Our Speakers

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The Challenges and Solutions to formulating with Stevia

August 13th, 2020

STEVIAONE
PASSIONATE ABOUT HEALTH

WELLNESS

Agenda

Overview

Marketing Trends
Stevia: Non-Caloric Natural Sweetener
Types and Varieties of Stevia
What are Steviol Glycosides
How do Glycosides Affect Final Taste of Formulation
Challenges and How to Overcome Them
Stevia One
Q&A

Sugar Vilified

On average Americans over the age of 1 are getting 13% of their daily calories from sugar, and a new July 2020 report from the USDA recommends a cut to 6%.

A large public health villain

The industry is divided on how to deal with the negativity and concerns surrounding sugar. Zero calorie and low-calorie sweetener solutions continue to gain momentum

The changing regulatory landscape

Label laws and DGAC guidelines show change is necessary. Zero calorie and low-calorie sweetener solutions continue to gain momentum

The sugar health connection

Concerns surrounding diabetes, cardiovascular health, and weight gain continue to push consumers towards a lower-sugar diet . 22% of consumers are influenced by low/ no sugar claims.

Consumer Attitudes Towards Sweeteners

The majority of consumers are sugar conscious, and were split by a recent report as follows:

The Prohibitionists

Concerns over too much sugar and artificial sweeteners in their products today. Driven by concerns around weight loss, mood and performance and blood sugar balance.

16% of consumers

The Moderationists

Believe balance is critical when it comes to sugar intake. Want higher quality products when they indulge on occasion. Improved ingredients and clean label with superior sensory performance are key.

28% of consumers

The Naturalists

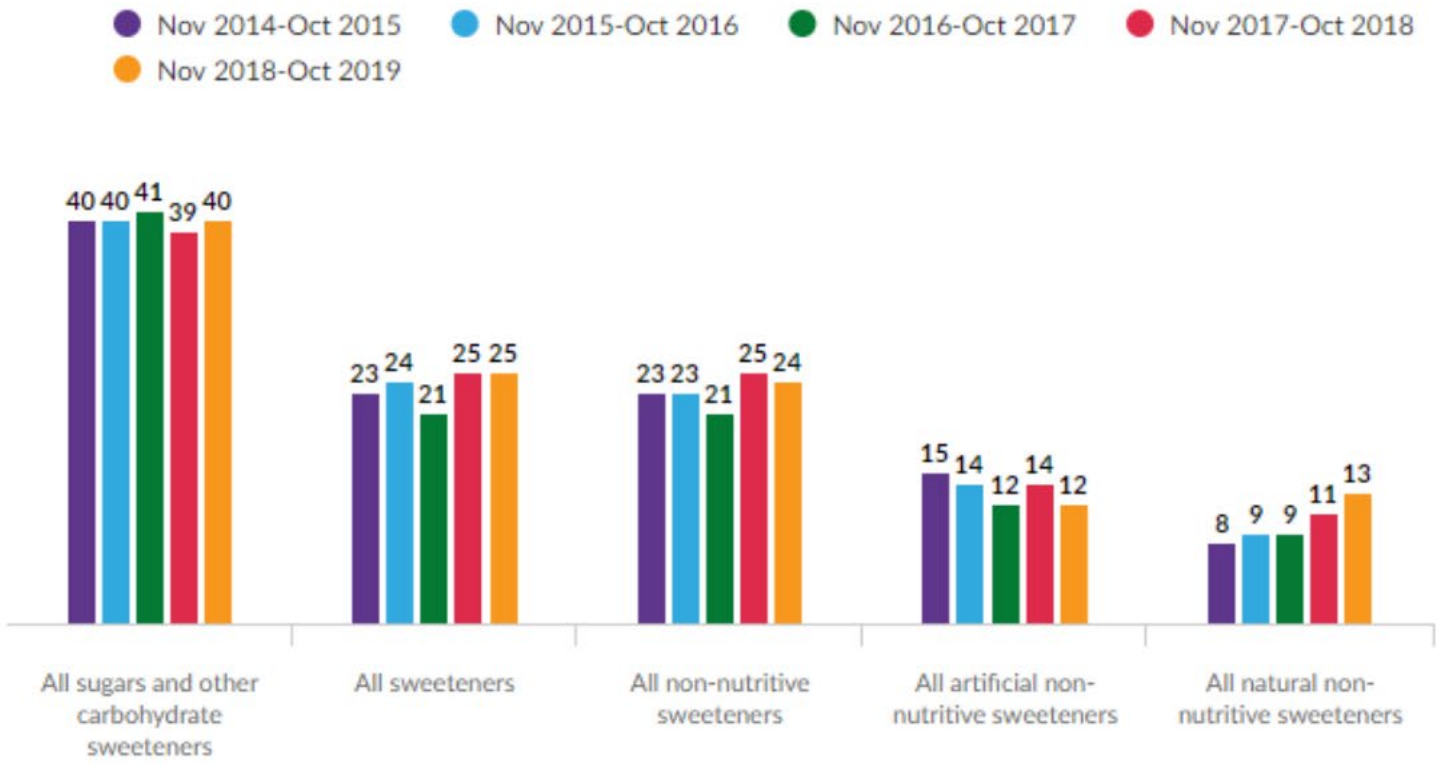
Embrace sugar when used purposefully. Want elevated experience from natural sources of sugar, as well as zero calorie natural sweeteners. Prefer less sweet products and included to purchase food and beverages that are naturally sweetened.

30% of consumers

Non-Nutritive Sweeteners Gain Populatity

Natural non-nutritive sweeteners have overtaken artificial non-nutritive sweeteners in drink launches

North America- Percentage of drink product launches that contain select carbohydrate sweeteners / additive sweeteners

