Yi Gong, Ph.D,
Tate & Lyle

TATE & LYLE

Trends and Innovative Methods for Sugar Reduction

Yi Gong, Ph.D.

Chicago Section IFT Supplier Symposium 2023 November 2, 2023

Beverages

01

Who We Are

02

Sugar Reduction Insights

03

Case Study

Beverages

Who We Are


BOILED CORN
20

This is Tate & Lyle

ORIGINS

Founded in the UK by Henry Tate in **1859** Henry Tate & Sons And Abraham Lyle & Sons merged their businesses to form Tate & Lyle in **1921**

PURPOSE

Transforming Lives through the Science of Food

CATEGORIES

Leading positions in **beverages, bakery and snacks, soups, sauces and dressings**

PEOPLE

Around

3,500

employees worldwide

OUR VALUES

Safety
Integrity
Respect

GLOBAL AND LOCAL

We have customer innovation and collaboration centres, labs, plants, offices and sales teams supporting customers in their local markets across **57** sites, in **39** countries

CUSTOMERS

Served in more than

120

countries

FINANCIALS

Listed as TATE.L on the London Stock Exchange within the FTSE 250

Revenue*

£1,375m

** Adjusted profit before tax*

£145m

**from Continuing Operations*

CARING FOR OUR PLANET

Target to deliver a **30%**

absolute reduction in our Scope 1 and 2 greenhouse gas emissions by 2030

EXPERTISE

We are leaders in **sweetening, mouthfeel and fortification**, experts in reducing sugar, calories and fat, and adding fibre, to food and drink

This is Our Global Footprint

TATE & LYLE

We Provide Ingredients and Solutions to the Global Food and Beverage Industries

TECHNICAL EXPERTISE IN KEY CATEGORIES

BEVERAGES

- Carbonated soft drinks
- Cocoa drinks and shakes
- Flavoured water
- Juices and juice drinks
- Powdered soft drinks and dilutables
- Functional drinks
- Ready-to-drink tea and coffee
- Energy and sports drinks
- Alcoholic drinks

SOUPS, SAUCES AND DRESSINGS

- Low fat sauces
- Mayonnaise and dressings
- Ketchup and red condiment sauces
- Dips and spreads
- Ready meals
- Creamy soups, broths and stews
- Filling and processing aids
- Dry mix blends
- Plant-based alternatives

DAIRY

- Yoghurt and yoghurt drinks
- Flavoured milk and other dairy beverages
- Ice cream and frozen desserts
- Dairy desserts
- Creams and creamers
- Cheese
- Dips and spreads
- Dairy alternatives

BAKERY AND SNACKS

- Breakfast cereals
- Breakfast and snack bars
- Packaged cakes and pastries
- Cookies and biscuits
- Savoury snacks
- Baking mixes
- Toppings and inclusions
- Bread and doughs

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OUR COMMITMENTS AND TARGETS

This is how we are caring for the planet

SIGNIFICANTLY REDUCING GREENHOUSE GAS EMISSIONS across our value chain **by 2030** and meeting our commitment to be **carbon net zero by 2050**

SCIENCE-BASED TARGETS
for Scope 1, 2 and 3 CO_2e emissions reductions

PURCHASING 100% RENEWABLE ELECTRICITY
in our operations **by 2030**.

BENEFICIALLY USING 100% OF WASTE
by 2030, with an ambition to reach **75% by 2025**

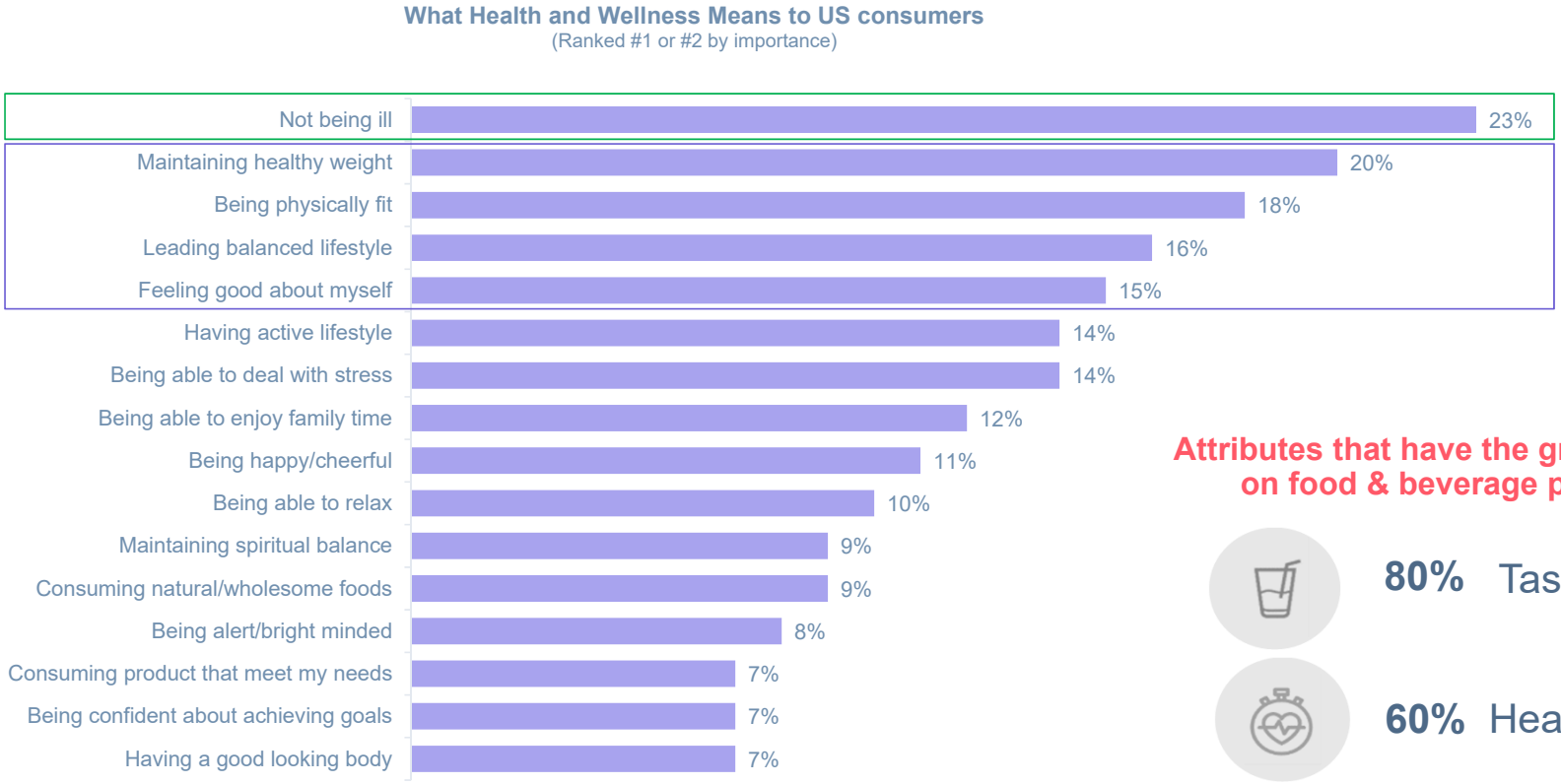
15% REDUCTION IN WATER USE
by 2030

SUPPORTING SUSTAINABLE AGRICULTURE
for key raw materials

Beverages

Sugar Reduction Insights

Consumer research confirms that healthfulness is playing an increasing role in purchase decisions, and the consumer definition encompasses many factors



