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A Review on Single Cell Protein (SCP)

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Abstract:

Single Cell Protein (SCP) refers to esculent unicellular microorganisms. The protein extract or protein biomass from pure or mixed cultures of algae, yeasts, fungi or bacteria may be used as an ingredient or a substitute for protein-rich foods, it is also suitable for human consumption or as animal feeds. The protein is most useful part of the microbial cells of the above organisms, also called single cell protein as natural protein concentrate. As increase the population in the world, the protein source proportionally decreases. In the Single Cell Protein (SCP) has high value of nutrition because it contains high protein, lipid materials, essential amino acid and vitamin. The protein derived from a culture of single-celled organisms, used especially as a dietary food supplement. They are used as animal feed and can be used for human feed as protein supplement. Some time also used as 'Novel food' and 'Minifood'. To convert various substrates into SCP (single cell protein) production technique, some kind of microorganism have been used. This process is used to solve the problem of protein crisis in all over world. In this review, SCP may be one of the valuable as well as cheapest products of protein are highlighted. Basically the main aim and objects are to study the development of the enrichment process of protein from the microbial biomass, and to study to remove the misconception about the microorganism and make them acceptable as protein source to the human beings.

Key Words:

SCP, Production, Fermentation, Economical aspects.

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Introduction:

Recently the protein deficiency is the huge labyrinth of human beings in the entire world.[1] Therefore find out alternate source of protein is very much necessary.[2][3] Microbial biomass has been considered the alternative source of protein from 1996[.4] The single cell protein production in large scale gives some useful prominence, for example; Change of state of substrate has high efficiency, Fast growth rate of microorganism has high and great productivity, Microorganisms are used in this purpose, which are enough present in the environment.[5]

Almost a century ago, the yeast was first recognized microorganism as animal feed supplement. Germany replaced half of imported protein sources by yeast. The first and foremost commercial single cell protein used as the additive of animal feed was Preteen.[6] From a nutritional viewpoint, Nucleic Acids content in Single Cell Protein is one of the main factors hindering its utilization as food. Uric acid precipitation occurs due to the excessive intakes of nucleic acid. It also lead for the causing health disorders, such as gout or kidney stone formation.[7] In human beings, nucleic acid contents must be reduced below 2%. Several technologies have been reported to reduce the nucleic acid content of microbial cells, including both chemical and enzymatic procedures.[8]

Table 1. Average different compositions of the main groups of microorganisms (% dry weight)[9]

Composition	Fungi	Algae	Yeast	Bacteria
Protein	30-45	40-60	45-55	50-65
Fat	2-8	7-20	2-6	1-3
Ash	9-14	8-10	5-10	3-7
Nucleic acid	7-10	3-8	6-12	8-12

Single Cell Protein:

It is a protein extracted from cultured algae, yeast, or bacteria used as a substitute for protein-rich food, especially in animal feeds or as dietary supplements. Many types animal feeds contain single cell proteins.[10] 60-80% dry cell weight; Contains nucleic acids, fats, CHO, vitamins and minerals; Rich in essential amino acids (Lys-Met).[11] Microbes can be used to ferment some of the vast amounts of waste materials, such as straws; Food, cannery

and food processing waste; and residues from alcohol production or from human and animal excreta.[12] It is good nutrition (complex vitamins); Simple to grow, in some cases (carbon dioxide, whey, cellulose as substrates, depending on organisms; Sometimes it is used in livestock feeding; In some regions SCP could become the principle protein source that is used for domestic livestock , depending upon the population growth and the availability of plant feed protein sources.[13],[14]

Single Cell Protein Production:

Produced protein contains impurities in it. Therefore carbohydrates, nucleic acids, lipid contains, salts etc. Pure protein isolation can be done by disrupting the cell wall through crushing, crumbling, grinding and thermal shocks.[15]

Nucleic acid can be removed by:

Treatment with NaCl 10%; Chemicals e.g., NaOH; Thermal shocks; Enzymes treatment e.g., ribonucleases.[16]

Fermentation:

It is the process involving the biochemical activity of organisms, during their growth, development, reproduction, even senescence and death.[17] It is used of organisms to produce food, pharmaceuticals and alcoholic beverages on a large scale industrial basis.[18] A bioreactor is different from a fermenter as it used for the mass culture of microorganisms. The chemical compounds synthesised by these cultured cells such as therapeutic agents can be extracted easily from the cell biomass.

Economical Aspects:

Large-scale fermenters are required for Single Cell Protein production. Therefore with high biomass production, high oxygen transfer rates and high respiration rates which in turn increase metabolic heat production and the need of an efficient cooling system ensued. In such a continuous operation for Single Cell Protein production the economics of this production must be strongly taken into account during this fermentation period are-

1. Investment,
2. Energy,
3. Operating costs,
4. Waste,

5. Safety and
6. The Global market.[21]

Substrate Costs- The substrate costs are the largest single cost factor. Simplifying the manufacture of raw materials is more economical in larger plants. Factors involved in the raw materials costs are site, raw material production, process capacity of the plant and substrate yield.

Utilities- The energy for compressing air, cooling, sterilizing and drying forms the next most important cost factor. Sites with cheaply available fossil, thermal, electrical or process derived energy are to be preferred.

Capital Load- By the cost of apparatus for the process, the capacity of a plant and the capacity conditions, the capital dependent costs are determined. The size of the plant is the most variable. Small plants can be profitable only if they include simplifications of processes and material to a considerable degree. The high productivities in fermentation are compensated by the greater expenditure on energy to achieve specific productivities, so that optimum can be determined

Product specific variables- Only by the product produced, the process costs arising are covered. The product's absolute value of the products is governed by the amount of product referred to the costs involved and by the quality of the product. The product may be upgraded by the purification and separation of the microbial biomass.[22]

Conclusion:

Single cell protein production, referring to the fact that most of the microorganisms used as procedures grow as single or filamentous individuals rather than as complex multi cellular organism such as plants or animals. Use of microbes in the production of proteins gives many advantages over the conventional methods. Microbes have shorter generation time, allow easy transformation, utilize many substrates, have no requirements in arable land or any particular season to grow and have the possibility of continuous production in any part of the world. The cell yield varies according to the substrate and type of microorganism

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