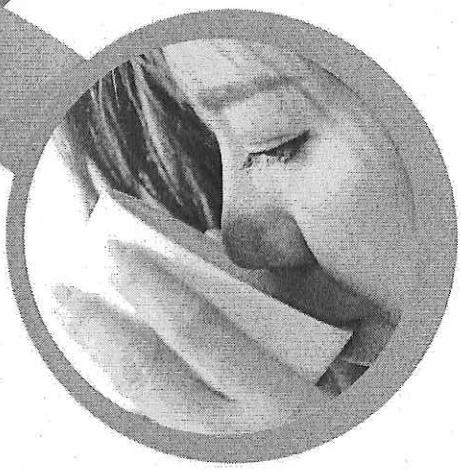
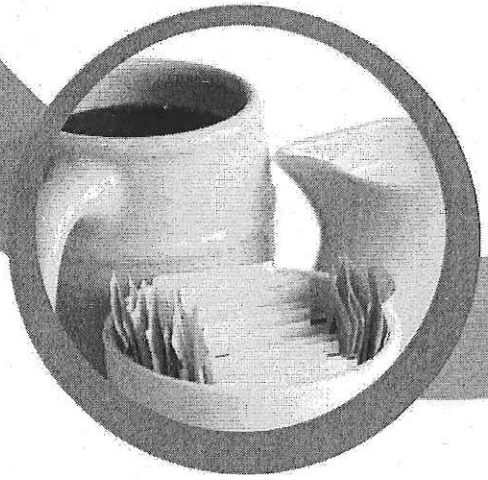


Seminar on

Sweeteners: Uses and Safety

Hilton Hanoi Opera, Hanoi, Vietnam
December 14, 2015



Organizer

ILSI Southeast Asia Region

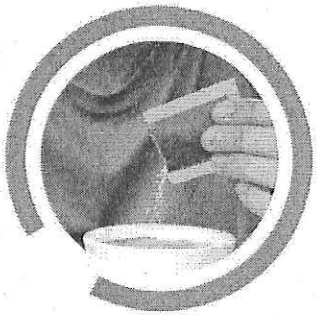
Co-organizer

VFA
BỘ Y TẾ
CỤC AN TOÀN THỰC PHẨM

Collaborator

VDD

Seminar on Sweeteners: Uses and Safety



Hilton Hanoi Opera, Hanoi, Vietnam
December 14, 2015

PROGRAM

12:30 - 13:30 hr	**Registration**
13:30 - 13:40 hr	**Opening Remarks** *Ms. Pauline Chan, ILSI SEA Region, Singapore*
13:40 - 13:50 hr	**Welcome Address** *Mrs. Tran Viet Nga, Vietnam Food Administration, Vietnam*

Session 1: Introduction to Sweeteners , their Uses and Consumer Perception
Chair: Mrs. Tran Viet Nga, Vietnam Food Administration, Vietnam

13:50 - 14:20 hr	**Introduction to Sweeteners and their Uses in Food & Beverages** *Prof. Dedi Fardiaz, Bogor Agricultural University, Indonesia*
14:20 - 14:45 hr	**Role of Sweeteners in Health** *Prof. Le Bach Mai, National Institute of Nutrition, Vietnam*
14:45 - 15:05 hr	**Consumer Perception of Sweeteners-Singapore Focus Group Study** *Ms. Pauline Chan, ILSI SEA Region, Singapore*
15:05 - 15:15 hr	**Q & A**
15:15 - 15:35 hr	**Teabreak**

Session 2: Safety Assessment of Additives and Sweeteners
Chair: Mrs. Tran Viet Nga, Vietnam Food Administration, Vietnam

15:35 - 16:00 hr	**Regulations on Food Additives in Vietnam** *Mr. Nguyen Xuan Truong, Vietnam Food Administration, Vietnam*
16:00 - 16:25 hr	**Regulation on Sweeteners in Malaysia** *Ms. Norhidayah Othman, Ministry of Health, Malaysia*
16:25 - 17:05 hr	**Global Regulatory Approvals and Safety Assessments of Sweeteners** *Dr. Berna Magnuson, Health Science Consultants Inc., Canada*
17:05 - 17:30 hr	**Discussion**
17:30 hr	**Adjournment**

About the Organizer

International Life Sciences Institute (ILSI) Southeast Asia Region

The International Life Sciences Institute (ILSI) is a non-profit, worldwide foundation based in Washington, DC, USA established in 1978 to advance the understanding of scientific issues relating to nutrition, food safety, toxicology, risk assessment and the environment. ILSI accomplishes its work through its branches and the ILSI Research Foundation.

Established in 1993, ILSI Southeast Asia Region facilitates and coordinates scientific programs, research and information dissemination in ASEAN, Australia, New Zealand and the Pacific Islands. Based in Singapore, ILSI Southeast Asia Region also oversees Country Offices and Committees in Australia, Indonesia, Malaysia, Philippines and Thailand.

By bringing together scientists from government, industry, academia and the public sector, ILSI seeks a balanced approach to solving problems of common concerns for the health and well-being of the general public. ILSI receives financial support from the industry, government, and foundations.

About the Co-organizer

Vietnam Food Administration (VFA)

The Vietnam Food Administration (VFA), under the Ministry of Health, was established in February 4, 1999. VFA is the national government agency in charge of regulating food safety, hygiene and quality as well as consumer's health in Vietnam. Passing the periods of development and overcoming many difficulties and challenges, VFA has gained many achievements and played very important role in food safety management nationwide.

The VFA is chiefly responsible for the development of national food safety policy, legislation and standards, as well as conducting and coordinating food inspection activities within the country.

About the Collaborator

National Institute of Nutrition (NIN)

The National Institute of Nutrition (NIN) under the Ministry of Health, Vietnam, was established in 1980 by the Government of Vietnam. NIN is the leading institution responsible for research, training, and implementation activities in the field of nutrition, food sciences, and clinical nutrition in Vietnam.