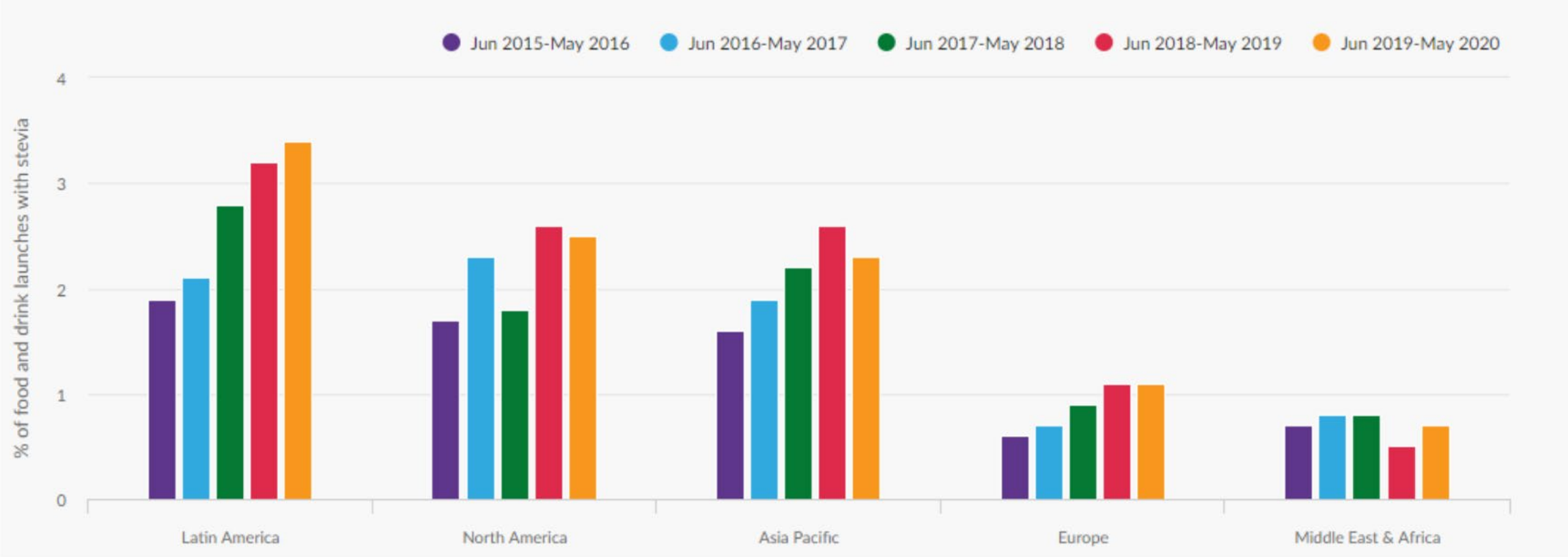


Source: Mintel

Stevia Continues to Grow Globally

Stevia continues to gain traction in global food and drink launches

Global- Percentage of food and drink launches that contain stevia by region



Source: Mintel

Where We Are Headed

Harness the Demand for Natural Sweetness

Sugar reduction is no longer just for diet products. Concerns over sugar intake and the role it plays in obesity will continue to be high. The search for effective natural alternatives will continue.

Natural Sugar Reduction

Alternatives to refined white sugar will continue to be sought after. With a consumer focus on clean label and natural ingredients, linking sugar replacers back to natural plant sources gives consumers comfort.

Focus on Taste in Indulgent Categories

Sugar reduction has moved beyond just diet foods. Sugar claims in these categories remain scarce, leaving much room for innovation. Taste still takes center stage in this product category.

Addressing Taste Challenges

The balance between delivering on health and taste continue to be a challenge. While previously stevia's taste profile has limited its use, new innovations open the door to better tasting products.

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The Challenges and Solutions to Formulating with Stevia

Acme-Hardesty August 2020

THE CHALLENGES AND SOLUTIONS TO FORMULATING WITH STEVIA

AUGUST 13TH, 2020

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1.STEVIA
NON-CALORIC
NATURAL SWEETENER

1. STEVIA: NON-CALORIC NATURAL SWEETENER

Generic Name	Stevia
Binomial Name	Stevia Rebaudiana Bertoni
Commercial Technical Name	Steviol Glycosides
Sweetening power	200 to 300 times sugar
Acceptable daily intake*	4 mg per kg of body weight

- Natural source, was discovered in Paraguay in the XIX century
- Non-caloric natural sweetener
- Does not induce a glycemic response in the blood
- It is currently cultivated in several countries of the world, mainly in China, under non-integrated models of small farmers.
- Estimated global consumption: 9000 TN/year Steviol Glycosides

2. TYPES AND VARIETIES OF STEVIA

2. TYPES AND VARIETIES OF STEVIA

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Steviol Glycosides Extracted from the leaf

Regulatory statement:
INS 960 a

Steviol Glycosides naturally extracted from Stevia leaves

Extraction process:
Stevia tea with stevia leaf and water – Purification – Filtration – Evaporation - Drying

Enzymatically Modified Stevia

GLYCOSILATED

Regulatory statement:
INS 960 b

Glycosylation process using enzymes to convert steviolglycosides into glycosylated steviolglyosides (flavor enhancer)

BIOCONVERSION

Regulatory statement:
INS 960 b

Bioconversion process using enzymes to convert steviolglycosides into eg Rebaudioside M/D/E

Fermentation

Regulatory statement:
INS 960 c

Fermentation process using a GMO yeast & sugar (cane sugar/dextrose) to produce Rebaudioside M/D

3. WHAT ARE STEVIOL GLYCOSIDES

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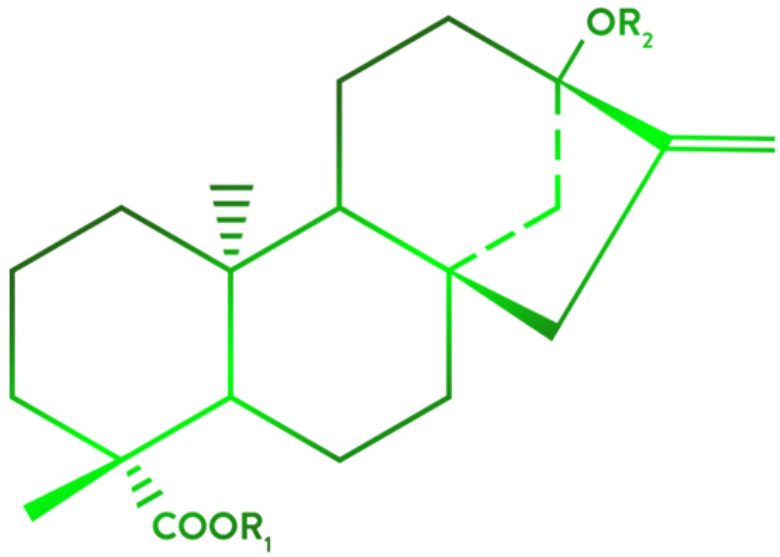
Steviol glycosides are a group of compounds naturally occurring in the plant Stevia rebaudiana Bertoni sharing a similar molecular structure where different sugar moieties are attached to the aglycone steviol (an ent-kaurene-type diterpene). They include any compound containing a steviol backbone conjugated to any number or combination of the principal sugar moieties in any of the orientations occurring in the leaves of Stevia rebaudiana Bertoni including, glucose, rhamnose, xylose, fructose, and deoxyglucose.



3. WHAT ARE: STEVIOL GLYCOSIDES

STEVIOL GLYCOSIDES	ABRV.	R_1	R_2
Stevioside (**1**)	Stev	ß-glc	ß-glc-ß-glc (2-1)
Rebaudioside A (**2**)	RebA	ß-glc	ß-glc-ß-glc (2-1) | ß-glc (3-1)
Rebaudioside B (**3**)	RebB	H	ß-glc-ß-glc (2-1) | ß-glc (3-1)
Rebaudioside C (**4**)	RebC	ß-glc	ß-glc-α-rha (2-1) | ß-glc (3-1)
Rebaudioside D (**5**)	RebD	ß-glc-ß-glc (2-1)	ß-glc-ß-glc (2-1) | ß-glc (3-1)
Rebaudioside E (**6**)	RebE	ß-glc-ß-glc (2-1)	ß-glc-ß-glc (2-1)
Rebaudioside F (**7**)	RebF	ß-glc	ß-glc-ß-xyl (2-1) | ß-glc (3-1)
Steviolbioside (**8**)	Stbs	H	ß-glc-ß-glc (2-1)
Dulcoside A (**9**)	DulcA	ß-glc	ß-glc-α-rha (2-1)
Rubusoside (**10**)	Rub	ß-glc	ß-glc

[a] R_1 and R_2 refer to Figure 1. glc, D-glucopyranosyl; rha, L-rhamnopyranosyl; xyl, D-xylopyranosyl.

