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### Recovery Processes for Biological Materials

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BOOK REVIEW

RECOVERY PROCESSES FOR BIOLOGICAL MATERIALS

edited by John F. Kennedy and Joaquim M. S. Cabral  
John Wiley and Sons, Chichester,  
hard cover 592 pages, 1993.

Professor Kennedy and Cabral offer an edited volume of bioseparations which covers almost every major unit operation associated with bench or process scale separation processes. This book appears to be the result of a major effort by the editors to enlist contributions by internationally known experts.

The preface nicely summarizes the *raison d'être* for such a volume: the high value of many biotechnology products, the need for effective downstream purification steps to obtain pure biomolecules for laboratory researchers, and cost considerations for process scale systems. The target audiences are practicing engineers in industry, and students enrolled in university downstream processing courses.

The book gives a compendium of basic principles and experimental techniques which a researcher may encounter in the laboratory. In this context the book should be useful as a reference for those who wish to quickly become familiar with the key characteristics of a given separation, or refresh their background before pursuing more detailed research. The introduction, which describes biological products ranging from flavors and fragrances to natural products and antibiotics, sets the tone and is consistent with many of the chapters which follow. While biological materials are often interpreted to be proteins, this book focuses on other products, and gives secondary emphasis to proteins, even though the second chapter (also by C. J. Gray) presents basic background on protein structure and function.

Chapters 3 through 12, and 16 and 17 focus on cell wall disruption (F. A. P. Garcia); filtration, sedimentation, and centrifugation (H. Pinheiro and J. M. S. Cabral); membrane separation processes (M. Mateus, J. A. L. Santos, and J. M. S. Cabral); liquid-liquid extraction, reversed micelles, and two phase aqueous extraction (M. R. Aires-Barros and J. M. S. Cabral); supercritical fluid extraction (T. J. Bruno et al.); protein precipitation (F. A. P. Garcia); crystallization (J. F. Kennedy, M. A. Hossain, and M. Patterson); and drying (Houssain and Kennedy). The other 4 chapters address sorption (M. G. Roig), chromatography (Garcia and Pires), electrokinetic separations (Roig) and process synthesis (W. R. Bowen).

The strengths of these chapters lie in their description of a historical perspective of the development of various separation techniques and basic theory. However, most chapters give only brief mention of examples or case studies involving isolation and purification of bioproducts. Recombinant proteins, properties of *E. coli* inclusion (protein) bodies, and refolding are not mentioned. Chapters 11 and 15 on supercritical extraction and electrokinetic phenomena, respectively, are notable by exception. The

chapter on Supercritical Fluid Extraction of Biological Products (by Bruno, Nieto de Castro, Hamel, and Paluvra) is well written and gives an excellent overview of its development as well as a lucid description of the many practical considerations and experimental challenges associated with supercritical extraction. The explanations of principles of fluid behavior, solubility effects, transport properties, and the role of entrainers are clear and concise. Since the explanations are combined with a description of the recovery of commercially important steroids, alkaloids, food additives, decaffeinated coffee, and cosmetic applications, these chapters offer interesting reading.

The chapter on electrokinetic methods is similar in organization of its content, explanation of principles, and use of examples. Its focus is on experimental techniques and the different types of apparatus for experiments ranging from free solution electrophoresis to zone electrophoresis. The effects of ionic strength, pH, composition of gel matrices, and apparatus configurations on separation are presented in a logical and useful sequence.

The chapters on sorption and chromatography give background and practical overviews which will be useful to students wishing to obtain an introduction to these fascinating fields. The section on process synthesis gives an overview of how the different unit operations of a separation process might be sequenced.

This book will serve well as a reference volume for students undertaking their first course in downstream processing. The many chapters which introduce a broad range of separation techniques are useful companion chapters to other, texts in mezzanine level/courses. However, its utility for teaching advanced scale-up principles, cost comparisons, and regulatory considerations in bioprocess design is limited by its general approach, and lack of specific examples. Overall, Recovery Processes for Biological Materials, addresses the intended use stated in the preface, namely, for bioseparation and downstream processing courses at the upper level undergraduate and post graduate levels.

Michael R. Ladisch