NIN conducts research on nutritional requirements and dietary intake of Vietnamese people in relation to physiological status and socio-economic conditions of the country; food and nutrition surveillance, nutritional epidemiology studies, and other nutrition-related health problems; research on nutritive values, health aspects, food hygiene, and food safety of Vietnamese foods; measures for improving nutritional status, food hygiene, and food safety; development of Dietary Allowances and Food-based Dietary Guidelines for Vietnamese people; coordination of the nutrition network for the country and implementing different nutrition action programs, and assisting the government in developing nutrition policies.

NIN has set up cooperative relationships with international agencies such as UNICEF, WHO, FAO, The Netherlands Government, ADB, WB, ILSI as well as many Non-Governmental Organizations and other research institutions/Universities including WU (Netherlands), INMU (Thailand) and Universities of Japan, University of Los-Banos (the Philippines), IRD, GRET (France).

NIN has been appointed as the WHO national participating Institution for Food Contamination Monitoring (1995), as the SEAMEO-TROPMED Collaborative Center in Community Nutrition (1994) and as the National Focal Point for Nutrition (1995) and the National Nutrition Strategy (2001).

About the Speakers

Prof. Dedi Fardiaz is a Professor at the Bogor Agricultural University, Indonesia with expertise in food components characterization, analytical technique and instrumentation. He is an Advisor to the Working Group on Harmonization of ASEAN Food Safety Standards. Prior to his current position, Prof. Fardiaz had served as the Deputy Head of National Agency for Drug and Food Control in the field of Food Safety and Hazardous Substance Control and as an Advisor in food affairs to the State Minister of Research and Technology. Prof. Fardiaz graduated from Bogor Agricultural University and received his MSc and PhD in Food Science from Michigan State University, USA.

Prof. Le Bach Mai is the Vice Director of the National Institute of Nutrition (NIN), Vietnam. She has been nominated as the Chair of the Ethics Committee of the Institute and Vice President of the Scientific Committee. Her recent research interests include intervention studies for monitoring and controlling food consumption, food habits, Community Nutrition, as well as obesity and the prevalence of metabolic syndrome in Vietnam. She is co-ordinator of the Vietnam SMILING project (Sustainable Micronutrient Interventions to Control Deficiencies and Improve Nutritional Status and General Health in Asia) which uses food-, fortification-, and supplementation-based approach to control micronutrient deficiencies. She is also an Associate Professor in Community Nutrition at the post-graduate university level at Hanoi School of Public Health, Hanoi Medical University and Thaibinh Medical University. Assoc. Prof. Le Bach Mai graduated from the Hanoi Medical University in 1982, received the DEA (Diplom d'Etude Approfondie) in Food and Nutrition Science in 1993, as well as a Certificate of Epidemiology Statistics Applied in Research on Public Health in 1994 in Belgium. She obtained her PHD from the Institute of Epidemiology in 2003.

Ms. Pauline Chan is Director of Scientific Programs for the Southeast Asian branch of the International Life Sciences Institute (ILSI). ILSI SEA Region is headquartered in Singapore and covers the 10 ASEAN countries, Australia, and New Zealand. Ms. Chan has extensive experience in developing scientific programs and facilitating dialogue between scientists, government regulators, and industry to address regional and international issues in nutrition, food safety, and health. A registered dietitian (RD) with the Academy of Nutrition and Dietetics (previously known as the American Dietetics Association), Ms. Chan received her Bachelor's degree in Chemistry from the Chinese University of Hong Kong, and her Master's degree in Nutrition and Dietetics from New York University, USA. She is also currently the Vice President of Singapore Nutrition and Dietetics Association (SNDA).

Mr. Nguyen Xuan Truong currently handles the legal documents concerning food additives and micronutrients in the Standard Management and Testing Office under the Vietnam Food Administration, Ministry of Health, Vietnam. He is also responsible for answering queries regarding food additive management. He graduated with a degree in Engineering, Quality Management in Food Industry from the Hanoi University of Science and Technology.

Ms. Norhidayah Othman is currently the Senior Assistant Director for the Additive Section under the Standard and Codex Branch, Food Safety and Quality Division, Ministry of Health, Malaysia. Currently, her field of work includes reviewing the development and amendment of food additive and food packaging regulations under Malaysia Food Regulations 1985 and coordinating the position of Malaysia for the National Codex Sub-committee mainly on Food Additives, Fats and Oils and as Malaysian Secretariat for the International Food Safety Authorities Network (INFOSAN). She was a contributor for the Total Diet Studies book published in 2011 by Springer and presented a poster entitled "Dioxin and dioxin-like PCB exposure in the diets of adult population in Malaysia" during the National Food Technology Seminar in 2012. She has also been listed as a chemical and microbiological risk assessor for the Ministry of Health Malaysia since 2013. Ms. Othman received her bachelor's degree in Food Science and Technology from the University Putra Malaysia.

Dr. Berna Magnuson is an internationally recognized food toxicologist and a Fellow of the Academy of Toxicological Sciences. She is currently managing her own consultancy practice and is a guest lecturer at the University of Toronto. As a consultant, she provides toxicology and food regulation expertise to clients from food, beverage, and dietary supplement industries, government regulatory agencies, and various health professional associations. Dr. Magnuson's background includes a BSc in food science, an MSc in toxicology, and a PhD in nutritional science. She has worked in the food industry in quality assurance and product development. Following her postdoctoral training in cancer research, she held professorships at the University of Maryland and the University of Idaho conducting research and teaching food, nutrition, and toxicology courses. Dr. Magnuson has published numerous peer-reviewed articles, book chapters, and professional articles, is on the editorial board of two journals, and is an active member of various professional associations. She is a frequent lecturer and guest speaker at international meetings.

SESSION 1

Introduction to Sweeteners, their Uses and Consumer Perception

Chair: Mrs. Tran Viet Nga, Vietnam Food Administration, Vietnam

Introduction to Sweeteners and their Uses in Food & Beverages

Prof. Dedi Fardiaz
Bogor Agricultural University
Singapore

Introduction to Sweeteners and their Uses in Food & Beverages

Prof. Dedi Fardiaz
Bogor Agricultural University
Indonesia

Sweetness derived from sugar or other sweeteners is important in imparting taste and improving the palatability of food. However, sweetness is not the only factor that influences the sensory characteristics of a food product. Other tastes such as bitterness, sourness, astringency, and even mouthfeel play an important role in enhancing the acceptability of the food by consumers. Generally, consumers expect to obtain pleasure from a food they consume; therefore, food and beverage industries are continuously making effort to improve the sensory quality of foods to respond to consumers' expectations. Along with consumers' efforts to lower sugar consumption in reducing the caloric content of foods, low-calorie and non-caloric sweeteners have been used as alternatives to the use of sugar.