3. WHAT ARE: STEVIOL GLYCOSIDES

Table 2.1.1-1 Molecular Weight and Formula, and R-Groups in Backbone Structure (See Figure 2.1.1-1)

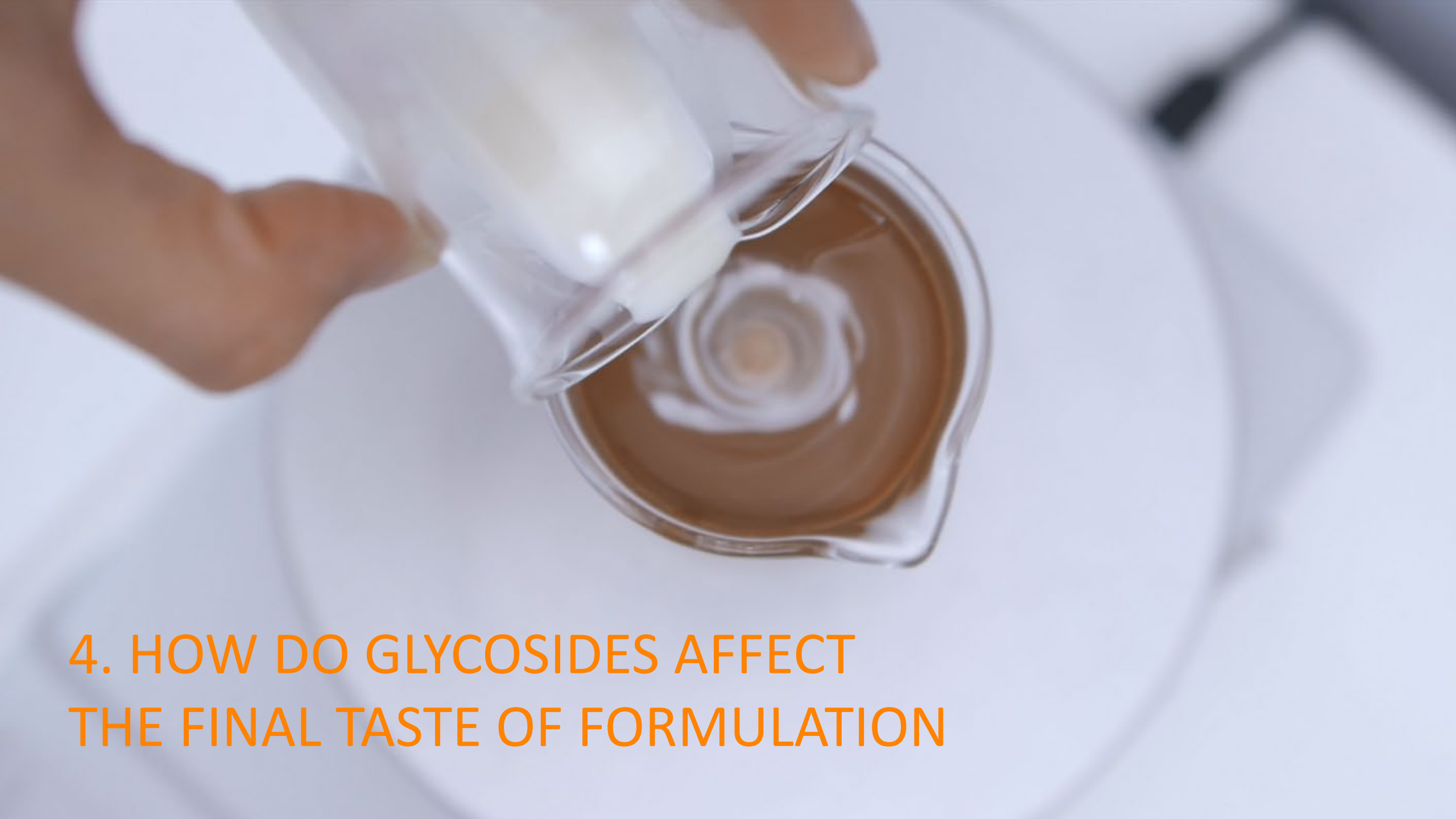
#	Common Name	CAS Number	Molecular Weight	Trivial Formula	R_1	R_2
-	Steviol	471-80-7	318.46	C20H30O3	H	H
1) Steviol + Glucose						
1.1	Steviolmonoside	-	480.59	$C_{25}H_{40}O_8$	H	Glcβ1-
1.2	Steviol-19-O-β-D-glucoside	60129-60-4	480.59	$C_{25}H_{40}O_8$	Glcβ1-	H
1.3	Rubusoside	64849-39-4	642.73	$C_{32}H_{50}O_{13}$	β-Glc	β-Glc
1.4	Steviolbioside	41093-60-1	642.73	$C_{32}H_{50}O_{13}$	H	β-Glc-β-Glc(2-1)
1.5	Stevioside	57817-89-7	804.88	$C_{38}H_{60}O_{18}$	β-Glc	β-Glc-β-Glc(2-1)
1.6	Stevioside A	-	804.88	$C_{38}H_{60}O_{18}$	β-Glc-β-Glc(2-1)	β-Glc
1.7	Rebaudioside B	58543-17-2	804.88	$C_{38}H_{60}O_{18}$	H	Glcβ(1-2)[Glcβ(1-3)]Glcβ1-
1.8	Rebaudioside G	127345-21-5	804.88	$C_{38}H_{60}O_{18}$	Glcβ1-	Glcβ(1-3)Glcβ1-
1.9	Stevioside B	-	804.88	$C_{38}H_{60}O_{18}$	Glcβ(1-3)Glcβ1-	Glcβ1-
1.10	Rebaudioside E	63279-14-1	967.01	$C_{44}H_{70}O_{23}$	Glcβ(1-2)Glcβ1-	Glcβ(1-2)Glcβ1-
1.11	Rebaudioside A	58543-16-1	967.01	$C_{44}H_{70}O_{23}$	β-Glc	Glcβ(1-2)[Glcβ(1-3)]Glcβ1-
1.12	Rebaudioside A2	-	967.01	$C_{44}H_{70}O_{23}$	Glcβ1-	Glcβ(1-6)Glcβ(1-2)Glcβ1-
1.13	Rebaudioside D	63279-13-0	1,129.15	$C_{50}H_{80}O_{28}$	B-Glc-β-Glc(2-1)	Glcβ(1-2)[Glcβ(1-3)]Glcβ1
1.14	Rebaudioside I	-	1,129.15	$C_{50}H_{80}O_{28}$	Glcβ(1-3)Glcβ1-	Glcβ(1-2)[Glcβ(1-3)]Glcβ1-
1.15	Rebaudioside L	-	1,129.15	$C_{50}H_{80}O_{28}$	Glcβ1-	Glcβ(1-6)Glcβ(1-2)[Glcβ(1-3)]Glcβ1-
1.16	Rebaudioside Q2	-	1,129.15	$C_{50}H_{80}O_{28}$	Glcα(1-2)Glcα(1-4)Glcβ1-	Glcβ(1-2)Glcβ1-
1.17	Rebaudioside Q	-	1,129.15	$C_{50}H_{80}O_{28}$	Glcβ1-	Glcα(1-4)Glcβ(1-2)[Glcβ(1-3)]Glcβ1-
1.18	Rebaudioside I2	-	1,129.15	$C_{50}H_{80}O_{28}$	Glcβ1-	Glcα(1-3)Glcβ(1-2)[Glcβ(1-3)]Glcβ1-
1.19	Rebaudioside Q3	-	1,129.15	$C_{50}H_{80}O_{28}$	Glcβ1-	Glcα(1-4)Glcβ(1-3)[Glcβ(1-2)]Glcβ1-
1.20	Rebaudioside I3	-	1,129.15	$C_{50}H_{80}O_{28}$	Glcβ(1-2)[Glcβ(1-6)]Glcβ1-	Glcβ(1-2)Glcβ1-
1.21	Rebaudioside M	1220616-44-3	1,291.3	$C_{56}H_{90}O_{33}$	Glcβ(1-2)[Glcβ (1-3)]Glcβ1-	Glcβ(1-2)[Glcβ(1-3)]Glcβ1-

