Low-Calorie Sweeteners: Present and Future
Low-Calorie Sweeteners: Present and Future

Volume Editor  
Antonietta Corti  
International Sweeteners Association (ISA),  
Brussels, Belgium

94 figures and 39 tables, 1999
Contents

VIII  Scientific Council
IX   Preface
1   Welcome Address
   Biacs, P. A. (Budapest)

Opening Address

3   Low-Calorie Sweeteners – From Molecules to Mass Markets*
   Bright, G. (Soham)

Sweetness and Sweeteners

10  Factors Affecting Sweetness*
    Beauchamp, G.K. (Philadelphia, Pa.)

18  The Evolution of Taste Perception*
    Glaser, D. (Zürich)

39  Double Functionality of Sweeteners: A Case to Study
    Borrego, F.; Montijano, H. López-Cremades, F.J.; Cano, J. (Zeneta/Murcia);
    Peris, A. (Barcelona)

New Developments in Low-Calorie Sweeteners

44  New Developments in Low-Calorie Sweeteners*
    Lindley, M.G. (Reading)

52  Discovery and Development of Neotame*
    Witt, J. (Mt. Prospect, Ill.)
58 Effect of Storage on the Flavours of Cola Drinks Sweetened with Different Sweetener Systems
Quinlan, M.E. (Reading); Mialon, V.; Everitt, M. (Chipping Campden)

64 Sweetness, Appetite, and Energy Intake: Physiological Aspects*
Drewnowski, A. (Seattle, Wash.)

77 Sweeteners and Weight Control*
Blackburn, G.L. (Boston, Mass.)

88 Role of Intense Sweeteners in Diabetes Management*
Ha, M.-A.; Ha, Th.K.K.; Lean, M.E.J. (Glasgow)

98 D-Tagatose – A Novel Low-Calorie Bulk Sweetener with Prebiotic Properties
Bertelsen, H. (Videbaek); Jensen, B.B. (Foulum); Buemann, B. (Frederiksberg)

110 Erythritol: A Novel Noncaloric Sweetener Ingredient
de Cock, P. (Vilvoorde)

117 Natural versus ‘Artificial’ Sweeteners: Regulatory Aspects*
Walker, R. (Guildford)

125 An Estimation of the Detection and Quantitation Limits of Neohesperidine DC by High-Performance Liquid Chromatography
Montijano, H.; Cano, J.; López-Cremades, F.J.; Bañón, J.; Canales, I.; Borrego, F.
(Zeneta/Murcia)

129 Thaumatin: A Natural Flavour Ingredient
Green, Ch. (Birkenhead)

133 Improved Powder Mix Quality with Twinsweet™
Hoek, A.C.; Vleugels, L.F.W.; Groeneveld, Ch. (Geleen)

140 Consumer Perceptions of Products Containing Sweeteners: USA*
O’Brien Nabors, L. (Atlanta, Ga.)

146 Consumer Behaviour and Attitudes towards Low-Calorie Products in Europe*
Bakker, D.J.G. (Utrecht)
159 Consumer Perceptions of Products Containing Sweeteners: Latin America*
Yokoyama S.M. (São Paulo)

164 Consumer Perceptions of Products Containing Sweeteners in Asian Countries*
Ishii, H. (Japan)

171 Use of Intense Sweeteners in Africa and Nutrition*
Lanton, B.R. (Noordhoek)

178 Intake of Intense Sweeteners*
Renwick, A.G. (Southampton)

201 The World Market for Intense Sweeteners*
Fry, J. (Oxford)

Regulators and World Trade Rules

212 Regulators and Industry: Priorities Compared*
Howlett, J. (Wembley Park)

218 The Role of Codex alimentarius*
von Rymon Lipinski, G.-W. (Frankfurt)

230 Building a Sweet Future – Conference Conclusions
Corti, A. (Brussels)

236 Posters

237 Author Index

238 Subject Index

The titles indicated by * are from invited speakers and represent the framework programme. All other articles were submitted following a ‘call for papers and posters’.
Scientific Council

Prof. Andrew G. Renwick
Department of Clinical Pharmacology
University of Southampton, UK

Prof. Ronald Walker
Food Safety Group, School of Biological Sciences, University of Surrey, UK

Prof. Adam Drewnowski
Nutritional Sciences Program
University of Washington, USA

Prof. G.-W. von Rymon Lipinski
Scientific Services and Regulatory Affairs, Nutrinova, Germany
Chairman, ISA Scientific and Regulatory Committee

