



## Production and Utilization of Single Cell Proteins - An Overview

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### ABSTRACT

*It is a main problem of protein deficiency in the world for the humans because protein is an essential part of life as a nutritional supplement. Many poor countries are facing the problems of food items and nutrients deficiency problems. To cope with these critical situations, there is a method of deriving single cell proteins from the leftover or useless organic masses. This is very important and well methodology to handle with world protein deficiency situations. The single cell proteins are obtained from desiccated form of cells of algae, fungi, yeast and bacteria. The obtained proteins from these organisms are very rich in nutrients and these are also used as good supplements of diet. To produce these single cell proteins, there is a need of substrate which is categorized into different substrates like mango wastes, coconut wastes, wheat straws wastes, sugarcane wastes, orange wastes and many other wastes. The single cell protein is also called as microbial protein. This microbial protein in case of diet supplement has high nutritional benefits to overcome the problems of protein deficiency in foods used for humans and animals. It is not seasonal production. It may be produced all over the year. This system is totally environment friendly and has low cholesterol level and it is overall a better method to produce proteins.*

**Keywords:** Protein, Microbial proteins, Organic matter, Lack of proteins, Nutritional supplements, Substrates.

### INTRODUCTION

It is a major problem for world's expanding population about nutritional supplements used along with diet. Protein is an important part of the diet. If, there is less or no supply of protein to the body the body is unable to nourish well (Adedayo et al., 2011). There are lot of efforts made to get proteins from alternate sources

with unconventional or modern methods. In 1996, protein products were obtained with new methods from yeasts, algae, fungi and bacteria. These protein products were named as Single Cell Proteins or SCP (Ageitos et al., 2011). The term SCP was first coined by Wilson in 1966.

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Single cell proteins are desiccated or dried forms of the microorganisms which provide the humans with enriched proteins supplements and also beneficial for animals feeds. It has about 61-83% proteins and is also enriched with minerals, fats, carbohydrates, nucleic acids and vitamins. The other good advantage is that the SCP is also a good source of essential amino acids like methionine and lysine. But these are very limiting in plants and animals sources. The different microorganisms use organic wastes as substrates and produce a well quality of proteins and amino acids. The protein produced by the single cell protein is high profile protein. The traditional substrates are fruits wastes, vegetables wastes and different starches but modern substrates include ethanol, methanol and petroleum products (Anderson et al., 2005). So, the protein got from microbes is named as single cell protein. Recently, different branches of science deal with the SCP like agriculture, human nutrition, animal nutrition, microbiology, genetics, biochemistry, veterinary science and medicine. The initial work was started by Delbruck when he used the yeast biomass as animal feed. The cellulose and hemicellulose obtained from the agricultural products are also used in single cell protein. The fibrous protein from animals like their horns, nails, hair and feathers are also utilized for making single cell proteins (Anupama, 2000).

### **Different Microbes Used in Single Cell Protein Production**

#### **Bacteria**

There are many characters which make the bacteria well-suitable for the production of single cell proteins. Because it has a less time figure for regeneration and it doubles after every 20 minutes up to 2 hours. The bacterium culture is easily grown on the starches, cellulose, carbohydrates and hemicellulose wastes as well. But these bacteria can also grow easily on the gaseous culture and hydrocarbons with a number of petroleum products like ethanol, methanol, ammonia, urea and other materials but on their waste forms. It is tested from various analysis that

the nutrients that are lacking in the SCP can be easily added to the bacterium culture in liquid form as well. Many number of bacteria can be used to produce single cell protein. These typically include *Thermomonospora fusca*, *Flavobacterium species*, *Pseudomonas fluoresscens*, *Cellulomonas species*, *Lactobacillus species* and many others (Ashoka et al., 2000).