It is well known that individual sweeteners have sensory limitations. For example, non-caloric sweeteners do not give a body that sugar has in a solution. Therefore, adding a little bodying agent may help to reduce this sensory limitation. The beverage industry frequently uses sweetener blends to overcome the sensory limitations of individual sweeteners. The application of sweetener blends in reduced-calorie beverages has been practiced by the beverage industry with many successful products well-established in the market-place. Several research results showed that high-intensity sweeteners have synergistic effects which provide an improved end result and also permit the reduction of the amounts needed for each individual component. The synergism of blends among different sweeteners makes possible the reduction of their individual quantities and more desirable than the isolated ones. It was shown that combinations of sweeteners have multiple benefits because they provide synergistic taste enhancement often associated with a perceived improvement of the taste profile. At the end, the use of sweeteners blends makes it possible to improve the sweetness quality and stability, to reduce costs and also to increase the choices for low calorie products for the consumer.

This presentation will discuss how sweetness and overall sensory characteristics are percieved by individuals, and how the synergistic effects of sweeteners are applied to improve the sensory quality of food and beverages.

Introduction to Sweeteners and their Uses in Food and Beverages

Dedi Fardiaz
Department of Food Science and Technology,
SEAFAST Center
BOGOR AGRICULTURAL UNIVERSITY

How do we classify sweeteners?

- **Natural sweeteners** (honey, maple syrup, molasses, date sugar, fruit juice)
- **Artificial sweeteners**

- **Natural sweeteners**
- **Extensive sweeteners (polyol, not as sweet as sugar)**
- **Intensive sweeteners**

- **Sugars**
- **Non-calorie sweeteners**
- **Low-calorie sweeteners**
- **Reduced-calorie sweteners**

- **Nutritive sweeteners (naturally occuring sugar, added sugars)**
- **Non-nutritive sweeteners (saccharin, etc)**

Which one do you choose?

Non-Caloric Sweeteners (NCS)

Intense Sweeteners	INS	Year of Discovery	Sweetness
Acesulphame potassium	950	1967	200
Alitame	956	1979	2000
Aspartame	951	1965	200
Aspartame-acesulphame salt	962		350
Cyclamate or Calcium cyclamate or Sodium cyclamate	952	1937	30-50
Neotame	961	1992	7000 – 13,000
Saccharin	954	1878	300
Stevia (Steviol glycosides)	960	1887	250 - 300
Sucralose	955	1976	600
Thaumatin	957	1972	100,000

www.nzfsa.govt.nz (2009)

Accepted Daily Intake (ADI) of Non-Caloric Sweeteners (NCS)

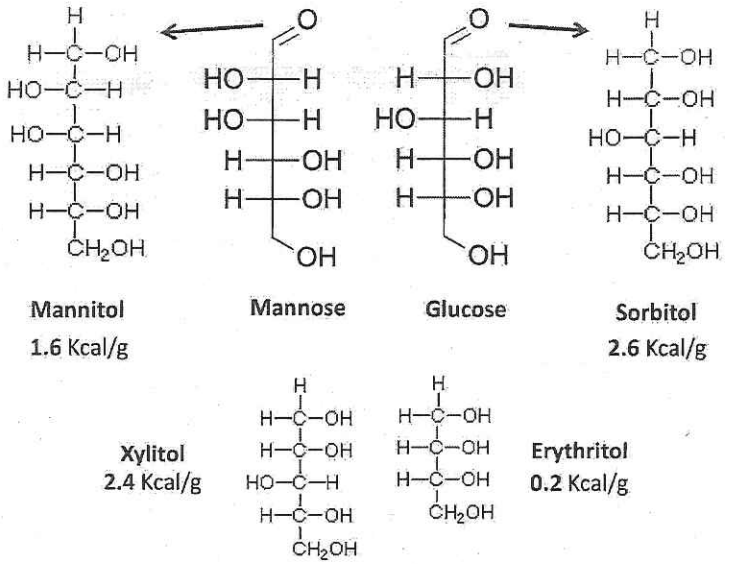
Intense Sweeteners	INS	ADI mg/KgBW
Acesulphame potassium	950	0 -15
Alitame	956	0 - 1
Aspartame	951	0 - 40
Aspartame-acesulphame salt	962	0 – 40 0 - 15
Cyclamate or Calcium cyclamate or Sodium cyclamate	952	0 - 11
Neotame	961	0 – 2
Saccharin	954	0 - 5
Stevia (Steviol glycosides)	960	0 - 4
Sucralose	955	0 - 15
Thaumatin	957	Not specified

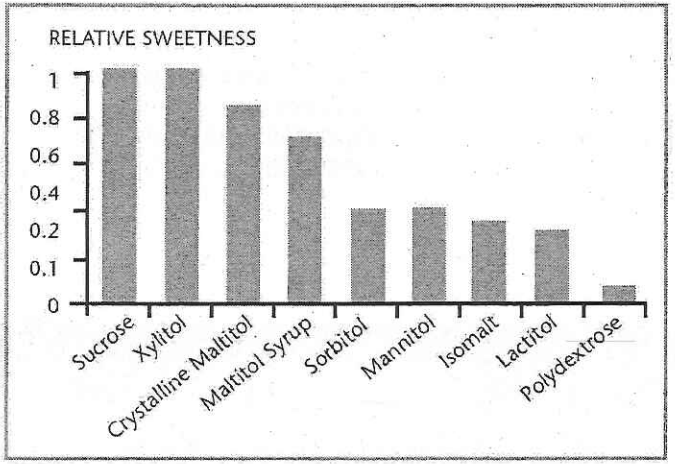
www.codexalimentarius.or (2009)

