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Review Article

A Review on "Biotechnological Production of Single Cell Protein from Microorganisms"

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A B S T R A C T

SCP are protein that consists of processed microorganisms (such as bacteria, algae, yeast, fungi) grown in culture and that is used as a source of food especially for livestock. SCP is used as an ideal food as it has a fairly high content of protein (50-80%) which contains most of the essential amino acids. The objective of these review is to use the potential ability Microorganisms utilize inexpensive feedstock and wastes as sources of carbon and energy for growth to produce biomass, protein concentrate or amino acids. Microbial biomass is also a source of dietary fiber, and is virtually free of cholesterol and produced worldwide by *Kluyveromyces marxianus*, A. *terreus GN, Chaetomium cellulolyticum, Saccharomyces cerevisiae, Candidautilisj Geotrichum candidum, Methylococcus capsulatus, Hyphomicrobium sp., Acinetobacter sp. and Flavobacterium, Methylophilus methylotrophus, Rhodopseudomonas* capsulate and other microorganisms. Global agriculture faces the prospect of a changing climate and the challenge of feeding the world's population that is growing annually at about 1.3%. In upcoming years population will double Ensuring enough protein is available to feed our world's population is crucial as protein is one of only three macronutrients in our diet: protein, carbohydrate, and fat. But nucleic acid content is very high (40% algae; 10-15% bacteria and 5-10% yeast) it makes Indigestion and allergic reactions and hence research is needed improve the production of SCP by reducing production costs, improve quality by effective downstream processing, and improvement in the producer organisms through rDNA.

Keywords

SCP (single cell protein), rDNA (Recombinant DNA technology)

Introduction

In 1960 by using fermentation proteins produce called SCP. According to Marriem Webster Dictionary, "protein that consists of processed microorganisms (as yeasts or bacteria) grown in culture and that is used as a source of food esp. for livestock". Due to increase in population the alternative source for protein used such as microbes and called as Single Cell Protein (SCP) it is dried cells of microorganism, used as protein supplement in human foods or animal feeds.

The term SCP was coined by Carol L Wilson. Microorganisms utilize inexpensive feedstock and wastes as sources of carbon and energy for growth to produce biomass. It is used since ancient African tribe people using algae as food. In late 19 century Max Delbruck and his colleagues used supplement for animals. SCP helpful in During World War I, after the end World War I, which emphasized on hunger and malnutrition problems of the world in 1960

Microbial biomass, has been considered an alternative to conventional sources of food or feed. The world population had a deficiency of protein intake in their diet. Due to improper climatic change, and low fertile land etc., many of them approaches alternative source and utilize indirectly to enrich the nutritive value toward many world. Soviet Union alone produced some 900,000 tons by 1970 of food and fodder yeast, to compensate agricultural protein production deficiency. Advance in Biotechnology techniques has participated in the development of SCP technology and helped in improving its quality and use of different organisms along with yeast for the production of SCP.

Source of protein

Conventional protein sources

Proteins are the polymers of amino acids and all essential amino acids are not synthesis by animals including human and hence we depend upon plant mainly as cereals and pulses, and animals, mainly as meat, *eggs* and milk. The proportions of such proteins eaten in various parts of the world differ widely

Non-conventional protein source

The non-conventional proteins are Algae, Yeast, Bacteria, Earthworm, maggots, termites and silkworm. Most of non-conventional source are added into diet by direct utilizing protein of by feeding to live stock animals.

Algae

Some tribal communities in African using algae (*Spirulina*) other algae used for SCP production are *Chlorella, Soendesmus, Coelastrum*. The advantage using algae is easy to cultivate, faster growth rate, utilization of solar energy, high protein and nutrient contain.

Yeast

Candida, Hansenula, Pitchia, Torulopsis, Saccharomyces and some filamentous species actinomycetes and filamentous fungi were reported to produce protein from various substrates. During the World War II, trails were made to utilize the cultures of *Fusarium* and *Rhizopus* grown in fermentation as a source of protein food. Very recently, SCP technology is using fungal species for bioconversion of lignocellulosic wastes.

Bacteria

Bacteria such as *Cellulomas* and *Alcaligenes* are the most frequently used bacterial species as a single cell proteins source. They have short generation times almost they can double their cell mass in 20 minutes to 2 hours and also capable of growing on a variety of raw materials. Some bacteria such as *Methylophilus methylotrophus* this bacteria is used in animal feed; in general produce a more favorable protein composition than yeast or fungi.

SCP production

Microorganism used in SCP production

Cellulomas, Alcaligenes M. clara, Hansenula, Pitchia, Torulopsis, Saccharomyces, Candidas, Candidautilis, Kluyveromyces fragilis, Saccharomyces cerevisiae, Fungi, Fusarium graminearum, Cephalosporium eichhorniae, Chaetomium cellulolyticum, Paecilomyces varioti, Penicillium opium, Scytalidium acidophthlum, Spirulina, Chlorella, Soendesmus, Coelastrum, etc.

Process and cultivation of SCP

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. The potential substrates for SCP include bagasse, citrus wastes, sulphite waste liquor, molasses, animal manure, whey, starch, sewage, etc.

There are two types of fermentation processes for SCP production

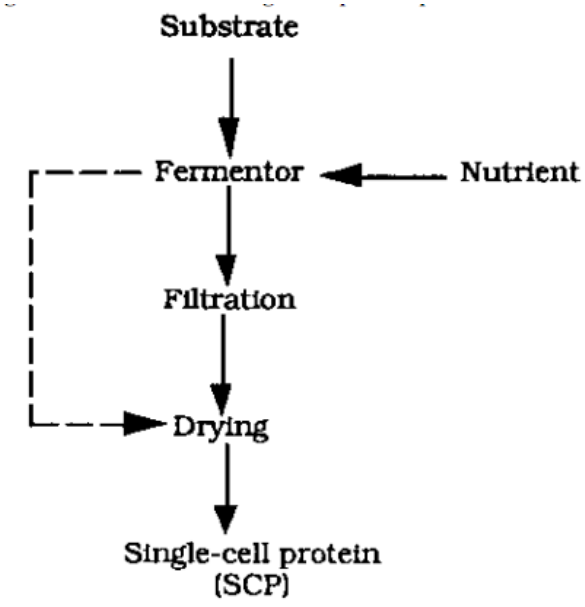
Submerged fermentation
Semisolid state fermentation

Economic aspects

Industrial production of SCP can be carried out in large scale as well as small scale. For large scale production the factors that should be taken into account during this fermentation period are: Investment, Energy, Operating costs, Waste, Safety and the Global market. Substrate costs. Small plants can be profitable only if they include simplifications of processes and material to a considerable degree. The substrate cost can be reduced using various alternative raw substrates for production but still. Large expenses invested to control metabolic heat and other parameters such as oxygen pH etc. Also more expenses can focused for qualify and acceptability of protein by using rDNA technology for Strain development for SCP production etc.

Protein is the fundamental need of most of individuals. Due to increase in population and their needs the SCP can be alternative source of protein. Due to low land require, broad substrate range of several microorganism alternative cheap raw materials can be used and production can be done through year. But still SCP is not preferred due to its allergic reaction, indigestible protein and high nucleic acid contain. rDNA techniques can be very helpful to reduce the allergic nature of protein and also to solve digestion.

Process and cultivation of SCP



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