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Mini Review

Recent Developments in Nanobiotechnology Use Fungi as a Real Tool

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ABSTRACT

Fungi have excellent potential for nanotechnology synthesis, applications, and the creation of novel goods. Due to the ecological friendliness of their metabolite-mediated nanoparticles, their safety, adaptability, and uses in numerous industries, fungi are receiving increased attention in recent years. Fungi are a true instrument for the synthesis of nanoparticles due to the diversity of their metabolites, which include enzymes, polysaccharides, polypeptides, proteins, and other macro-molecules. Numerous studies on the greenly generated metal nanoparticles produced by fungi have provided a thorough understanding of the molecular mechanism of fungal nano-biosynthesis. Fungal nanobiotechnology has been used in the industrial, medical, and agricultural sectors to improve and provide goods and services to people. It has found use in agriculture for managing plant diseases and creating ecologically friendly, non-toxic pesticides and fungicides. To increase all aspects of agricultural production. Through more effective drug delivery methods, fungal nanoparticles have enhanced medical detection and treatment of diseases, particularly those with microbial origins. This has had significant positive effects on the pharmaceutical industry. Therefore, this review examined the synthesis, characterisation, and possible applications of fungal nanobiotechnology in a variety of human endeavours for the delivery of products and services.

Keywords: Polysaccharides; Polypeptides; Proteins

INTRODUCTION

In general, fungi are eukaryotic creatures that primarily break down organic matter. Fungi are thought to exist in about 1.5 million different species today, yet only 70,000 of them have been accurately taxonomically classified. Additionally, when high-throughput sequencing was used, about 5.1 million fungal species were discovered. Despite the variations in the fungal population around the world recorded by various research [1], it is important to note that fungi are genuinely everywhere and that their number may perhaps be higher than has ever been indicated in any study. The primary global traits of the fungal kingdom are found in extracellular substrate breakdown, production of crucial enzymes to reduce highly complex molecules to simpler forms, and utilisation of diverse food sources. Therefore, it is crucial to investigate fungi and their implications for and promise in nanobiotechnology [2].

Thus, the term "myconanotechnology" refers to the intersection of mycology and nanotechnology. Myconanotechnology has enormous potential, in part because of the diversity and range of mushrooms. Mycology is the study of mushrooms, whereas nanotechnology is the study of the design, production, and use of tiny, strategically placed particles for technological purposes. Mycofabrication is the word used to describe the design and production of metal nanoparticles utilising fungi [3]. A significant bionanofactory for the synthesis of nanoparticles of gold, silver, CdS, platinum, etc. has recently been identified as the microbial system. Fungal bionanofactories have created significant, monodisperse nanoparticles with good diameters.

MATERIALS AND METHODS

Fungi are also known to produce considerable amounts of proteins, which is necessary for the creation of nanoparticles on a big scale. Metal ions are hydrolyzed by the majority of fungal proteins. Fungi are also simple to isolate and cultivate [4]. Additionally, fungal nanoparticles containing enzymes, polysaccharides, protein, and other macromolecules are varied in size and are primarily released extracellularly. Therefore, fungi serve a crucial role in minimising environmental pollution, making the extraction and purification of fungal enzymes less complex than techniques that produce synthetic enzymes. The use of biological systems, such as fungi, has recently emerged as a novel strategy, and the use of microorganisms in the synthesis of nanoparticles is an appealing green nanotechnology option.

Any microorganism that would be taken into consideration for nanobiotechnological applications is thought to have to be generally acknowledged as safe (GRAS) status on all fronts without any form of disagreement. Similar to this, the GRAS status of fungi

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is their primary characteristic in nanobiotechnology, and regardless of their biology, habitat, or enzyme, they must be generally safe [5]. Fascinatingly, fungi that produce significant nanoparticles have GRAS certification. Fungi are also of great interest in the bio- logical development of metallic nanoparticles due to their tolerance and potential for metal biological accumulation. Fungi can collect metal ions by physical, chemical, and biological processes such extracellular binding of polymers and metabolites, binding to specific polypeptides, and accumulation that is regulated by metabolism.

In addition, fungi Furthermore, one key benefit of utilising fungi in the creation of nanoparticles is their ease of scaling up, even in thin solid substrate fermentation techniques. Additionally, because fungi are skilled secretors of extracellular enzymes, large-scale enzyme processing is feasible. The simplicity of using biomass is another advantage of employing a green method to create metallic nanoparticles via fungal. Numerous fungal species grow quickly, making it simple to cultivate and maintain them in a lab setting. Fungi have received a lot of attention since they are widely cultivable and have potential applications. Enzyme secretion from extracellular sources is also advantageous for managing and digesting downstream biomass [6]. A second characteristic of fungi that made it popular for nanobiotechnological uses is increased intracellular metal absorption and wall-binding. By utilising a reducing enzyme, either intracellular or extracellular, and a biomimetic mineralization process, fungi can produce metal nanoparticles/meso and nanostructures. Fungi are superior protein secretors to bacteria and other microbes, producing a larger production of nanoparticles. Fungi have the ability to dissimulate, making quick and environmentally beneficial solutions possible.

