Project Background

National Mango Board’s mission is to increase the consumption of mango in the U.S. by inspiring and educating consumers about the culture, flavor, and nutrition of mangos while bringing the industry together. NMB has a keen interest in understanding consumer perception and the attributes of frozen mango products.

Attribute Analytics’ trained panel measures and defines flavors and textures with objective, sensory data. Revealing the “flavor DNA” of the products assists with the ability to communicate and provides a deep understanding and ownership around frozen mango products and the entire category.

As the food industry shifts towards technology and data driven-decisions, food quality traits are rapidly gaining importance. Creating a standard lexicon improves communication and efficiencies along the entire supply chain: farmers, producers, consumers, marketers, and researchers.

A universal language will emerge by correlating work from previous studies on varieties and texture: 2020 Consumer Acceptability of Frozen Mango from Different Varieties, University of Florida; 2015 Describing Quality and Sensory Attributes of Three Mango Cultivars at Three Ripeness Stages Based on Firmness, University of California at Davis.

The objective of this project was to analyze and write Descriptive Analysis Profiles on frozen varieties: Keitt, Tommy, Kent, and Edward and following, probe consumers about perceptions, usage and ideas around frozen mango chunks using a consumer focus group.

This project will fill knowledge gaps in frozen fruit research from both a sensory technical and consumer point of view while providing visualized tools that will help define industry standards.
**Materials and Methods**

The mango varieties tested were Keitt (conventional), Kent (conventional), Tommy Atkins (conventional) and Edward (conventional). Edward was sourced via retail source using BB Date and Country of Origin. Frozen mango pieces from other varieties were shipped as available, via Fed Ex. They were verified and sent by the Quality team at Patagonia Foods to Attribute Analytics for testing. The mango products were kept frozen.

**Trained panel sensory testing**

Attribute Analytics’ internal sensory panel consists of highly trained panelists from the food and beverage industry. Each panelist has descriptive analysis training and experience in sensory testing of beverages and food products including mangos and other tropical fruits. For this project, the trained panelists received additional orientation and calibration by evaluating mango products including dried mango, mango juice, and fresh mango that were included in blind evaluations.

Frozen mango pieces were thawed via refrigeration prior to tasting and were room temperature at time of tasting. Panelists evaluated the frozen mango in the Attribute Analytics dedicated tasting room. Approximately 5-7 pieces of each mango sample were placed in 4 oz. white plastic cups and labeled with 3-digit random numbers. Samples were placed on a tray for panelists for evaluation. Whole mango pieces were tested individually as they arrived from origin and as a complete set. The mango was also evaluated pureed to ensure consistency and to verify and replicate descriptive data.

Descriptive analysis data is presented in Descriptive Analysis Profile, each variety was plotted on a graph and using attribute and intensity scales, displayed in a summary chart.

**Consumer focus group**

Consumer panelists were recruited via email from a list of participants from previous focus groups. 12 panelists were chosen for a range of ethnicity, and from those who indicated they consumed frozen or fresh mangos more than two times per month. Mango pieces were thawed via refrigeration prior to tasting and were room temperature at time of tasting. After an initial mango discussion, paper questionnaires were administered with de-thawed mangos on a divided plate. Panelists were queried about liking using hedonic scale (ranged from 1=dislike extremely to 5=neither like nor dislike, to 9=like extremely) and about purchase intent. After the panelists tasted and filled out questionnaires, the group was moderated for a guided discussion using a prewritten moderation guide. Research is summarized in highlighted topic sections.
Descriptive Analysis is a way of gathering data. It’s a valuable tool for providing information on appearance, aroma, flavor and texture of food and beverage products. It is one of the key instruments of Sensory Analysis; when used effectively it benefits product and process development, shelf-life studies, product improvement, quality assurance/control and marketing. These profiles provide a deep understanding and language for frozen mango and its attributes. Our understanding of frozen mango attributes correlated with consumer insights helps us understand how to deliver high quality product that answers a need for consumers.

**Assessment Design and Methodology**

- Mango Samples and Initial Assessment: Seasonal collection via retail and Patagonia Foods who sent verified cultivar type. Panel reorientation to mangos flavor and mango qualities.

