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Book Reviews

Modelling and Optimization of Fermentation Processes. Edited by B. Volesky & J. Votruba, Elsevier Science Publishers, London, 1992. ISBN 0-444-89588-4. Price: US$134.50.

Fermentation industry has expanded considerably in the last ten to fifteen years, and as a result, modelling of biological processes has not only improved the understanding of the bioreaction, but has also helped in predicting the performance of micro-organisms. The authors have aimed this book to be read widely by both scientists and engineers, in particular the non-fermentation scientists. The book starts off with a very promising preface written with journalistic flow and giving it a sales pitch.

This book is divided into three main sections covering the quantitative aspects of fermentation processes: Part 1 focuses on the modelling approaches to fermentation processes; this is followed by Part 2, on the fundamentals of mass balances in different reactor configurations; Part 3 is a case study of Acetone-Butanol-Ethanol fermentation process alternatives which illustrates the application of Parts 1 & 2. References and nomenclature are listed at the end of each part.

Part 1, entitled *Modelling of Fermentation Processes* is subdivided into three subsections, under the following headings: (1) System analysis approach to mathematical modelling of fermentation processes, (2) Identification of mathematical models, and (3) Application of models in simulation and optimisation of fermentation processes. In the first subsection the authors have described how microbial process engineering fits amongst other scientific disciplines and the relationship between micro-organisms and its' surrounding environment. Various simple kinetic expressions commonly used to mathematically model a fermentation process are outlined and illustrated with examples. The authors have also considered other aspects relating to biochemical reaction, namely: stoichiometry, physiological aspects, oxygen transfer and mixing models for simulation of fermentation. The subsection of *Mathematical Model Identification* outlines the procedures for preliminary analysis of experimental data and concludes with an explanation on statistical evaluation of model parameters. The third subsection deals with simulation and optimisation of fermentation processes, examining the sensitivity of process parameters and their effects. The topics covered here are complemented by computer algorithms and they are also illustrated with worked examples.

The first part of the book is novel and philosophical, but it can be better appreciated by those who have some knowledge of fermentation processes, or alternatively, by those who have already read Part 2 of the book! The computer algorithms, however, date back to the 1960s and 70s! Moreover, emerging concepts in modelling, for instance the 'cybernetic models for microbial growth' (Dhurjati *et al.*, 1985), or those based on fuzzy logic (e.g. Postlethwaite, 1989), are hardly considered.

In Part 2, the authors have set out to provide the non-engineers with a fundamental background of mass and heat balances. The procedures for formulating material balance equations are outlined for steady-state and non steady-state systems, with an without chemical reactions. The section on transient mass balances is of particular importance to the control of the fermentation process, in which the rate of substrate uptake or the rate of product formation is related to various process variables. In this section the authors discuss the design equations for various reactor configurations. This section, also containing discussions on mass and heat balances, is very pedestrian, and better exposition of this topic can be found in several general books on biotechnology and biochemical engineering.

The third and the final part of this book contains a case study on the *Modelling of Acetone-Butanol-Ethanol (A-B-E) fermentation process alternatives.* For the purpose of the case study the authors have selected a well-established fermentation process that uses sugar as a limiting carbohydrate source and a strict anaerobic bacterium *Clostridium acetobutylicum* to catalyse the bioreaction. The case study kicks off with a description of the process and how the sugar conversion fits into the biochemical pathway for the production of A-B-E. The case study examines model formulation for batch culture, continuous-flow culture, fed-batch culture, and immobilised cell culture. Reported experimental data are analysed using the various models developed for the different process operations, and the kinetic parameters are deduced. In the case of immobilised cell culture, the options of using growth and non-growth-related medium in a continuous stirred tank reactor, or tubular fixed-bed reactors are also examined, and the findings summarised. Part 3 succeeds in elucidating the modelling concepts which the authors have illustrated in Part 1; the use of various reactor configurations to demonstrate the modelling concepts is interesting.