"Poly-Ols (Sugar Alcohols)" Low-Caloric Sweeteners (LCS)

INS No	Additive	Functional Class	Year Adopted	Dietary Energy (Kcal/g)	ADI mg/Kg BW
968	Erythritol	Flavour enhancer, Humectant, Sweetener	2001	0.2	Not Specified (NS)
966	Lactitol	Emulsifier, Sweetener, Thickener	1999	2.0	NS
965(i)	Maltitol	Bulking agent, Emulsifier, Humectant, Stabilizer, Sweetener, Thickener	1999	2.1	NS
421	Mannitol	Anticaking agent, Bulking agent, Humectant, Stabilizer, Sweetener, Thickener	1999	1.6	NS
964	Polyglycitol syrup	Sweetener	2001	3.0	NS
420(i)	Sorbitol	Bulking agent, Humectant, Sequestrant, Stabilizer, Sweetener, Thickener	1999	2.6	NS
967	Xylitol	Emulsifier, Humectant, Stabilizer, Sweetener, Thickener	1999	2.4	NS

Source: GSFA (www.codexalimentarius.org)



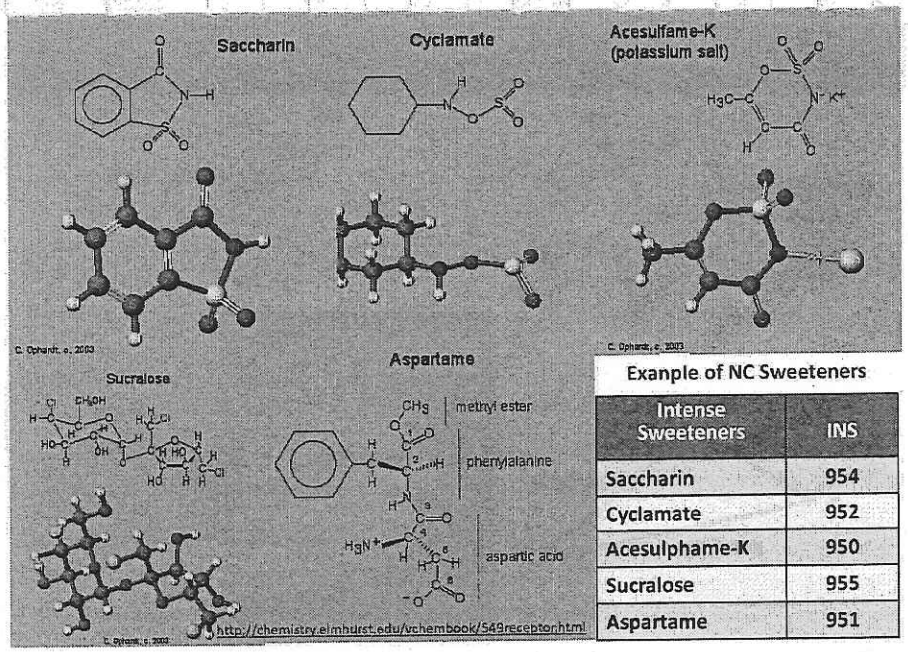


Relative sweetness of selected sugar alcohols (polyols)

http://www.nordicsugar.com/fileadmin/Nordic_Sugar/Brochures_factsheet_policies_news/Download_center/Functional_properties_of_sugar_on_a_technical_level/Functional_prop_on_tech_level_uk.pdf

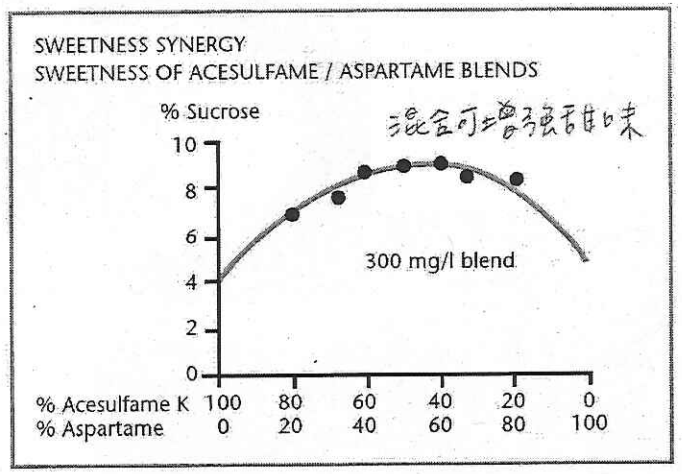
- When added to foods, **polyols add sweetness, bulk** and **texture.**
- They also help food stay **moist, prevent browning when heated** and add a **cooling sensation** to products.
- Polyols are often combined with **artificial sweeteners** to **enhance sweetness.**
- Polyols can be used in the food with **the same volume as sugar** but with about **half of the calories.**

- Examples of products with **polyols:**
  - Chewing gum
  - Candy
  - Ice cream
  - Frozen desserts
  - Baked goods
  - Chocolate
  - Cough drops
  - Cough syrup



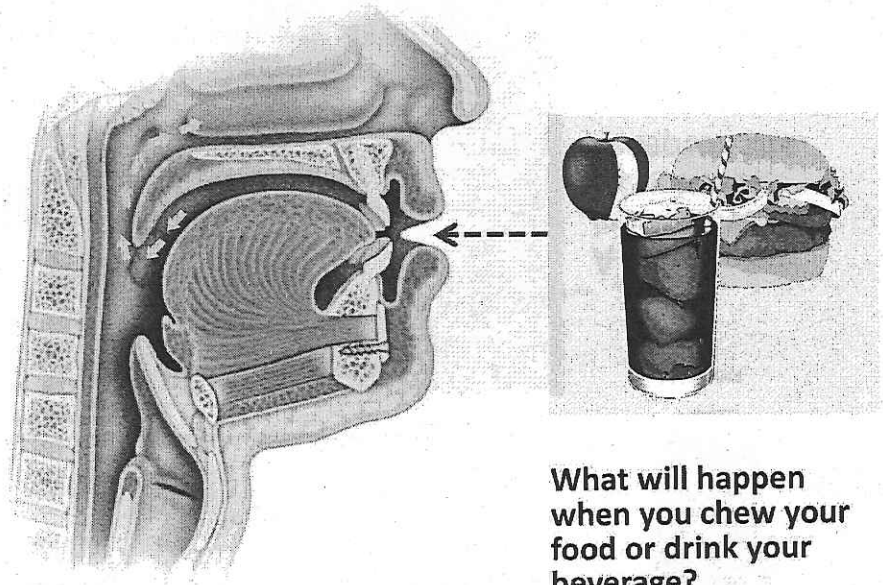
Exanple of NC Sweeteners

Intense Sweeteners	INS
Saccharin	954
Cyclamate	952
Acesulphame-K	950
Sucralose	955
Aspartame	951