- Blind Coded Assessment of four types frozen mango samples — Identified, described, and quantified mango sensory attributes using intensity scale.

- Mango Lexicon Terms: Developed, referenced, and refined throughout project process.

- Developed visualized profiles for each mango type. Data was analyzed and visualized based on Descriptive Analysis Profile for each variety and used as basis for additional charts.
A mango lexicon including attributes and references was developed from our years of assessments of mango products as well as recent samples. Future use will continue to validate the use of this lexicon by evaluating samples that contain these or other unique features.

The lexicon used in this study is relevant for sensory panel use but also as a communication tool for producers in the mango industry at large or manufacturers who use mango as an ingredient. Mango descriptions can be made based on this terminology and these same terms can be used for consumer or customer education and in product development of mango flavored consumer products.

It may necessary to create appropriate sub-lexicons for specific objectives such as evaluation of a new origin, or specific to kinds of preparations; for example, a sub-lexicon for frozen, fresh or processed.

This lexicon should be considered a living document that can be added to or modified over time when needed allowing stake holders for expansion and ownership of this technical vocabulary.
Descriptive Analysis Profile

Product: Frozen Kent Mango Chunks
Supplier: Patagonia Foods
Lot Code:
Category: Frozen Fruit
Evaluation Date: July 15 - Sept. 15 2021
Assessment: 2 oz. sample, defrosted to room temperature

**Appearance:**
- **Color Range:** Green/Yellow
- **Size:** 1.5cm x 1.5 cm
- **Aroma:** Tropical fruit, Citrus
- **Flavor Release:** Fast
- **Texture:** Slippery, dissolved quickly, perceivable hardness, low fiber
- **Aftertaste:** Mango, Sour

<table>
<thead>
<tr>
<th>Flavor - In Order of Appearance</th>
<th>Intensity (1-15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet</td>
<td>9</td>
</tr>
<tr>
<td>Mango</td>
<td>7</td>
</tr>
<tr>
<td>Sour</td>
<td>8</td>
</tr>
<tr>
<td>Tropical Fruit Mix</td>
<td>6</td>
</tr>
<tr>
<td>Perfumy</td>
<td>3</td>
</tr>
<tr>
<td>Umami</td>
<td>2</td>
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Notes:
### Analytical Testing

<table>
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<th>Product/Lot Number</th>
<th>Brix</th>
<th>pH</th>
<th>Odor</th>
<th>Flavor</th>
<th>HEM</th>
<th>Foreign</th>
<th>Color</th>
<th>Defect</th>
<th>Character</th>
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<tbody>
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### Microbiological Testing

<table>
<thead>
<tr>
<th>Product/Lot Number</th>
<th>SPC CFU/g</th>
<th>Yeast CFU/g</th>
<th>Mold CFU/g</th>
<th>Total CFU/g</th>
<th>E. Coli</th>
<th>Salmonella</th>
<th>L. mono</th>
<th>E. Aspergillus CFU/g</th>
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<tbody>
<tr>
<td>20221</td>
<td>5,600</td>
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<td>Negative</td>
<td>Negative</td>
<td>Negative</td>
<td>&lt;10</td>
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</table>

### microbiology

- **Product Type**: Frozen Mango Kent
- **Received**: July 30, 2021
- **Maintained Storage Temperature**: 0 \(^\circ\) C
- **Supplier/Lot Code**: Patagonia/20221
- **Test Method — Brix Refractometer**: 14
### Descriptive Analysis Profile

**Product:** Frozen Keitt Mango Chunks  
**Supplier:** Patagonia Foods  
**Lot Code:**  
**Category:** Frozen Fruit  
**Evaluation Date:** July 15 - Sept. 15 2021  
**Assessment:** 2 oz. sample, defrosted to room temperature  

<table>
<thead>
<tr>
<th>Appearance</th>
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<tr>
<td>Size</td>
<td>1.5cm x 1.5cm</td>
</tr>
<tr>
<td>Aroma:</td>
<td>Tropical fruit, fresh squeezed orange, perfumy</td>
</tr>
<tr>
<td>Flavor Release:</td>
<td>Fast</td>
</tr>
<tr>
<td>Texture:</td>
<td>Slippery, dissolved moderately, low hardness scale, low fibers</td>
</tr>
<tr>
<td>Aftertaste:</td>
<td>Mango, sweet</td>
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</table>

