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Submerged Fermentation for Truffles: A Potential Replacement and Production

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Abstract

Because of its distinctive and recognisable perfume, ruffle (Tuber spp.), sometimes known as "underground gold," is a common ingredient in many different cuisines. Presently, nature and somewhat artificial farming are the main sources of truffle fruiting bodies. The latter takes a long time to grow and often takes 4 to 12 years before the fruiting body can be harvested, whereas the former source is uncommon. In Tang's laboratory, the submerged fermentation method for truffles was initially created as an alternative to their fruiting bodies. To the best of our knowledge, Tang's team is responsible for the majority of reports on truffle submerged fermentation. The present condition of the submerged fermentation method for truffles is examined in this review. First, a summary of the approach taken to optimise the submerged fermentation process for truffles is given; under these final circumstances, the greatest documented truffle biomasses as well as the largest production of extracellular and intracellular polysaccharides were produced. Second, a comparison of the metabolites produced by fruiting bodies and truffle fermentation is made, with the former coming out on top. Third, fermentation process optimisation may be able to control the metabolites (such as volatile organic compounds, equivalent umami concentration, and sterol) produced during the fermentation of truffles. These results suggested that a promising alternative to producing truffle fruiting bodies in a bioreactor is submerged fermentation of truffles for the commercial generation of biomass and metabolites.

Keywords: Macrofungi • Mycelia • Food industry• Bioreactor• Metabolite • Bioproduct

Introduction

A technique for growing microorganisms in liquid nutrient media is submerged fermentation. This entails growing the chosen microorganism for industrial production in closed containers known as bioreactors that contain nutritional broths. The system design for bioreactors enables monitoring and control of several parameters, including pH, temperature, viscosity, dissolved oxygen, foam formation, biomass production, substrate utilisation, and desired product formation. It also enables provision of oxygen as needed for aerobic microorganisms. The usage of submerged fermentation, where fermentation occurs in sizable fermenters with volumes ranging from thousands to hundreds of thousands of litres, has been made easier by the capacity to modify parameters online. For instance, submerged fermentation is used to create 90% of commercial xylanases. High viscosity of the culture broth, which restricts oxygen and mass transfer and can influence enzyme activity, is frequently linked to fungal submerged fermentation. With the use of various submerged fermentation techniques, this restriction can be minimised or even overcome. Batch culture, fed batch culture, continuous culture, and perfusion batch culture are the four different submerged fermentation procedures [1-5].

Discussion

The biological process of turning complicated substrates into simple chemicals by a variety of microorganisms, including bacteria and fungus, is known as fermentation. They emit a number of other substances during this metabolic breakdown in addition to the typical by products of fermentation, such as carbon dioxide and alcohol. These extra substances are referred to as secondary metabolites. Many different antibiotics, peptides, enzymes, and growth hormones are examples of secondary metabolites. The advancement of processes like Solid State Fermentation (SSF) and Submerged Fermentation (SmF) has enabled the manufacture of bioactive chemicals at an industrial scale.

A type of fermentation employed in the manufacture of enzymes is known as solid state fermentation. As the name implies, fermentation is a biological process in which microbes are cultivated on a solid substrate or surface with very low moisture content. For growing bacteria, a single insoluble substrate supplies nutrients like carbon, nitrogen, etc. Adherent microorganisms develop on the solid substrate. Rice husk, wheat bran, sugar beetroot pulp, wheat and maize flour, and other composite and heterogeneous agricultural or agro-industrial byproducts are frequently used in solid-state fermentation. Thus, the substrates are less expensive and more easily accessible [6].

Mushrooms that are used for food and medicine are typically regarded as a reliable source of rare bioactive metabolites that have the potential to improve human health. An uncommon edible and medicinal fungus called Antrodia cinnamomea, which is common in Taiwan, has received a lot of attention recently due to its high value for both scientific research and practical applications due to its potent therapeutic effects, particularly for its hepatic protection and anticancer activity. The cultivation of A. cinnamomea by submerged fermentation looks to be a feasible alternative due to the dearth of fruiting bodies and has several distinct advantages, such as a short culture time and high feasibility for scale-up production. However, compared to those obtained from the wild fruiting bodies, the amount of fungal bioactive metabolites derived from the cultured mycelia of A. cinnamomea cultivated by submerged fermentation is significantly lower. Therefore, it is vital to resolve this disparity between the bioactive metabolites of wild fruiting bodies and those of farmed mycelia. In order to increase the synthesis of fungal bioactive components, the mycelial submerged fermentation of A. cinnamomea can be enhanced by optimising growth conditions and controlling fungal metabolism, which is the focus of this article. This review offers important details for future biotechnological uses of A. cinnamomea and other mushrooms as sources of bioactive compounds through submerged fermentation [7-10].

Conclusion

One of the production platforms for fermented goods is filamentous fungus. The aggregation of mycelia, which is influenced by external factors and results in dramatically varied rheology for fermentation broth, is the distinctive feature of their submerged fermentation. Such rheological changes have an impact on the biosynthesis of target products as well as the effectiveness of their production. They also affect the transmission of mass, heat, and momentum. This article reviews methods for controlling the morphology of filamentous fungi and adds further commentary on the effects of calcium signal transduction and chitin production on hyphal apical development and mycelial branching for mycelium aggregation. The process of fermentation has been extensively employed to produce a wide range of compounds that are extremely advantageous to both people and industry. Due to its benefits for the economy and ecology, fermentation processes have become increasingly important throughout time. To increase productivity, old methods have been further improved and modernised. The creation of new tools and procedures was also involved. Submerged Fermentation (SmF) and Solid State Fermentation (SSF), two general fermentation processes, have emerged as a result of this rapid progress. The discovery of various secondary metabolites (bioactive chemicals) produced by microbes that have beneficial properties has led to increased research into fermentation as a method of producing these substances.

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