Final Report

Sensory Testing of Frozen Mango Pieces

For the National Mango Board

From Charles Sims, University of Florida

February 3, 2023

Table of Contents

Summary	3
Objective	3
Materials and Methods	3-4
Results	4-6
Conclusions	6
Figures	7-9
Questionnaire	10-24

Sensory Testing of Frozen Mango Pieces

Summary

Four varieties of mangos (Kent, Keitt, Tommy Atkins and Tommy-Kent) were grown in Mexico, harvested at 2 maturities (green mature and ¾), and frozen using 2 methods (IQF and traditionally frozen). The frozen mangos were shipped to the University of Florida for sensory testing in the fall of 2022. The frozen mango pieces were thawed in the original shipping containers and subjected to sensory testing in 4 sessions (one session of 4 treatments of each variety). Approximately 100 consumers of mangos evaluated the samples for overall liking, preference and several sensory attributes. The results showed that the traditional freezing method was consistently rated higher and more preferred than the IQF method across both harvest maturities. The differences between maturities were less clear and depended on the variety.

Objective

The objective of this research project and sensory testing was to evaluate the consumer acceptability of frozen mango pieces from 4 different varieties (Kent, Keitt, Tommy Atkins, and Tommy-Kent) that were harvested at 2 maturity stages (green mature and ¾) and frozen in 2 ways (IQF and traditional). The green mature ripeness is defined as the maximum ripening degree according to EMEX, A. C. criteria = number 3. The ¾ ripeness is defined as a level above green mature, intermediate before the natural fall of the fruit from the tree, with the maximum total soluble solids, minimum acidity, maximum Brix/Acid ratio, and appropriate firmness for ethylene conditioning. This project was completed in late Fall of 2022.

Materials and Methods

Mangos were grown, harvested, and processed in Mexico under the direction of the Dr. Osuna, INIFAP. Once frozen, the mango pieces were shipped frozen to the Food Science and Human Nutrition Department (FSHN) at the University of Florida. The samples were received and immediately placed in frozen storage in the containers they were shipped in. A large portion (over half) of the plastic containers the mangos were shipped in were damaged at some point in transit and many were split open. The sensory test was conducted about 1 month after receiving the samples.

For sensory testing, the 4 treatments of each variety were tested separately on different days for a total of 4 sensory tests spread over two weeks. The frozen mango samples were thawed overnight in a refrigerator and kept cold during testing. The traditional frozen samples were rather large pieces and were diced by hand to about the same size as the IQF pieces. The IQF pieces were tested as is.

One hundred (100) panelists were recruited via email from a database of potential panelists to participate in the panels. Only panelists who indicated they are regular consumers of mangos were chosen. The sensory tests were conducted in the sensory testing laboratory in the FSHN department. This lab has 18 individual booths and is equipped with computer data entry using

the software Compusense. Once panelists checked in and signed the informed consent form, they were seated in one of the booths to evaluate the 4 samples.

Approximately 3-5 pieces (depending on the size) of each of the 4 samples were placed in small plastic cups labeled with 3-digit random numbers. All orders of presentation were presented approximately an equal number of times. All 4 samples were placed in the proper order on trays and presented to the panelists for evaluation. Panelists answered a few demographic questions first, including gender, ethnicity, income, education level, and mango consumption frequency (see attached questionnaire). Panelist then rated aroma liking, appearance liking, color liking, overall liking, flavor liking, and texture liking on the 9-point hedonic scale where 1=dislike extremely, 5=neither like nor dislike, and 9=like extremely. Panelists also rated the color, sweetness, sourness, mango flavor and texture on a 5-point Just-About-Right (JAR) scale which ranged from 3=just right, 1= much too little of that characteristic, and 5= too much of that characteristic (see attached questionnaire for exact wording). This basically forces the panelists to provide an opinion of those characteristics. Panelists also rated the fibrousness of the samples on a 0-100 scale where 0=no fibrousness and 100=very fibrous and were asked whether there were any off-flavors (yes or no). Finally, panelists were asked to rank the 4 samples for preference (1=most preferred, 4=least preferred). Panelists were given water and unsalted crackers to cleanse their palates between samples.