Prof. Lluís Serra Majem
Department of Clinical Sciences
University of Las Palmas de Gran Canaria, Spain

Prof. Yuzo Ninomiya
Department of Oral Physiology
Asahi University School of Dentistry, Motosu-gun, Japan
Preface

ISA/IUFoST World Conference on Low-Calorie Sweeteners
‘Let’s Build a Sweet Future Together’
Barcelona, April 26, 1999

It is a great pleasure for me to welcome you to the first ISA/IUFoST World Conference on Low-Calorie Sweeteners. We, at the International Sweeteners Association, are particularly pleased to have IUFoST, the International Union of Food Science and Technology, co-sponsor this event. The co-operation of scientists, food technologists and the industry is crucial to the field of intense sweeteners.

This conference is all about the interaction between the two. To the benefit of the consumer.

I would like to begin with just a few words about the ISA

The ISA is located in Brussels. Our membership includes producers and industrial users of sweeteners. We have organized Europe-wide Conferences in the past and we have also focused some of our gatherings on regional issues and have brought together regulators, industry delegates and scientists from Central and Eastern Europe in Prague and Budapest, from all over India in New Delhi and from the Middle East in Abu Dhabi. This Conference, however, is the first with a truly global focus.

Role of the ISA

One of the main roles of the ISA is to keep abreast of scientific developments in relation to sweeteners and to submit this information to regulators in the context of approval or regulatory procedures.

An interesting example of this is the role ISA played in the elaboration at European Union level of harmonized rules for the use of sweeteners in foodstuffs.
Four years ago, the European Parliament and Council adopted a directive on the use of sweeteners, along with one on purity criteria for sweeteners and a series of related legal texts. The procedure is ongoing, as new amendments and additions tend to broaden the range of harmonized issues.

The prominence of science in the procedure cannot be overlooked. Let me explain why.

The role of science

First of all, the discovery of intense sweeteners usually occurs in a scientific context, although surprisingly – or maybe not – rarely by precise scientific approach but often by ‘mistake’.

Before a sweetener (or any additive) can be proposed as an ingredient in food, it has to undergo the scrutiny of expert committees who set an Acceptable Daily Intake. Without an ADI, no sweetener can be used in food, beverages or pharmaceuticals.

The ISA has co-ordinated several scientific dossiers for individual sweeteners. These dossiers were submitted for evaluation, or in some cases, re-evaluation, to the Scientific Committee for Food, which evaluates additives at European level, or to the JECFA (Joint Expert Committee on Food Additives of the UN World Health Organisation and Food and Agriculture Organisation (FAO) of the UN), which does the job at the level of the United Nations. The creation of a scientific dossier – which often runs to thousands of pages and contains numerous studies – can take up to 7 years to complete, if not longer.

Once an ADI is set, the next step is for regulators to determine maximum levels of use for a sweetener. Again, science intervenes, since maximum levels are set on the basis of the demonstration of technological need for the sweetener. Obviously, the final product has to go beyond science to include more complex components such as consumer preferences. In the case of sweeteners this would mean the kind of sweetness that is expected or the level of sweetness required. So, it is back to the science lab again in order that formulas can be fine-tuned to meet consumer demand.

And, once a product is on the market, additional issues require clarification because they may be somewhat controversial, i.e. are sweeteners really useful in weight management or as an ingredient for people with diabetes and do they not, through a subtle biological mechanism, trigger appetite rather than reduce it?

To reply to such queries and questions, it is again to science that we must turn, because an emotional approach to the debate will only cloud the issues.
Sweeteners approved in Europe

At European level, the following low-calorie sweeteners can currently be used in foods and drinks, according to specific levels and conditions: acesulfame K, aspartame, cyclamates, saccharins, neohesperidine and thauamatin. Two more recently developed sweeteners, alitame and sucralose, are being evaluated by the SCF.

Rest of the World

But, the European Union is only one part of the world, of course, currently containing a population of around 375 million people. Beyond Europe, sucralose and alitame, which were among the later discoveries in the area of sweeteners, are already used in many applications in foods and drinks in countries such as Canada, Australia, Mexico etc. Neotame, the latest and most intense sweetener yet, was submitted for approval to the Food and Drug Administration of the USA last Spring.

In certain other parts of the world, mainly Asia, some sweeteners of ‘natural’ origin such as stevioside have been used for several years. This stems back to former legislative philosophy, in particular in Japan, where any additive originating from a ‘natural’ source could be used without undergoing evaluation. In the USA and Europe, stevioside has not yet obtained a clear bill of safety. The very question of whether there is a difference between ‘natural’ and ‘synthetic’ substances from the point of view of safety will be discussed during this Conference.