Example of Synergy in Intense Sweeteners

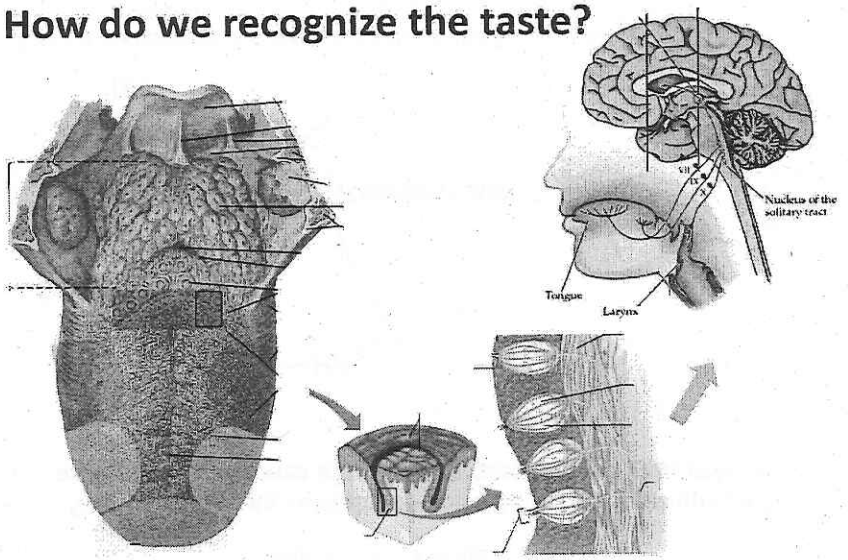
http://www.nordicsugar.com/fileadmin/Nordic_Sugar/Brochures_factsheet_policies_news/Download_center/Functional_properties_of_sugar_on_a_technical_level/Functional_prop_on_tech_level_uk.pdf



What will happen when you chew your food or drink your beverage?

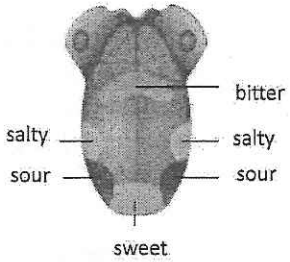
www.elperfecto.com

How do we recognize the taste?

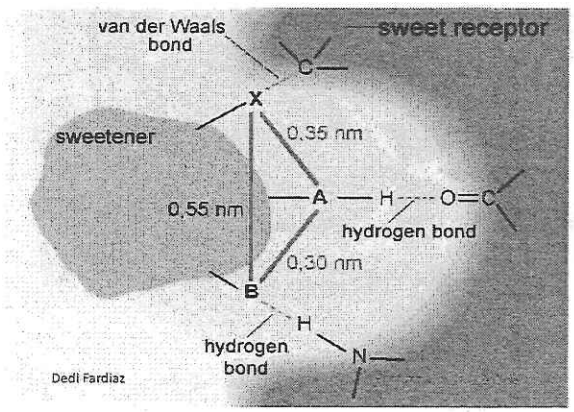


www.lifo.comcastbiz.net

A sweetener tastes sweet Why?



http://www.science.uva.nl/research/amstel/dws/sweeteners/index.php?PageName=model_zoetreceptor

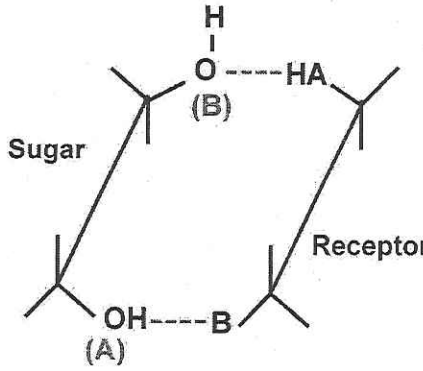


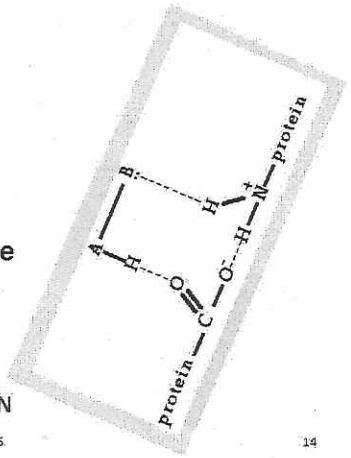
A sweetener interact with sweetness receptor site

Schallenberg's "saporous unit" theory

Shallenberger and Acree (1967)

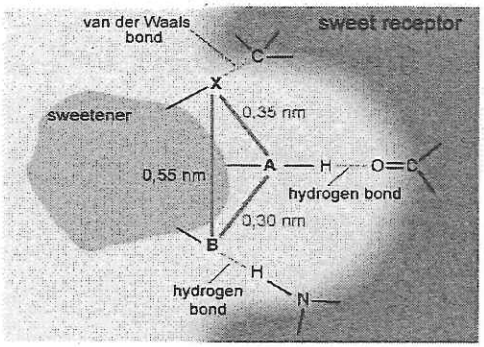
"Sweet" molecule contains H-bonding forming groups such as hydroxyls, amines etc. Sweetness: "AH – B" Hypothesis

