The Impact of Innovative Sweetening Ingredients on Calorie Reduction

March 10, 2015
LEARNING OBJECTIVES

1. Explain the importance and the fundamental need for ingredient innovations to meet obesity-related public health needs.

2. Discuss how consumer dissatisfaction with current reduced or lower calorie options can lead to failed behavior change and affect compliance despite advice from health professionals to decrease calories from sugar.

3. Discuss how ingredient innovations can play an important role in encouraging positive behavior change.

4. Describe the characteristics, uses and value of a new sweetening ingredient that can help lower calories while meeting consumer demand for great tasting solutions without compromise.
THE OBESITY EPIDEMIC

OBESITY HAS BECOME A MAJOR HEALTH CHALLENGE.

Percent of US adults are obese.

Worldwide obesity has more than DOUBLED SINCE 1980.


WHO and other leading health authorities are focusing on strategies to help individuals achieve energy balance and halt further increases in obesity.

2010 Dietary Guidelines for Americans and WHO address the growing epidemic of obesity with recommendations around eating patterns that focus on consuming fewer calories.


HEALTH CARE PROFESSIONALS (HCP) RESEARCH STUDY

• In May 2014, on-line surveys were administered to 300 health care professionals.
• Respondents were screened to be more likely to spend time working with patients on health issues where diet plays an important role in wellness or treatment regimen.

• Six types of HCPs were included in the sample:
  • Registered Dietitians (54)
  • Physicians Assistants (52)
  • Nurse Practitioners (53)
  • Primary Care Physicians (51)
  • Diabetes Educators (51)
  • Pediatric Physicians (59)

• Respondents were screened to report at least 40% of patients were receiving dietary counseling as part of their wellness or treatment regimen.

Tate & Lyle Research, 2014
Health Professional Advice is Consistent with Dietary Guidance: Increase Fruit and Vegetable Intake, Decrease products high in calories from sugars

• The most common advice, given to about half of patients receiving dietary guidance, is to drink more water, eat more fruit, and to cut back on products high in sugars and saturated fat

• Avoidance of foods and beverages high in calories from sugars is most frequently recommended by Diabetes Educators, Pediatric Physicians, and Registered Dietitians.
HEALTH PROFESSIONALS RATE NON-COMPLIANCE IN DIET-COUNSELING AS A SERIOUS ISSUE

- A majority of HPs (79%) believe that non-compliance with recommended eating patterns and dietary changes is an extremely serious or serious issue.
- Registered Dietitians (43%) and Diabetes Educators (41%) are the most likely to believe that their patients’ non-compliance with dietary recommendations is an extremely serious issue.

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<tbody>
<tr>
<td>Top 2 Box</td>
<td>A 79  B 80  C 79  D 72</td>
<td>E 75  F 84  G 83</td>
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<tr>
<td>Extremely Serious</td>
<td>33</td>
<td>43</td>
<td>35</td>
<td>30</td>
<td>20</td>
<td>41</td>
<td>27</td>
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<tr>
<td>Serious</td>
<td>46</td>
<td>37</td>
<td>44</td>
<td>42</td>
<td>55</td>
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<td>56</td>
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<td>13</td>
<td>19</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Somewhat Serious</td>
<td>6</td>
<td>7</td>
<td>2</td>
<td>11</td>
<td>6</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Not a serious issue</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Q9. How serious an issue is non-compliance with these diet-counseling patients – in terms of their inability to actually follow recommended eating patterns and dietary changes?
CONSUMERS AND LABELING

Percent of consumers are looking for information on calories on the package label.

65%

Percent of consumers are looking for sugar content on the package label.

61%
TASTE, PRICE, AND HEALTHFULNESS HAVE BIGGEST IMPACT ON CONSUMER PURCHASING BEHAVIOUR

Source: IFIC, USA 2014 Food and Health Survey
90% of consumers say taste is their top purchase motivator.
THE NEED GAP IN TODAY’S SWEETENING SOLUTIONS

Manufacturers continue to look for healthier options that still taste great.