Segue to framework programme

We have seen that the role of science is omnipresent. And the main objective of this Conference is precisely to provide us, in a mere 3 days, with a complete update on all the aspects of the science in, around and about sweeteners.

The framework programme (all articles indicated by an asterisk) of this Conference was developed with the collaboration of some of the most prominent specialists in the field. It is logically arranged to move from science, through applications, to the marketing of products.

Framework programme

We open the Conference with a session on sweetness and sweeteners. That session will be followed by one on the new developments of sweeteners this afternoon.

The usefulness and relevance of low-calorie sweeteners in nutrition and as one aspect of weight control and calorie intake are being examined.

An eminent specialist deals with the differences between ‘synthetic’ and ‘natural’ sweeteners.
The role of industry

However, sweeteners without an industry to incorporate them into foods and drinks for the consumer would be of little use. And that leads us to the third day of the programme which will entail the more economic, or shall I say ‘political’ dimension of sweeteners once they have left the scientific context and are used in foods that are being consumed all over the world.

Sweetener-containing products can be found in many parts of the world, this is true. However, sweeteners, like all other ingredients in foods, are used, applied, viewed and developed differently in different regions, depending on many aspects, such as the level of development of the economy, cultural preferences, the habits and local circumstances of a region and certainly the regulatory context which, in turn, depends greatly on all the other factors. For example, sweeteners obviously appear more in processed foods – and these are not yet presently available everywhere in the world.

Wednesday programme

Several speakers explore the differing perceptions, according to region, of how sweetener-containing products are viewed on different continents.

One of the arguments set forth by opponents of sweeteners is sometimes that they are ‘hidden’ in too many products. The regulators in many developed countries have evaluated the intake of sweeteners at regular intervals. At European level, the Sweeteners directive and directives regulating other additives actually contain provisions requiring Member States to regularly monitor the consumption of sweeteners. The sweetener industry showed particular foresight in having commissioned several intake studies from independent bodies, precisely to monitor the consumer’s intake. A summary of this data will be presented as part of the third day of our programme.

World markets

We cannot pretend to be complete without taking a scrutinizing look at the globe and analyzing the future of the world markets. We have, therefore, an expert on our programme who has been studying sweetener and sugar markets for many years. He will take us through the developments which are likely to occur, with a particular focus on China, an emerging market which holds an enormous economic and demographic potential.

Role of regulators

Finally, as our economy has become increasingly global, the World Trade Organisation or WTO has been set up to deal with economic and trade issues, which might confront governments. Smaller companies, and
companies of a national dimension, are not always fully aware that, among all the issues discussed and negotiated at Codex Alimentarius level, which is a sort of a technical tool for the WTO, a standard for sweeteners is also included. This standard, once adopted, is very likely to be used as a reference point for legislation by many developing countries.

Papers and posters
Both IUFoST and ISA made calls for papers and posters to ensure that anybody out there with novel information to present may include their data in this update.

Proposed papers were reviewed by an international team of experts, the Scientific Council. Those accepted were integrated as short presentations (see Contents).

Conclusion
So the Conference came to an end and these proceedings will hopefully leave the reader with some thought-provoking propositions.

Antonietta Corti,
Secretary General of the International Sweeteners Association
Abbreviations

ADI  Acceptable daily intake
ACE (Ace K)  Acesulfame K
ALI  Alitame
APM (ASP)  Aspartame
BMI  Body mass index
CYC (CYCL)  Cyclamate
EU  European Union (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom)
FAO  Food and Agriculture Organization of the United Nations
FDA  Food and Drug Administration, USA
FEMA  Flavors and Extracts Manufacturers’ Association
GDP  Gross domestic product
GRAS  ‘Generally recognized as safe’
GSFA  Codex General Standard on Food Additives
HFCS  High fructose corn syrup
IDDM  Insulin-dependent diabetes mellitus
JECSA  Joint Expert Committee on Food Additives of the WHO/FAO
LOAEL  Lowest-observed adverse effect level
MAFF  Ministry of Agriculture, Fisheries and Food, UK
NHDC  Neohesperidine DC
NIDDM  Non-insulin dependent diabetes mellitus
NOEL  No-observed-effect Level
SAC (SACH)  Saccharin
SCF  Scientific Committee on Food of the European Commission
SUC (SUCR)  Sucralose
WHO  World Health Organization of the United Nations