**Flavor - In Order of Appearance - Intensity**

<table>
<thead>
<tr>
<th>Flavor</th>
<th>Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet</td>
<td>8</td>
</tr>
<tr>
<td>Mango</td>
<td>8</td>
</tr>
<tr>
<td>Perfumey</td>
<td>5</td>
</tr>
<tr>
<td>Tropical Fruit Mix</td>
<td>8</td>
</tr>
<tr>
<td>Umami</td>
<td>4</td>
</tr>
<tr>
<td>Sour</td>
<td>7</td>
</tr>
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</table>

**Notes:**
### PATAGONIA FOODS

#### CERTIFICATE OF ANALYSIS

**Product:** Mango IQF Chunks Keitt  
**Quantity:** 2 cases / 10 lbs  
**Product Origin:** Mexico

#### Analytical Testing

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<tr>
<th>Brix</th>
<th>pH</th>
<th>Odor</th>
<th>Flavor</th>
<th>HM</th>
<th>Foreign</th>
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#### Microbiological Results

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<th>Production/ Lot Number</th>
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<th>Total CFU/g</th>
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<th>Salmonella /CFU/g</th>
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#### Production/ Lot Number

<table>
<thead>
<tr>
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<tr>
<td>BL01</td>
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**Received:** Sept. 2, 2021  
**Maintained Storage Temperature:** 0°C  
**Supplier/Lot Code:** Patagonia/ 23921  
**Test Method—Brix Refractometer:** 12

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Yagmur Alpay
Quality Control
# Descriptive Analysis Profile

**Product:** Frozen Tommy Mango Chunks  
**Supplier:** Patagonia Foods  
**Lot Code:**  
**Category:** Frozen Fruit  
**Evaluation Date:** July 15 - Sept. 15 2021  
**Assessment:** 2 oz. sample, defrosted to room temperature

<table>
<thead>
<tr>
<th>Appearance</th>
<th>nix</th>
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</thead>
<tbody>
<tr>
<td>Color Range</td>
<td>Yellow/Orange</td>
</tr>
<tr>
<td>Size</td>
<td>2cm x 2cm</td>
</tr>
<tr>
<td>Aroma</td>
<td>Tropical fruit, perfumy, green fruit</td>
</tr>
<tr>
<td>Flavor Release</td>
<td>Fast</td>
</tr>
<tr>
<td>Texture</td>
<td>Slippery, chewy, moderate hardness scale, moderate fiber</td>
</tr>
<tr>
<td>Aftertaste</td>
<td>Tropical Fruit</td>
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</table>

### Flavor - In Order of Appearance - Intensity (1-15)

<table>
<thead>
<tr>
<th>Flavor</th>
<th>Intensity</th>
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</thead>
<tbody>
<tr>
<td>Sour</td>
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</tr>
<tr>
<td>Mango</td>
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<tr>
<td>Sweet</td>
<td>6</td>
</tr>
<tr>
<td>Green Fruit</td>
<td>6</td>
</tr>
<tr>
<td>Citrus</td>
<td>6</td>
</tr>
<tr>
<td>Tropical Fruit</td>
<td>7</td>
</tr>
<tr>
<td>Umami</td>
<td>4</td>
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</table>

![Flavor Profile Diagram](image.png)
**Product Type**: Frozen Mango Tommy

**Received**: July 30, 2021

**Maintained Storage Temperature**: 0°C

**Supplier/Lot Code**: Patagonia/20121

**Test Method**—Brix Refractometer

<table>
<thead>
<tr>
<th>Lot Code</th>
<th>Code</th>
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<tbody>
<tr>
<td>20121</td>
<td>2</td>
<td>25oz</td>
<td>Jul 29</td>
<td>25</td>
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<tr>
<td>Total</td>
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**Attribute Testing**

