Book review

A handbook of protein bioprocessing?

Bioseparation and Bioprocessing: A Handbook
Volume 2 (xviii + 474 pages) ISBN 3 527 28876 7

Unlike volume 1 (see review in this issue), volume 2 of Bioseparation and Bioprocessing: A Handbook addresses a greater diversity of topics. The book’s 15 chapters have been contributed by 25 authors. The chapters are grouped into three sections: processing; quality and characterization; and economics, safety, and hygiene. About half the book is devoted to processing.

Books on downstream processing typically contain in-depth chapters on the various individual unit operations but have nothing on how the operations should be organized into an efficient product recovery train. This book is different. In chapter 1, the book thoroughly examines the factors governing the synthesis of a recovery process. Additional complementary material on integrated assessment of a recovery scheme occurs in a later chapter entitled ‘Strategies and considerations for advanced economy in downstream processing of biopharmaceutical proteins’. Ultimately, the performance and economics are determined by the overall design of the process, not individual operations.

Other chapters address protein stability in downstream processing; production of transgenic proteins; methods of harvesting recombinant protein inclusion bodies; glycobiology aspects of recombinant glycoproteins; disruption of cells; many aspects of microcarrier culture of animal cells; purification and characterization of monoclonal antibodies; biological standardization of interferons and other cytokines; a case study of matrix-assisted laser desorption ionization mass spectroscopy as a tool for biopharmaceutical development; quality control of protein primary structure by automated sequencing and mass spectrometry; strategies for characterization of carbohydrates in recombinant glycoproteins; principles and practice of biosafety; and process hygiene in chromatography.

Attaining high purity is a prime concern in processing of biopharmaceutical proteins, but so is achieving a good recovery. Inevitably, some product is lost to various causes during recovery. Many processing conditions destabilize bioactive proteins. Some of the mechanisms of stability loss and the factors that influence stability are discussed in one of the chapters. A good understanding of the how and why of protein instability is essential to rational design of purification processes.

Bioprocesses once extensively relied on animal and human tissue as the starting raw material for obtaining active proteins. The focus gradually shifted to microorganisms and cell cultures. Microorganisms and animal cells should continue to dominate the production scene for...
the foreseeable future; however, an increased role is reemerging also for animal-derived products. In ‘Production of transgenic protein’, the authors provide a somewhat superficial overview of product recovery and purification from the milk of transgenics. Despite the book’s focus on processing aspects, a more substantial discussion than given was warranted of the methods of generating a transgenic organism.

Many recombinant proteins are produced as dense denatured granular inclusion bodies in bacteria and yeasts. Recovering inclusion bodies requires cell disruption and a solid–liquid separation step. The book has a chapter on cell disruption and one on ‘harvesting’ of inclusion bodies. The latter chapter focuses on filtration and centrifugal methods of recovery. These methods are well established for various applications in the bioprocess industry, but their use in inclusion body recovery requires suitable modifications because the cell homogenates also contain other fine debris. Converting the denatured protein in inclusion body to a bioactive molecule is an important issue that should have been discussed in a chapter of its own. However, this topic is not ignored entirely and sections in other chapters consider aspects of inclusion body processing.

A chapter on microcarrier culture of animal cells addresses many of the relevant issues but the discussion is slow-paced, the style is verbose, and the language needs polishing. Animal cells are the principal source of monoclonal antibodies (MAbs) and other products. A chapter is devoted specifically to purification and characterization of MAbs, even though the purification and product characterization are little different than for any other bioactive protein. Commercially, MAbs are a highly successful class of bioactive proteins. Their use is widespread predominantly in diagnostics, immunoassays, and affinity purifications. The long awaited in vivo medial use of MAbs as imaging and targeting agents has been a success, although it is not extensively practiced at present. Ingenious approaches to generating human MAbs are being implemented to greatly increase the therapeutic use potential of monoclonal antibodies.

The four chapters under the ‘quality and characterization’ theme provide useful perspectives on the many different aspects of assessing consistency, quantity, and quality of a bioproduct. Aspects discussed include determining the peptide sequence of proteins, the carbohydrate moiety characterization in glycoproteins, and the biological activity standardization issues. The latter are well illustrated with reference to interferons and cytokines.

Bioprocesses pose special and unusual hazards to the health and safety of process personnel and the general public. Also, because of inadequacies in processing, an otherwise satisfactory product may end up being hazardous to patients and consumers. Similarly, there is the potential for adverse environmental and ecological impact of poorly designed processes. A good chapter on process biosafety considers the relevant issues. Discussed are the assessment of risk, containment of biohazard, use of the various types of biological safety cabinets, design considerations for process buildings and facilities, containment features of process machinery, personnel protective equipment, and the need for training and medical surveillance of workers.

This two-volume handbook could have been better organized: most of volume 2 should really be volume 1 and, within a given volume, the ordering of the chapters could be improved. For example, the chapter on harvesting of the intracellular inclusion body proteins properly belongs after the chapter on cell disruption. Similarly, the chapter on process hygiene in production chromatography better fits in with the material in volume 1.
This book is similarly well produced as volume 1. The book has a detailed table of contents and the 14-page index is useful. Together, the two volumes generally provide good overviews of the topics they address; however, they also ignore many aspects of bioprocessing and bioseparation. A truly comprehensive treatment of bioprocessing would have required at least a dozen thick volumes and a totally unaffordable price tag for the individual purchaser. This two-volume set sells for a bearable US$ 459.00. The two books cover a range of sufficiently important topics to interest any biotechnologist, biochemist, and bioprocess engineer. The books are highly recommended.

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