

**Jan M.C. GEUNS**

**Proceedings of the 9th Stevia Symposium  
organised by EUSTAS 2016**

# **From Field to Fork**

Department of Food and Bioscience at the  
SP Technical Research Institute of Sweden  
Frans Perssons väg 6

41296 Gothenburg, Sweden

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## Contents

1. Synthesis of Rebaudioside A from Stevioside and their Interaction Model with hTAS2R4 Bitter Taste Receptor. Vikas Jaitak	5
2. Flavour characterisation of Stevia products in water solution. Gunnar Hall, Susanne Ekman	19
3. Rheological properties, melting behaviours and physical quality characteristics of sugar-free chocolates processed using inulin/polydextrose bulking mixtures sweetened with stevia and thaumatin extracts. Roger Aidoo	21
4. Stevia innovation: improved leaf extracts from advanced understanding of taste. John Fry	33
5. Changes in sensory characteristics and their relation with consumers' liking, wanting and sensory satisfaction: Using dietary fibre and lime flavour in <i>Stevia rebaudiana</i> sweetened fruit beverages. Line Ahm Mielby	41
6. R&D experiences and challenges of stevia innovation in sugar reduction. Sandra Einerhand	49
7. Does similar intake in degree of sweetness of Rebaudioside A have favorable health effects on insulin sensitivity and regulatory genes in the liver and muscles compared to high fructose corn syrup and aspartame? Per Bendix Jeppesen	59
8. Effect of nitrogen content in leaves of <i>Stevia rebaudiana</i> Bertoni on plant biomass elaboration and steviol glycoside accumulation. Claire Barbet-Massin	87
9. Impact of Arbuscular Mycorrhizal Fungi (AMF) and phosphorus fertilization on stevia ( <i>Stevia rebaudiana</i> Bertoni) growth, yield and steviol glycosides. Andrea Martini	101
10. 2nd year cultivation results of the Danish 'Green Stevia' project – a natural sweetener for organic food products. Kai Grevsen	115
11. Development of Simple sequence repeat (SSR) and Single nucleotide polymorphism (SNP) molecular markers as a tool for <i>Stevia rebaudiana</i> 's germplasm characterization and future breeding purposes. Schurdi-Levraud	127
12. Tools for a new era in plant breeding: breeding per chromosome. Rob Dirks	137

13. Development of Stevia and Steviol Glycosides Industry in China. Jinwen Sun	145
14. Steviol glycosides in purified Stevia leaf extract sharing the same metabolic fate. Sidd Purkayastha	151
15. Stevia application challenges in compliance with the regulations and changes in Europe and beyond. Suzanne Preddie-Atterby	165
16. Stevia and the rules on access and benefit sharing. Francois Meienberg	167
17. A sustainable <i>Stevia rebaudiana</i> European Supply Chain: the 2015 Case “Enjoy it’s from Europe”. Joel Perret	173

## Posters

P 1: Effect of Different Harvest Times on Stevioside and Rebaudioside A of Stevia rebaudiana; B. Tutuncu	187
P 2: Effect of different light spectra and intensities on growth and steviol glycoside production in Stevia rebaudiana; B. Yücesan	189
P 3: Acceptability of Sugar Reduced Sour Cherry and Chocolate Ice Creams by Using Stevia Extract; A. A.Kulcan	191
P 4: Effect of Stevia as a Replacement for added Sugar on Physicochemical and Sensorial Attributes of Lemonade and Fruit Nectars; A.A. Kulcan	193
P 5: Cytoprotective Eigenetic and Molecular Mechanisms of Stevia rebaudiana Against Degenerative Diseases; K. Ponnusamy	195
P 6: Effects of Arbuscular mycorrhizal fungi and phosphorus fertilization on the antioxidant activity of <i>Stevia rebaudiana</i> . Cecilia Bender, Barbara Passera, Silvia Tavarini, Luciana Angelini, Helmut H. Weidlich	197
P 7: Steviol, the colonic metabolite of steviol glycosides, inhibits human osteosarcoma cell line U2OS; Jun-ming Chen	199
P 8: Exploration of Molecular Interaction of Steviol Glycosides from <i>Stevia rebaudiana</i> (Bertoni) with Sweet Taste Receptors: A Computational Approach; Ramit Singla, Vikas Jaitak	201
P 9: Anther Culture of Stevia rebaudiana Bertoni for Double-Haploid Technology; K. Turgut	203
P 10: Evaluation of <i>Stevia rebaudiana</i> Genotypes under Field Conditions in the South west of France for Organic Production Establishment; Cécile Hastoy, Patrick Cosson, Eric Schlaunich, Pierre Jannot, Philippe Boutié, Sébastien Cavaignac, Dominique Rolin, Valérie Schurdi-Levraud	204

## CHAPTER 1

# Synthesis of Rebaudioside A from Stevioside and their Interaction Model with hTAS2R4 Bitter Taste Receptor

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### ABSTRACT

Steviol glycosides (SG's) from *Stevia rebaudiana* (Bertoni) have been used as natural low-calorie sweeteners. Their aftertaste bitterness restricts its use for human consumption and limits its application in food and pharmaceutical products. In the present study, we have performed computational analysis in order to investigate the interaction of two major constituents of SG's against the homology model of the hTAS2R4 receptor. A molecular simulation study performed using stevioside and rebaudioside A revealed that the sugar moiety at the C-3'' position in rebaudioside A causes restriction of its entry into the receptor site, thereby preventing to trigger the bitter reception signaling cascade. Encouraged by the current finding, we have also developed a greener route using  $\beta$ -1,3-glucanase from *Irpex lacteus* for the synthesis of de-bittered rebaudioside A from stevioside. The rebaudioside A obtained was of high quality with a percent conversion of 62.5 %. The results here reported can be used for the synthesis of rebaudioside A which has a large application in food and pharmaceutical industry.