1. Make low-calorie products taste even better.

2. Reduce calories in full-sugar options while maintaining consumer acceptance.

3. Listen to consumer demand for better-tasting, naturally-sweetened options, when formulating with stevia.
HELPING FOOD AND BEVERAGE MAKERS WITH THE BEST OF BOTH WORLDS

Food with all the Taste, Texture and Functional Benefits of Sugar, without all of the Calories

Dolce = Italian word for sweet
Prima = First or Best
IT’S A SUGAR

Dolcia PRIMA™ Allulose enables manufacturers to create healthier options that still taste great.

1. Make low-calorie products taste even better.

2. Reduce calories in full-sugar options while maintaining consumer acceptance.

3. Listen to consumer demand for better-tasting, naturally-sweetened options, when formulating with stevia.
HOW DOES ALLULOSE COMPARE TO SUCROSE

A sugar that provides all the taste and texture of sucrose without all the calories.

- Percent of the sweetness of sucrose: 70%
- Percent of calories compared to sucrose: <10%
Allulose is one of many different sugars that exists in nature.

Tate & Lyle has developed a proprietary process to make allulose widely available to food and beverage makers.
ALLULOSE IS GENERALLY RECOGNIZED AS SAFE (GRAS)
Current use levels set for foods and beverages

<table>
<thead>
<tr>
<th>Food Category</th>
<th>Intended Level of Use</th>
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</thead>
<tbody>
<tr>
<td>Rolls, cakes, pies, pastries, and cookies, dietetic or low calorie</td>
<td>10%</td>
</tr>
<tr>
<td>Chewing gum</td>
<td>50%</td>
</tr>
<tr>
<td>Fat-based cream used in modified fat/calorie cookies, cakes and pastries</td>
<td>10%</td>
</tr>
<tr>
<td>Hard candies, low calorie (including pressed candy, mints)</td>
<td>70%</td>
</tr>
<tr>
<td>Frozen dairy desserts (regular ice cream, soft serve, sorbet), low calorie</td>
<td>5%</td>
</tr>
<tr>
<td>Carbonated beverages, reduced and low calorie</td>
<td>2.1%</td>
</tr>
<tr>
<td>Non-carbonated beverages, reduced and low-calorie</td>
<td>2.1%</td>
</tr>
<tr>
<td>Soft candies, low-calorie (non-chocolate, plain chocolate, chocolate coated)</td>
<td>25%</td>
</tr>
<tr>
<td>Sugar substitutes (carrier)</td>
<td>100%</td>
</tr>
<tr>
<td>Yogurt (regular and frozen), low calorie</td>
<td>5%</td>
</tr>
<tr>
<td>Medical foods</td>
<td>15%</td>
</tr>
<tr>
<td>Ready-to-eat cereals (&lt; 5% sugar)</td>
<td>10%</td>
</tr>
<tr>
<td>Coffee mix</td>
<td>30%</td>
</tr>
</tbody>
</table>

GRN 400, CJ Cheiljedang Inc., 2011
• Calculated EDI based on conditions of use (Cheiljedang data)
• Mean = 12.6 g/p/d
• 90th percentile = 28.5 g/p/d

<table>
<thead>
<tr>
<th>Food Category</th>
<th>Intended Level of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beverages (non-alcoholic), low calorie, reduced calorie, sugar-free</td>
<td>3.5%</td>
</tr>
<tr>
<td>Cereals, regular</td>
<td>2%</td>
</tr>
<tr>
<td>Cereals, low calorie, reduced calorie, sugar-free</td>
<td>5%</td>
</tr>
<tr>
<td>Chewing gum</td>
<td>50%</td>
</tr>
<tr>
<td>Confections and frostings</td>
<td>5%</td>
</tr>
<tr>
<td>Frozen dairy desserts (ice cream, soft serve, sorbet), low calorie, sugar-free</td>
<td>5%</td>
</tr>
<tr>
<td>Yogurt and frozen yogurt, low calorie, reduced calorie, sugar-free</td>
<td>5%</td>
</tr>
<tr>
<td>Dressings for salad</td>
<td>5%</td>
</tr>
<tr>
<td>Gelatins, pudding and fillings, low calorie, reduced calorie, sugar-free</td>
<td>10%</td>
</tr>
<tr>
<td>Hard candies, low calorie, reduced calorie, sugar-free</td>
<td>50%</td>
</tr>
<tr>
<td>Soft candies, low calorie, reduced calorie, sugar-free</td>
<td>25%</td>
</tr>
<tr>
<td>Jams and jellies</td>
<td>10%</td>
</tr>
<tr>
<td>Sugar</td>
<td>10%</td>
</tr>
<tr>
<td>Sugar substitutes</td>
<td>100%</td>
</tr>
<tr>
<td>Sweet sauces and syrups, low calorie, reduced calorie, sugar-free</td>
<td>10%</td>
</tr>
</tbody>
</table>