For data analysis, all the 9-point rating data and the fibrousness data was subjected to a 2-way analysis of variance (panelists and sample effects) and the means separated by Tukey's Honestly Significant Difference test ($p < 0.05$). The JAR and off-flavor data was summarized as the % of panelists who chose each category (1-5, yes or no) for each sample. The preference ranking data was analyzed by Friedman's analysis and the rank totals separated by Tukey's Honestly Significant Difference test for rank totals. **A lower rank total indicates more preferred**. Data is summarized in the attached bar charts or in the Results section. The off-flavor data (yes or no) showed no real trends and usually less than 20% of panelists indicated an off-flavor, so this data is not shown. The same goes for fibrousness as well, all the ratings were the same and this data is not shown. The appearance rating data is also not shown since it is identical to color and deemed to be too redundant to show.

Results

Panelist Demographics

For the 4 sensory panels there were between 82-101 panelists for each sensory test, ranging from 55-72 females and 27-38 males. The ethnicity was reported as 17-26% Asian, 11-14% Black, 11-23% Hispanic/Latino, 36-49% White, and 0-4% Other. For income, 45-51% of the panelists reported income from $15,000-$50,000 and 49-55% reported income from $50,000-$200,000+. For education levels, 43-59% ranged from high school graduate to some college, while 41-57% ranged from college graduate to post-graduate. For mango consumption, 44-53% of the panelists reported that they consumed mangos once every 2-3 weeks or more often, and 47-56% reported they consumed mangos once a month or less. In general, there were substantially more females

than males, the ethnicity of the panelists was diverse, the panelists were fairly well-educated and well-paid, and were regular consumers of mangos.

Tommy-Kent

The ¾ mature traditionally frozen had the highest aroma liking of the 4 treatments while the green mature traditionally frozen and ¾ mature IQF were the same. The green mature IQF had the lowest aroma liking. The ¾ mature treatments, regardless of freezing method, were rated higher in color liking and overall liking than the green mature treatments. The JAR results indicated that panelists thought the green mature treatments were somewhat too pale compared to the ¾ mature. There were no differences in freezing methods on color or overall liking. For overall flavor liking and overall preference, the ¾ mature treatments were more preferred and rated higher in flavor liking than the green mature treatments, and the traditional freezing methods were more preferred and rated higher than the IQF. The JAR results indicate that the green mature treatments lacked mango flavor and were not sweet enough compared to ¾ mature, and the IQF treatments were not as sweet or flavorful as the traditional freezing. The only treatment that was rated lower than the rest for texture liking was the green mature IQF, which was rated the lowest. In general, the ¾ mature and traditional freezing method were preferred over green mature and IQF.

Tommy Atkins

The aroma liking were fairly similar for all four treatments, although the ¾ mature traditional frozen was rated higher than green mature IQF. There IQF treatments were generally rated lower for color liking than the traditional freezing treatments, and the JAR data indicated that the IQF treatments were somewhat too pale compared to the traditional freezing treatments, especially with the green mature. The ¾ mature traditional freezing treatment was generally rated higher than the other treatments for overall liking and flavor liking, and was the most preferred. The JAR data indicated that the ¾ mature traditional freezing treatment was sweeter and had more mango flavor than the other treatments. The IQF treatment for the ¾ mature was rated substantially lower than the traditional freezing method for overall liking, flavor liking, texture liking and was less preferred. This was not the case with the green mature, where the traditional freezing method was rated similar to the IQF for most characteristics and preference. In general, there were not consistent differences between the 2 maturities and the IQF treatment only lowered the quality of the ¾ mature.

Kent

The aroma liking ratings were similar for all 4 treatments, the only significant difference was between ¾ mature traditional freezing and green mature IQF. In general, the ¾ mature samples had higher color liking ratings than the green mature, although it was only significant for the mature green traditional freezing. The JAR data indicate that the mature green treatments were somewhat too pale. The traditional freezing treatments tended to be rated higher than IQF for overall liking and flavor liking, especially for the green mature. The JAR data indicated that all the treatments were not sweet enough and lacked mango flavor. The texture liking was similar

for all treatments, with the only significant difference being the green mature traditional freezing having higher ratings than the ¾ mature IQF. For overall preference, the traditional freezing treatments were more preferred than the IQF for both maturities, but especially for mature green. In general, the traditional freezing method was rated higher and more preferred, but there were no consistent differences between the two maturities.

