Recent Advances in Research on Molecular Mechanisms of Fungal Signaling

Subjects: Mycology

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Biochemical signaling is one of the key mechanisms to coordinate a living organism in all aspects of its life. It is still enigmatic how exactly cells and organisms deal with environmental signals and irritations precisely because of the limited number of signaling proteins and a multitude of transitions inside and outside the cell. Many components of signaling pathways are functionally pleiotropic, which means they have several functions. A single stimulus often results in multiple responses, a distinct response can be triggered by numerous stimuli and signals initiated by different stimuli are often transduced via commonly used network components. This review sheds light on the most important molecular mechanisms of cellular signaling in fungi and consequently provides a comprehensive overview about the current state of research on the road to understand the impact of signal transduction in eukaryotic microorganisms.

Keywords: cAMP signaling ; quorum sensing ; alternative splicing ; lipid signaling ; MAPK cascade ; multistep phosphorelay ; pheromone signaling ; glucose signaling ; light signaling ; fungal signaling ; fungi

Adaptation and resilience to environmental changes is a prerequisite for cells and organisms to live, survive and evolve. The expansion of signaling pathways in three kingdoms—Archaea, Bacteria and Eukarya—came about through the horizontal transfer of bacterial genes and the coevolution of the components of the respective systems [1][2][3]. Consequently, in terms of their functional properties and molecular architecture, signaling systems in unicellular eukaryotes represent an intermediate stage in the evolution of signaling systems between pro- and higher eukaryotes [2]. All living cells have in common that the functional organization of fundamental processes of the cell—growth, metabolism, differentiation and apoptosis—includes four basic components: (i) a signal receptor, which specifically recognizes a signal molecule; (ii) a signal transport, which is associated to the receptor; (iii) a signal amplifier, which is an ion channel or an enzyme producing second messengers; and (iv) an effector (signal receiver), which initiates single or multiple intracellular signal cascades, resulting in the response to the external changes [1].

Here, we aim to map the great diversity of molecular signal transduction processes in fungi to show how signaling proteins encrypt information, coordinate different transmission routes and deploy response to various environmental stimuli. Therefore, we present an overview of the most important mechanisms of molecular cellular signal transduction by showing selected and prominent examples.

References

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