3 glucoses

4 glucoses

5 glucoses

6 glucoses



4. HOW DO GLYCOSIDES AFFECT THE FINAL TASTE OF FORMULATION

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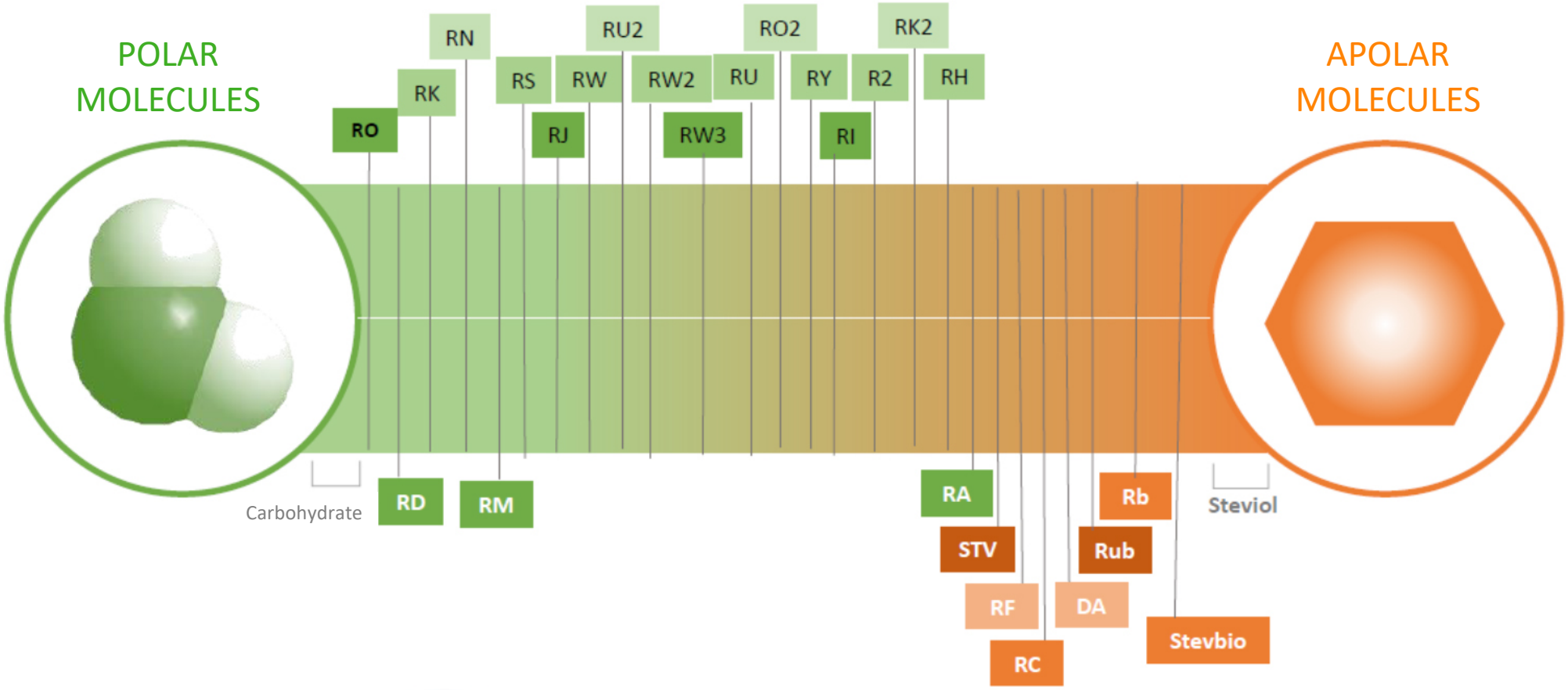


THE STEVIOL GLYCOSIDES COMPOSITION MATTERS

POLAR SG's

- All the SG's with higher polarity than RebA.
- Generally higher molecular mass and higher glucose bonds. These are the most common: Reb D, Reb M, Reb E.
- The least known include: RebO, O2, RebE, RebN, RebI, RebI2, RebI3, RebK, RebH, RebJ, RebV, RebQ, RebQ2.
- All the polar SG's have a clean and sweet taste, similar to RebM

APOLAR SG's

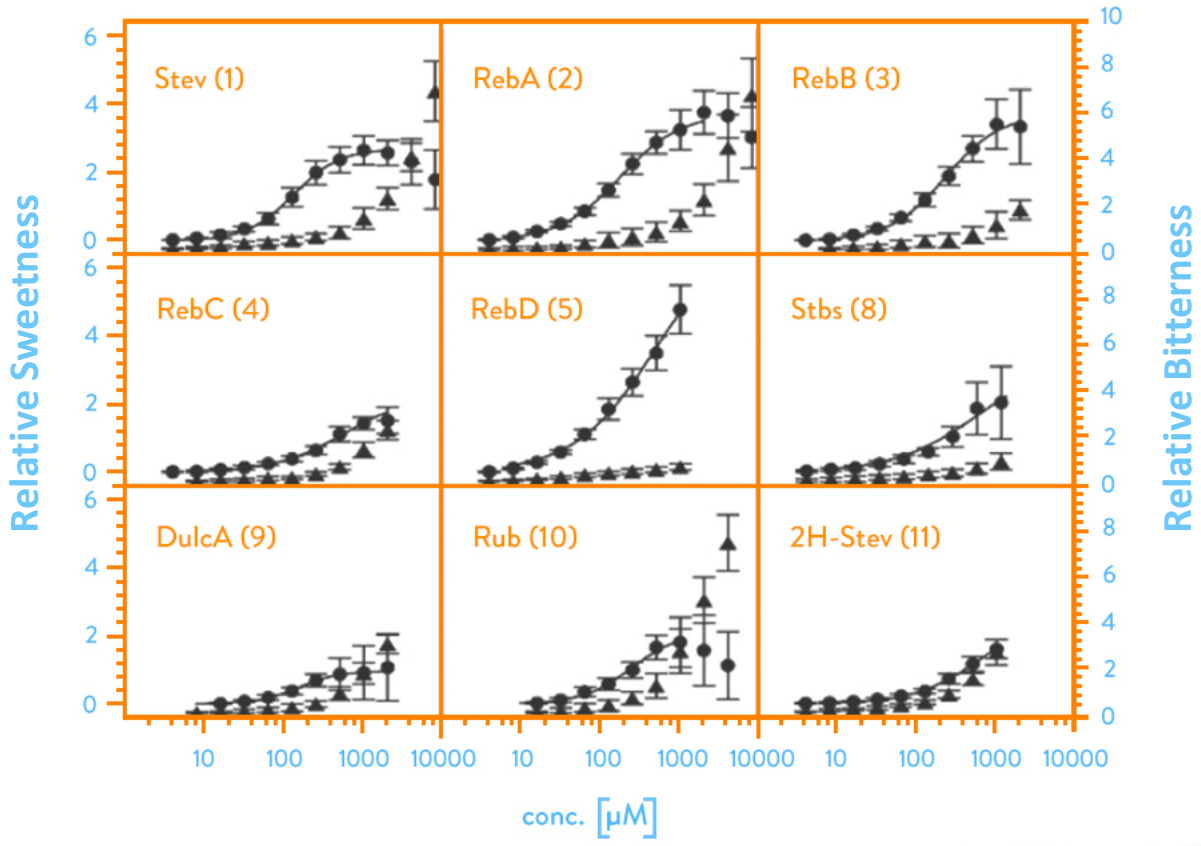
- All the SG's with lower polarity than Stevioside.
- Generally lower molecular mass and combined with rhamnose, xylose, fructose.
- The most common: RebC, RebF, RebB.
- The least known include: RebF2, RebF3, RebG, Stevioside B, Dulcoside B/C.
- Almost all the apolar SG's have metallic and/or bitter taste, but correctly combined can give a great taste and high sweetness level to the application.