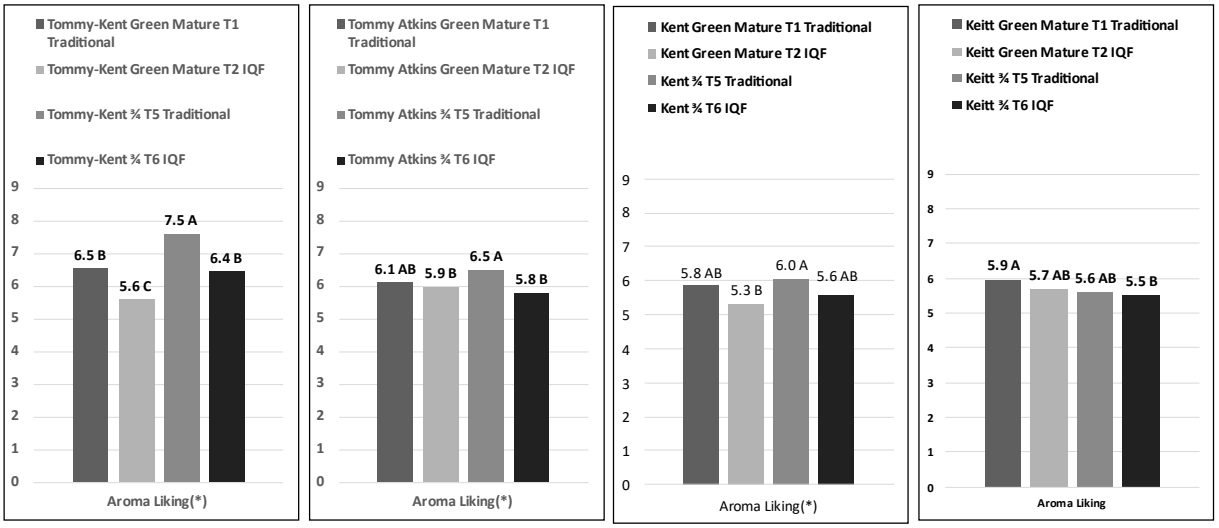
Keitt

The aroma liking ratings were similar for all 4 treatments, the only significant difference was the green mature traditional freezing was rated higher than the ¾ mature IQF. Likewise, all color liking ratings were very similar, the only exception was that the ¾ traditional freezing had a higher color rating than the ¾ IQF. The JAR data indicated that all treatments were somewhat too pale. The traditional freezing method was rated higher than the IQF for overall liking, flavor liking and texture liking, although it was significant for only the ¾ mature. The JAR data showed that all the treatments were not sweet enough and did not have enough mango flavor, especially the ¾ mature IQF. For preference, the traditional freezing method was clearly preferred over IQF. In general, the traditional freezing method was rated higher and was more preferred, but there were no consistent differences between the two maturities.

Conclusions

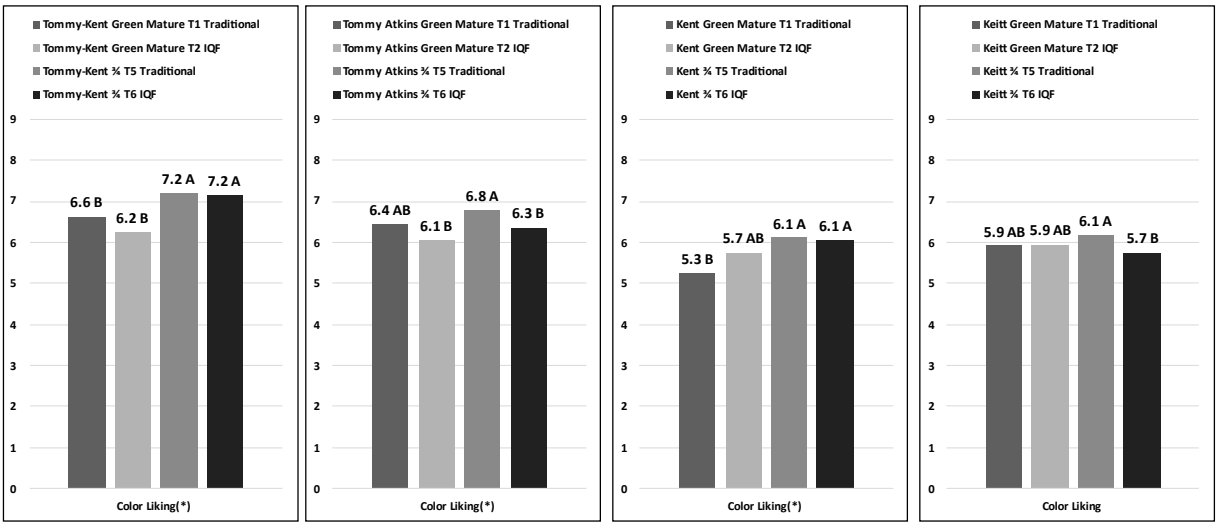
Focusing on overall liking and preference, it was clear that the traditional freezing method was consistently liked better and more preferred than IQF across both maturities. This was driven primarily by flavor. Nearly all the samples were rated as not sweet enough and not enough mango flavor, but this was especially true for IQF. The differences between maturities were less clear and depended on variety. Tommy-Kent was the only variety where the ¾ mature was rated higher and was more preferred over mature green. However, for the traditional freezing method, the ¾ mature was more preferred in Tommy-Kent and Tommy Atkins, and tended to be in Kent.