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<th>Color</th>
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<th>Foreign</th>
<th>C.L.</th>
<th>Defect</th>
<th>Character</th>
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<tbody>
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<td>3.9</td>
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<td>0</td>
<td>0</td>
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<td>0</td>
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<table>
<thead>
<tr>
<th>Lot Number</th>
<th>SPL</th>
<th>Test</th>
<th>Mold</th>
<th>Total Cell</th>
<th>E. Coli</th>
<th>Salmonella</th>
<th>L. Mon</th>
<th>S. Aureus</th>
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<tbody>
<tr>
<td>20121</td>
<td>350</td>
<td>99</td>
<td>97C</td>
<td>&lt;20</td>
<td>Norgan</td>
<td>Norgan</td>
<td>Norgan</td>
<td>&lt;20</td>
</tr>
</tbody>
</table>

**Analysis**

Yamini Almeida

Quality Control
Descriptive Analysis Profile

Product: Frozen Edward Mango Chunks
Supplier: Patagonia Foods
Lot Code:
Category: Frozen Fruit
Evaluation Date: July 15 - Sept. 15 2021
Assessment: 2 oz. sample, defrosted to room temperature

Appearance: 

- Color Range: Green/Orange
- Size: 3cm x 2cm
- Aroma: Tropical fruit, fresh orange, pine

Flavor Release: Fast
Texture: Slippery, dissolved moderately, low hardness scale, low fiber

Aftertaste: Green Mango, Tropical Fruit, Perfume

Flavor - In Order of Appearance - Intensity (1-15)

- Mango: 7
- Metallic: 4
- Umami: 6
- Sweet: 6
- Green Fruit: 6
- Tropical Fruit Mix: 7
- Pine: 4
- Bitter: 3
- Sour: 4
<table>
<thead>
<tr>
<th>Attribute Analytics Edward Mangoes</th>
<th>Frozen Mango Edward</th>
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<tbody>
<tr>
<td><strong>Product Type</strong></td>
<td>Frozen Mango Edward</td>
</tr>
<tr>
<td><strong>Received</strong></td>
<td>April 2021</td>
</tr>
<tr>
<td><strong>Maintained Storage Temperature</strong></td>
<td>0 °</td>
</tr>
<tr>
<td><strong>Supplier/Lot Code</strong></td>
<td>Peru/Trader Joes</td>
</tr>
<tr>
<td><strong>Test Method — Brix Refractometer</strong></td>
<td>11</td>
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</tbody>
</table>
Descriptive Analysis Profile

Product: Frozen Edward Mango Chunks
Supplier: Patagonia Foods
Lot Code:
Category: Frozen Fruit
Evaluation Date: July 15 - Sept. 15 2021
Assessment: 2 oz. sample, defrosted to room temperature

Appearance: nix
Color Range: Green/Orange
Size: 3cm x 2cm
Aroma: Tropical fruit, fresh orange, pine
Flavor Release: Fast
Texture: Slippery, dissolved moderately, low hardness scale, low fiber
Aftertaste: Green Mango, Tropical Fruit, Perfume

Flavor - In Order of Appearance - Intensity (1-15)

<table>
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<th>Flavor</th>
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</tr>
<tr>
<td>Sweet</td>
<td>6</td>
</tr>
<tr>
<td>Green Fruit</td>
<td>6</td>
</tr>
<tr>
<td>Tropical Fruit Mix</td>
<td>7</td>
</tr>
<tr>
<td>Pine</td>
<td>4</td>
</tr>
<tr>
<td>Bitter</td>
<td>3</td>
</tr>
<tr>
<td>Sour</td>
<td>4</td>
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Notes:
<table>
<thead>
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<th>Attribute</th>
<th>Value</th>
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<tr>
<td><strong>Product Type</strong></td>
<td>Frozen Mango Edward</td>
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<tr>
<td><strong>Received</strong></td>
<td>April 2021</td>
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<tr>
<td><strong>Maintained Storage Temperature</strong></td>
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<tr>
<td><strong>Supplier/Lot Code</strong></td>
<td>Trader Joe's/Peru</td>
</tr>
<tr>
<td><strong>Test Method—Brix Refractometer</strong></td>
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</tbody>
</table>
# Descriptive Analysis Profile

**Product:** Frozen Edward Mango Chunks  
**Supplier:** Patagonia Foods  
**Lot Code:**  
**Category:** Frozen Fruit  
**Evaluation Date:** July 15 - Sept. 15 2021  
**Assessment:** 2 oz. sample, defrosted to room temperature