#### **Algae**

In Mexico, for a longer period of time *Spirulina species* were cultivated by the native people. They normally dried them and used them as a food item. The most commonly used algae is *Spirulina* to which astronauts take in to space as a food source. Same like that, the mass content obtained from the *Senedessmus* and *Chlorella* has used by the humans after drying well. It is an important source of food because it is very cheaper to grow, uses well solar light energy and fast growth rate and more proteins contents. The blue green algae are also utilized in the single cell protein system. In this technique, the algae is grown on the waste material, the waste material may be starch, carbohydrate or any other medium but the medium is always residue of by-products. The alga colony grows on the medium. After a long period, the alga is dried well and all protein content is isolated and utilized by the humans (Arora et al., 1991).

#### **Yeasts**

The microbial protein got from yeasts is a high profile protein which is very nutritive for the humans. It is a good alternate of daily food like if there is any deficiency of protein or any other nutrient, we can easily fulfill the lack of nutrients. The common yeasts used in the SCP production are *Saccharomyces species*, *Torulopsis species*, *Pichia species*, *Candida species* and many others. These different yeasts species are grown on the fruits wastes, vegetables wastes, starches, cellulose and hemicellulose to produce microbial proteins as well. The submerged method of cultivation is normally utilized in the yeasts SCP production (Attia et al., 2003).

## Fungi

Fungi species themselves are utilized directly as a food source and protein sources. Because fungi are available in the markets as a food items like Mushrooms but some fungi may be poisonous. Many kinds of fungi are utilized in the single cell protein production. The fungal species that are used for SCP include *Fusarium graminearum*, *Penicillium cyclopium*, *Trichoderma viridae* and many others. Some others include *Chaetomium celluloliticum*, *Aspergillus oryzae* and other ones. But we should remember that some species of the fungi are highly toxic and are unsuitable for single cell protein production. So for this, we should do proper experiments to test whether the SCP is useful or harmful (Azzam, 1992).

## Production Technology

The production technology in single cell proteins production is very easy to understand. The all processes take place by the fermentation in microbial proteins. The process is very simple. First of all, the different strains of the bacteria, fungi, yeasts and algae are taken in a medium. The medium or substrate is that media on which the microorganisms grow (Bamberg, 2000). Then, the substrates are selected according to suitability like wheat straw wastes, fruits wastes, vegetables wastes and many others. Then, the strains start to grow. After a long period, their colonies are spread and have a lot of biomass. This biomass is separated from media and dried very well. Then, the isolated mass is used as a food or feed after some processes of further fortifications or minerals addition. The methods used in the single cell protein production are submerged fermentation, semisolid fermentation and solid state fermentation (Bacha et al., 2011).

## Benefits of Microbial proteins

There are a lot of benefits of microbial proteins or single cell proteins because these obtained proteins are highly rich in carbohydrates, proteins, amino acids, vitamins, minerals, fats, ashes and glucoses etc. Another advantage is that this technique can be utilized throughout the year, it takes less area to be

grown because it is grown on the laboratories or small areas conditions. It is very cheaper technique because it does not require so much investments. It is less laborious and less time consuming but it is a very good source of nutrients. It is totally environmental friendly technique (Azzam, 1992).

## Disadvantages of Microbial Proteins

There are some disadvantages of the microbial proteins like cell wall which is obtained from yeast and alga has unsuitable color and fragrance which makes it unacceptable. The germs must be killed before consumption because otherwise it will cause stomach problems. So, there is also another problem when protein of bacteria is taken it has high nucleic acid amount which is very problematic during cell cycle (Attia et al., 2003).

## CONCLUSION

It is concluded from the above discussion that the single cell protein is very nutritive and healthy for human and animal foods as well as feeds. It is very cheaper and less laborious technique by which we can easily produce a massive content of proteins as well as minerals, vitamins and fats. It is done normally when microbes grow on the substrates and waste material is organic and used as substrate. So, a lot of biomass of protein is produced which fulfills the requirements of protein deficiency.

## Future Aspects

It is expected in the near future that the microbiologists will try their best to adopt such methods for single cell protein production which will reduce the unsuitability of the proteins consumed by humans and animals.

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