Flavours and Fragrances

Chemistry, Bioprocessing and Sustainability

R. G. Berger (Ed.)

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With 231 Figures and 61 Tables

Springer

Prof. Dr. Ralf Günter Berger
Universität Hannover
FB Chemie, Institut für Lebensmittelchemie
Wunstorferstraße 14
30453 Hannover, Germany
rg.berger@lci.uni-hannover.de

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Preface

Our ancestors lived in intimacy with nature and knew well that their survival depended on a safe and fertile environment. The introduction of three-field rotation in the eighth century bc, for example, counteracted the depletion of soil and increased crop yields without negative side effects. The first definition of the modern term "sustainability" is usually ascribed to forest chief captain H. C. von Carlowitz, who in 1713 in his *Sylvicultura Oeconomica* formulated principles for a sensible economy of wood. From J. S. Mill (*Of the Stationary State*) to modern academic representatives, such as K. Boulding, D. E. Meadows (*The Limits to Growth*), R. Easterlin and H. E. Daly, the "ecological economists" have remained a concerned but rather ignored minority. The situation started to change after the famous Brundtland report (*Our Common Future*) of the UN defined sustainability as a desirable characteristic of development, which will not only meet current needs of people, but also will not jeopardise the ability of future generations to meet their demands and to choose their style of life. This definition includes a social dimension and was also adopted by Agenda 21 of the UNCED in 1992 in Rio de Janeiro.

A set of rules may aid in assessing the sustainable quality of a process:

- Consumption and regeneration of the raw materials should be balanced.
- Non-regenerative goods should be replaced.
- Generation of waste and its biological elimination should be balanced.
- Technical processes should match biological processes on the time scale.

A merely growth oriented economy must violate these rules. According to the first law of thermodynamics, energy in a closed system like the planet earth is finite (if we neglect the solar photon flux). Today mankind secures its survival by exploiting low-entropy resources, such as fossil fuels, concentrated minerals and higher plants, and by converting them to high-entropy products, such as carbon dioxide, cars and fine chemicals. However, as proven by our office desks, high entropy levels can only be lowered by energy input. Here the first and the second law of thermodynamics collide, and we apparently encounter the inner core of the conflict.

With the world running out of crude oil, species dying out at an alarming rate and political leaders seemingly little concerned about the predicted disasters, scientists should feel challenged to suggest solutions. A sustainable production

of natural flavours, like wood, fats and oils, saccharides, phytomedicines, bioethanol, biopolymers and natural colours, mainly depends on the existence of reliable plant sources. But how long will the traditional sources of flavours last? Quality of soil, unfavourable weather conditions, insect infestations and sociopolitical instabilities may all adversely affect classical agricultural production. Are there new biosources that could replace exhausted ones? Will, as with vanillin production, the exploitation of waste streams of the agricultural and food industries gain importance? "White biotechnology" is propagated as an alternative option, but will bioprocesses possess stability, specificity, up-scalability and profitability? Will the recent advances in biotechnology be successfully transferred to industrial scales? How can the aspired match of economy and ecology be achieved?

In an attempt to compile the current status of sustainability in the flavour industry and the developments in the foreseeable future of flavour production, the present volume discusses consumer trends and preferences, legal and safety aspects; it describes renewable resources of flavours, such as spice plants, fruits, vegetables, fermented and heated plants, and natural building blocks; it presents analytical methods, such as gas chromatography coupled to human or electronic noses or to mass spectrometers; it deals with the isolation, quality control and formulation of flavours for liquid or dry products, with biotechnology to provide novel renewable resources, with enzymes, microbial and fungal cells to biotransform cheap substrates or to produce flavours de novo, and with plant cells as a resource of genes coding for metabolic activities in transgenic producers.

The manufacturers of flavours and fragrances and their scientists are working at the leading edge of research, they look back on a long history of using natural resources, and are profitable on the basis of renewables. A wealth of experience has been gathered on issues such as provenance and quality, safety, authenticity and on problems of isolation, processing and shelf life. On the basis of this fundament of knowledge, we should start to deal with sustainability now, before the looming problems start to deal with us.

Finally, I should like to express my sincere thanks to the contributors for their thoughts and writing efforts, and to the publishers for their continuing support and patience.

Hanover, Summer 2006 Ralf Günter Berger

Contents