GRN 498, Matsutani Chemical Industry Ltd., 2013
• Calculated EDI based on conditions of use
• Mean = 9.0 g/p/d
• 90th percentile = 24.8 g/p/d
CLINICAL RESEARCH

- Metabolism Study
- Glycemic Response Studies
- Gastrointestinal Tolerance
ALLULOSE IS ABSORBED BUT NOT METABOLIZED

Methods:
• $[^{14}\text{C}(U)]$-Allulose (776 nCi) + 15 g Allulose
• Plasma, urine, feces collected over 168 hours total radioactivity; 48 hour metabolic profiling
• Expired air collected first 6 hours post dose $^{14}\text{CO}_2$ detection
• n = 8 healthy men

Results:
• $^{14}\text{C}$ Radiotracer was not detectable in expired air during 6-hours post dose indicating $[^{14}\text{C}(U)]$-Allulose is not metabolized.
• $^{14}\text{C}$ radiotracer was rapidly absorbed with peak plasma concentrations occurring within 1 hour, clearing within 24 hours.
• 86% of $^{14}\text{C}$ radiotracer was recovered in urine (n=7); 82% (n=8).
• 3.1% of $^{14}\text{C}$ radiotracer was recovered in feces (n=8).
• Radiochromatographic profiling (urine and feces) showed that Allulose was the most abundant compound recovered and that no other metabolic breakdown products were recovered.
ALLULOSE DOES NOT RAISE BLOOD GLUCOSE

- Published research shows that allulose blunts the effect of carbohydrates on blood glucose
- Three studies supported by Tate & Lyle found that allulose when consumed alone does not raise blood glucose or insulin in those with normal glycemia nor in those with type 2 diabetes

Study design
  - Randomized, controlled, double-blind, cross-over studies

Treatments (Beverages)
  - 25g glucose
  - 25g allulose
  - Provided in the morning after a 10-14 hour fast

Outcomes
  - Blood glucose and insulin taken at various time points

Subjects
  - Study 1: Normal glycemic men and women (n=10)
  - Study 2: Normal glycemic men and women (n=12)
  - Study 3: Men and women with type 2 diabetes (n=12)

2. Wolever T, Jenkins AJ. A Randomized, Controlled, Crossover Study to Assess the Effects of a Sweetener on Postprandial Glucose and Insulin Excursions in Healthy Subjects. 2015. Glycemic Index Labs. Toronto, ON, Canada.
3. Wolever T, Jenkins AJ. A Randomized, Controlled, Crossover Study to Assess the Effects of a Sweetener on a Postprandial Glucose and Insulin Excursions in Subjects with Type 2 Diabetes. 2015. Glycemic Index Labs. Toronto, ON, Canada.
ALLULOSE DOES NOT RAISE BLOOD GLUCOSE OR INSULIN LEVELS

**Study 1:** Blood Glucose Response in Healthy Adults after 25g dextrose (glucose) or 25g allulose

1. Values are means+SEM for n=10 subjects.
2. Allulose significantly different from Glucose.
3. After Allulose, significantly less than mean fasting before Allulose (p<0.05).
4. After Glucose, significantly greater than mean fasting before Glucose (p<0.05).
5. After Glucose, significantly less than mean fasting before Glucose (p<0.05).

**Study 2 & 3:** Blood Glucose and Insulin Response in Healthy Subjects and Subjects with Diabetes after 25g glucose or 25g allulose

1. Values are + SEM; n = 12 Subjects
2. Concentrations while on Allulose significantly less than after glucose at time points indicated (p<0.01).