4. HOW DO GLYCOSIDES AFFECT THE FINAL TASTE OF FORMULATION

TASTE COMPARISON BETWEEN THE STEVIOL GLYCOSIDES

● Sweetness

▲ Bitterness



5. CHALLENGES AND HOW TO OVERCOME THEM

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CHALLENGES

METALIC AFTERTASTE

ACIDITY

TASTE

SWEETNESS LEVEL

TEXTURE

BITTERNESS

BULK

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SOLUTIONS

FIRST:
DEFINE
THE GOAL

CONTROL	GOAL
Full sugar version	To reduce sugar by x%
Version with sweeteners	To replace the other sweeteners with Stevia by x%
Version with stevia	To improve the taste
Version with stevia	To reduce the cost
Full sugar version	Saving Project with stevia
No Control	To develop a new product with good taste

TASTE IS SUBJECTIVE… A TARGET IS NEEDED, ALWAYS !

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WHY DO WE NEED A TARGET?

…IT'S NOT ONLY ABOUT NATURAL SWEETNESS… IT'S ALSO ABOUT:

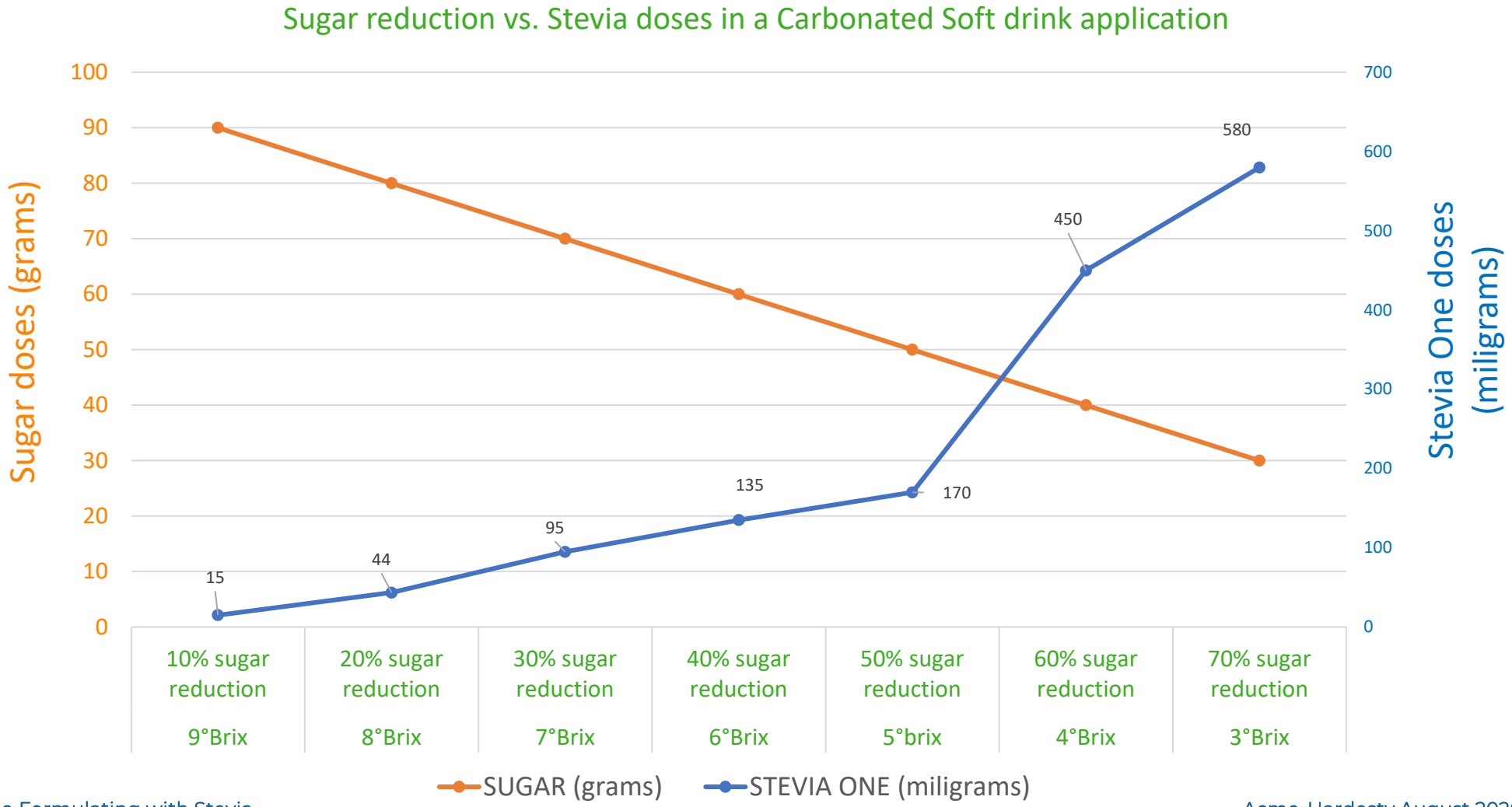
1	2	3	4	5	6
SWEETNESS What is the desired sweetness level and sensation?	TASTE How to avoid taste distortion?	TEXTURE What is the best option to replace the texture?	MOUTHFEEL How does the product feel in the consumers mouth?	ACIDITY Acids doses needs to be adjusted.	TOTAL BRIX Some ingredients contribute to the total Brix

