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FOREWORD

Special issue on desiccation biology

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A minority of living organisms are able to dry out completely and yet remain viable, a phenomenon known as desiccation tolerance. Its occurrence is established in prokaryotes and eukaryotes across all life kingdoms, including plants and lower invertebrates. In the dry state, the metabolism of the organisms is suspended. Even more striking, desiccation tolerant organisms are often also highly resistant to other environmental stresses, surviving extremes of temperature and pressure, for example. How do organisms survive without water, the driving force for cellular organization, and why does the lack of water confer such prodigious abilities, have intrigued scientists for the past 40 years.

The mechanisms of desiccation tolerance are increasingly being understood. They mainly include a set of protective proteins (late embryogenesis abundant proteins and heat shock proteins) and non-reducing sugars to maintain structural integrity in the dry state. In addition, antioxidant defenses and coordinated shut-down of metabolism have been developed to avoid oxidative stress and repair mechanisms are in place to limit desiccation-induced damage during rehydration. How these mechanisms are connected to each other, whether they are synergistic or redundant, and how they are regulated, remains poorly understood.

In March 2014, an international workshop entitled "New Frontiers in Anhydrobiosis" was held in Pornichet, France. It highlighted the latest findings in the molecular aspects leading to survival in the dry state across all kingdoms, including microorganisms, fungi, plants and animals. This special issue in Planta on "Desiccation Biology" is a result of this successful event. By providing a number of peer-reviewed articles on algae, lichens, seeds, resurrection plants, and animals, this special issue shows that the mechanisms of desiccation tolerance are remarkably similar despite the big differences in the taxonomic, evolutionary position, and complexity of the desiccation tolerant organisms. It also highlights the progress made using functional genomics and transcriptome mining approaches to unravel the function of genes that make a desiccation tolerant organism. This special issue also addresses the evolutionary mechanisms that have led to the adaptation to survive in the dry state, and the challenges of preserving stable living human tissues and genetic resources in the dry state.

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