SCP – SINGLE CELL PROTEIN

Bacteria, yeast, fungi and algae were used to produce protein biomass named Single Cell Protein (SCP). The term SCP was coined in 1966 by Carol L. Wilson. Single cell protein is dried cells of microorganism, which are used as protein supplement in human foods or animal feeds. Besides high protein content (about 60 82% of dry cell weight), SCP also contains fats, carbohydrates, nucleic acids, vitamins and minerals. Another advantage with SCP is that it is rich in certain essential amino acids like lysine and methionine which are limiting in most plant and animal foods. Microorganism like bacteria, yeast, fungi and algae utilize inexpensive feedstock and waste to produce biomass, protein concentrate or amino acids. Conventional substrates such as starch, molasses, fruit and vegetable wastes have been used for SCP production, as well as unconventional ones such as petroleum by-products, natural gas, ethanol, methanol and lignocellulosic biomass. The protein obtained from microbial source is designated as Single Cell Protein (SCP).

**Choice of microorganism for SCP production**

Bacteria

Characteristics that make bacteria suitable for SCP production include rapid growth of bacteria, short generation time and can double their cell mass in 20 minutes to 2 hours. They are also capable of growing on a variety of raw materials that range from carbohydrates such as starch and sugars to gaseous and liquid hydrocarbons which include methane and petroleum fractions to petrochemicals such as methanol and ethanol, nitrogen sources which are useful for bacterial growth include ammonia, ammonium salts, urea, nitrates.

Bacteria like: Brevibacterium , Methylophilus methylitropous, Acromobacter delvaevate, Acinetobacter calcoacenticus, Aeromonas hydrophilla, Bacillus megaterium, Bacillus subtilis, Lactobacillus species, Cellulomonas species, Methylomonas methylotrophus, Pseudomonas fluorescens, Rhodopseudomonas capsulate, Flavobacterium species, Thermomonospora fusca.

Algae

Spirulina is the most widely used algae for SCP. Alga is used as a food in many different ways and its advantages include simple cultivation, effective utilization of solar energy, faster growth and high protein content. Blue green algae having strong antioxidant activity and a free radical scavenging enzyme system. A diet enriched with Spirulina and other nutraceuticals help protect the stem/progenitor cells.

Yeast

Yeast single-cell protein (SCP) is a high- nutrient feed substitute most popular yeast species are Candida Hansenula, Pitchia, Torulopsis and Saccharomyces. The production of single cell protein using Saccharomyces cerevisiae grown on various fruit waste. Cucumber and orange peels are used for the production of single cell protein using Saccharomyces cerevisiae by submerged fermentation.

Fungi

Many fungal species are used as a source of protein rich food. Many other filamentous species are also used as source of single cell protein The filamentous fungi that is used as SCP include Chaetomium celluloliticum, Fusarium graminearum, Aspergillus fumigates, A. niger, A.oryzae, Cephalosporium cichorniae, Penicillium cyclopium, Rhizopuschinensis, Scytalidum aciduphlium, Tricoderma viridae, andTricoderma alba Paecilomyces varioti.

**Potential substrates for SCP production**

Many raw materials considered as substrate for SCP production. substrates such as starch, molasses, fruit and vegetable wastes have been used for SCP production, as well as unconventional ones such as petroleum by-products, natural gas, ethanol, methanol and lignocellulosic *biomass*  Carbohydrate substrates are most widely used for SCP production.

Cultivation methods

 The production of single cell protein takes place in a fermentation process .This is done by selected strains of microorganisms which are multiplied on suitable raw materials in technical cultivation process directed to the growth of the culture and the cell mass followed by separation processes. Process development begins with microbial screening, in which suitable production strains are obtained from samples of soil, water, air or from swabs of inorganic or biological materials and are subsequently optimized by selection, mutation, or other genetic methods.

Single cell protein produced by fermentation processes, namely:

In submerged process the substrate used for fermentation is always in liquid state which contains the nutrients needed for growth. The fermentor which contains the substrate operated continuously and the product biomass is continuously harvested from the fermentor, the product is filtered or centrifuged and then dried. Aeration is an important , heat generated during cultivation is removed by using a cooling device. Single cell organisms like yeast and bacteria are recovered by centrifugation while filamentous fungi are recovered by filtration.

Semisolid fermentation The cultivation involves many operations which include stirring and mixing of a multiphase system, transport of oxygen from the gas bubbles through the liquid phase to the microorganisms and the process of heat transfers from liquid phase to the surroundings.

Solid state fermentation This process consists of depositing a solid culture substrate, such as rice or wheat bran, on flatbeds after seeding it with microorganisms; the substrate is then left in a temperature-controlled room for several day. Accurately managing the synthesis of the desired metabolites requires regulating temperature, soluble oxygen, ionic strength and pH and control nutrients. Accurately managing the synthesis of the desired metabolites requires regulating temperature, soluble oxygen, ionic strength and pH and control nutrients.

Advantages of Single-Cell Protein

Large-scale Single-Cell Protein production has multiple advantages over conventional food production practices such as:

* Microorganisms have a high rate of multiplication which means a large quantity of biomass can be produced in a comparatively shorter duration.
* The microbes can be easily genetically modified to vary the amino acid composition.
* A broad variety of raw materials, including waste materials, can be used as a substrate. This also helps in decreasing the number of pollutants.
* Production is independent of climatic conditions.

Disadvantages of Single-Cell Protein

In spite of many advantages, there are few drawbacks**.**Single-Cell Protein has not been widely accepted for human consumption owing to certain problems as follows:

* High level of nucleic acid in biomass makes it difficult for consumption as it lead to gastrointestinal problems.
* The biomass trigger an allergic reaction if the digestive system recognizes it as a foreign product.
* The presence of nucleic acids in high content leads to elevated levels of uric acid.
* In certain cases, the development of kidney stone and gout if consumed in high quality.
* Possibility for the presence of secondary toxic metabolites which results in Hypersensitivity and other skin reactions.

**Applications of Single-Cell Protein**

1. Provides instant energy.
2. It is extremely good for healthy eyes and skin.
3. Provides the best protein supplemented food for undernourished children.
4. Serves as a good source of vitamins, amino acids, minerals, crude fibres, etc.
* **Used in therapeutic and natural medicines for:**
1. Controlling obesity.
2. Lowers blood sugar level in diabetic patients.
3. Reducing body weight, cholesterol and stress.
4. Prevents accumulation of cholesterol in the body.
* **Used in Cosmetics products for:**
1. Maintaining healthy hair.
2. Production of different herbal beauty products, like- Biolipstics, herbal face cream, etc.
* **Used in Poultry:**
1. As it serves as an excellent and convenient source of proteins and other nutrients, it is widely used for feeding cattle, birds, fishes etc.