Aroma Liking



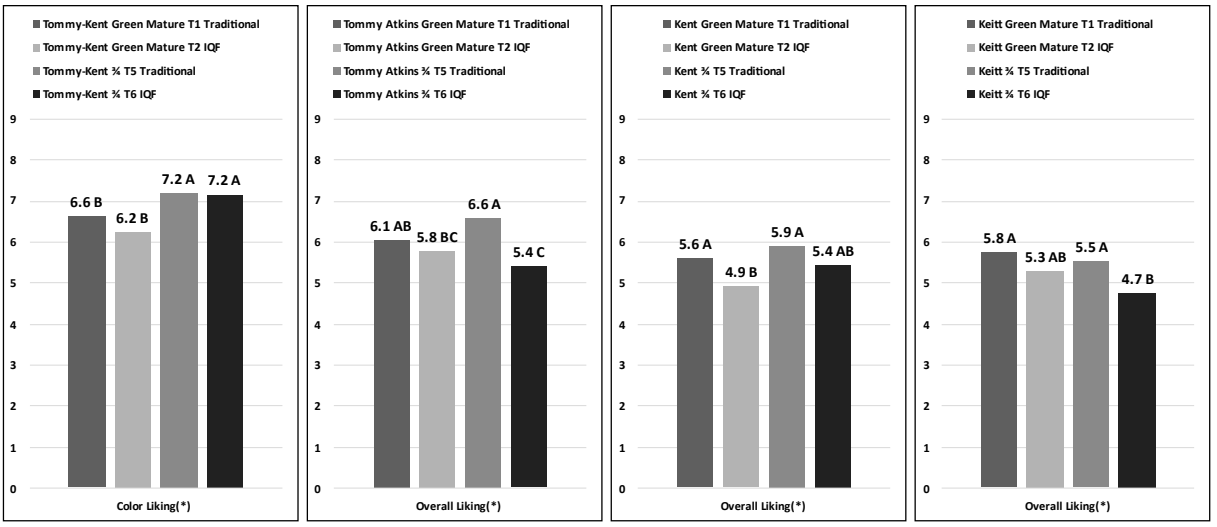
Compusense

ColorLiking



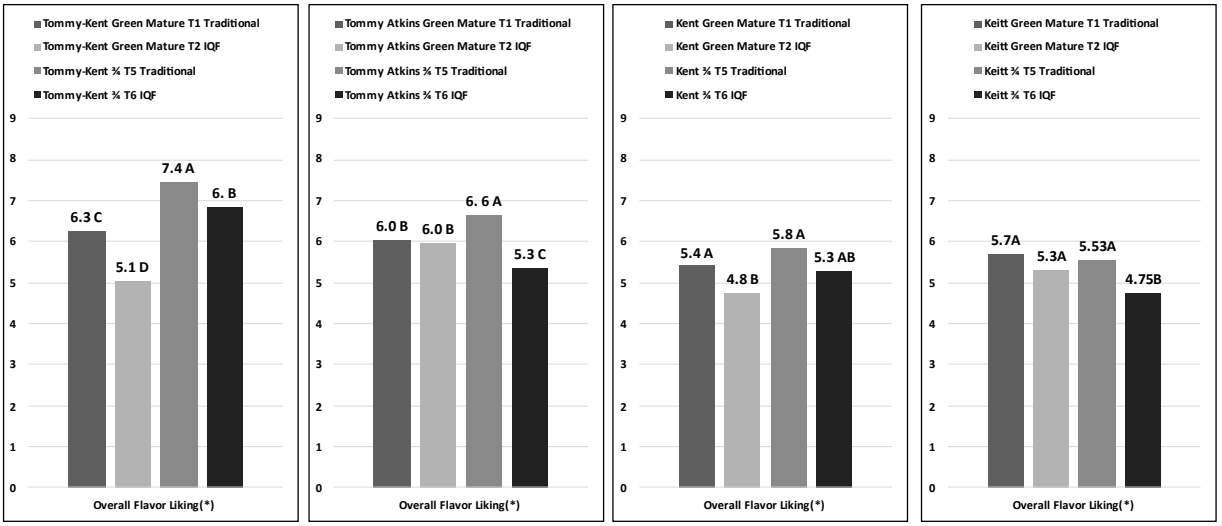
Compusense