Attributes that have the greatest impact on food & beverage purchases

80% Taste

60% Healthfulness

Source: International Food Information Council Foundation, Food & Health Survey, 2022

Source: Tate & Lyle Primary Research, 2022
QB3 Thinking about health and wellness in general, which of the following best describes what health and wellness means to you? "1" is the statement that is most important, "2" second most and "3" third most important.

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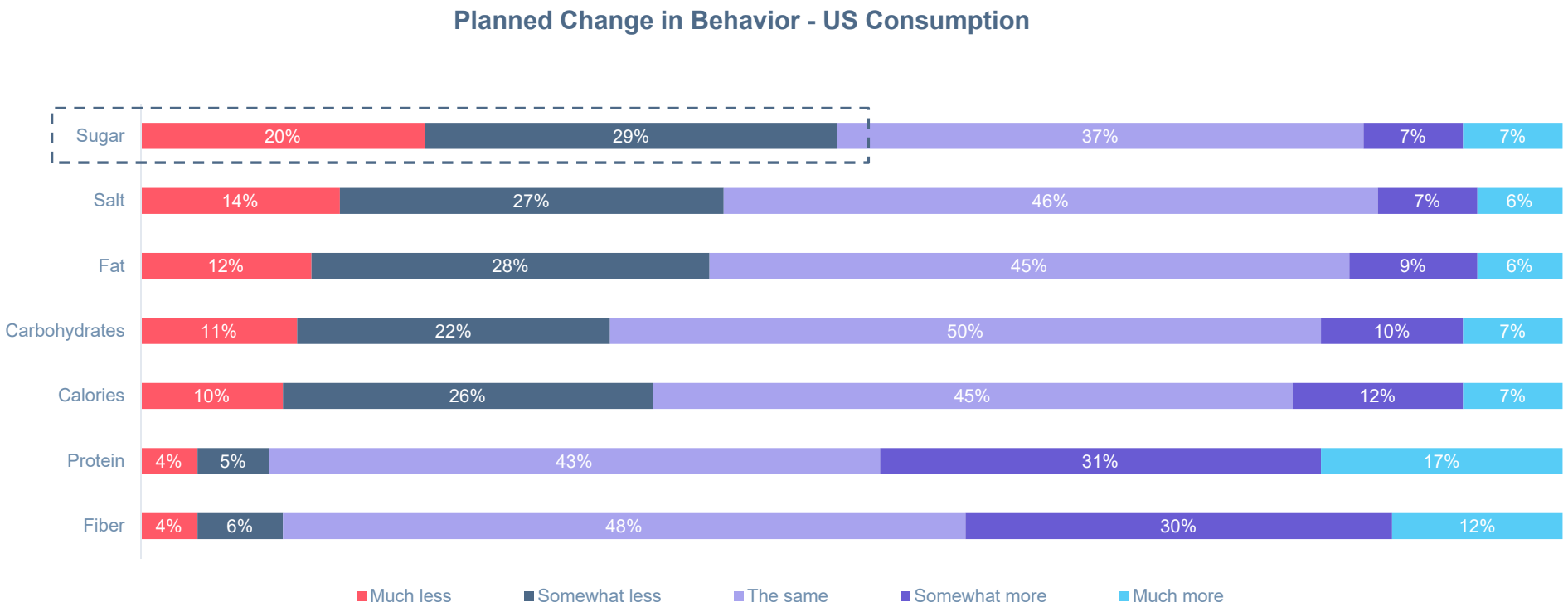
The dynamic is likely to intensify going forward as consumers plan to adjust their consumption habits based primarily on sugar reduction



Source: Tate & Lyle Primary Research, 2022
QB1b How much, if any, do you plan to change your consumption of the following items over the next 12 months? Would you say you plan to consume each item…

Sugar Tax Summary
Taxes on sweetened beverages began in 2012 and likely to continue