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2. Wolever T, Jenkins AJ. A Randomized, Controlled, Crossover Study to Assess the Effects of a Sweetener on Postprandial Glucose and Insulin Excursions in Healthy Subjects. 2015. Glycemic Index Labs. Toronto, ON, Canada.
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ALLULOSE IS WELL TOLERATED AT MODERATE DOSES

• Research on allulose also shows that it is well tolerated at GRAS levels (equivalent to 28.5g/day).

• Published research indicates allulose is tolerated in healthy adults at 30g/day.

• Furthermore, Tate & Lyle research shows excellent tolerance at this level.
# Nutrition Highlights of Allulose

<table>
<thead>
<tr>
<th></th>
<th>Calorie Reduction Percentage</th>
<th>Calorie Reduction Per Serving</th>
<th>Comparison to Sugar (Sucrose)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yogurt</td>
<td>25%</td>
<td>30</td>
<td>Taste parity to sugar</td>
</tr>
<tr>
<td>Sweetened tea</td>
<td>60%</td>
<td>30</td>
<td>Taste parity to sugar</td>
</tr>
<tr>
<td>Chocolate cookie</td>
<td>7%</td>
<td>10</td>
<td>Taste parity to sugar</td>
</tr>
<tr>
<td>Ice cream</td>
<td>7%</td>
<td>10</td>
<td>Taste, stability and quality at parity with sugar</td>
</tr>
<tr>
<td>Sweet pastry</td>
<td>12%</td>
<td>30</td>
<td>Taste parity to sugar and improved stability</td>
</tr>
</tbody>
</table>

Source: Tate & Lyle sensory testing, 2013-2014
**HOW ALLULOSE APPEARS ON THE LABEL:**

**ALLULOSE WILL NOT RAISE BLOOD GLUCOSE OR INSULIN LEVELS**
**INCLUDED UNDER CARBOHYDRATE AND SUGARS ON THE NUTRITION FACTS PANEL**

### Yogurt

**Nutrition Facts**

- **Serving Size (170g)**
- **Servings Per Container**
- **Calories**: 130
- **Calories from Fat**: 10
- **Total Fat**: 1.5g (2%)
- **Saturated Fat**: 1g (5%)
- **Trans Fat**: 0g
- **Cholesterol**: 10mg (3%)
- **Sodium**: 90mg (4%)
- **Total Carbohydrate**: 31g (10%)
- **Dietary Fiber**: 0g
- **Sugars**: 2g
- **Protein**: 5g

### Flavored Water

**Nutrition Facts**

- **Serving Size**: 8 fl oz
- **Calories**: 0
- **Calories from Fat**: 0%
- **Total Fat**: 0g
- **Saturated Fat**: 0g
- **Trans Fat**: 0g
- **Cholesterol**: 0mg
- **Sodium**: 0mg
- **Total Carbohydrate**: 5g
- **Dietary Fiber**: 0g
- **Sugars**: 5g
- **Protein**: 0g

- **Possible additional on pack messaging:**
  Contains 8g of allulose/serving. Allulose is a low calorie sugar that does not raise blood sugar or insulin levels.

**INGREDIENTS:** Skim Milk, Sugar, Allulose, Blueberry Puree, Modified Food Starch, Cream, Nonfat Dry Milk, Blueberry Juice Concentrate, Gelatin, Natural Flavor, Potassium Sorbate, Citric Acid.

**INGREDIENTS:** Water, Allulose, Citric acid, Natural flavor, Potassium citrate, and Sucralose.

- **In this yogurt example, there are a total of 27 grams of sugars**
- **Allulose accounts for 8 grams of that sugar**
- **The remainder of the sugar grams are from other sources**
- **30 fewer calories vs. full-sugar yogurt**

- **In this flavored water example, there are 0 calories, but 5 grams of sugar coming from allulose**
AN EXAMPLE OF CALORIE REDUCTION WITH ALLULOSE

25% REDUCTION IN A FULL-SUGAR BEVERAGE – WHILE MAINTAINING THE SAME TASTE

Carbonated Soft Drink – Control formula

Nutrition Facts
Serving Size 12 fl oz (355g)

Calories 120
0% Daily Value

Total Fat 0g
0% Daily Value
Saturated Fat 0g
0%
Trans Fat 0g
0%
Cholesterol 0mg
0%
Sodium 0mg
0%
Total Carbohydrate 29g
10%
Dietary Fiber 0g
0%
Sugars 29g
0%
Protein 0g
0%

Vitamin A 0%
• Vitamin C 0%
Calcium 0%
• Iron 0%

*Percent Daily Values are based on a 2,000 calorie diet.