Overall Liking



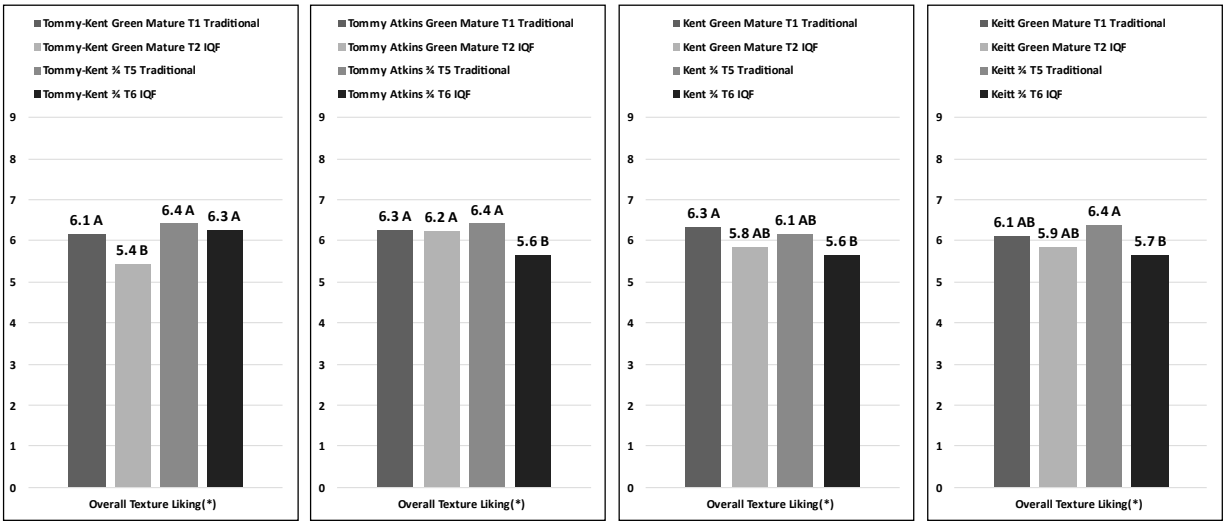
Compusense.

Overall Flavor Liking



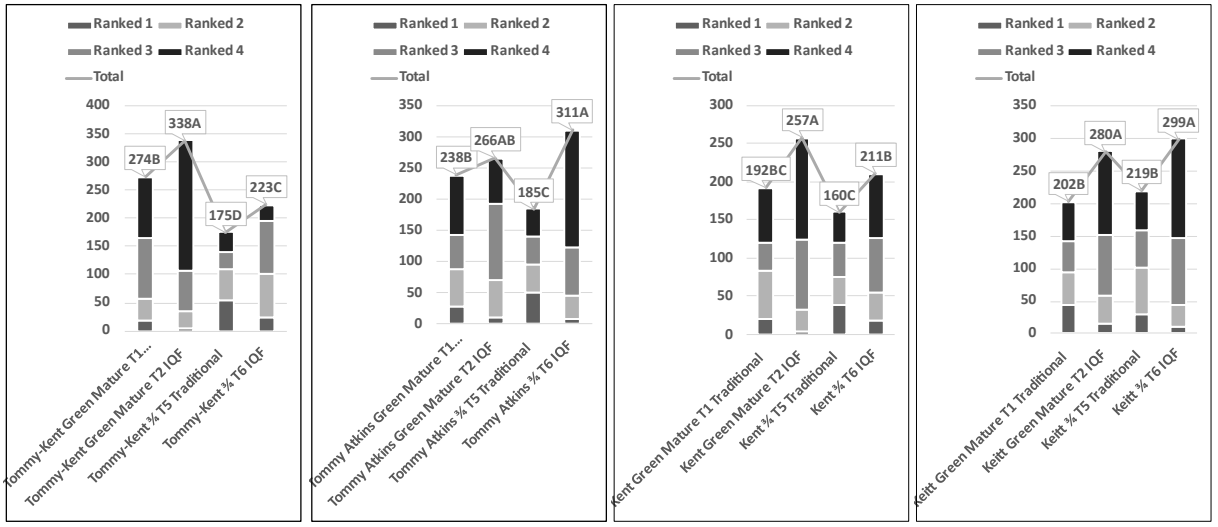
Compusense.