2012 France (EUR7.16/100 litres)

2014 Mexico (4%), Chile (10 and 18%)

2015 Berkley (USD0.01/fluid oz.)

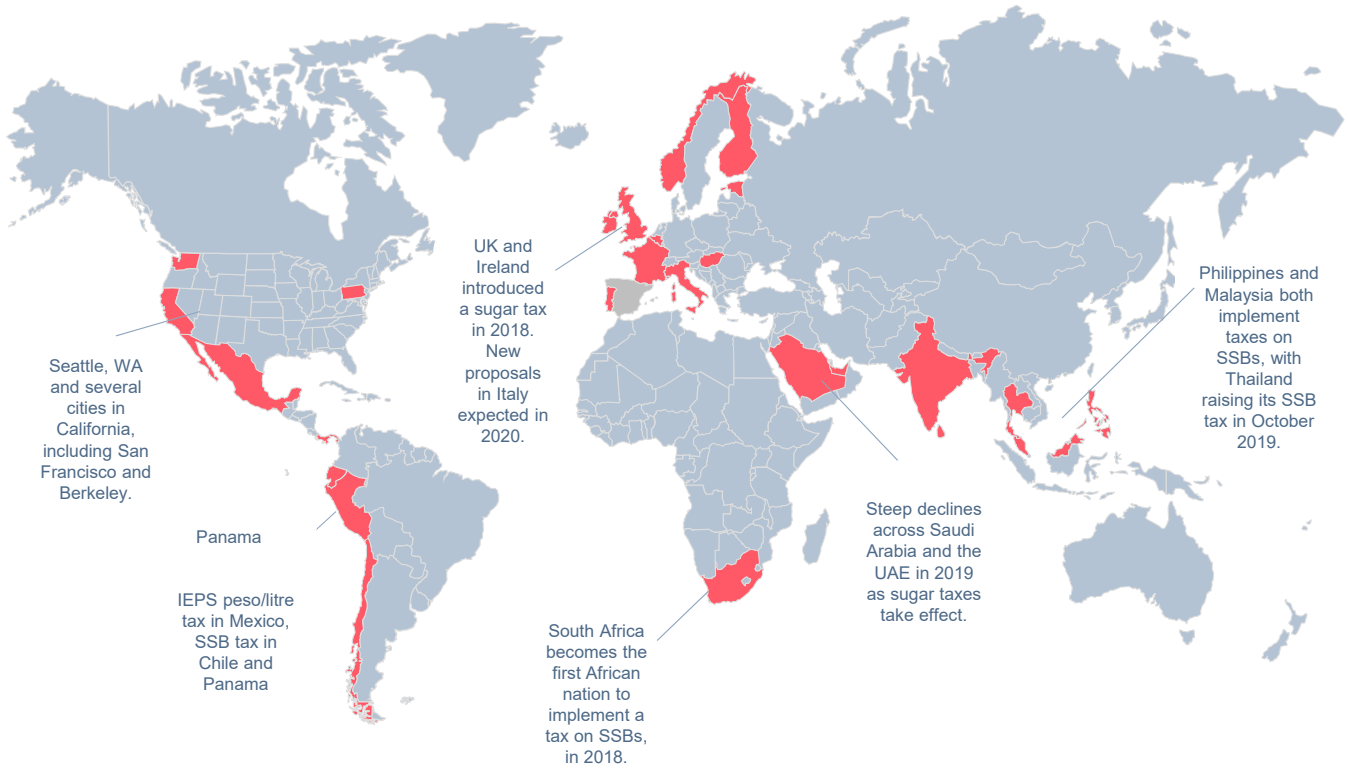
2016 Multiple US states

2017 Portugal (EUR0.16/litre + VAT on CSD >80g of sugar. Thailand (bi-annual tax increase)

2018 Philippines (PHP6/litre and PHP12 on HFCS), UK, Ireland, South Africa

2019 Malaysia (MYR0.40/litre), Saudi Arabia and UAE broadens taxes to juices and still SD

2020 Italy scheduled to introduce higher rate of tax on sugar sweetened beverages



Source: WHO Taxes on sugary drinks: Why do it? https://iris.who.int/bitstream/handle/10665/260253/WHO-NMH-PND-16.5Rev.1-eng.pdf

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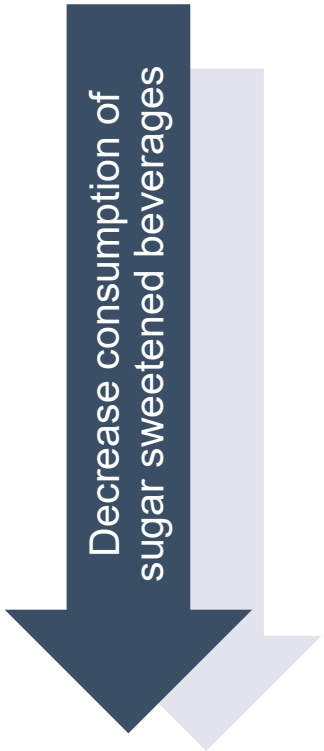
Sugar Reduction Trends

Multiple factors impact the consumption of sugar in food and beverages



Price (Taxes) & Labelling Implications

- Taxes on sugar sweetened beverages passed on to the consumer in the form of higher prices per serving.
- Some countries implemented FOP warning labels
- FDA's 2022 proposal to include a limit on the amount of added sugars in foods bearing the nutrient content claim "healthy"

Reformulate Products

Beverage manufacturers launching new products to provide consumers low/no sugar options

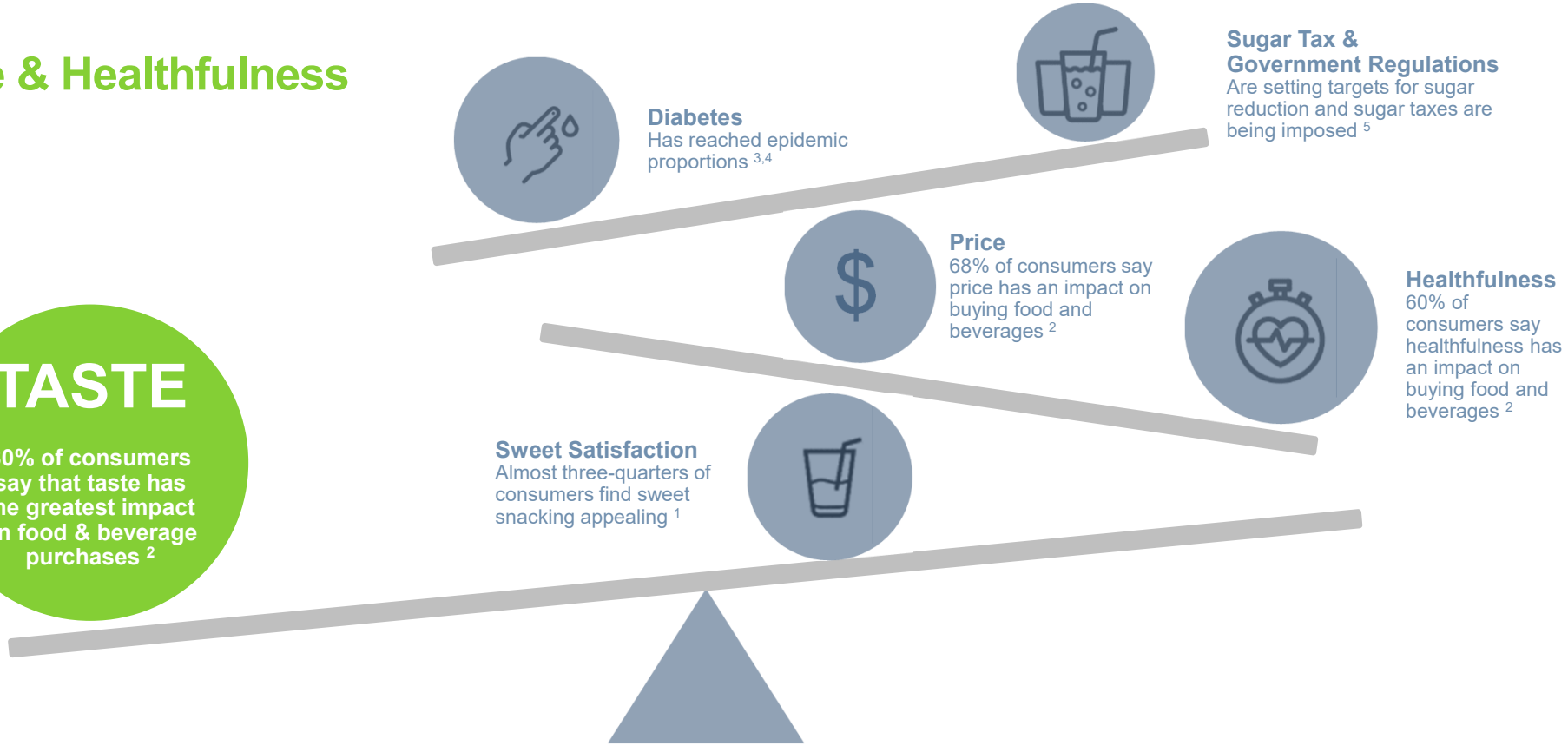
- Smaller package sizes
- Non-caloric sweeteners
- Un-sweetened alternatives