<table>
<thead>
<tr>
<th>Appearance:</th>
<th>Result: nix</th>
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<tbody>
<tr>
<td>Color Range</td>
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<td>Size</td>
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</tr>
<tr>
<td>Aftertaste:</td>
<td>Green Mango, Tropical Fruit, Perfume</td>
</tr>
</tbody>
</table>

## Flavor - In Order of Appearance - Intensity (1-15)

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<tr>
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<th>Intensity</th>
</tr>
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</tr>
<tr>
<td>Umami</td>
<td>6</td>
</tr>
<tr>
<td>Sweet</td>
<td>6</td>
</tr>
<tr>
<td>Green Fruit</td>
<td>6</td>
</tr>
<tr>
<td>Tropical Fruit Mix</td>
<td>7</td>
</tr>
<tr>
<td>Pine</td>
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</tr>
<tr>
<td>Bitter</td>
<td>3</td>
</tr>
<tr>
<td>Sour</td>
<td>4</td>
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![FLAVORSVALUE]
<table>
<thead>
<tr>
<th></th>
<th>Frozen Mango Edward</th>
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<td><strong>Product Type</strong></td>
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<td>April 2021</td>
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<tr>
<td><strong>Maintained Storage Temperature</strong></td>
<td>0 °F</td>
</tr>
<tr>
<td><strong>Supplier/Lot Code</strong></td>
<td>Peru/Trader Joes</td>
</tr>
<tr>
<td><strong>Test Method — Brix Refractometer</strong></td>
<td>11</td>
</tr>
</tbody>
</table>
Mango is an edible stone fruit produced by the tropical tree Mangifera indica which is believed to have originated in southern Asian.

Mango can contain a variety of flavors from perfume to pine which makes it very evocative to humans and one of the top trending fruit flavors in the world.

Shared terms and intensities for specific mango attributes were plotted on a graph to compare the mango varieties tested.

Please see the MANGO Lexicon chart for term definitions.

The spider graph at left visualizes and compares frozen mango varieties using descriptive analysis data.

The attributes of four varieties: Keitt, Edward, Kent and Tommy were assessed by a trained sensory panel.

Following, flavors were plotted on a graph using attributes and numerical intensity number.
Overall Frozen Mango Summary

Using frozen mango Kent, Keitt, Edward and Tommy Descriptive Analysis data points, Attribute Analytics devised a frozen mango summary or scorecard. The following data was used to assign a numerical number to each product for an overall score.

Mango Complexity = The number of specific attributes associated with the mango variety.

Mango Flavor Intensity = Using a universal 15-point intensity scale the panel assigned a number specific to the strength or intensity of the mango flavor within each variety.

Mango Aroma Impact = Using a universal 15-point scale the panel assigned an overall intensity number to the aroma.
Focus Group for Qualitative Research and Insights on Frozen Mango

- A consumer focus group was conducted to gain an unbiased perspective and snapshot of opinions of frozen mango
- Consumers were screened, recruited based on heavy mango use.
- 12 frequent mango users met in rented conference space.
- Attribute Analytics conducted and moderated in-person, 2-hour session, paid consumers in Whole Foods Market gift cards.
- Consumers were orientated with a general mango discussion, they taste tested four varieties and answered questionnaire before participating in a group discussion.
- Gained understanding of taste and texture preferences, language and mango sales and marketing opportunities.
- Obtained key insights and understanding around mango product usage.

Mango “super users” tasted four varieties: Keitt, Edward, Kent and Tommy. Mango pieces were thawed for focus group session.
There were 12 total consumer panel participants. 11 female panelists and 1 male panelists.
Consumers identified as: White (4), Asian (2), Black (2) and Hispanic (4) and were between ages of 25-55.
All having some college or post graduate degree.
All of the panelists consume mangos at least twice a month and had purchased frozen mango within the past three months.
Due to Covid-19, income level and employment information were not surveyed.
How Would You Describe Mango to Someone Who Had Never Eaten It?

**Sweet, juicy, has a pit. Like a Popsicle with no stick**

**Slightly sweet, slimy**

**Luxurious, juicy, flavorful**

**Light yellow = sour**
**Softer = sweeter. Wide range of flavors and usage**

**Beautiful, creamy, perfumy quality, festive and gorgeous**

I am from Mexico and we have lots of mango. We have all types, sizes and flavors. Can tell by looking at them what’s good. We eat as snack not in dishes. **Creamy, sweet**, some have fibers.