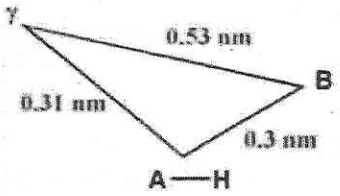


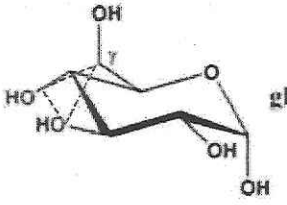


A dan B electronegative atom, typically O and N
H hydrogen

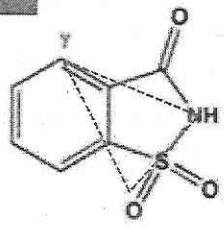
http://www.science.uva.nl/research/amstel/dws/sweeteners/index.php?PageName=model_zoetreceptor





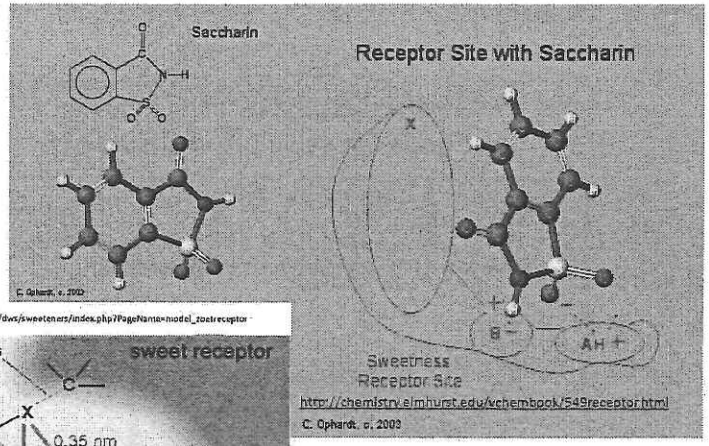


glucose

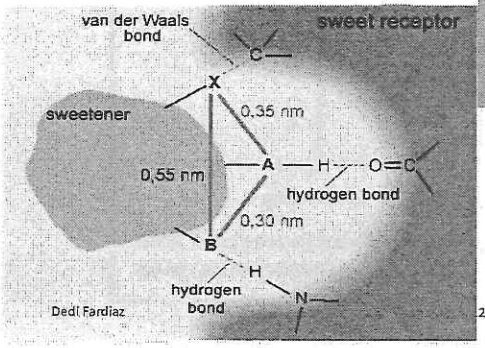


saccharin (sodium salt)

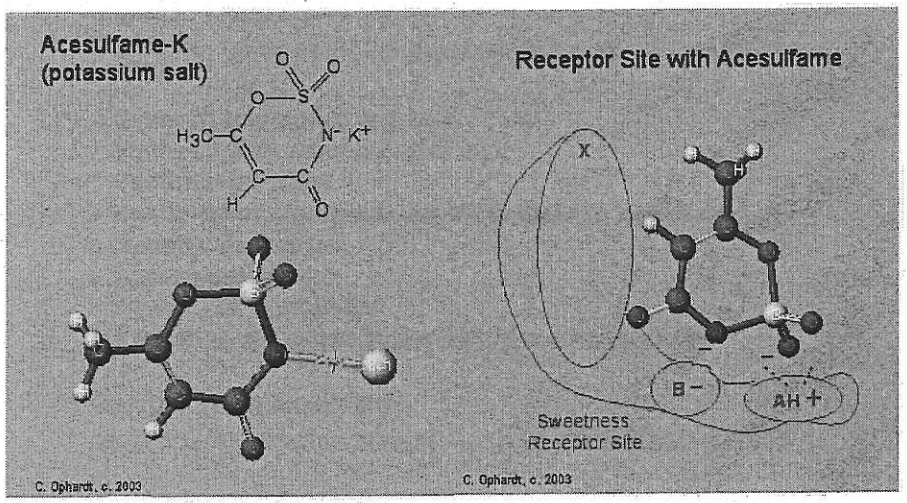
Geometrical saporous group is important to interact with the sweetness receptor site



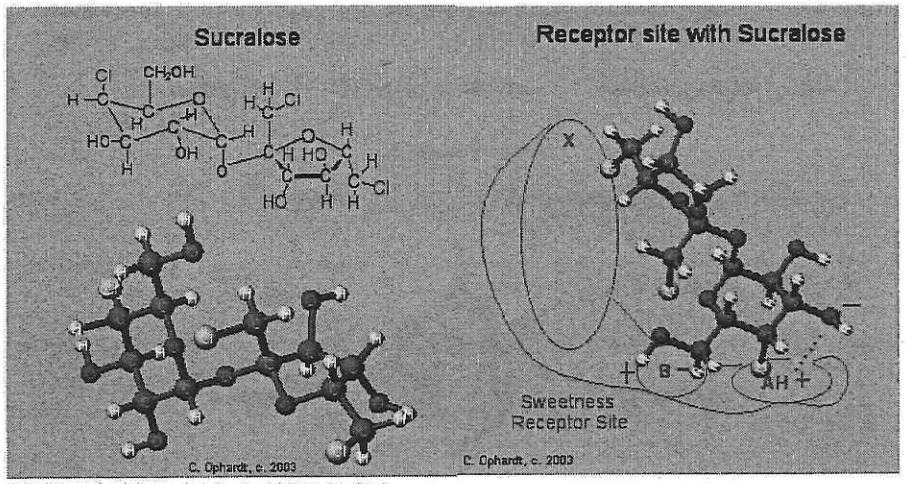
http://www.science.uva.nl/research/amstel/dws/sweeteners/index.php?PageName=model_zoetreceptor



