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MICROORGANISMS: A MARVELOUS SOURCE OF SINGLE CELL PROTEIN

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Abstract

The rising number of people living in poverty is prompting researchers to explore alternative protein sources that are less expensive than traditional ones. Single-cell proteins (SCP), obtained from microorganisms such as algae, fungi, and bacteria, offer a promising solution due to their rapid growth and high protein content. SCP can be cultivated on various substrates with minimal reliance on soil, water, and climatic conditions, making them a versatile option for both human consumption and animal feed. Industrial production of SCP involves using algal biomass, yeast, and fungi, among other methods. However, despite their potential benefits, SCP can have drawbacks, including risks of toxicity from mycotoxins and bacterial toxins, which must be managed carefully.

Keywords: Advanced technology, single cell protein (SCP), microbial protein, advantages, disadvantages, toxins

Introduction

Single-cell proteins (SCP) are also known as microbial proteins because they are made from unicellular organisms such as yeast, fungi, algae, and bacteria, which are cultured on various carbon sources to produce protein. These proteins are rich in vitamins such as thiamine, riboflavin, and ascorbic acid. Essential amino acids, minerals, nucleic acids, and lipids are also present. SCP is mostly produced from agricultural waste products, which carries the environmental and water footprint of industrial farming. Moreover, SCP can also be generated through autotrophic growth methods that do not depend wholly on agricultural waste, offering more efficient nutrient recycling and diverse growth options. Carol Wilson in 1967 introduced the term "single-cell protein" altering the less favorable term "petro protein." SCP technology emerged due to the shortage of protein in developing countries. It is used for both human and animal consumption.

Here is a table of microorganisms which are used for the production of SCP;

Fungi	Yeast	Bacteria	Algae
Aspergillus niger	Candida utilis	Pseudomonas fluorescens	Chlorella pyrenoidosa
Rhizopus cyclopean	Saccharomyces cerevisiae	Bacillus megaterium	Chondrus crispus
Aspergillus fumigatus	Candida tropicalis	Lactobacillus	Spirulina sps

Need for SCP from microorganisms

Single cell protein (SCP) proposes a solution to global food shortage by offering an alternative to typical protein crops, which need a huge amount of land and produce relatively low levels of protein per unit area. SCP technology has th potential to satisfy up to 10% of the world's protein demands using only one- third of a square mile. SCP manufacturing, unlike agriculture, is unaffected by weather, making it a more reliable choice. Furthermore, SCP technology can solve the limits of animal protein sources, which suffer similar climatic and resource constraints. Microorganisms used in SCP manufacturing include algae, fungus, protozoa and bacteria, all of which are chosen depending on certain microorganisms.

Nutritional aspects of SCP

The microorganisms and substrates employed, along with other important variables including amino acid profiles, protein, carbohydrate, fat content, minerals, and vitamins, can all affect the nutritional value of single-cell proteins (SCP). Additionally, to be considered are gastrointestinal symptoms, possible allergies, and palatability. To evaluate the possible toxicological and carcinogenic consequences of SCP, clinical studies have to be carried out. When evaluating the nutritional quality of SCP, critical nutritional variables such as net protein utilization (NPU), protein efficiency ratio (PER), biological value (BV), and protein digestibility value (PDV) are crucial. Lysine, thiamine, biotin, riboflavin, and niacin are abundant in yeasts, but methionine is not present in them. In accordance with WHO guidelines, *Aspergillus niger* has a profile that is balanced. Generally, SCP products contain about 50-70% crude protein, with bacteria typically having a crude protein content of around 80% of their dry weight.

Single Cell Protein production method

The selection of quickly growing, protein-rich microorganisms with the right growth traits is the initial stage in the synthesis of SCP. Next step is the selection of, appropriate substrates that are necessary for the formation and proliferation of particular microorganisms. Fermenters are used for fermentation, primarily for the bulk cultivation of plant or animal cells. Within the medium that is placed inside the fermenter, the microorganisms proliferate and flourish. Abiotic factors like temperature, pH, humidity, and oxygen concentrations within the fermenter are meticulously regulated to maximize the healthy development of microorganisms.

The microbial cells are collected and removed from the growing media once the fermentation is finished. The extraction and purification of the microbes, however, continues to be a challenge for the SCP production process. The collected microbial cells undergo post-harvest treatments such as drying, conserving, and lowering their bulk, which facilitates storage and transportation. After that, the dried microbial cells are examined to get rid of contaminants and enhance their flavor, texture, and nutritional value.

Advantages of Single Cell Protein

Microorganisms are exploited for producing single-cell proteins (SCP) due to several advantages. They grow much more quickly than protein-rich grains, which take a year to harvest. Microbial proteins typically offer higher quality and quantity, ranging from 60-80%. They can be cultivated using a variety of inexpensive raw materials and the production process is straightforward and efficient. Additionally, microorganisms can be genetically engineered with ease and can be grown year-round. They are capable of using diverse substrates, making SCP production both environmentally friendly and cost-effective, as well as energy-efficient.

Disadvantages of Single Cell Protein

Producing single-cell proteins (SCP) is a complex process that demands careful regulation of various environmental conditions. Ensuring the quality of SCP is challenging, particularly due to difficulties in harvesting and purifying the product after production. SCP often lacks some essential amino acids, so it is usually used as a supplement rather than a complete protein source. Despite its many potential advantages, SCP faces a significant hurdle in consumer acceptance, as some people may be wary of eating a product derived from microorganisms.

Potential Applications of Single Cell Proteins

Applications of single cell proteins (SCP) in animal nutrition and feed include feeding and fattening pigs, calves, laying hens, and poultry. As food additives, they improve the nutritional content of prepared foods, baked products, soups, and other foods by serving as emulsifiers, vitamin transporters, and carriers of aromas. SCP is used in industrial operations such as the production of paper and leather, as well as foam stabilization. It gives malnourished youngsters a high-quality dose of protein along with vital vitamins, minerals, and amino acids. Furthermore, SCP has great promise for application in natural and therapeutic medicine to treat obesity, have anti-diabetic effects, reduce stress, and stop cholesterol accumulation. SCP is added to cosmetics such as hair care products and cosmetics like bio-lipsticks and face creams.

Conclusion

Single-cell proteins are intriguing because they can enrich plants'and animals' diets with nutrients. SCP can be created at any time of year because it is not affected by changes in the weather or the seasons. It can be made using a variety of substrates. Single cell proteins are typically isolated proteins that are grown on various substrates in well regulated environments from microbes. SCP is a great source of vitamins, minerals, vital amino acids, and proteins. *Acinetobacter calcoaceticus, Achromobacter delvaevate, Flavobacterium spp., Lactobacillus spp., Methanotrophic spp., Pseudomonas fluorescens,* and *Rhodopseudomonas* are only a few of the several bacterial species that can be used in the synthesis of SCP. Nucleic acid extraction, semi-solid fermentation, washing, purification, and drying are the processes used to create bacterial SCPs.

SCP has been used more frequently and has drawn a lot of attention lately. Production of SCPs is a developing field in science. In the future, SCP will be essential to guaranteeing safe and healthy food for humans and healthcare, and its expansion is also dependent on dietary preferences and demand. Consequently, it can be concluded that SCP has no adverse effects and can readily take the place of traditional animal and plant protein sources in the diets of both humans and animals.

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