5. CHALLENGES AND HOW TO OVERCOME THEM

1

SWEETNESS

The sweetness replacement is NOT Linear

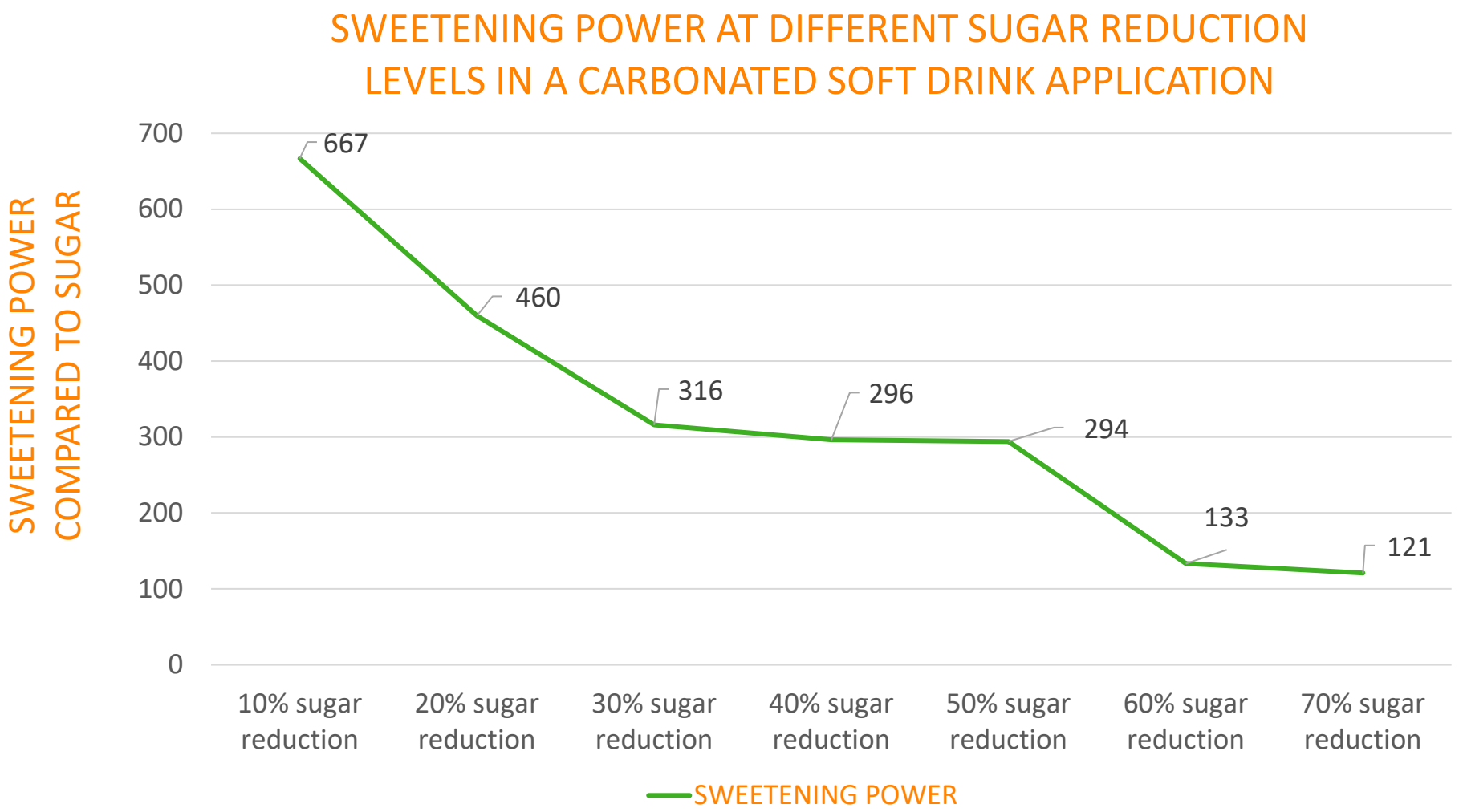


5. CHALLENGES AND HOW TO OVERCOME THEM

1

SWEETNESS

The sweetening power is NOT Linear neither

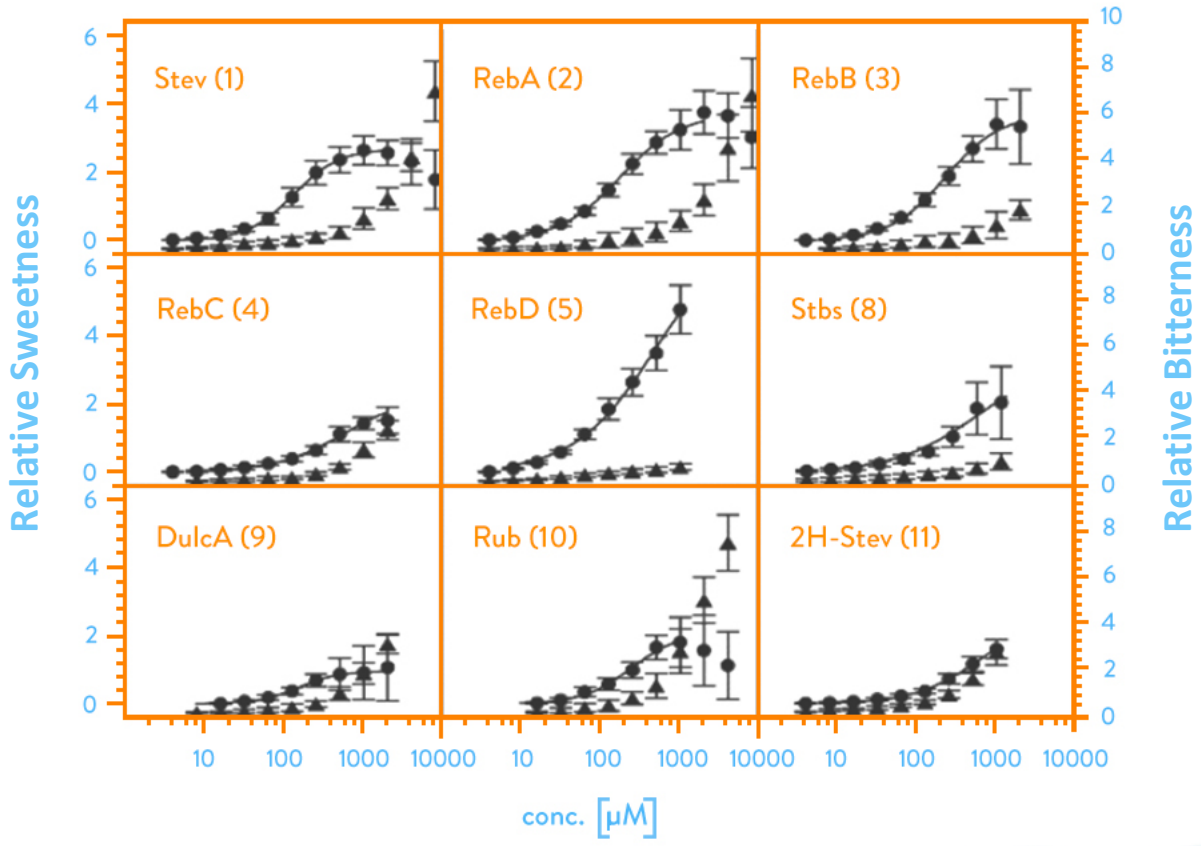


4. HOW DO GLYCOSIDES AFFECT THE FINAL TASTE OF FORMULATION

TASTE COMPARISON BETWEEN THE STEVIOL GLYCOSIDES

● Sweetness

▲ Bitterness

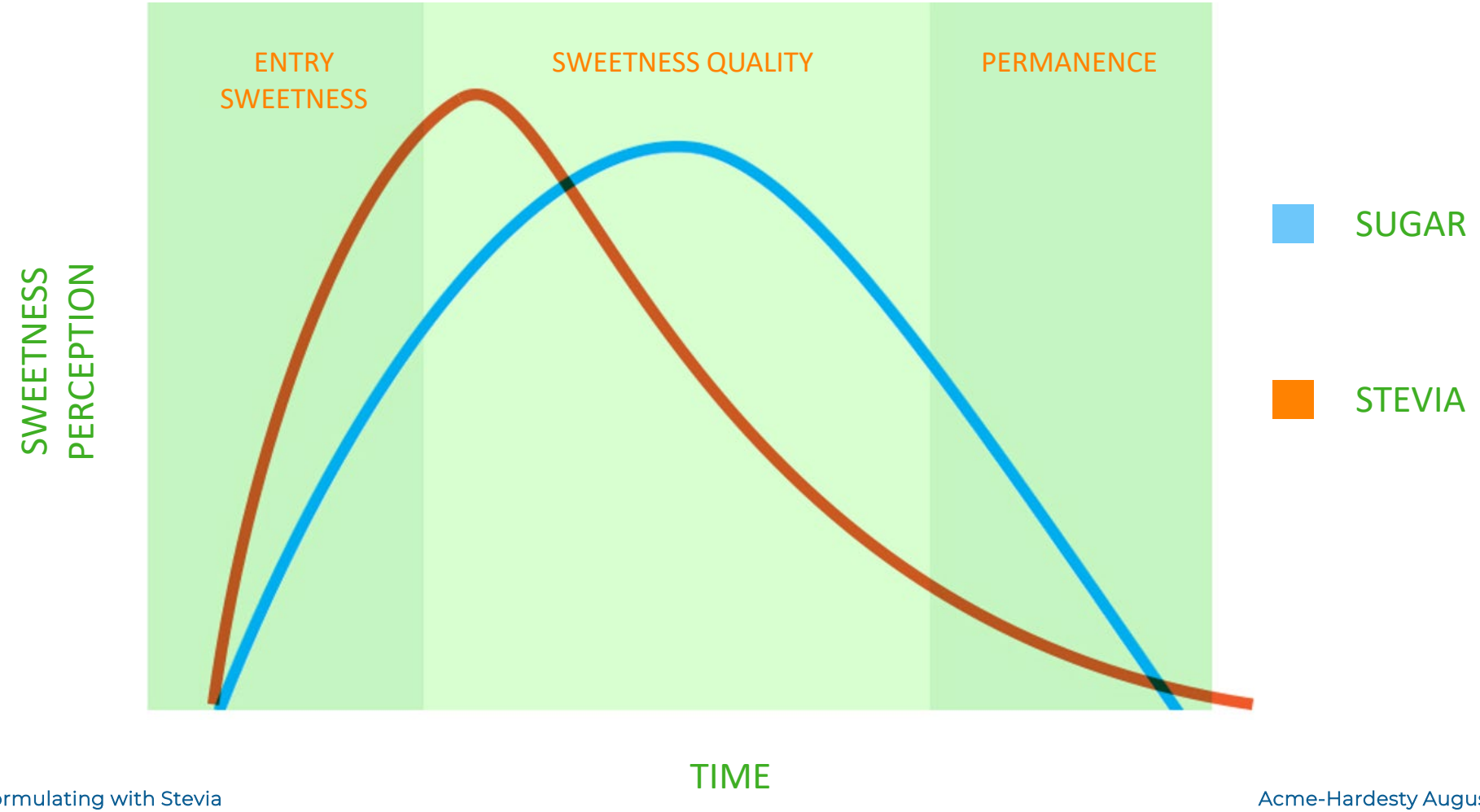


5. CHALLENGES AND HOW TO OVERCOME THEM

1

SWEETNESS

The sweetness behaviour of stevia is not the same as



5. CHALLENGES AND HOW TO OVERCOME THEM

2

TASTE

How to avoid taste distortion?

AGGRESSIVE SUGAR REDUCTION

- STEVIOL GLYCOSIDES COMPOSITION IS VERY RELEVANT, CHOOSE THE RIGHT STEVIA
- EVERY STEVIA IS UNIQUE