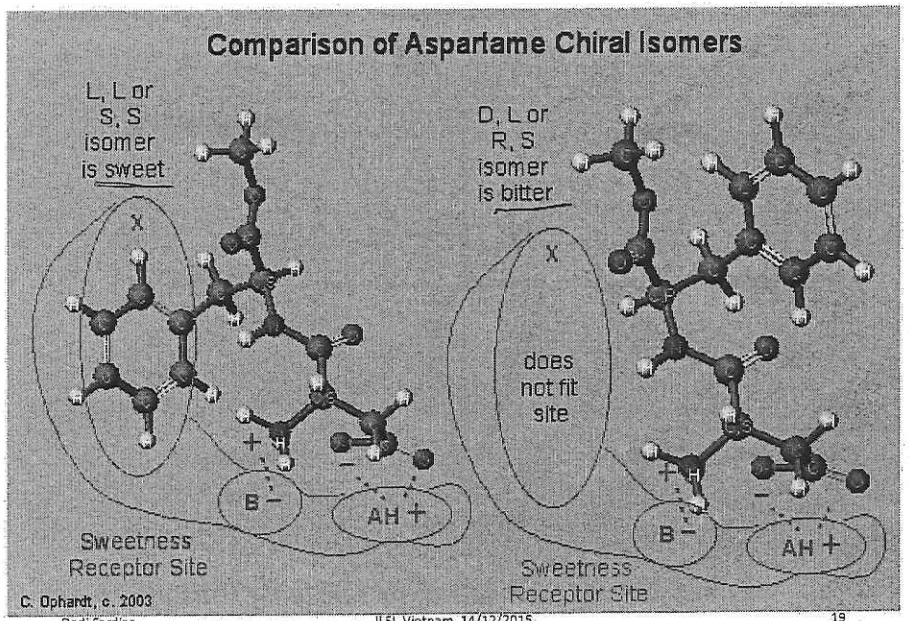
How sweetness receptor site interact with sweeteners (saccharin)



http://chemistry.elmhurst.edu/vchembook/549receptor.html

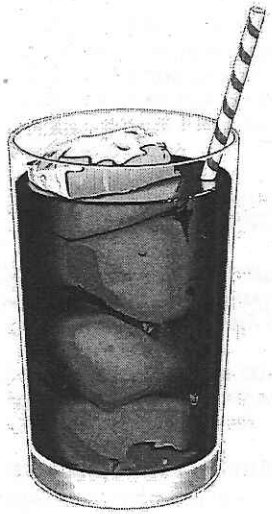


http://chemistry.elmhurst.edu/vchembook/549receptor.html



http://chemistry.elmhurst.edu/vchembook/549receptor.html

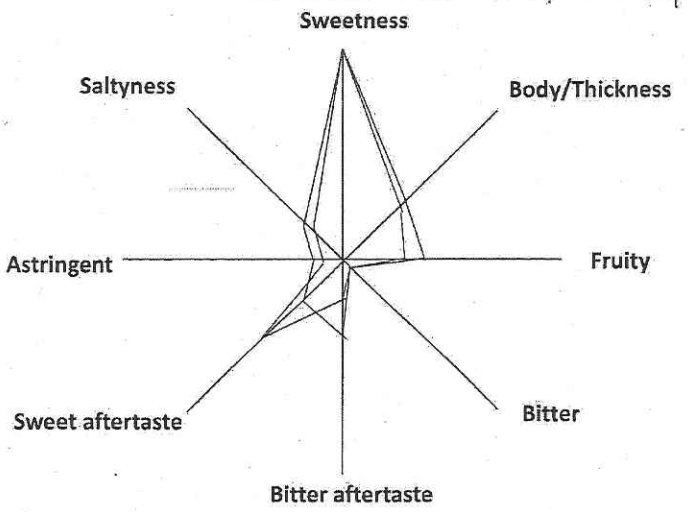
How do we measure the sweetness of sweeteners?



- By comparing them to sugar (sucrose)
- Standard: a sugar solution of 36 mg/mL
- Example : a sweetener solution (4 mg/ml) tastes as sweet as sugar solution (36 mg/ml), then the sweetness is 36/4 = 9 (nine times as sweet as the sugar solution)

Flavor Profiles of Sugar and Sweeteners?

QDA (Quantitative Description Analysis)



Saccharin often gives a bitter metallic aftertaste at high levels. Blend or add certain compounds such as tartaric acid, dipeptides or gluconates to reduce this aftertaste.

Compound Sweetener:
A product made from various natural or synthetic sweeteners together to produce compound taste and function.

Criteria of good qualty compound sweetener:
- **Good taste (very similar to cane sugar)**
- **Enhances flavors, particularly those of fruit, chocolate, coffee and vanilla**
- **Masks the bitter after-tastes of intense sweeteners such as cyclamate and saccharin**
- **Easy to handle**
- **High solubility**
- **High freezing point depression**
- **High osmotic pressure in solution (low water activity)**
- **Acts as a good humectant**
- **Low viscosity in solution**
- **Browns readily (Maillard reaction)**

Application: Used in beverage, fruit juice, cold drink, dairy products, preserved foods, bakery foods, confectionery, etc.

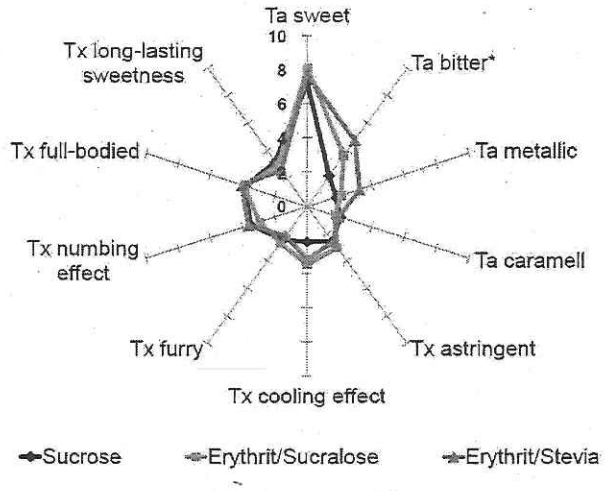
Challenges in Formulation with High Intensity Sweeteners

Various high intensity sweeteners to a varying degree have inherent flavor properties:

- **a delay in the onset of the perceived sweetness;**
- **a lingering sweetness;**
- **bitter aftertaste;**
- **metallic aftertaste;**
- **a non-linear sweetener concentration to sweetness equivalency ratio;**
- **adaptation or desensitizing**; and
- **a lack of mouthfeel or body.**

High intensity sweeteners extracted from plants may have an herbal or licorice type flavor.