Federal Register :: Food Labeling: Nutrient Content Claims; Definition of Term "Healthy"
https://www.federalregister.gov/documents/2022/09/29/2022-20975/food-labeling-nutrient-content-claims-definition-of-term-healthy

Sugar Reduction strategies

Sugar Reduction is a Balancing Act

Taste & Healthfulness



Sources: 1) The Food Institute: Consumers are Eating More Often, Prefer Sweet Snacks; 2) International Food Information Council Foundation, 2022 Food & Health Survey, 2022; 3) US Center For Disease Control; 4) World Health Organization Projections Of Global Mortality And Burden Of Disease From 2002 to 2030; 5) multiple sources

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Beverages

Case Study 1

Beverage

Four Step Process to Replacing Sugar in Beverages

	1 Current Sugar Content	2 Reduction Target	3 Maintain Sweetness	4 Build Back Function
Challenge	Understand the source of sugar and total sweetness	Set sugar reduction target and understand sugar functionality in the beverage matrix	Use sweetness toolbox to select sweetness alternative and achieve sweet equivalency	Optimize formula to maintain mouthfeel or add functional benefits
Approach & Solution	Dependent on: - Level of sugar reduction - Required sweetness impact and temporal profile - Initial source to be replaced: sucrose, HFCS, fructose - Functionality of sweetener - Type of matrix : liquid /solid - Regulatory/ labeling concerns	Review: - Customer consultation on desired goals/targets concerning cost and nutritional requirements - Understand technical functionality of the ingredient being replaced in the beverage - Consider scale-up requirements - Understand regulatory requirements	Sweeteners: -Sucralose -Stevia Leaf Extract -Monk Fruit Extract -Monk Fruit Juice Concentrate -Allulose	Fibers: -Soluble Corn Fiber -Polydextrose Sweeteners: -Allulose -Monk Fruit -Stevia FMP

Replacing Sugar in Beverage
Current Sugar Content

Orange Blossom Citrus Punch - Control

Step 1

Understand the source of sugar and total sweetness

Nutritional (8 oz)	Control
Calories	90 kcal
Total Carbohydrates	24 g
Total Sugar	24 g

Mixture of natural sugar from juice concentrate, and added sugar

Equivalent to 10 SEV sweetness

Approach & Solution

Dependent on

- Level of sugar reduction
- Required sweetness impact and temporal profile
- Initial source to be replaced:
- sucrose, HFCS, fructose
- Functionality of sweetener
- Type of matrix : liquid /solid
- Regulatory/ labeling concerns

INGREDIENT STATEMENT: WATER, **SUGAR**, ORANGE JUICE CONCENTRATE, CARROT JUICE CONCENTRATE (COLOR), GRAPEFRUIT JUICE CONCENTRATE, LIME JUICE CONCENTRATE, CITRIC ACID, NATURAL FLAVORS, ASCORBIC ACID.

Replacing Sugar in Beverage
Reducing Sugar

Orange Blossom Citrus Punch

Step 2

Set sugar reduction target and understand sugar functionality in the beverage matrix

Nutritional (8 oz)	Control	0% Added Sugar
Calories	90 kcal	35 kcal
Total Carbohydrates	24 g	7 g
Total Sugar	24 g	7 g

Solutions needs to bridge a 7 SEV (Sucrose Equivalence) sweetness and mouthfeel

Approach & Solution

Review

- Customer consultation on desired goals/targets concerning cost and nutritional requirements
- Understand technical functionality of the ingredient being replaced in the beverage
- Consider scale-up requirements
- Understand regulatory requirements

INGREDIENT STATEMENT: WATER, **SUGAR**, ORANGE JUICE CONCENTRATE, CARROT JUICE CONCENTRATE (COLOR), GRAPEFRUIT JUICE CONCENTRATE, LIME JUICE CONCENTRATE, CITRIC ACID, NATURAL FLAVORS, ASCORBIC ACID.

Replacing Sugar in Beverage
Maintaining Sweetness

Orange Blossom Citrus Punch - Prototype 1

Step 3

Use sweetness toolbox to select sweetness alternative and achieve sweet equivalency

Nutritional (8 oz)	Control	0% Added Sugar
Calories	90 kcal	25 kcal
Total Carbohydrates	24 g	7 g
Total Sugar	24 g	7 g

Approach & Solution

Sweeteners

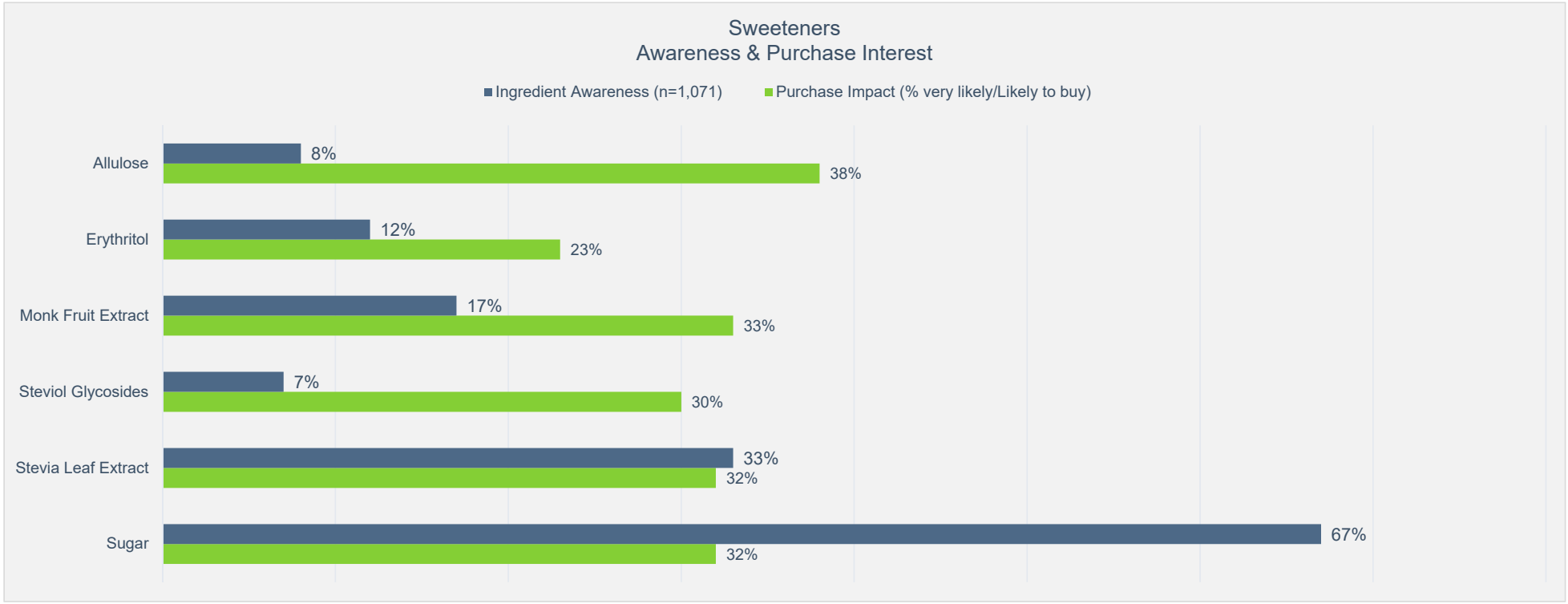
- Sucralose
- **Stevia Leaf Extract**
- Monk Fruit Extract
- Monk Fruit Juice Concentrate
- Allulose

