THE MOLECULAR BIOLOGY AND BIOCHEMISTRY OF FRUIT RIPENING

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WILEY-BLACKWELL

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Preface

Evolution has fashioned multiple means of protecting seed and dispersing them upon maturation. None is as fascinating nor as consequential to humankind as the ripe and delectable fleshy fruit. Ripe fruits comprise a significant and expanding proportion of human and animal diets, which the medical community contends should only be increased. In addition to being visual delights with seductive tastes and aromas, ripe fruits deliver a diverse array of antioxidants and nutrients to those who consume them, in addition to healthy doses of carbohydrates and fiber. The chemistry of fruits comprises attributes that producers, processors, and distributors alike seek to understand, optimize, and deliver to increasingly health-conscious consumers expecting high quality and diversity of choices. Plant scientists have endeavored to unravel the mysteries of fleshy fruit biology and the underlying molecular and biochemical processes that contribute to fruit ripening and the resulting desirable attributes of fruits and fruit products.

This book offers a useful overview of fruit ontology and evolution emphasizing the exponential growth in advances and discoveries in ripening-related chemistry and associated regulatory processes accumulated in the last decade. The reader will appreciate the broad and deep impact of comprehensive genomics and metabolomics in addition to the computational tools necessary to decipher the resulting data on the progress of the field. As a consequence of these all-encompassing approaches, fruit biology has advanced from the investigation of single genes and enzymatic reactions to the development of nuanced molecular regulatory models overseeing complex biochemical pathways leading to numerous metabolic outputs. Looking at the physiological and molecular symphony of events impacting textural changes of the ripening fruit, the array of novel phenolic metabolites, or the network of genes and signaling processes regulating ethylene hormone response, it becomes strikingly clear that recent technical advances have moved ripening biology forward at an astounding rate. This book captures the advances of the field and couches them in an evolutionary context and a fundamental knowledge of fruit biology, making it an excellent primer for those interested in the field and a comprehensive reference for those familiar with it. *The Molecular Biology and Biochemistry of Fruit Ripening* is essential reading for any student of plant science and those especially interested in fruit biology and its relationship to human diet and nutrition.

1 Biochemistry of Fruit Ripening

Sonia Osorio and Alisdair R. Fernie

Introduction

This chapter is intended to provide an overview of the key metabolic and regulatory pathways involved in fruit ripening, and the reader is referred to more detailed discussions of specific topics in subsequent chapters.

The quality of fruit is determined by a wide range of desirable characteristics such as nutritional value, flavor, processing qualities, and shelf life. Fruit is an important source of supplementary diet, providing minerals, vitamins, fibers, and antioxidants. In particular, they are generally rich sources of potassium, folate, vitamins C, E, and K as well as other phytonutrients such as carotenoids (beta-carotene being a provitamin A) and polyphenols such as flavonols (Saltmarsh et al., 2003). A similar, but perhaps more disparate, group of nutrients is associated with vegetables. Thus nutritionists tend to include fruits and vegetables together as a single "food group," and it is in this manner that their potential nutritional benefits are normally investigated and reported. Over the past few decades, the increased consumption of fruits and vegetables has been linked to a reduction in a range of chronic diseases (Buttriss, 2012). This has led the WHO to issue a recommendation for the consumption of at least 400 g of fruits and vegetables per day. This in turn has prompted many countries to issue their own recommendations regarding the consumption of fruits and vegetables. In Britain this has given rise to the five-a-day recommendation. A portion in the United Kingdom is deemed to be around 80 g; so five-a-day corresponds to about 400 g per day. Other countries have opted for different recommendations (Buttriss, 2012), but all recognize the need for increased consumption.

The rationale for the five-a-day and other recommendations to increase fruit and vegetable consumption comes from the potential link between high intake of fruits and vegetables and low incidence of a range of diseases. There have been many studies carried out over the last few decades. The early studies tended to have a predominance of case-control approaches while recently more cohort studies, which are considered to be more robust, have been carried out. This has given rise to many critical and systematic reviews, examining this cumulative

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