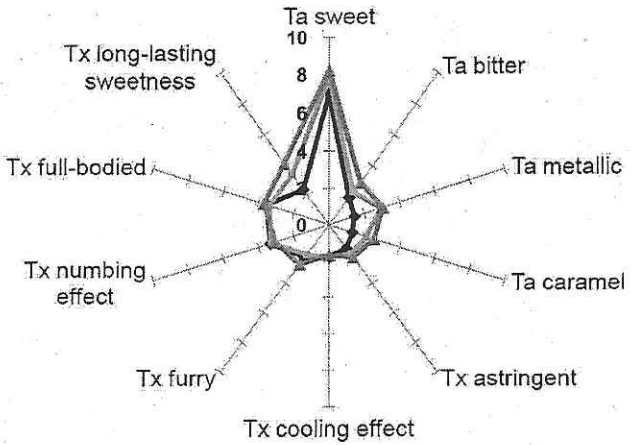
QDA data



Significant differences exist in the **bitter taste** between **sucrose** and the **erythritol/stevia** combination. This combination indicates higher intensities in this attribute.

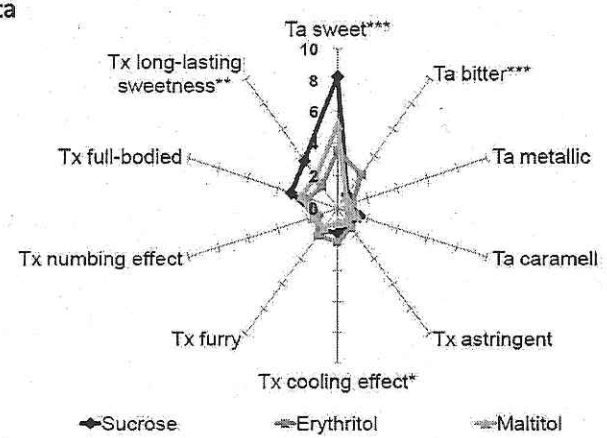
http://www.dgsens.de/files/dgsens/download/Poster/Food/Heikel_Optimising%20comb.%20of%20sugar%20substitutes_Eurosense_Heikel.pdf

QDA data



http://www.dgsens.de/files/dgsens/download/Poster/Food/Heikel_Optimising%20comb.%20of%20sugar%20substitutes_Eurosense_Heikel.pdf

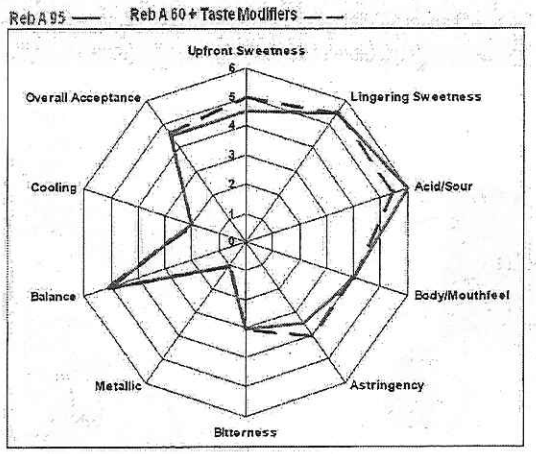
QDA data



Erythritol: the lowest intensities in **sweet taste** (half as strong as sucrose), the highest intensities in the **bitter taste.** Higher intensities than maltitol in **the cooling effect.**
Maltitol: sweeter than erythritol, **less sweeter** than sucrose. Together with sucrose it shows **significant lower intensities in the bitter taste and the cooling effect.**
Sucrose: the sweetest sample and the sweetener which has the significant highest intensities **in the long-lasting sweetness.**

http://www.dgsens.de/files/dgsens/download/Poster/Food/Heikel_Optimising%20comb.%20of%20sugar%20substitutes_Eurosense_Heikel.pdf

QDA data



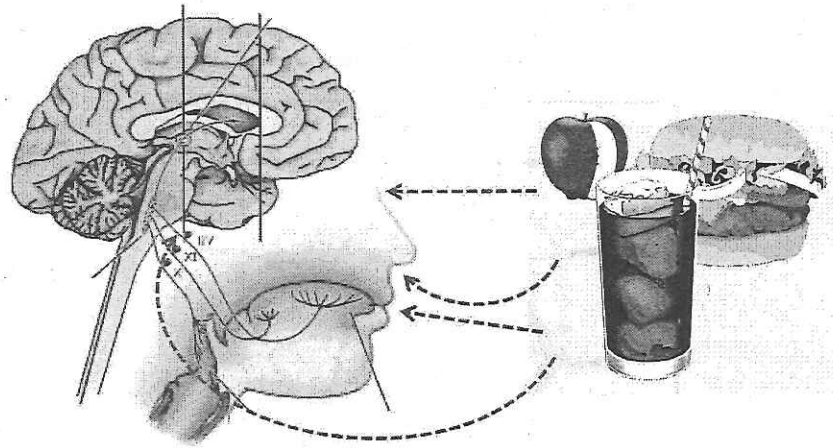
Improving the Taste of Stevia with Taste Modifiers

(http://www.foodprocessing.com/assets/knowledge_centers/WILD_Flavors/assets/sweeteners_and_taste_modification.pdf)

Consideration in formulating sweety products

- **We talk about the total flavor acceptability, not only the sweetness**
- **Several factors may influence the perception of flavor:**
  - **appearance**
  - **mouthfeel or texture**
- **Viscosity influences the perception of sweetness. Example:**
  - **Sorbitol is more viscous than other polyol (same T and C)**
  - **Replacing sucrose or corn syrup with intense sweeteners will significantly affect the viscosity, body, and mouthfeel**
  - **Adding solids or ingredients that increase viscosity will likely change the flavor perception**
  - **Because intense sweeteners are used at low level they have no influence on the surface tension or viscosity of the finished product**
- **The temperature at which the product is consumed influences the perception of sweetness and flavor (volatility of certain compounds)**

In producing acceptable products we need CREATIVITY



What is it important? Sensory characteristics of a food product will greatly influence the consumer preference