INGREDIENT STATEMENT: WATER, ORANGE JUICE CONCENTRATE, ALLULOSE, CARROT JUICE CONCENTRATE (COLOR), GRAPEFRUIT JUICE CONCENTRATE, LIME JUICE CONCENTRATE, CITRIC ACID, NATURAL FLAVORS, ASCORBIC ACID, **STEVIA LEAF EXTRACT**.

Market & Consumer Landscape

US Awareness & Purchase Intent

Consumer awareness is similar for Steviol glycosides and stevia leaf extract, but consumers are more likely to purchase products labeled with ‘Stevia Leaf Extract.’



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Stevia Solubility
Technical Attributes

Solubility and Handling

Stevia sweetener solubility differs based on several factors

Product conditions (e.g. pH, temperature) affect solubility

Mixed glycoside compositions can demonstrate very high solubility due to co-solubility of different glycoside combinations

Many commercial products can be used above expected solubility levels depending on conditions

Foaming properties can be changed when stevia is incorporated into formulations

Steviol Glycoside	Approximate Solubility (%)	Approximate Solubility (ppm)
Reb A	0.80	8,000
Reb M*	0.14*	1,400*
Reb D	0.04–0.05*	400–500*

Source: Crammer, B., & Ikan, R. (1987). *Developments in Sweeteners*, *3*, 45-64.
*From estimation in T&L (in water at room temperature)

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Replacing Sugar in Beverage
Build Back Function

Orange Blossom Citrus Punch – Prototype 2

Step 4

Optimize formula to maintain mouthfeel or add functional benefits

Nutritional (12 oz)	Control	0% Added Sugar
Calories	90 kcal	35 kcal
Total Carbohydrates	24 g	11 g
Total Sugar	24 g	7 g

Approach & Solution

Fibers:

- **Soluble Corn Fiber**
- Polydextrose

Sweeteners:

- Allulose
- Monk Fruit
- Stevia FMP

INGREDIENT STATEMENT: WATER, ORANGE JUICE CONCENTRATE,**SOLUBLE CORN FIBER**, CARROT JUICE CONCENTRATE (COLOR), GRAPEFRUIT JUICE CONCENTRATE, LIME JUICE CONCENTRATE, CITRIC ACID, NATURAL FLAVORS, ASCORBIC ACID, **STEVIA LEAF EXTRACT**.

Promitor® Soluble Fiber

1 Ease of Use: Excellent stability and solubility

Does not breakdown in high heat/ shear/ low-pH system – no need to “overdose”

2 Superior digestive tolerance

Fermentation process throughout large intestine increases tolerance
~ 65g/ day

3 Supports friendly label formulations

Can be labelled as ‘Soluble Corn Fibre,’ ‘Resistant Maltodextrin,’ ‘Maltodextrin (fibre) (country-dependent)

4 Health benefits and clinical studies

For calorie and sugar reduction, enhanced calcium absorption, favorable postprandial blood glucose response (country-dependent)

5 Global supply network

Produced in 3 major regions in different formats, and thereby improves supply security (applicable to PROMITOR® 70)

6 Cost Efficient Alternative

Different varieties, including liquid are suitable for various operation formats can result in lower cost in use

As with all decisions concerning food labeling, manufacturers should consult with their own regulatory and legal advisors prior to making labeling decisions. Users
should also check applicable foreign regulations in the case of food products that may be exported.

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Replacing Sugar in Beverage
Build Back Function

Orange Blossom Citrus Punch – Prototype 3

Step 4

Optimize formula to maintain mouthfeel or add functional benefits

Nutritional (12 oz)	Control	0% Added Sugar
Calories	90 kcal	30 kcal
Total Carbohydrates	24 g	14 g
Total Sugar	24 g	7 g

