Industrial bacteria

The Actinobacteria

The Actinobacteria are the Firmicutes with G+C content of 50% or higher. They derive their name from the fact that many members of the group have the tendency to form filaments or hyphae (actinis, Greek for ray or beam). The industrially important members of the group are the Actinomycetes and Corynebacterium. Corynebacterium spp are important industrially as secreters of amino acids.

The Actinomycetes

They have branching filamentous hyphae, which somewhat resemble the mycelia of the fungi, among which they were originally classified. In fact they are unrelated to fungi, but are regarded as bacteria for the following reasons. First they have peptidoglycan in their cell walls, and second they are about 1.0 µ in diameter (never more than 1.5µ), whereas fungi are at least twice that size in diameter. As a group the actinomycetes are unsurpassed in their ability to produce secondary metabolites which are of industrial importance, especially as pharmaceuticals. The best known genus is Streptomyces, from which many antibiotics have been obtained. The actinomycetes are primarily soil dwellers hence the temptation to begin the search for any bioactive microbial metabolite from soil

Eucarya: Fungi

Fungi are members of the Eucarya which are commonly used in industrial production. The fungi are traditionally classified into the four groups given in Table 2. namely Phycomycetes, Ascomycetes, Fungi Imprfecti, and Basidiomycetes. Among these the following are those currently used in industrial microbiology

1-Phycomycetes (Zygomycetes)

Rhizopus and Mucor are used for producing various enzymes.

2-Ascomycetes

Yeasts are used for the production of ethanol and alcoholic beverages

Claviceps purperea is used for the production of the ergot alkaloids

3-Imprfecti Fungi

Aspergillus is important because it produces the food toxin, aflatoxin, while *Penicillium* is well-known for the antibiotic penicillin which it produces.

4-Basidiomycetes

Agaricus produces the edible fruiting body or mushroom Numerous useful products are made through the activity of fungi, but the above are only a selection.

Table 2 Description of the various groups of fungi

Group	*Ordinary Name*	*Septation of hyphae*	*Sexual Spores*	*Representative*
Zygomycetes (Phycomycetes)	Bread molds	Non-septate	Zygospre	*Rhizopus, Mucor*
Ascomycetes	Sac fungi	Septate	Ascospore (in Perithecia)	*Neurospora, Saccharomyces* (Yeasts)
Basidiomycetes	Mushrooms	Septate	Basidiomycetes (Mushrooms)	*Agaricus*
Deuteromycetes	Fungi imperfecti	Septate	None	*Penicillium, Aspergillus*

Characteristics important in used in industrial microbiology

Microorganisms which are used for industrial production must meet certain requirements including those to be discussed below.

i. The organism must be able to grow in a simple medium and should preferably not require growth factors (i.e. pre-formed vitamins, nucleotides, and acids).

ii. The organism should be able to grow vigorously and rapidly in the medium in use. A slow growing organism no matter how efficient it is, in terms of the production of the target material, could be a liability. In the first place the slow rate of growth exposes it, in comparison to other equally effective producers which are faster growers, to a greater risk of contamination. Second, the rate of the turnover of the production of the desired material is lower in a slower growing organism which lead to lower profits.

iii. Not only should the organism grow rapidly, but it should also produce the desired materials, whether they be cells or metabolic products, in as short a time as possible, for reasons given above.

iv. Its end products should not include toxic and other undesirable materials, especially if these end products are for internal consumption.

v. The organism should have a reasonable genetic, and hence physiological stability. An organism which mutates easily is an expensive risk.

vi. The organism should lend itself to a suitable method of product harvest at the end of the fermentation. If for example a yeast and a bacterium were equally suitable for manufacturing a certain product, it would be better to use the yeast if the most

appropriate bacterial diameter is approximately 1, yeasts are approximately 5. Assuming their densities are the same, yeasts would sediment 25 times more rapidly than bacteria. The faster sedimentation would result in less expenditure in terms of power, personnel supervision etc which could translate to higher profit.

vii. Wherever possible, organisms which have physiological requirements which protect them against competition from contaminants should be used. An organism with optimum productivity at high temperatures, low pH values or which is able to elaborate agents inhibitory to competitors has a decided advantage over others. Thus a thermophilic efficient producer would be preferred to a mesophilic one.

viii. The organism should be reasonably resistant to predators such as Bdellovibrio spp or bacteriophages.

ix. Where practicable the organism should not be too highly demanding of oxygen as aeration (through greater power demand for agitation of the fermentor impellers, forced air injection etc) contributes about 20% of the cost of the finished product.

x. Lastly, the organism should be fairly easily amenable to genetic manipulation to enable the establishment of strains with more acceptable properties.