Carbonated Soft Drink - Featuring DOLCIA PRIMA™ Allulose

Nutrition Facts
Serving Size 12 fl oz (355g)

Calories 90
0% Daily Value

Total Fat 0g
0% Daily Value
Saturated Fat 0g
0%
Trans Fat 0g
0%
Cholesterol 0mg
0%
Sodium 0mg
0%
Total Carbohydrate 34g
11%
Dietary Fiber 0g
0%
Sugars 34g
0%
Protein 0g
0%

Vitamin A 0%
• Vitamin C 0%
Calcium 0%
• Iron 0%

*Percent Daily Values are based on a 2,000 calorie diet.

A 25% reduction in calories is achieved

Sugars change from 29g to 34g (due to the inclusion of allulose being 70% as sweet as sucrose)

Allulose contributes 12 of the sugar grams

SIGNIFICANT AND MEANINGFUL CALORIE REDUCTION CAN BE ACHIEVED WITH ALLULOSE
Temporal Profile Comparison
ALLULOSE PROVIDES SIMILAR MOUTH-FEEL AS SUCROSE

• One of the key formulation challenges when removing sucrose from food is losing the mouth-feel sensation.
• Allulose provides a similar mouth-feel sensation as sugar.

Attribute Definitions

Thickness – viscosity
Mouth-coating – the degree to which a coating is present in the mouth after swallowing
1. Ideal in beverages, frozen desserts, yogurt, dressings and sweet sauces, jams/jellies and candies.
DOLCIA PRIMA™ ALLULOSE APPLICATIONS SUMMARY

1. Ideal in beverages, frozen desserts, yogurt, dressings and sweet sauces, jams/jellies and candies.

2. Provides desirable browning, caramelisation and flavour in baked goods, and it offers extended shelf life and enhanced moisture binding.
DOLCIA PRIMA™ ALLULOSE APPLICATIONS SUMMARY

1. Ideal in beverages, frozen desserts, yogurt, dressings and sweet sauces, jams/jellies and candies.

2. Provides desirable browning, caramelisation and flavour in baked goods, and it offers extended shelf life and enhanced moisture binding.

3. Closely matches the temporal profile of sucrose and works in synergy with high-potency sweeteners.
HEALTH PROFESSIONALS ARE CURRENTLY RECOMMENDING PRODUCTS WITH LOW CALORIE SWEETENERS

Q15. Thinking about the patients/clients that you recommend reduce their caloric intake, or cut back on foods and beverages high in added sugar, to what percentage do you recommend the following foods and beverages made with no and low-calorie sweeteners.

Percent of HCPs who recommend **at least 1** type of food made with a low-calorie sweetener

97%

Percent of HCPs who recommend **9 or more** types of food made with low-calorie sweeteners

58%

Tate & Lyle Research, 2014
A WINNING PROPOSITION WITH HEALTH CARE PROFESSIONALS

- 73% of HCPs overall indicated a high degree of interest in recommending products made with Allulose to help patients reduce the amount of total calories and added sugar they consume.

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</thead>
<tbody>
<tr>
<td>A</td>
<td>73%</td>
<td>74%</td>
<td>75%</td>
<td>70%</td>
<td>75%</td>
<td>71%</td>
<td>76%</td>
</tr>
</tbody>
</table>

Q17. Foods and beverages sweetened with Allulose would be priced competitively to other no calorie and reduced calorie products. How likely would you be to recommend foods and beverages sweetened with Allulose to your patients attempting to reduce the amount of total calories, and added sugar they consume?
EXPECTED MAIN CATEGORIES OF USE

- Yogurt
- Juice, flavored waters and teas
- Cookies and baked goods
- Carbonated soft drinks
- Ice cream
- Cereal and snack bars

Dolcia PRIMA™
The Low-Calorie Sugar
THANK YOU!