Approach & Solution

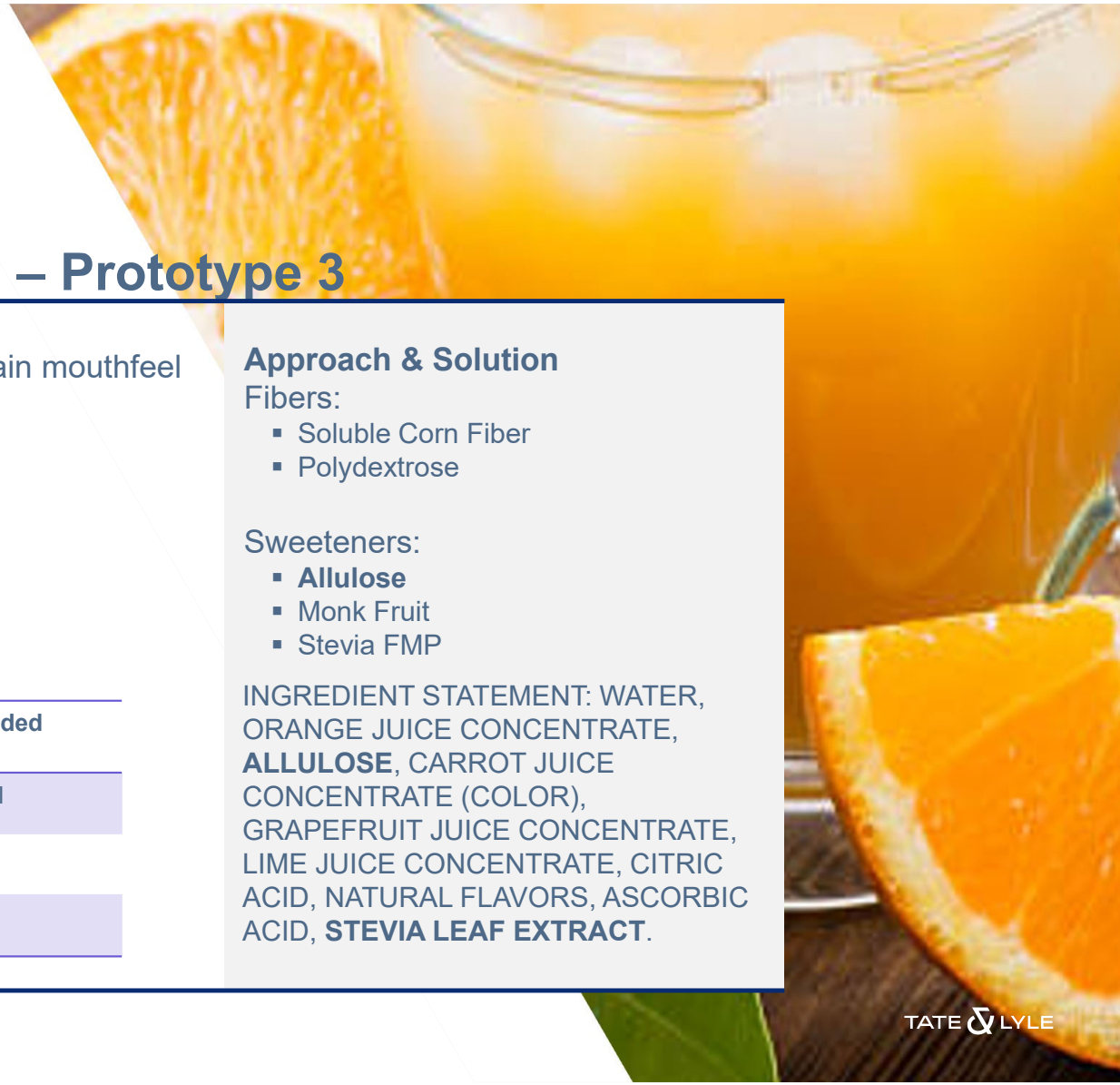
Fibers:

- Soluble Corn Fiber
- Polydextrose

Sweeteners:

- **Allulose**
- Monk Fruit
- Stevia FMP

INGREDIENT STATEMENT: WATER, ORANGE JUICE CONCENTRATE, **ALLULOSE**, CARROT JUICE CONCENTRATE (COLOR), GRAPEFRUIT JUICE CONCENTRATE, LIME JUICE CONCENTRATE, CITRIC ACID, NATURAL FLAVORS, ASCORBIC ACID, **STEVIA LEAF EXTRACT**.

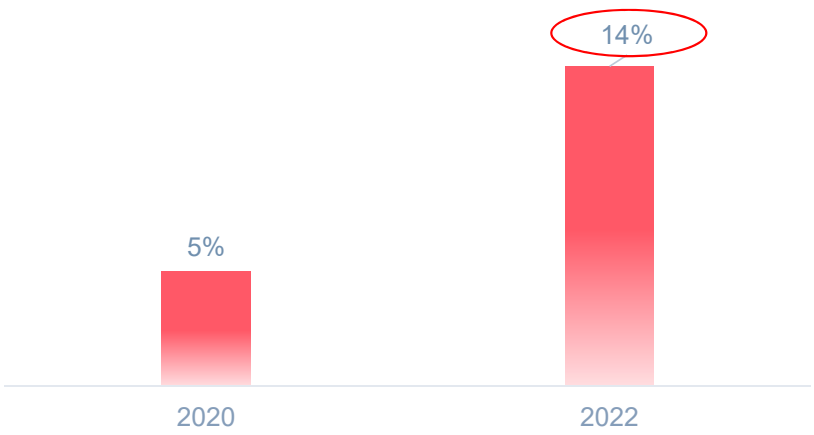


DOLCIA PRIMA® ALLULOSE
Features and Benefits

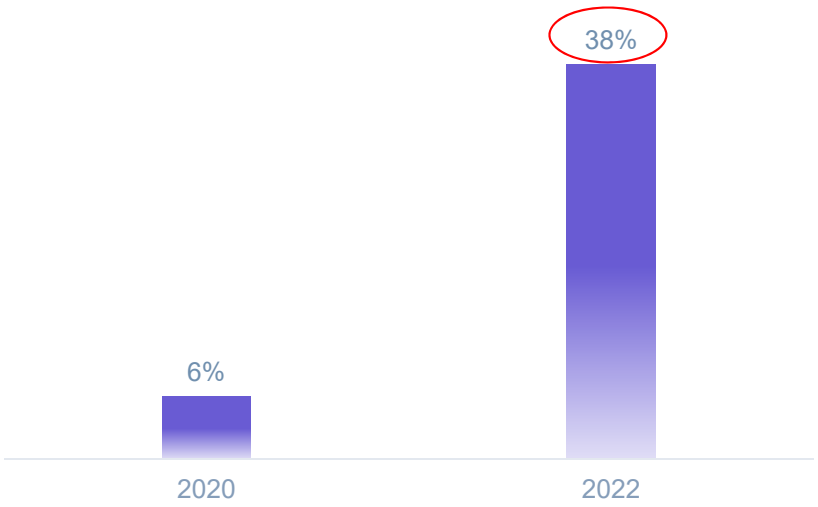
SWEETNESS	• 70% the sweetness of sugar • 90% fewer calories vs. sugar (0.4kcal/g vs. 4kcal/g for sucrose) • Similar temporal profile as sucrose • Fast onset and dissipation of sweetness
NUTRITION	• Does not increase blood glucose levels • Does not increase blood insulin levels • Has digestive tolerance at approved usage levels
REGULATORY	• Allowed exemption from sugars and added sugars per FDA guidance • Non - artificial sweetener
FUNCTIONALITY	• Provides the bulk and texture of a sugar • Freeze thaw stability • Freezing-point depression

Consumer Awareness and Purchase Impact of Allulose Increased Significantly from 2020 to 2022

Allulose Awareness
(n=1071)



Allulose Purchase Impact
(%Very likely/Likely to buy)



QB4 Below is a list of ingredients that are commonly used in food or drinks. Which of these ingredients are you aware of?
QC1 Please indicate what impact, if any, these ingredients typically have on your purchase decision if you read it on the label of a product you were thinking about purchasing (variable base sizes)

TATE & LYLE

Orange Blossom Citrus Punch

Featuring our TASTEVA™ M Stevia Sweetener,

DOLCIA PRIMA® Allulose & PROMITOR® Soluble Corn Fiber

Key Benefits:

- Bright, fruity citrus notes paired with delicate floral blossoms for trendy flavor pairing
- Contains 30% fruit juice
- Provides 3 grams of fiber per 8 fl oz
- TASTEVA™ M Stevia Sweetener provides an upfront sweetness profile with a clean finish
- PROMITOR® Soluble Corn Fiber provides fiber and adds bulk for a smoother mouthfeel
- DOLCIA PRIMA® Allulose provides bulk and mouthfeel while balancing flavor, sweet and acid profiles

