

## Lec. 4

## Fermentation Technology

### Industrially important microorganisms:

The most publicized advances in biotechnology over the last ten years have been those in recombinant DNA technology ., whilst these advances have resulted in the development of extremely valuable new commercial processes and have improved many others., the diversity of microorganisms may be exploited still by searching for strains from the natural environment able to produce products of commercial value.

**Isolation:** The first stage in the screening for microorganisms of potential industrial application is their isolation , isolation involves obtaining either pure or mixed cultures followed by their assessment to determine which carry out the desired reaction or produce the desired product.

In some cases it is possible to design the isolation procedure in such a way that the growth of producers is encouraged or that they may be recognized.

### **There are a number of criteria as being important in the choice of organism:**

**1: The nutritional** characteristics of the organism, it is frequently required that a process be carried out using a very cheap medium or a pre- determined one ., ex. the use of methanol as an energy source ., these requirements may be met by the suitable design of the isolation medium.

**2: The optimum temperature** of the organism., the use of an organism having an optimum temperature above 40 C° considerably reduces the cooling costs of a large - scale fermentation and therefore, the use of such a temperature in the isolation procedure may be beneficial.

**3: The reaction** of the organism with the equipment to be employed and the suitability of the organism to the type of process to be used.

**4: The stability** of the organism and its amenability to genetic manipulation.

**5: The productivity** of the organism, measured in its ability to convert substrate into product and to give a high yield of product per unit time.

**6: The ease** of product recovery from the culture.

### **The preservation of industrially important microorganisms**

The isolation of a suitable organism for a commercial process may be a long and very expensive procedure and it is therefore essential that it retains the desirable characteristics that led to its selection.

Also the culture used to initiate an industrial fermentation must be viable and free from contamination ., thus industrial cultures must be stored in such way as to eliminate genetic change, protect against contamination and retain viability., thus, preservation techniques have been developed to maintain cultures in a state of "suspended animation" by storing either at reduced temperature or in a dehydrated form.

### **Storage at reduced Temperature**

#### **1: Storage on agar slopes :**

Cultures grown on agar slopes may be stored in a refrigerator (5 C° ) or a freezer (-20 C°) and sub - cultured at approximately 6 monthly intervals ., the time of subculture may be extended to 1 year if the slopes are covered with sterile medical grade mineral oil.

#### **2: Storage under liquid nitrogen:**

Cultures grown at very low temperatures ( -150 C° - 169 C° ) which may be achieved using a liquid nitrogen refrigerator fungi, viruses, algae, yeasts have all been preserved .

### **Storage in a dehydrated form**

**A: Dried cultures:** dried soil cultures have been widely for culture preservation, particularly for spore forming mycelia organisms., silica gel and porcelain beads are suggested alternatives and detailed methods are given for these techniques.

**B: Lyophilization :** lyophilization or freeze - drying involves the freezing of a culture followed by its drying under vacuum, which results in the sublimation of the cell water.

### **The properties of industrial strains after selection**

#### **1: The selection of stable strains :**

The ability of the producing strain to maintain its high productivity during both culture maintenance and a fermentation is very important quality , but loss of productivity during the fermentation is far more difficult to control ., A decrease in the productivity of a commercial strain is normally due to the occurrence of lower - yielding, spontaneous revertant mutants which frequently have a higher growth rate than the high producing parent., so that yield decay is especially problematical in long - term fermentations such as fed - batch or continuous culture.

#### **2: The selection of strains resistant to infection :**

It may be possible to design the host organism of a recombinant fermentation such that it is more resistant to phage infection ., because bacterial fermentation may be affected very seriously by phage infections., which may result in the lysis of the bacteria.

#### **3: The selection of non - foaming strains:**

Foaming during a fermentation may result in the loss of broth, cells and product via the air outlet as well as putting the fermentation at risk from contamination, foam is usually due to a component of the medium or from property of growing organism., therefore, it is may be controlled by strain selection.

#### **4: The selection of strains which are resistant to component in the medium:**

Some media component which are required for product formation may interfere with the growth of the organism .,ex : strains of *Streptomyces rimosus* are resistant to high levels of phosphate which prevents product synthesis ( oxytetracyclin) ., so

must use the media that containing high levels of corn steep liquor ( which is rich in phosphate ).

**5: The selection of morphology of favorable strains:**

The morphology of microorganism in submerged culture frequently has an effect on economics or ease of operation of a process., ex. flocculation of yeasts is the adherence of cells in clumps resulting in the separation of the cells from the liquid in which they were suspended ., thus the flocculating property of yeasts may be described as a morphological characteristic.

**6: The selection of strains which are tolerant of low O<sub>2</sub> tension :**

This is may be achieved by screening for increased production under oxygen limited conditions., ex: lysine - producing strain selected to maintain its productivity under aeration conditions which decreased the parental strain productivity by almost a half.