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Coumarins: Fungal Metabolites with Potential Medicinal Properties

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Introduction

Coumarins are a diverse group of 2H-chromen-2-one compounds classified as members of the benzopyrone group of secondary metabolites. Coumarin derivatives are of particular interest due to their wide practical application and the unique reactivity of molecularly fused benzene and pyrone ring systems. Coumarins have unique antiviral, antimicrobial, antioxidant, anti-inflammatory, antiadipogenic, cytotoxic, apoptosis, antitumor, antitubercular, and cytotoxic properties. For thousands of years, natural products have played an important role in filling the pharmaceutical pipeline. Natural coumarins' biological effects have provided the foundation for low-toxic and highly effective drugs. More than 1300 coumarins have been discovered in plants, bacteria, and fungi. Fungi, as cultivated microbes, have provided many of the nature-inspired drug syntheses.

Fungal mycelia produce a diverse range of bioactive molecules, including coumarins. Further research into the conditions and products of natural and synthetic coumarin biotransformation by fungal cultures holds promise for solving the urgent problem of finding materials for biomedical engineering. The current review assesses fungal coumarins, their structural peculiarities, and their potential therapeutic utility. Special emphasis has been placed on coumarins successfully bioprospected from fungi, whereas industry demand for the same coumarins previously discovered in plants has encountered challenges. Some aspects of the molecular mechanisms underlying the biological activity of coumarins have also received considerable attention. The compounds are chosen and classified based on their cytotoxic, anticancer, antibacterial, antifungal, and other effects [1].

Description

Natural compounds have provided the basic chemical foundation for the production of a wide range of biotechnologically significant products and pharmaceutical agents. Microorganisms are an important source of natural products with a variety of bioactive properties. Fungi are one of the microorganism groups that are widely recognised as bioproducers of valuable metabolites and are being researched for compounds with medicinal applications. However, only a small percentage of economically important metabolites have been discovered, indicating future exciting fungal products. Fungi, which are also an excellent source of coumarins, are constantly producing novel natural products with diverse chemical structures. Coumarins are prominent among natural products. These are benzopyrone compounds from the secondary metabolite flavonoid-like moiety [2].

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Furthermore, fungi were discovered to be the most effective source of coumarin-based pharmaceutical products ever seen. The diversity of bioactivities among coumarins is so huge that the phrase “pharmacological promiscuity” has been applied in their case. Fungi biosynthesize the natural coumarin products discussed in this work. Because of their distinct structural features, their bioactivities are of interest, with applications in fields as diverse as cancer and neuronal injury or degeneration, microbial and parasitic infections, and others. As a result, fungal-sourced coumarin-class chemical agents are of immediate interest to the pharmaceutical industry. The purpose of this review is to describe coumarins as one of several groups of biotechnologically valuable compounds that are typically derived from fungi.

Srikrishna et al. described novel synthetic methods for many molecules based on the coumarin ring system. These synthetic routes have resulted in interesting coumarin analogues with pharmacological activities. According to Zhu and Jiang's review, the specific site on the core structure of coumarin exhibits one or more activities as a result of the electronic or steric effects of the substituents. This review is intended to aid in the rational design and development of more active and less toxic coumarin scaffolded agents. Hu et al. reviewed coumarin and its derivatives as anti-tuberculosis agents and outlined the critical aspects of design and the structure-activity relationship of these coumarin derivatives [3].

A large number of recent coumarin-related reviews compelled us to make drastic changes. Keeping this in mind, the current review assesses coumarins, fungal-sourced bioactive agents, their structure-related peculiarities, and their potential therapeutic utility. Fungal-derived biological activities, primarily cytotoxic, antibacterial, antitubercular, antifungal, and antiviral natural coumarins, as well as other fungi-derived coumarins of pharmacological value, have received special attention. Coumarins, which have been successfully bioprospected from fungi but were previously known only as herbal metabolites, have received special attention. The coumarin derivatives studied in clinical and preclinical testing have also been taken into account, but not in a comprehensive manner, as the majority of these coumarins are not fungal-derived but synthetic hybrid compounds that have already been extensively quoted in the literature.

Natural products have been playing a major role in the search for novel drugs for numerous illnesses. Prominent producers of these natural products are found in fungi. One should remember that the discovery of the antibiotic penicillin from a fungus almost a century ago heralded an era of intense exploration of compounds from prokaryotic and eukaryotic organisms for their pharmaceutical potential. It was the tremendous success of penicillin as an antibiotic in the early 1940s that shifted the focus of natural product-based drug sources from plants to microorganisms .Throughout human history and especially in the past century, natural products have remained virtually undisputed leaders among the various therapeutic tools humans have employed to combat numerous diseases, including cancer.

While plant-derived products have long played an important role in traditional medicine, more or less comprehensive research into fungal natural products became possible with the advancement of natural sciences during the twentieth century. Secondary metabolites of microbial origin are well known as a valuable source of lead molecules in the selection of drug candidates for infectious diseases, cancer, and a variety of other diseases. Endophytic microorganisms, particularly fungi, have the potential to produce

both known and novel natural products. In the face of a less successful traditional plant-based industrial pipeline, the ever-increasing demand for potent drugs has virtually catapulted these enigmatic microorganisms to unprecedented biomedical prominence [4,5].

Conclusion

While plant-derived products have played an important role in traditional medicine for thousands of years, more or less comprehensive research into fungal natural products became possible with the development of natural sciences during the twentieth century. Secondary metabolites of microbial origin are well known as a valuable source of lead molecules in the selection of drug candidates against infectious diseases, cancer, and a variety of other illnesses. Endophytic microorganisms, particularly fungi, are potential sources of both known and novel natural products. The ever-increasing demand for potent drugs, combined with a less successful traditional plant-based industrial pipeline, has pushed these enigmatic microorganisms to unprecedented biomedical prominence.

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Conflict of Interest

There are no conflicts of interest by author.

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