7. They should not be harmful to human.

Types

- Microorganisms are used in industry to produce a variety of organic compounds, including acids, growth stimulants and enzymes:

a) Acids

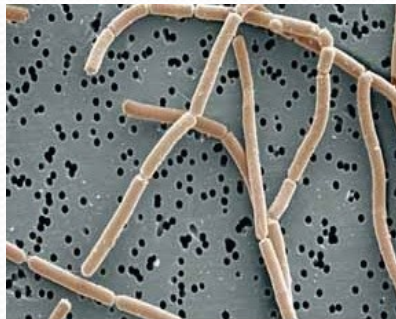
i) Citric acid

- This organic compound used in soft drink, candies, inks, pharmaceutical (like anticoagulant).
- The organism most widely used in citric acid production is the mold: *Aspergillus niger*



ii) Lactic acid

- A compound employed to preserve foods, finish fabrics
- Lactic acid is commonly produced by bacterial activity on the whey portion of milk.
- Microorganism involved in this organic compound:
Lactobulgaricus



iii) Gluconic acid

- Is used in medicine as a carrier for calcium because gluconic acid is easily metabolized in the body, leaving a store of calcium for distribution.
- This acid is produced from carbohydrate by *Gluconobacter* and species of the bacterium cultivated in fermentation tank.



Gluconobacter

iv) Glutamic acid

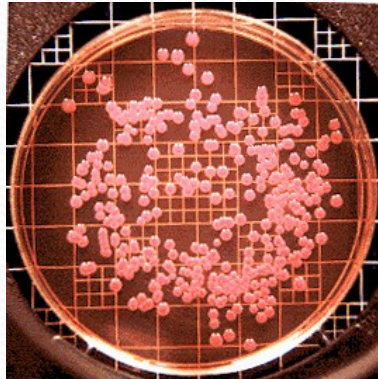
- Produced from amino acid by certain species of *Micrococcus*, *Arthrobacter* and *Brevibacterium*.
- Is used in food supplement for human and animals, and its sodium salt (monosodium glutamate) is utilized in food preparation.



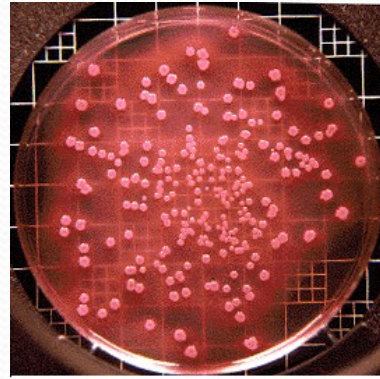
Brevibacterium

v) Lysine

- Produces from amino acid by 2 organisms: *E.coli* & *Enterobacter aerogenes*



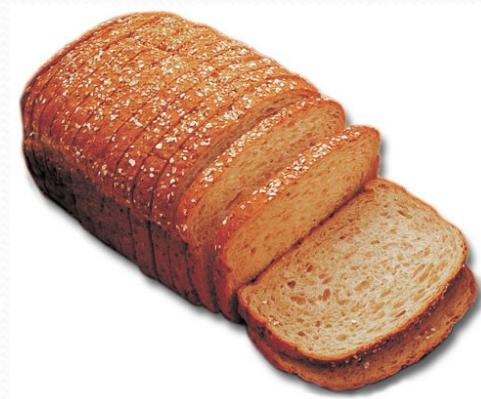
Enterobacter aerogenes
MacConkey agar



Escherichia coli
MacConkey agar

- First *E.coli* cultivated in a medium of glycerol of corn steep liquor and the compound diaaminopimelic acid (DAP) accumulates.

