Metabolomics as a Tool in Nutrition Research
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Many studies carried out on animals and humans using nutritional interventions and/or epidemiological observations have shown that many diseases are linked to poor nutrition. In the past two decades, we have witnessed nutrition research moving from disease treatment to promotion of health and disease prevention. With this, there has been an increased emphasis placed on nutritional recommendations. However, considering the interindividual variability in response to food components, optimum levels of physiological functions of individuals have to be determined to optimize recommendations, the purpose being to reach personalized nutrition. The recent development of high-throughput technologies (transcriptomics, proteomics, and metabolomics) that enable the generation of large-scale molecular-level measurements has increased attention of scientists in medical, biological, and nutritional sciences as these tools offer the possibility of characterizing global alterations associated with disease conditions or nutritional exposure and subtle changes in metabolism due to stimuli.

Among the “omics” technologies, the metabolomics field has been mainly developed in pharmaceutical and plant sciences. However, its application to nutrition is still relatively new although this topic constitutes a growing domain of interest with potential large impacts in nutrition research. The main objectives of this book are on one hand to show the recent progress made in the utilization of metabolomics as a tool in nutrition research and its major applications and on another hand to discuss the major challenges that scientists still have to face and solve in order to allow metabolomics to reach its real potential and to move nutrition from a rather reductionist approach to a global one.

To achieve the aims of the book, we have divided this book in two major parts. The first one deals with principles and methodology issues of metabolomics. The focus of this section is on major challenges for using metabolomics in nutrition research, starting from the experimental design to data integration using bioinformatics tools. Details on the principle of the analytic techniques are well covered in other books, so instead, we chose to focus on challenges with respect to nutrition research.

Part 2 of the book has been divided into nine chapters dealing with application of metabolomics in nutrition research. Chapter 4 summarizes the applications of lipidomic platforms for identifying biomarkers of diseases and metabolic processes associated with diet and for controlling food quality and detecting fraud in food products. Chapter 5 presents how human metabolism can be modelled using metabolic network and how this model can be used to analyse metabolomics data, to interpret the metabolic relationships connecting a set of biomarkers for assessing the metabolic impact of different diets. The role of gut microbiota in nutrition and disease using a metagenomic approach is discussed in Chapter 6, while Chapter 7 focuses on the role of metabolomics and in particular metabotyping in moving towards personalized nutrition.
Chapter 8 describes the application of metabolomics in biomarker discovery for early disease detection and biomarkers for the prediction of the evolution of the health status towards metabolic pathologies. In Chapter 9, the potential of metabolomics for the identification of new biomarkers of intake is discussed. It also describes the challenges that lie ahead, including the validation of identified biomarkers and the development of sharing tools for data and resources. Chapter 10 describes how analysing dynamic metabolomics data (obtained during challenge tests) has been successful in identifying metabolic phenotypes in the predisease state and identifying subtle metabolic changes following dietary interventions. Chapter 11 (“Foodomics”) highlights how metabolomics offers the possibility to analyse the effects of cultivation, processing, and digestion on the nutritional value of food. The last chapter (Chapter 12) not only summarizes the perspectives outlined in the different chapters but also discusses a long-term view of the future direction.

We hope that you will enjoy this book and that it encourages you to employ metabolomics techniques in your research. We look forward to seeing this field grow and follow the developments in nutrition research as a result of the use of metabolomics as a tool.
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