**KEYWORDS:** Steviol glycosides, Homology Model, Ramachandran plot, hTAS2R4,  $\beta$ -1,3-glucanase, Transglycosylation

## CHAPTER 2

### Flavour characterisation of Stevia products in water solution

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#### Abstract

Steviol glycosides are the purified components of the Stevia leaf that give Stevia its sweet taste. Like all glycosides they have a non-sweet fraction (Steviol) and a sweet fraction (monosaccharide). The monosaccharide type, number and attachment position on Steviol determine the characteristic taste of a Steviol glycoside component. Rebaudioside A (Reb A) and Stevioside, the sweetest Steviol glycosides, are the most frequently used as sweeteners. Stevioside is also the most abundant Steviol glycoside in Stevia leaves. Using Steviol glycosides in food applications is challenging since many of them have other tastes than the sweet taste. The aim of this study was to investigate the sensory profile of six different Stevia products and sucrose at three different concentrations (low, medium, and high) in water solutions. An external analytical sensory panel characterised the samples according to the method Descriptive sensory analysis. In collaboration with a panel leader the panel developed the attributes appropriate to describe the perceived sensory characteristics, and how they should be evaluated. The panel identified and defined five sensory attributes related to taste and flavour. The intensities of each attribute were assessed at three different time points; after 10, 30 and 60 seconds. Statistical differences in perceived intensities were found between the samples for all attributes and at the three time points. This means that each Steviol glycoside has its own time dynamic sensory profile which needs to be taken into account when optimising the sweet taste in food applications.

## CHAPTER 3

# **Rheological Properties, Melting Behaviours and Physical Quality Characteristics of Sugar-free Chocolates Processed Using Inulin/polydextrose Bulking Mixtures Sweetened with Stevia and Thaumatin Extracts**

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### **ABSTRACT**

Demand for use of natural sweeteners and prebiotic compounds for the manufacture of sugar-free chocolates has dramatically increased over the past decennium. However, their applicability in product formulation and how these will affect the flow (rheological) and physical quality characteristics still remains a big challenge. This study investigated the rheological properties, melting behaviours and other physical quality characteristics of sugar-free chocolates processed from inulin and polydextrose mixtures as bulking agents sweetened with stevia and thaumatin extracts. Standard reference chocolate was developed using sucrose and the effects of the inulin/polydextrose and stevia/thaumatin ingredients on the rheological properties, melting profiles, colour and hardness of the derived products measured using standard methods. Generally, the sugar-free chocolates showed similar flow (rheological) and melting properties as

## CHAPTER 4

### **Stevia Innovation: Improved Leaf Extracts From Advanced Understanding Of Taste**

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#### **ABSTRACT**

Following the 2008 launch of high-purity rebaudioside A in the USA, the desire for lower cost leaf extracts led to a wide range of stevia products of lower reb A content. Some of these were surprisingly effective. This prompted an intensive sensory investigation of purified steviol glycosides, both individually and in combination. Single glycosides were characterised for sweetness, bitterness and liquorice concentration response. Results were combined with the characteristics of binary and higher order mixtures into a predictive model. This model was used to suggest suitable synergistic combinations of glycosides for further examination and commercial development in the form of standardised mixed leaf extracts of reliably superior taste.

#### **KEYWORDS**

Steviol glycosides, Synergy, Sensory, Taste, Model

#### **INTRODUCTION**

From the first launch of high purity rebaudioside A (reb A) in Western markets in 2008, it was apparent that steviol glycosides provided not only sweetness but also less attractive non-sweet side tastes. Typically described as bitter or liquorice, these side tastes were particularly noticeable at higher use levels.



## CHAPTER 5

### **Changes in Sensory Characteristics and Their Relation with Consumers' Liking, Wanting and Sensory Satisfaction: Using Dietary Fibre and Lime Flavour in Steviol Glucoside Sweetened Fruit Beverages**

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#### **NOTES**

The presentation is primarily based on the results published in the paper by the same title (Mielby et al., 2016). In addition, the presentation also includes a small study on the comparison of a sugar sweetened fruit beverage and the steviol glucoside sweetened counterpart not published elsewhere. This manuscript will primarily include information on the unpublished study which in this manuscript is called the “Sugar comparative study” and information from Mielby et al (2016) needed to understand the Sugar comparative study. Otherwise references are made to Mielby et al. (2016).

#### **ABSTRACT**

The beverage industry has long revolved around sugar reduction as a response to heightened calorie and health awareness. More recently, dietary fibre has also garnered attention to meet the consumer's demands for low calorie and yet more satiating food and beverages. From a health perspective the sweetener steviol glycosides and the fibre  $\beta$ -glucan seem like very good solutions, as steviol glycosides are the only authorised natural non-nutritive sweetener and  $\beta$ -glucans have been related to various health benefits besides increasing satiety. However, both also have distinctive perceptual effects on the sensory characteristics of the products they are added to. To gain knowledge on the sensory characteristics of fruit based beverages sweetened with steviol glucosides and added  $\beta$ -glucans and lime flavour, and how consumers respond to the products, sensory descriptive