**Celebration in your mouth and rainbow of deliciousness. It’s so beautiful. A big sticky mess!**

**How Would You Describe Mango to Someone Who Had Never Eaten It?**

**Small, football shape, judge ripeness by red color**

**Lots of work but worth it because it’s like a flavor explosion and tastes like sunshine**

**Soft, juicy, short window of time, to eat, only 2 days**

**Tropical fruit, fleshy, juicy when ripe. Silky.**

**Gaging consumer beliefs and perceptions reveals customer attitudes and opinions about Mango products.**
Consumer Research Insights & Highlights

Talk about one or two foods that you associate or eat with mango.

**Mango Pairing**
- Lime & Salt
- Mango Chicken or Fish
- Coconut & Spicy
- Salsa
- Adobo & Jerk Chicken
- Pureed Mango
- Lime & Cilantro
- Frozen Treats - Ice Cream
- Plain — As is!
- Tajin
- Milkshake
- Passionfruit, Soursop or Sorbet
- Citrus, salt, avocado
- Smoothie

**Flavor Family**

- Tropical
- Citrus
- Salt
- Avocado

**Smoothie**

**Frozen Treats - Ice Cream**

**Talk about one or two foods that you associate or eat with mango.**
**Frozen Mango Tasting, Questionnaire and Response Module**

- Consistent with what I’d expect
- Surprised at how different they all were
- Wanted more sweet. When you taste side-by-side all very different.
- Some texture was sort of spongy and not as vibrant. Soft color = less flavor
- Types look similar but taste so different and have different textures. Each gave me a different feeling
- Not quite as good as fresh but I would make something with it.
- Did not get that burst of mango flavor and not delivering on fresh experience but so convenient.
- Texture is so important. These are good for smoothies.
- Should freeze when mango is overripe as some pieces are too hard and sour to eat
Exploring Frozen Mango Varieties— Talk about Your Favorite and Why — Highlights

**What do you do with frozen mango?**

- **Keitt**: Color, texture and abundance of mango flavor. Great flavor. Tastes like candy. Sweetest with good texture. It was my favorite and would buy for my family. Juicy, sweet.
- **Tart, good for kids!**

- **Tommy**: Exactly how I want my mango to taste. Great flavor and couldn’t tell it was frozen. Juicy and sweet.
- **Good color. No aftertaste.**
- **Sweet and sour. Perfectly ripe. Good texture. Creamy texture.**

- **Edward**: Good consistency, sour and sweet.

- **Kent**: Nice larger piece size!
Ripeness & nutrition stickers on mango or frozen mango package

Honor the origin and growing region via marketing campaign

QR code for info on variety and it’s “Mango Journey” providing transparency to end consumer

More social media influencers sharing about type and recipes
Sell frozen chunks in cup ready for blending a “to-go smoothie”

Sell by color and ripeness level from Green — to “Marigold” or Super Ripe

Offer frozen by variety and region

Celebrate Mango During Hispanic Heritage Month
Larger cut frozen pieces for new applications “like grilling”. New Mango plant based burger like Jackfruit?

Co-brand with Tajin— added seasoning packs

Prepared & Cut Frozen Mango Salsa with avocado and citrus

Help consumers understand how to celebrate the mango rainbow!
Consumer Research Insights & Highlights

Share an idea to elevate mango!

Package to convey “Preciousness & Luxurious” nature

More POS Info & Education on ripeness and usage

Chef, restaurant partnerships & recipes — “Grilled Mango”

More sealable, stylish designed packaging w/product descriptions and recipes.
Frozen Mango

Presented by Attribute Analytics for The National Mango Board

Sensory Research

Mango Label & Packaging Ideas

Larger Pieces, Pre-Spiced, Frozen Mango Salsa, By Variety and/or Ripeness Level, Frozen chunks to-go cup

Consumer Insights

Top Frozen Mango Uses

CONSUMERS DO
Sweet Treats, Mango to Frozen Smoothies, Bowl, Bowl, Salad

CONSUMERS SAY
Intense mango flavor, Ripeness level, Texture, Color, Convenience

How They Eat & Pair

Consumers Talk Mango

Physical with no seed, "Lucious", "Fruitful", "Tastes Like Sunshine", "Nectarous"

Mango is an edible stone fruit produced by the tropical tree Mangifera indica which is believed to have originated in southern Asia.