Fungi are the main organism in the world today that secretes nanoparticles in a method that is far less harmful to the environment. The variety of fungi has been cited as an important biological component for the creation of nanoparticles. Copper nanoparticles were synthesised using Penicillium aurantiogriseum, Penicillium citrinum, and Penicillium waksmanii, it was reported. The artificial nanoparticles had a spherical shape and were remarkably homogenous [7]. According to UV-vis and fluorescence spectra, proteins made from fungi are capable of hydrolyzing metal precursors to create metal oxides extracellularly. It has also been demonstrated that the fungi Penicillium aurantiogriseum, Penicillium citrinum, and Penicillium waksmanii may produce gold nanoparticles in vitro. The produced gold nanoparticles displayed a spherical shape that was largely consistent; with a Z-average diameter of 153.3 nm and 172 the produced nanoparticles have a good monodispersity and a fairly well-defined diameter. The produced nanoparticles had an average diameter of 60 nm, were spherically shaped, and were superiorly monodispersed [8]. The outcome demonstrated the highly strong scolicidal effects of the produced nanoparticles at all four concentrations assessed and at varying exposure durations compared to the control group [9].

RESULT

This finding is fantastic news because nanobiotechnology is already demonstrating its value in a variety of industries, particularly the medical industry where a high degree of purity is necessary for any chemical. Fungi are currently crucial in medicine for the detection and treatment of diseases, most especially for the effective delivery of drugs to previously inaccessible locations. Moreover, gold there have been reports of Aspergillus, Neurospora, Fusarium, Pleurotus, and Verticillium species producing nanoparticles. Trichoderma viride produces 5–40 nm polydispersed silver nanoparticles at room temperature. In general, fungi secrete a variety of nanoparticle sizes. Important nanoparticles have been described from harsh environments in addition to fungi-mediated nanoparticles from the regular environment [10]. The classification of extremophiles and their ecology, according to Tiquia-Arashiro, is the first step in developing procedures and products that will benefit mankind. Extremophiles are biotechnologically intriguing because they produce extremozymes, or enzymes that function in extreme environments. Extremozymes are crucial in industrial manufacturing processes and have many uses in research because they can continue to function in challenging circumstances such high pressure, pH, and temperature. Just 1% of the species have been reported, and even fewer have had the beneficial qualities of those species sequenced, therefore study into the identification of extremophiles from natural habitats has barely begun. Though, as discovery of extremophiles has created opportunities for commercial, biotechnological, and medical uses, as many researchers have noted.

DISCUSSIONS

Extremozymes can be used in exceptionally severe settings, which can result in substrate transitions that aren't achievable with conventional enzymes, giving them a lot of potential in industrial biotechnology. Chemical catalysis cannot achieve the complicated chemo-, regio-, and stereo-selectivity that enzyme-mediated reactions can. The long-term survivability and reusability of enzymes, however, have been recognised as important barriers to their widespread usage. In industrial biotechnology, a variety of nanoparticles have recently been added to traditional enzyme immobilisation techniques to increase enzyme loading, function, and stability while lowering biocatalyst costs. Comparing the synthesis of fungi-mediated nanoparticles to that of bacteria and actinomycetes, there are many advantages.

CONCLUSION

Fungi have many wonderful benefits to give, some of which are their ease of handling and downstream procedure, economic viability, and ecological friendliness to cover a big surface. Metal ions are converted into nanoparticles by enzymes in the cytoplasm and cell wall of fungus. Fungi are more productive and more tolerant of metals in terms of producing nanoparticles, particularly in the setting of the high cell wall binding capability of metal ions with biomass. The positive charge that the metal ions have draws fungi, which starts the biosynthetic process. But certain proteins are also activated by metal ions, and these proteins cause the metal ions to be hydrolyzed. Several recent research projects research on utilising fungus to create nanoparticles. As previously mentioned, fungi are better suited than other species of microbes for the creation of nanoparticles due to the presence of proteins on their cell surfaces. The most frequent method of intracellular biological synthesis is the reduction of reductase enzymes found in the cell wall of fungal cells to produce metal nanoparticles. Fungi create nanoparticles as a cellular defence mechanism against the chemical toxins present in their surroundings, and numerous chemical processes convert harmful ions to their metal nanoparticles.

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