- FLAVOR MODULATORS ARE NEEDED. NOT ALL THE STEVIA MODULATORS WORK WELL WITH ALL STEVIA PRODUCTS.
- OTHER SWEETENERS MAY BE NEEDED BECAUSE OF STEVIA DOSES AND AFTERTASTE CONSTRAINTS
- ACIDS NEED TO BE BALANCED TO ENSURE THAT THE FINAL PRODUCT IS WELL ROUNDED

CONSERVATIVE SUGAR REDUCTION

- EVERY STEVIA IS UNIQUE. CHOOSING THE RIGHT STEVIA IS VERY IMPORTANT
- FLAVOR MODULATORS TECHNOLOGY MAY BE NEEDED DEPENDING ON THE APPLICATION AND THE TOTAL REDUCTION LEVEL
- ACIDS NEED TO BE BALANCED TO ENSURE THAT THE FINAL PRODUCT IS WELL ROUNDED

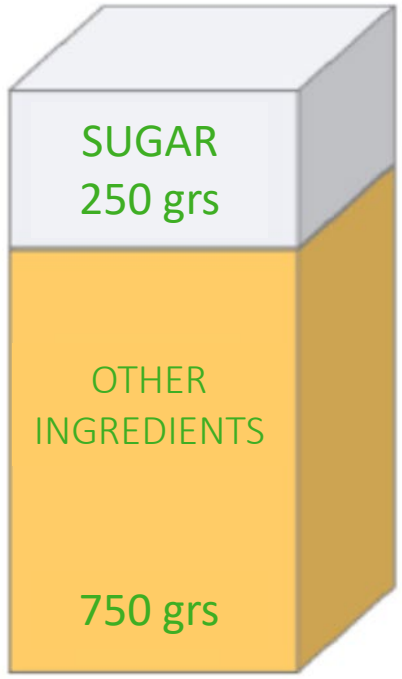
5. CHALLENGES AND HOW TO OVERCOME THEM

3

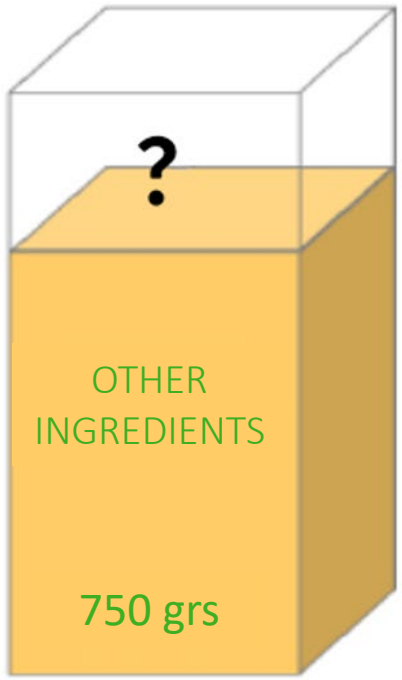
TEXTURE What is the best option to replace the texture?

4

MOUTHFEEL How does the product feel in the consumers mouth?