Overall Texture Liking



Compusense

Rank



Compusense

Welcome!

Today's Samples: Frozen & Thawed Mango

Click the *next* button to begin

Next

Please enter the **number** on the card you were given.

Please ask a worker if you have any questions.

Next

Please indicate your gender.

- Male
- Female

Next

Please indicate your age.

Next

Which of the following best describes you?

- American Indian or Alaska Native
- Asian
- Black or African American
- Hispanic or Latino
- Native Hawaiian or Pacific Islander
- White
- Other

Next

Please indicate your estimated annual household income. (If you are a student, please include your parents' income)

- Less than $15,000
- $15,000 to $24,999
- $25,000 to $34,999
- $35,000 to $49,999
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $149,999
- $150,000 to $199,999
- $200,000 or more

Next

Which of the following best describes the highest level of education you have completed?

- Some high school
- Highschool graduate
- Trade or technical school
- Some college (less than 2 years)
- Some college (2 years or more)
- College graduate
- Post-graduate (including M.S., Ph.D, M.D., etc.)

Next

How often do you buy and/or consume frozen mango?

- Once a week or more often
- Once every 2-3 weeks
- Once a month
- Once every 2-3 months
- Once every 4-6 months
- Once a year
- Never

Next

Now, you will evaluate **sample BC111** only on **AROMA and APPEARANCE.**

Please **DO NOT TASTE** the product until you are prompted to do so.

WHEN ANSWERING ANY QUESTION, MAKE SURE THE NUMBER ON THE CUP MATCHES THE NUMBER ON THE MONITOR.

Next

How much do you **LIKE** or **DISLIKE** the **AROMA** of sample **BC111** ?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like nor dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Next

How much do you **LIKE** or **DISLIKE** the **APPEARANCE** of sample **BC111** ?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like nor dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Next

How much do you **LIKE** or **DISLIKE** the **COLOR** of sample **BC111** ?

Dislike extremely	Dislike	very much	Dislik	e moderately	Dislike	slightly	Neither	like nor dislike

How would you describe the **COLOR** of sample **BC111?**

Much too pale	Somewhat too pale	Just about right	Somewhat too dark	Much too dark
1	2	3	4	5

Next

Take a bite of cracker and a sip of water to cleanse your palate. Remember to do this before you taste each sample.

You are now ready to taste sample **BC111.**

Please eat enough of the sample to form an opinion and answer the following questions, but please save some sample for the end of the test.

WHEN ANSWERING ANY QUESTION, MAKE SURE THE NUMBER ON THE CUP MATCHES THE NUMBER ON THE MONITOR.

Next

OVERALL how much do you **LIKE** or **DISLIKE** sample **BC111** ?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like nor dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Next

How much do you **LIKE** or **DISLIKE** the **OVERALL FLAVOR** of sample **BC111**?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like nor dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Next

How would you describe the **SWEETNESS** of sample **BC111?**

Not at all sweet enough	Somewhat not sweet enough	Just about right	Somewhat too sweet	Much too sweet
1	2	3	4	5

Next

How would you describe the **SOURNESS** of sample **BC111?**

Not at all sour enough	Somewhat not sour enough	Just about right	Somewhat too sour	Much too sour
1	2	3	4	5

Next

How would you describe the **MANGO FLAVOR** of sample **BC111?**

Not at all enough mango flavor	Somewhat not enough mango flavor	Just about right	Somewhat too much mango flavor	Much too much mango flavor
1	2	3	4	5

Next

How much do you **LIKE** or **DISLIKE** the **<u>OVERALL TEXTURE</u>** of sample **BC111**?

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like nor dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

Next

How would you describe the **TEXTURE** of sample **BC111?**

Much too soft	Somewhat too soft	Just about right	Somewhat too firm	Much too firm
1	2	3	4	5

Next

How you would describe the **FIBER CONTENT** of sample **BC111**?