On the whole, the utility of this book is very limited. It does not lead readers to further work on any given topic and the references at the end of each part are not exhaustive. It therefore falls short of being a reference

book. Furthermore, it lacks a balanced coverage of all aspects relating to fermentation modelling which is required of a good text book. It only succeeds in partially enlightening an uninitiated reader!

R. Patel & K. Niranjan

Carbohydrates and Carbohydrate Polymers, Analysis, Biotechnology, Modification, Antiviral, Biomedical and Other Applications. Frontiers in Biomedicine and Biotechnology, Vol. 1. Edited by Manssur Yalpani, ATL Press, Inc. Science Publishers, 1993. vi + 314 pp. ISBN 1-882-360-40-0. Price: US$175.00.

This book contains nearly 30 contributions on important topics involving carbohydrates and carbohydrate polymers. This volume is based on a symposium on industrial polysaccharides which was held at the 204th National Meeting of the American Chemical Society in Washington, DC in August 1992.

Recently there has been a surge in carbohydrate research producing many significant developments, which are well covered by this book. The scope of the book is broad, covering basic aspects such as synthesis of carbohydrates to new areas such as their use as antitumour and antiviral agents. The book is split into 6 sections: Biotechnology, Antitumour and antiviral activities, Biomedical Applications, Analysis and Conformation, Chemical Modifications and New Applications.

In the first section, Biotechnology, there are 7 chapters on production, synthesis and analysis of carbohydrates from different sources. The next 4 chapters are in a section entitled Antitumour and Antiviral activities and describe some of the very interesting work being done in this area on the use of sulphated polysaccharides as anti-HIV agents and the chemical modifications necessary for their success and on the antitumour properties of some fungal glucans. Both of these research areas have tremendous potential applications.

In the third section of this book biomedical applications of carbohydrates are discussed in 3 chapters which include the use and development of chitosan polymers for wound healing and the conjugation of hydroxyethylstarch to human haemoglobin for use in blood transfusions. The next 5 chapters, comprising the fourth section, deal with analysis and conformation of polysaccharides and their polymers, and the fifth section contains 5 chapters on chemical modifications. The last section covers new applications of polysaccharides and polysaccharide polymers such as preparation of chitosan films with improved characteristics and preparation of biodegradable plastics with starch-zein mixtures.

All of the chapters of this book are of a high standard and the presentation is excellent and very clear. As it has a broad scope this book would be useful to specialists in the field as well as to non-experts whose work touches on some aspects of polysaccharide science.

Barbara Andrews

Fruit Juice Processing Technology. Edited by Steven Nagy, Chin Shu Chen & Philip E. Shaw. Ag. Science Inc., 1993. x + 713 pp. ISBN 0-9631397-1-1. Price: US$97.00.

Comprehensively prepared by Steven Nagy (one of the Editorial Board members of *Food Chemistry*) and two of his fellow authorities in this field, this volume is an imposing and valuable work. It focuses on the technology of over 22 temperate subtropical and tropical fruits, horticultural varieties and quality factors. It is very well presented with tables, figures and more than 700 bibliographic citations—definitely not for bed-time reading but essential as a reference tool for those of us interested in this section of food technology.

I found very few errors but did notice 'citrus' acid on p. 41 and the page heading of chapter 2 on physicochemical principles became shortened to 'physiochemical'. Indeed the comprehensive authority of the book is matched by its freedom from mistakes and it succeeds totally in portraying how technology is harnessed to achieving high quality in taste, flavour and overall acceptability. Intriguingly a TASTE evaporator (Thermally Activated Short Time Evaporator) is one of the modern technological devices for ensuring this steady control of quality in the fruit juice industry.

One thing which is quite inadequate in the book is its index which makes it very difficult to find details such as sweetness, authenticity testing and adulteration, which are major concerns.

Fruit juices vary enormously in composition and this may be one reason why models of their major component solutes (i.e. sugars) are used for reference purposes. For example, the appendix of this book (pp. 659–698) consists almost entirely of an extensive table relating Brix values of sucrose solutions to apparent densities and solids by weight.

Overall, I am highly impressed by the contents and pleased to have a copy. The price is very competitive and I congratulate the editors on the scientific success of the book.

Gordon Birch