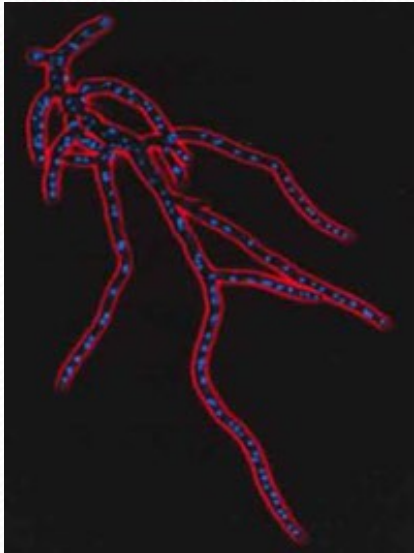
- After several days, *Enterobacter aerogenes* is added to the mixture. This organism produces an enzyme that removes the carboxyl group from DAP to produce lysine
- Lysine used in bread, cereals and other foods.



b) Vitamins

i) Riboflavin (vitamin B₂)

- Produce by *Ashbya gossypii*, a mold that produces 20,000 times the amount it needs for its metabolism.



Ashbya gossypii

ii) Cyanocobalamin (Vitamin B₁₂)

- Produced by *Pseudomonas*, *Propionibacterium*, *Streptomyces* grown in a cobalt-supplement medium.
- This vitamin used in bread, flour, cereal products and animal feeds.

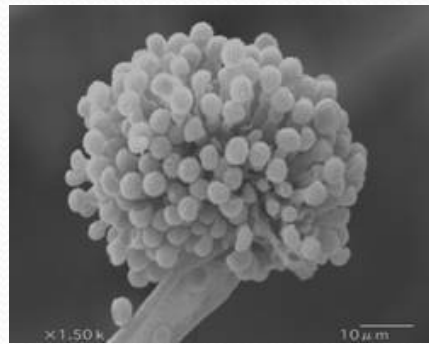


Propionibacterium

c) Enzymes and other products

i) Amylase

- Is produced by the mold of *Aspergillus oryzae*
- It is used as a spot remover in laundry presoaks, as an adhesive in baking.



Aspergillus oryzae

ii) Pectinase

- Is produced by *Clostridium spp*
- It is used to ret flex for linen and also used in fruit juice.



Clostridium spp

iii) Proteases

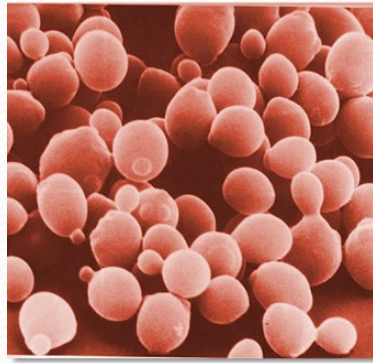
- Is a group of protein digesting enzyme produced by *Bacillus subtilis*, *Aspergillus oryzae*
- Certain proteases are used in leather manufacturing, liquid glues, laundry presoaks, meat tenderizers, drain openers and spot removers.



Bacillus subtilis

iv) Invertase

- Is an enzyme produced by yeasts and use in making soft centered chocolate.



Yeast

v) Gibberellins

- Is a plant growth hormone by fungus, *Gibberella fujikuroi*.
- They have been used to promote growth by stimulating cell elongation in the stem, hasten seed germination and flowering and increase the yields of fruits.



G. fujikuroi

vi) Methylglutones

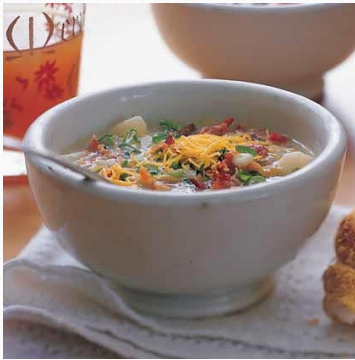
- Is a flavoring agent derived industrially from *Penicillium roqueforti*
- Used in making cheese associated flavors in dairy product.



P. roqueforti

vii) Alginates

- Is a typical of the miscellaneous microbial products.
- Is a sticky substrate used as a thickener in ice cream, soups or other food.





Conclusion