Preface

Why a book on *Cold-Adapted Yeasts*? What is the scientific background that encouraged us to edit a book on the biodiversity, adaptation strategies and biotechnological implications of these attractive microorganisms that are apparently able to survive and even to grow at low temperatures in really inhospitable habitats?

Over 80 % of the Earth's environments are permanently or periodically exposed to temperatures below 5 °C. Cold environments include deep seas, cold deserts and glacial habitats (i.e. glaciers and related habitats, icy seas, ice caps and continental ice sheets and frozen ground, which are characterised by the presence of ice in extensive masses and cover about 10 % of the Earth's surface at the present time). In many natural ecosystems, cold conditions are frequently associated with other limiting environmental factors (e.g. low water activity and nutrient availability, high hydrostatic pressure and oxidative stress, high solar irradiation, etc.) which make such extreme habitats very inhospitable (or even life-limiting) ecosystems. A few cold habitats are also associated with human activities (e.g. refrigeration technology in food industry).

Current knowledge on microbial biodiversity and ecology has shown that cold habitats harbour a wide diversity of psychrophilic prokaryotic and eukaryotic microbial life, including archaea, bacteria, cyanobacteria, yeasts, filamentous fungi, algae and protozoa. Low temperatures have a strong influence on microbial life, both indirectly (change of the physical state of water) and directly (low metabolic rate due to the reduced enzymatic activity). The key feature of both prokaryotic and eukaryotic organisms adapted to cold is to successfully overcome the negative effects of low temperatures through the development of structural and functional adaptations.

Yeasts are a group of eukaryotic organisms belonging to the Kingdom of Fungi which are widely distributed in worldwide microbiomes. Their manifest ubiquity in the Earth's biosphere is however balanced by their great diversity and specificity for the different habitats. Yeasts are probably one of the most relevant microbial groups in both traditional fermentation technologies and biotechnological applications. Most people associate yeasts with the ascomycetous species *Saccharomyces cerevisiae* (the so-called "baker yeast"), traditionally involved in the production of alcoholic beverages and in leavened bread, although this technologically domesticated species represents only a infinitesimal bit of the vast

biodiversity occurring inside the yeast world. Since the 1950s, the study of cold-adapted yeasts has attracted an increasing number of scientists: consequently the number of papers published and the number of psychrophilic and psychrotolerant yeast species described in literature spectacularly increased.

In this book, prominent authors from universities and research centres present an up-to-date state-of-the-art on the biodiversity, adaptation strategies and biotechnological significance of cold-adapted yeasts in order to provide an additional source of information to all those scientists who are interested in the microbiology of these microorganisms. The book is subdivided into four main Parts:

i. an introductive part devoted to conceptual and methodological aspects related to the study of cold-adapted yeasts in natural ecosystems and the role of culture collections in handling the ever-increasing number of preserved strains and relevant data
ii. a second part reporting an overview on the diversity and ecology of cold-adapted yeasts (including the so-called "black yeasts") in worldwide cold habitats (i.e. Arctic and Antarctic regions, Alpine, Apennine and Patagonian cold areas)
iii. a third part describing the different physiological, biochemical and molecular adaptation strategies used by cold-adapted yeasts to survive or even thrive successfully in cold habitats
iv. a final part devoted to the biotechnological impact of cold-adapted yeasts as biocatalysts in traditional and advanced (actual and potential) biotechnologies or as food spoilers.

As studies of cold-adapted yeasts have been carried out over more than 60 years, original strain identification was performed using taxonomic criteria of current use at the time of isolation: hence, many species names cited in the early literature are not adjourned. Accordingly, all original taxonomic designations reported in the cited references were checked and, if necessary, updated according to the latest taxonomic guidelines published in Kurtzman et al. (2011), or more recent literature.

It is obvious that the book does not claim to be comprehensive of all aspects concerning the life of these fascinating organisms. Some topics not covered here are dealt with elsewhere, in particular the general introduction to the climate of snow and ice as boundary condition for microbial life, published in Margesin et al. (2008). Other topics are still characterized by a general insufficiency of studies (e.g. diversity and ecology of cold-adapted yeast populations in Himalayan areas) and are therefore not covered in this book.

The editors of this book want to thank all the authors for their excellent contributions and hope that this book will provide a useful tool to increase the interest in cold-adapted yeasts which, hopefully, will stimulate increasing efforts in supporting research on this attractive field. P. Buzzini would like to thank his retired colleague Prof. Ann Vaughan-Martini for the trust she demonstrated over the years. He would also like to dedicate this book in memory of his teacher (and friend) Prof. Alessandro Martini, who supported him since early 2000s in the study

of this fascinating matter. Finally, the editors would like to thank the Springer team, especially Dr. Jutta Lindenborn, for valuable and continuous support during the preparation of this book.

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Innsbruck, Austria, May 2013 Rosa Margesin

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