Mango can contain a variety of aromas and flavors from perfume-like to pine which makes it very evocative to humans and one of the top-selling fruit flavors in the world.

Shared terms and intensities for specific mango attributes were plotted on a graph for comparison among the mango varieties tested.

The spider graph visualizes and compares frozen mango varieties using descriptive analysis data. The attributes of four varieties: Kent, Edmead, Kent, and Tommy were assessed by a trained sensory panel. Following, flavors were plotted on a graph using attributes and numerical intensity number.

Mango Category Quick View is a tool developed as an infographic.

It is based on key findings from research so readers and stakeholders can quickly interpret and correlate data sets.
2021 Research Results Summary

1. Sensory and Quality attributes of four frozen mango cultivars - Kent, Keitt, Tommy, Edward
   • Analyzed and developed Descriptive Analysis Profiles for each cultivar
   • Developed lexicon or library of frozen mango attributes or descriptors
   • Visualized attributes and intensities in profiles, plotted on graph, and captured data on summary chart for comparison

2. Qualitative research on Frozen Mango products for understanding key emotions, language and patterns
   • Conducted “super mango user” moderated focus group
   • Gained incredible consumer insights on frozen mango products

Key Conclusions

Frozen Mango Sensory Research — Understanding frozen mango from sensory perspective

1. Identified New Lexicon Terms and Defined Others — Pine, Sweet, Sour, Umami, Green Fruit, Tropical Fruit, Mango, Perfumy
   • Correlate to consumer terms for better understanding of frozen products, ways to market, and product naming
   • Develop quality standards and set “flavor” goals to bring more fresh-like attributes to frozen mango
   • Use to mitigate undesirable traits or off-notes like bitter and metallic
   • Standardize vocabulary and create a master lexicon for better industry and consumer communication

2. Analyzed and visualized descriptive data using profiles and charts
   • Determine mango product gold standards
   • Understand improvement opportunities at farm level or in production plants
   • Compare cultivar types and understand key differences between fresh and frozen product
Key Conclusions

Frozen Mango Consumer Insights — *Understanding frozen mango from a consumer perspective*

1. **Key vocabulary terms** — leads us to usage opportunities, and understanding about what’s important to consumers in their own terms— “Popsical with no stick” (natural summertime treat), “Luxurious” (maybe more costly fruit but has uniquely elevated status), “Gorgeous” (symbol of beauty), “Silky” (enjoy smooth texture, low fiber), “Tastes like Sunshine” (symbolizing positive emotions and strong energy) and “Marigolds” (vibrant color and strong flavor preference emerged).

2. **What matters** — Intense mango flavor, ripeness level, soft, non-fibrous texture, response to bold color, more ways to make the fruit convenient from cups to larger size. Can echo back these terms and concepts when marketing, selling, naming new varieties, describing, and developing product.

3. **Usage Deep Dive** — How they use the product — Sweet Treats, Sangria & Frozen cocktails, Smoothies, Sorbet, Salsas and Side dishes — Answers how to support consumers by providing more recipes and usage ideas. Also helps us generate ideas to get consumer to use mango in unique ways and occasions.

4. **Mango Flavor Family** — Correlating other products like Lime, Coconut, Salt, Spice, Passionfruit, Avocado, Grapefruit enables us to understand where there are pairing opportunities, product partnerships and “white space” within the category. These foods provide opportunities to develop new products or partner with adjacent industries. Can highlight product new uses and additional recipes.

5. **What They Want** — Consumers offered an incredible array of concepts. 16 total ideas and insights — 7 frozen specific and the remaining 10 could be applied to both fresh or frozen products. Most concepts are low level of complexity and offer NMB and producers additional sku ideas, and concept innovation. Key ideas: larger pieces, pre-spiced, RTE frozen mango salsa, highlight variety and/or ripeness level, and packaging from bulk bags to selling convenience by offering frozen chunks in to-go cup.