Next

Would you say sample **BC111** had any off-flavors?

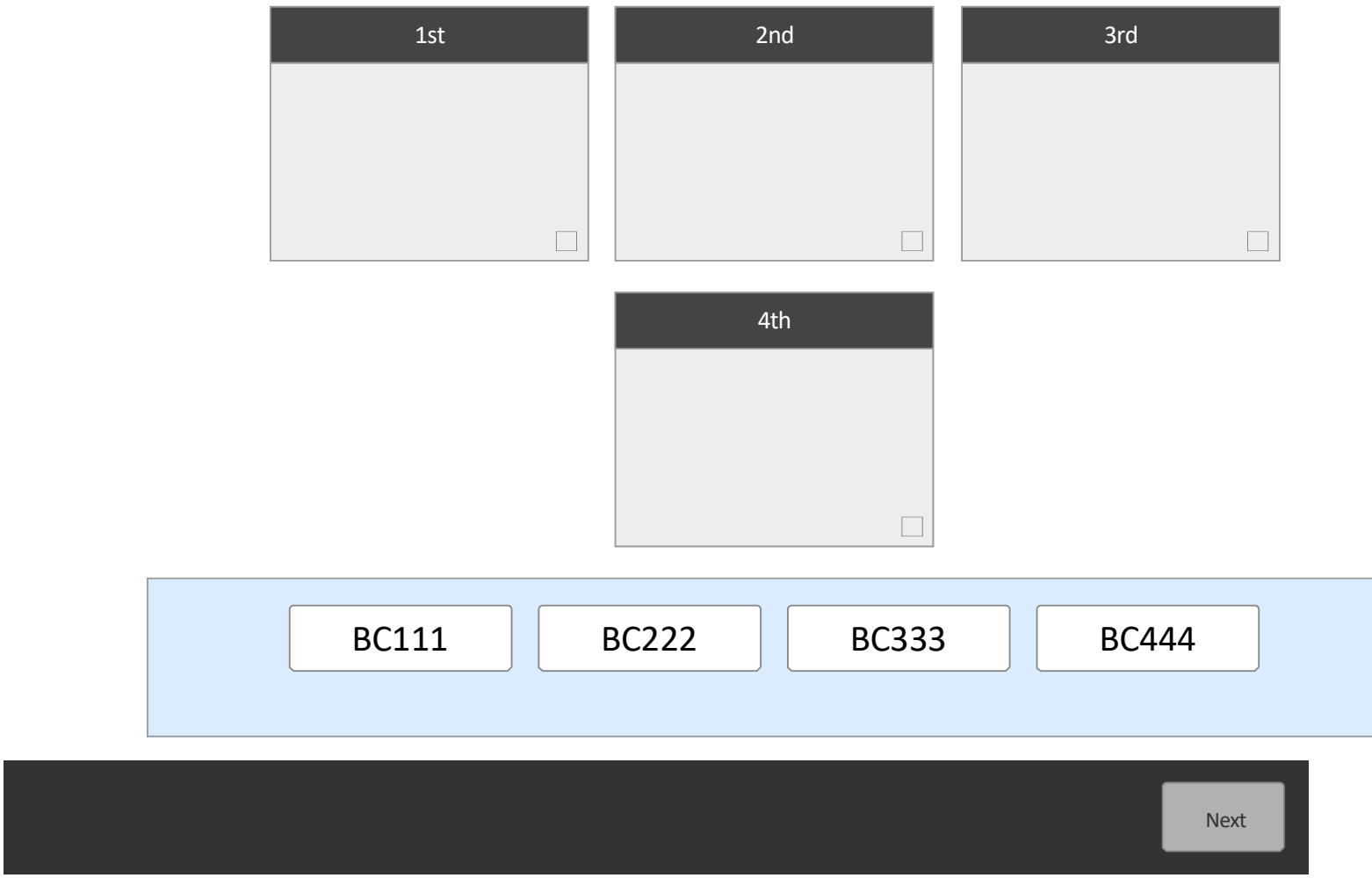
- Yes
- No

Next

Please describe any off-flavors you may have noticed. Please be specific.

Next

Beginning with the sample on the left, please taste each sample again and RANK them from the MOST preferred (1st) to LEAST preferred (4th).



Thanks for completing this test!

Please DO NOT EXIT out of your browser.

You may turn your booth light on and pick up your compensation where you checked in.

Finished