TASTEVA® M Stevia Sweetener

PROMITOR® Soluble Fiber

DOLCIA PRIMA® Allulose

Nutrition Facts

servings per container
Serving size **(240g)**

Amount per serving

Calories	**35**
	% Daily Value*
Total Fat 0g	**0%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 0mg	**0%**
Total Carbohydrate 17g	**6%**
Dietary Fiber 2g	**7%**
Total Sugars 7g	
Includes 0g Added Sugars	**0%**
Protein 0g	
Vitamin D 0mcg	0%
Calcium 6mg	0%
Iron 0mg	0%
Potassium 110mg	2%

*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

INGREDIENT STATEMENT: Water, Orange juice concentrate, Allulose, Soluble corn fiber, Carrot juice concentrate (for color), Grapefruit juice concentrate, lime juice concentrate, Citric acid, Natural flavors, Ascorbic acid, Stevia leaf extract

Nutritional Gummies

Case Study 2

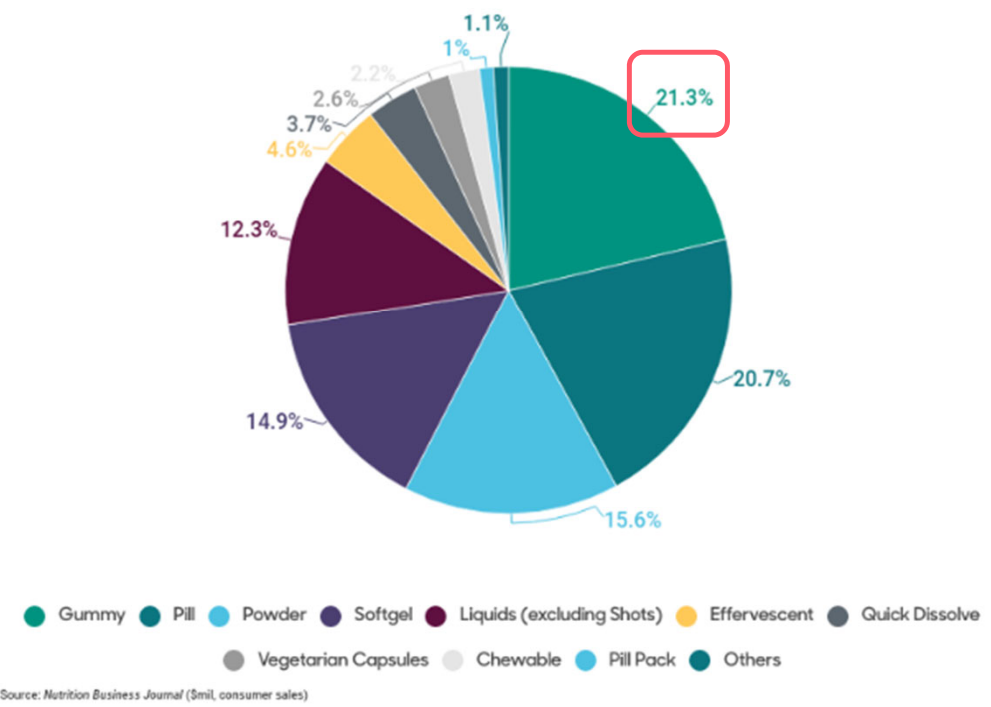
Sugar-Free* Gummy

*Based on the finished product containing <0.5 g sugar (mono and disaccharides) per serving

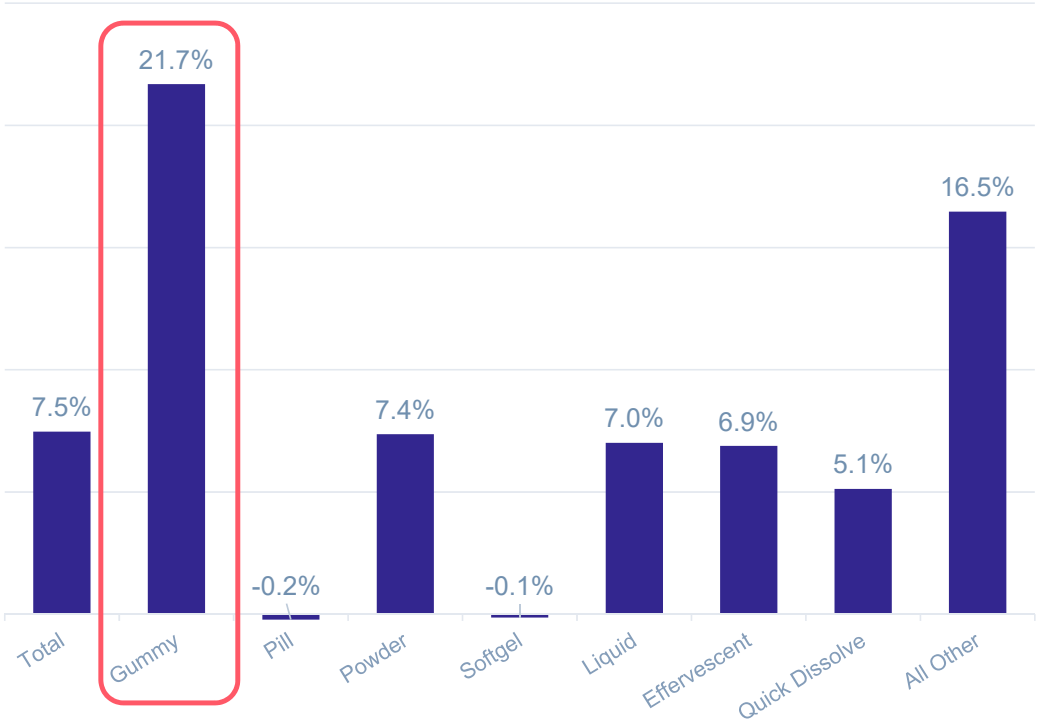
Nutritional Gummies

The gummy segment makes up the lion's share of $ sales in the supplements category and is expected to outpace the growth of the overall category by nearly 3X.

Supplement Market Share by Delivery Format, 2021e



Anticipated 5-Yr CAGR by Format



Source: 2022 NBJ Delivery Formats Special Report

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Typical Full Sugar Gummy Composition and Nutrition

Syrups derived from corn, tapioca, wheat

Sugar (derived from beet, sugarcane)

Stabilizer (gelatin, pectin, starch)

Minor Ingredients (Color, flavor, acid)

Nutrition Facts

servings per container

Serving size (30g)

Amount per serving

Calories 100

	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 40mg	2%
Total Carbohydrate 25g	9%
Dietary Fiber 0g	0%
Total Sugars 17g	
Includes 17g Added Sugars	34%
Protein 0g	
Vitamin D 0mcg	0%
Calcium 0mg	0%
Iron 0mg	0%
Potassium 0mg	0%

*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Total sugar and ‘added sugar” may increase up to 25 g per 30 g serving size depending on the composition.

