


Molecular mechanisms of mushroom life cycle control -Do mushroom hormones exist?-

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Purpose and Background of the Research

Mushroom is the common name for higher fungi that form fruiting bodies, and the fruiting bodies of these fungi are also generally referred to as mushrooms. It is said that there are more than 100,000 species of mushrooms on the earth and several thousand species in Japan, however, no one knows exactly how many of mushrooms exist. In addition, there are more than 10,000 species of mushrooms that have been named, and many remain "nameless". Thus, mushrooms, which are also largely unnamed but are a major presence in the living world, repeat a "life cycle" of spores to mycelia, mycelia to fruiting bodies, and fruiting bodies to spores (Figure 1). However, the molecular mechanisms that regulate this life cycle are completely unknown.

Through almost 40 years of chemical and biochemical research on mushrooms, the principal investigator came up with the hypothesis that each stage of the life cycle is regulated by common hormones in mushrooms.

The purpose of this study is to elucidate "What molecules regulate the mushroom life cycle?" and "Are mushroom hormones present?"

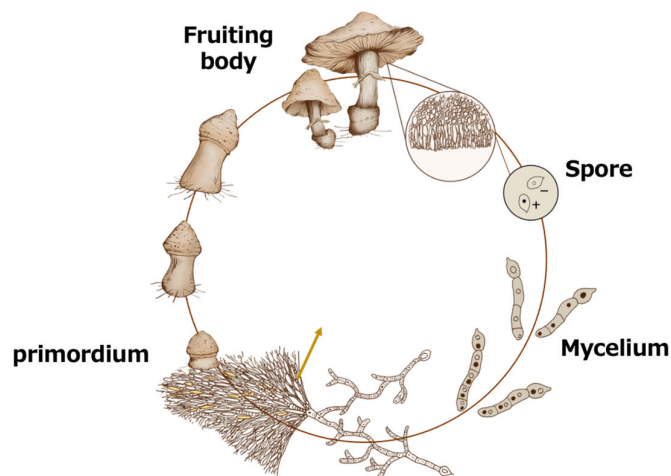


Figure 1 Life cycle of mushrooms

Expected Research Achievements

This research is based on "natural product chemistry", which is a branch of chemistry that studies organic compounds that exist in nature (natural organic compounds). It involves the isolation, structure determination, synthesis, and biological activity of natural organic compounds, as well as the elucidation of the mechanisms by which biological activity is expressed. Through these studies, it aims to elucidate the significance of natural products in living organisms and their relationship to biological phenomena, as well as the mechanisms of life and problems in biological evolution" (Iwanami Shoten, Rikagaku Jiten).

Ultimately, we aim to "prove the existence of mushroom hormones" for the first time in history. Taking plant hormones as an example, the definition is "a substance produced by plants themselves and having the function of regulating their own physiological activity and information transmission at low concentrations, which exists universally in plants and whose chemical body and physiological actions have been clarified. Unlike hormones in animals, secretory organs and target organs are not clear, nor is the mechanism of transport common" (Kyoichi Koshiba and Yuji Kamiya, eds., New Plant Hormone Science, Kodansha). Currently, only six (Obunsha Biological Encyclopedia; auxin, gibberellin, cytokinin, flowering hormone, abscisic acid, ethylene) or seven (Encyclopedia Nipponica; auxin, gibberellin, cytokinin, ethylene, abscisic acid, brassinolide, jasmonic acid) are recognized as plant hormones.

In this study, we will focus on compounds that control each step of the life cycle, especially fruiting body formation triggers/promoters. We will also study spore germination and mycelial growth stimulants. To this end, we will elucidate the molecular mechanisms of mushroom life cycle regulation from the following four completely different approaches (tasks) and distinguish between individual mushroom life cycle regulators and "mushroom hormones" according to the hormone definition: 1) Elucidation of life cycle regulators in the "fruiting liquid (FL)" (Task 1), 2) Proof of Fairy Chemicals (FCs) as mushroom hormones (Task 2), 3) Proof of the hypothesis that "one of the hormones is a steroid" (Task 3), and 4) Search for life-ring regulators in spores (Task 4)(Figure 2). On the applied side, we aim to artificially cultivate Matsutake mushrooms.

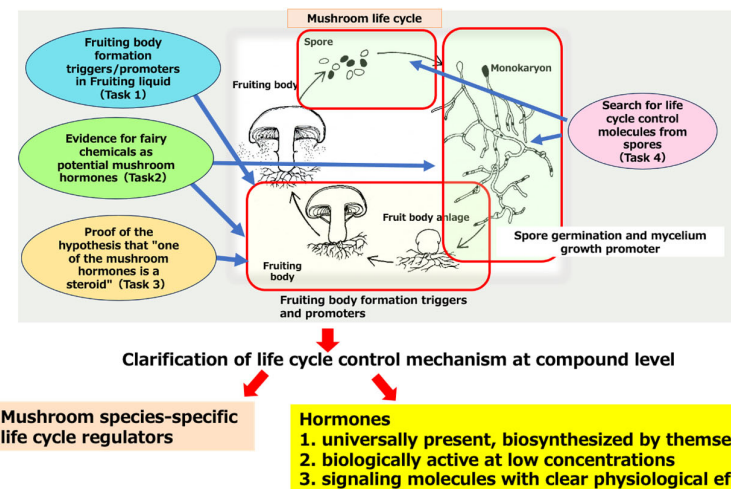


Figure 2 Overall research picture