Wine Chemistry and Biochemistry

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Editors

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Foreword

Winemaking is a most fascinating and complex transformation process of a raw plant material. It starts with the arrival of the harvest at the cellar and ends with the most active and decisive fermentation steps. After this, for some wines, comes the long aging period of the wine, during which the bouquet and taste of the wine is developed and refined. The transformation of grape must in wine is a priori a spontaneous phenomenon. The microbial complex present on the grape berry is exposed to a new ecosystem when the grapes are crushed and pressed. It then evolves spontaneously following the conditions dictated by both the nature of the microorganisms present and the composition of the community.

Without the skill and attention of the oenologist and winemaker, the system would evolve into a fermented product, the quality of which would have little chance of satisfying the consumer. This expertise is based on scientific knowledge of the phenomena that occur in this complex environment. After its beginnings mainly based on observation and empiricism, oenology now uses scientific data derived from research in chemistry, biochemistry and microbiology. Together with biochemical reactions catalyzed by enzymes of yeasts and bacteria, chemical reactions also occur between molecules already present in the must, those gradually extracted from the grape solids during fermentation, those derived from metabolisms and, possibly, also those released by the wood. For many of them the temperature and dissolved oxygen parameters related to technological operations of the winery can have dramatic effects and the quality of the final wine depends on the type and intensity of reactions taking place.

From the beginning of the twentieth century, chemistry and microbiology have been used in an attempt to interpret the observations used by winemakers. These constitute the foundations on which the basic rules for winemaking and aging were established. Hence, as producers' control of the events of winemaking and aging steadily increased, so did wine quality. First, defects and the most critical alterations have been avoided. After that, knowledge has become more accurate and reliable, and more technological tools have been developed, and now the winemaker can control the evolution of the system as a whole with great efficiency.

Continuously, researchers in oenology, both chemists and biologists, appropriate the most efficient analytical methods and data to conduct their research. New molecules of wine aroma, color and flavor have been identified. Sensory analysis,

increasingly present in the laboratory alongside chemical analysis methods, reveals the importance of molecules present even at very low concentrations and the importance of interactions between them. Genomics is used in research on yeast and bacteria and reveals the extraordinary complexity of the microbial consortium, giving microbiologists keys for the optimal use of the natural biodiversity of species involved in fermentation.

The authors, invited by M.C. Polo and M.V. Moreno-Arribas to write this book, are recognized in their own field for their research and ability to transfer scientific results from the laboratory to the winemaking process and storage cellar, and here provide updates on the most recent advances in the field.

With this manual, oenologists will be able to update their knowledge and benefit from a deeper understanding of the phenomena they observe in practice. Moreover, researchers in oenology are now highly specialized, and must conduct their activities at the basic level, while finding in the cellars and caves the elements of their thinking. While in the laboratories, chemists specializing in macromolecules or volatile compounds and microbiologists specializing in yeasts or bacteria must continue their research into the interactions taking place. Working individually without knowledge of research in this field from other specialists their efforts lose all meaning and progress remains erratic or limited. Scientists will, therefore, benefit from this handbook that enables them to contemplate and understand the results and progress made in other specialities related to this area.

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Introduction

M. Carmen Polo and M. Victoria Moreno-Arribas

The aim of this book is to describe chemical and biochemical aspects of winemaking which are currently being researched. The areas of most interest at present and the subjects in which this interest is likely to continue or to increase in the following years have been selected.

The first part of the book concerns the most important aspects of winemaking technology and microbiology. The second part, the most extensive, deals with the different groups of compounds, how these are modified during the various steps of the production process, and how they influence the wine quality and its sensorial aspects and physiological activity. The third section describes undesirable alterations of wines, including those that affect quality and food safety. Finally, two aspects have been considered which have not yet been tackled in any other book on oenology – automatic analysers used in oenological laboratories for control and research purposes, and the statistical treatment of data. In this last subject, the author not only describes the tools available for analytical data processing but also indicates the most appropriate treatment to apply, depending on the information required. The chapter is illustrated throughout with examples from the oenological literature.

'Wine chemistry and biochemistry' is scientifically written including current trends but also in a style that is easy and clear to understand. It is hoped that it will serve as a most useful text and reference source for wine researchers and oenologists alike, as well as for winemakers and other professionals of the sector, and students of oenology, food technology and similar disciplines.

The editors would like to express their thanks to Springer and all the authors who contributed their expertise and know-how to the success of this book.