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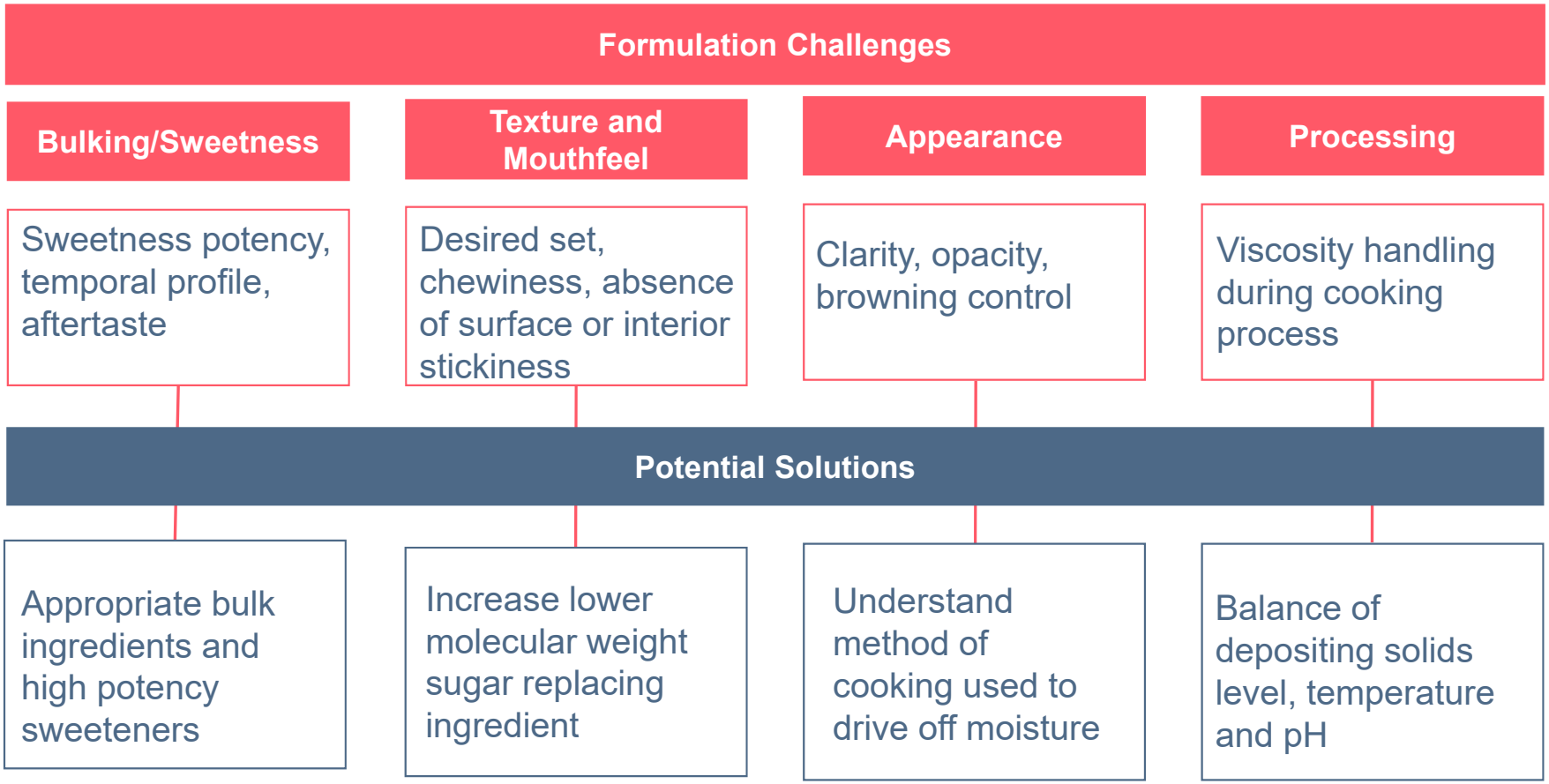
Key Challenges – No sugar Added/Sugar Free pectin Gummies

& how we have the right solution for your need



TATE & LYLE

“Sugar Free” Nutritional Pectin Gummy*

Made with PROMITOR® Soluble Fiber 85L, DOLCIA PRIMA® LS Liquid Allulose and TASTEVA® M Stevia Sweetener

All the goodness of nutrition without excessive sugars

Various benefits include:

- <0.5 g sugars per serving*
- 60% reduction in calories**
- Short, clean bite without stickiness
- Compatible with traditional processing
- Excellent sweetness and flavor release
- Prebiotic fiber
- Delivery of nutritional supplement with prebiotic fiber

*<0.5 g sugars per serving (2 gummies, 8 g)
Label claims may vary by country. Prospective purchasers are advised to conduct their own tests, studies, and regulatory review to determine the fitness of Tate & Lyle products for their particular purposes, product claims, or specifications.

**Compared to reference full sugar pectin jelly candy.

Reference

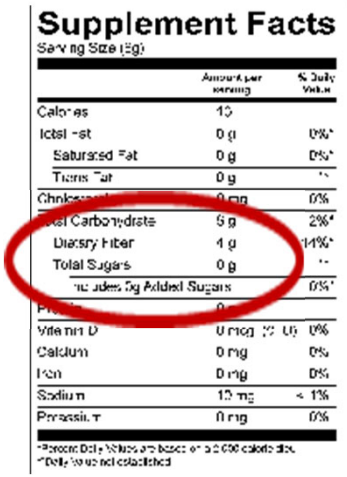
Supplement Facts
Serving Size (8g)
Servings Per Container

	Amount per serving	% Daily Value
Calories	25	
Total Carbohydrate	7 g	3%*
Total Sugars	4 g	**
Includes 4g Added Sugars		8%*
Sodium	10 mg	< 1%

Percent Daily Values are based on a 2,000 calorie diet
**Daily Value not established.

Ingredients: Corn Syrup, Sugar, Pectin, Citric Acid, Sodium Citrate, Natural Flavor, Vegetable Juice (Color)

“Sugar Free”



Ingredients: Soluble Corn Fiber, Allulose, Pectin, Citric Acid, Sodium Citrate, Natural Flavor, Stevia Extract, Vegetable Juice (color)

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Discover cutting-edge solutions, starter recipes consumers will love, and the trail-blazing people behind them.
The future of food starts here.

Visit the Innovation Kitchen

See what possible looks like

Chicago Section IFT Supplier Symposium 2023 Nov.

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Questions?