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**Media for industrial fermentation**

All microorganisms require water , sources of energy , carbon , nitrogen , mineral elements and possibly vitamins plus oxygen if aerobic ., on a large scale one must normally use sources of nutrients to create a medium which will meet as many as possible of the following criteria :

**1:** It will produce the maximum yield of product or biomass per gram of substrate .

**2:** It will permit the maximum rate of product formation .

**3:** There will be the minimum yield of undesired products .

**4:** It will be with a consistent quality and be readily available throughout the year .

**5:**It will cause minimal problems during media making and sterilization .

**6:** It will cause minimal problems in production process particularly aeration and agitation , extraction , purification and waste treatment .

The use of cane molasses , beet molasses , cereal grains , as carbon sources because they contain starch , glucose , sucrose and lactose . , and corn steep liquor , soy bean meal , slaughter – house waste nad fermentation residues as nitrogen sources , have tended to meet most of the above criteria for production media because they are cheap substrates , however other more expensive pure substrates may be chosen if the overall cost of the complete process can be reduced because it is possible to use simpler procedures .

**Precursors and metabolic regulators in media**

Some components of a fermentation medium help to regulate the production of the product rather than support the growth of the microorganism , such additives include precursors , inhibitors and inducers , all of which may be used to manipulate the progress of the fermentation .

**Precursors** : some chemicals , when added to certain fermentation are directly incorporated into the desired product ., ex. : the addition of phenyl acetic acid and its derivatives to the medium were capable of both increasing penicillin production threefold and to directing biosynthesis towards increasing the proportion of benzyl penicillin from 0 to 93 % at the expense of other penicillin .

**Inhibitors** : when certain inhibitors are added to fermentation more of a specific product may be produced ., one of the earliest examples is the microbial production of glycerol ., Glycerol production depends on modifying the ethanol fermentation by removing acetaldehyde ., the addition of sodium bisulphate to the broth leads to the formation of the acetaldehyde bisulphate addition compounds ( Sodium hydroxyl ethyl sulphite ).

**Inducers** : the majority of enzymes which are of industrial interest are inducible ., inducers are often substrates such as starch or dextrin for amylases ., pectin for pictinases ., some inducers are very potent , such as isovaleronitril inducing nitralase.

**Antifoams** : in most microbiological processes , foaming is a problem , it may be due to a component in the medium or some factors produced by the microorganisms , the most common cause of foaming is due to proteins in the medium , such as corn – steep liquor , yeast extract and meat extract , these proteins may denature at the air – broth interface and form a skin which does not rupture readily ., the foaming can cause removal of cells from the medium which will lead to autolysis and further release of microbial cell proteins will probably increase the stability of the foam ., if uncontrolled , then numerous changes may occur and physical and biological problems may be created .

**There are five patterns of foaming in fermentation :**

**1:** Foaming remains at a constant level through – out the fermentation , initially it is due to the medium and later due to microorganism activity .

**2:** A steady fall in foaming during the early part of the fermentation , after which it remains constant ., initially it is due to the medium but there are no later effects caused by the microorganisms .

**3:** The foaming falls slightly in the early stages of the fermentation ., then rises ., there are very slight effects caused by the medium but the major effects are due to microorganism activity .

**4:** The fermentation has a low initial foaming capacity which rises , these effects are due solely to microorganism activity .

**5:** A more complex foaming pattern during the fermentation which may be a combination of two or more of the previously described patterns .

**If excessive foaming is encountered there are three ways of approaching the problem :**

**1:** To try and avoid foam formation by using a defined medium and a modification of some of the physical parameters ( pH , Temperature , aeration , agitation )., this assumes that the foam is due to a component in the medium and not a metabolite .

**2:** The foam is unavoidable and antifoam should be used ., this is more standard approach .

**3:** The foam is removed by using a mechanical foam breaker .

Antifoams are surface active agent , reducing the surface tension in the foams and destabilizing protein films by :

**1:**  hydrophobic bridges between two surfaces .

**2:** displacement of the absorbed protein .

**3:** rapid spreading on the surface of the film .

**So , an ideal antifoam should have the following properties :**

**1:** Should disperse readily and have fast action on an existing foam .

**2:** Should be active at low concentrations .

**3:** Should be long acting in preventing new foam form .

**4:** Should not be metabolized by the microorganisms .

**5:** Should be non – toxic to the microorganism.

**6:** Should be non – toxic to humans and animals .

**7:** Should not cause any problems in the extraction and purification of the product.

**8:** Should not cause any handling hazards.

**9:** Should be cheap.

**10:** Should be heat sterilizable.

**11:** Should have no effect on oxygen transfer .

**The following compounds have been founds to be most suitable in different fermentation processes :**

**1:** Alcohol : stearyl and octyl decanol .

**2:** Esters

**3:**Fatty acids .

**4:** Silicones .

**5:** Sulphonates .

**6:** Miscellaneous :poly – pro – pylene.