VOLUME, TEXTURE & MOUTHFEEL NEED TO BE REPLACED OR RE-CRATED



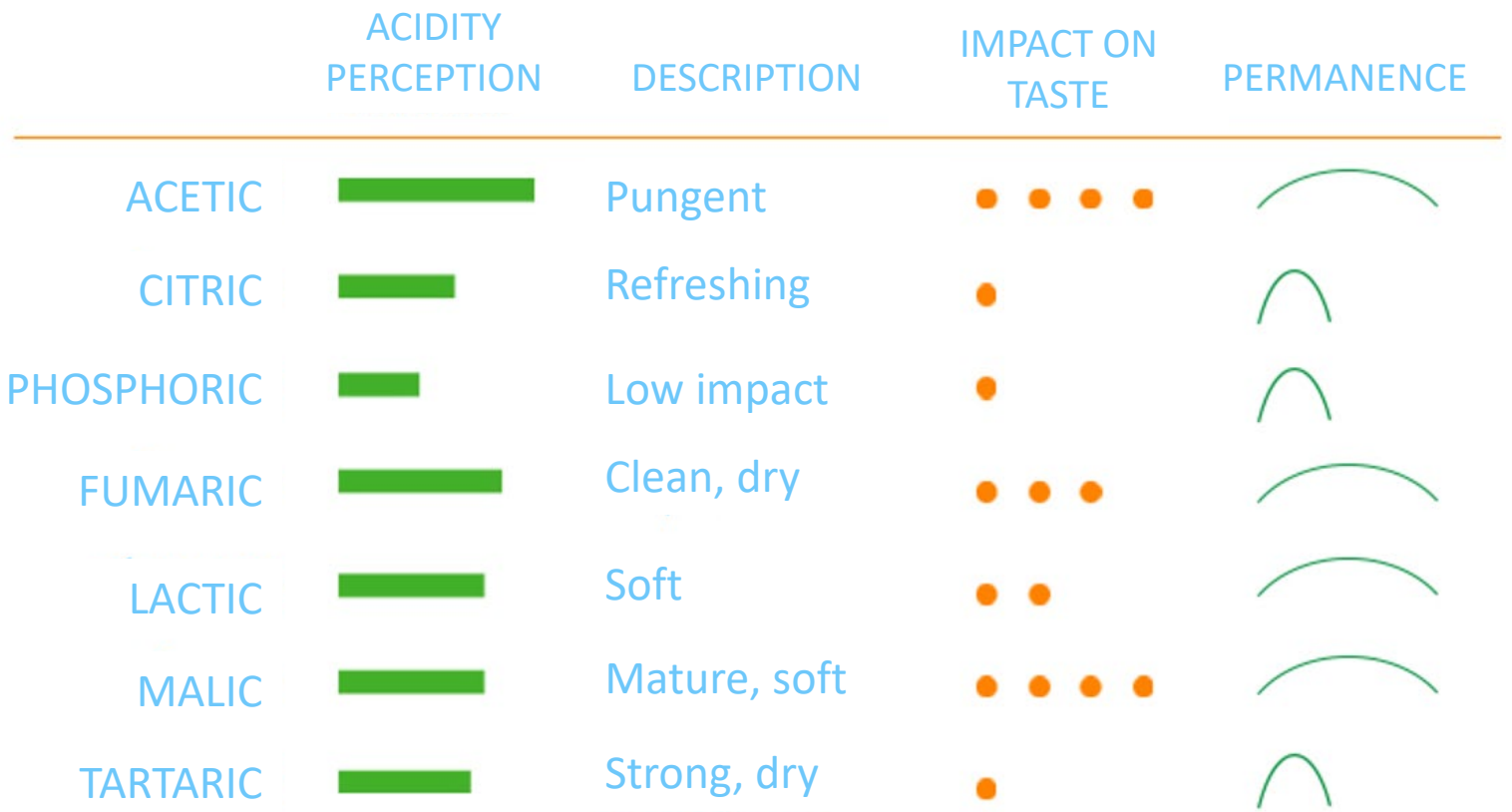
TEXTURE, VOLUME & MOUTHFEEL AGENTS

GUMS, PECTINS, HYDROCOLLOIDS, POLYOLES, FIBERS

5. CHALLENGES AND HOW TO OVERCOME THEM

5

ACIDITY Acids doses needs to be adjusted.

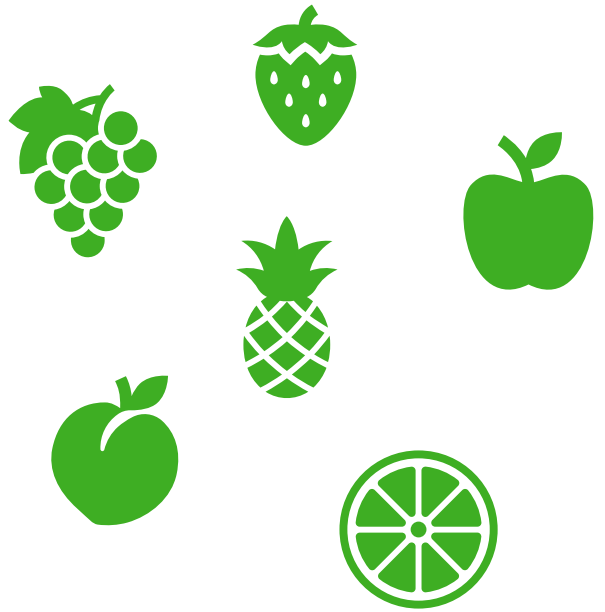


6

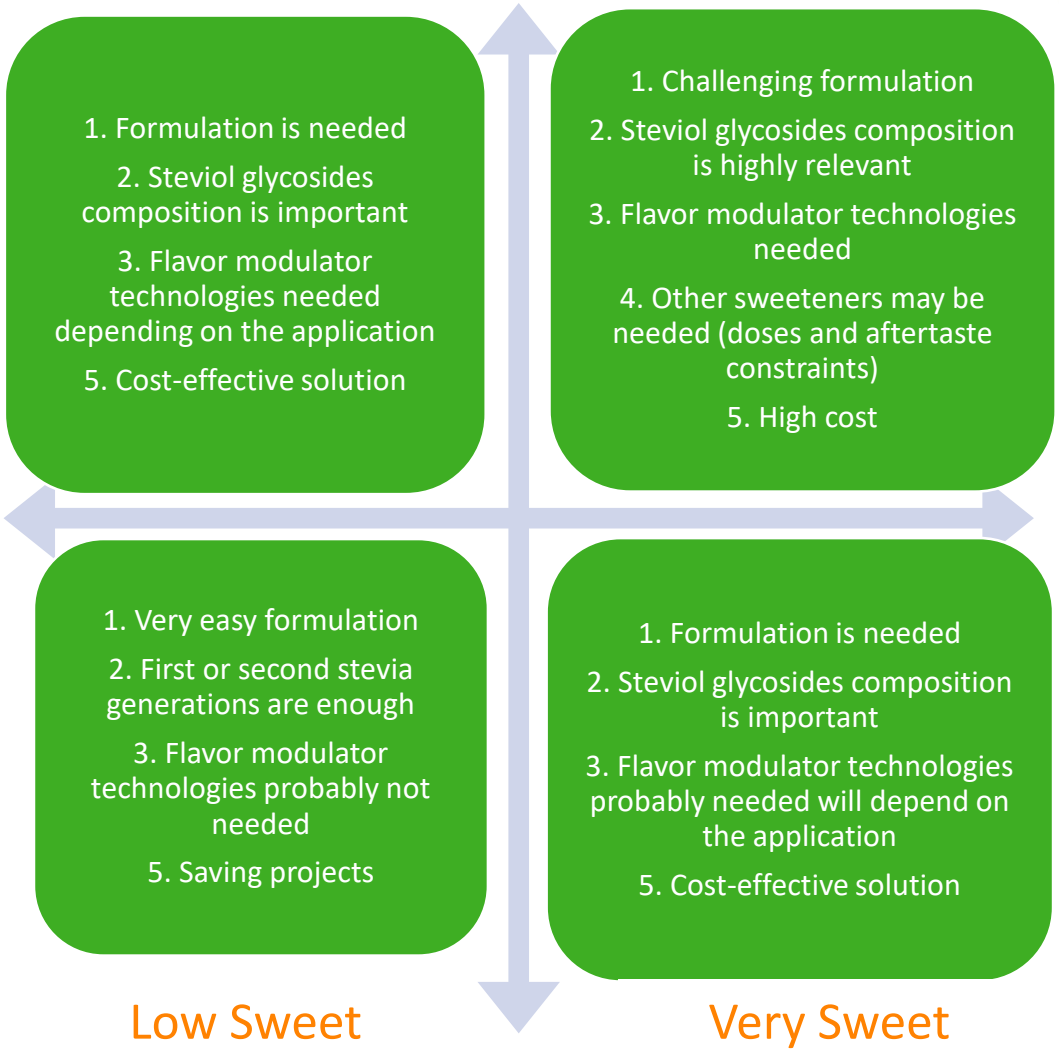
TOTAL BRIX

Some ingredients contribute to the total Brix

IF THE GOAL IS TO REDUCE TOTAL SUGARS INSTEAD OF ADDED SUGAR, REMEMBER TO CONSIDER THE SUGARS FROM THE FRUIT, MILK OR OTHER INGREDIENTS IN THE APPLICATION



5. CHALLENGES AND HOW TO OVERCOME THEM



6. STEVIA ONE

6. STEVIA ONE: WHY PERU?

We strategically located ourselves in Peru to allow us to diversify the risk of weather conditions whilst growing Stevia in its native environment.

Ideal agricultural conditions precipitation, altitude, temperature, sunlight.

Vast extensions of land available. The project can grow extensively.

Excellent growth and production 4 to 6 commercial harvests per year due to proximity to the equator (5° South).

Use of new agricultural areas. Positive social and environmental impact for the country.

6. STEVIA ONE: OUR UNIQUE PROPOSAL

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PURE & NATURAL PROCESS

A unique Water-Based Extraction process, resulting in our amazing natural Stevia extract

TRACEABLE & RELIABLE

Reliability through vertical integration & constant focus on quality

From the seeds to the final product, we are able to track & trace every batch of Stevia that we produce

SUSTAINABLE

Our Stevia products proudly carry the Rainforrest Alliance Certified seal, meeting comprehensive standards for environmental, social & economic sustainability

Thank you for your attention!

For questions, copy of the presentation and anything else we can help you with, please email **dmulicka@acme-hardesty.com**

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