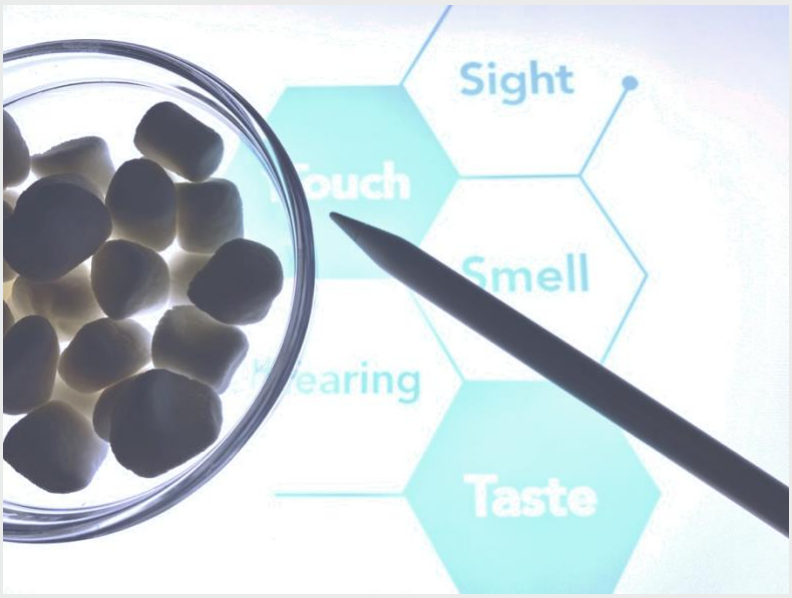

Exploring Taste Within a Virtual Setting

Sensory Lab Report

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Nutrition 205: Scientific Principles of Food Preparation

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Abstract

A set of techniques may be needed in order to invoke a person's senses when presenting a sample. This is where sensory evaluation is used. One of the main reasons for sensory evaluation is for product development. Although this is normally done in a lab setting, the recent pandemic of COVID-19 has forced this evaluation to be proctored in a virtual setting. 12 untrained Nutrition 205 students from Grossmont College in San Diego, California were given a virtual sensory evaluation via Zoom in real time. The test was administered by Professor Christine Zoumas with the assistance of Professor James Arens. The tests given include: A Triangle Test, a Paired Comparison Test, a Ranking Test, 3 Descriptive Tests (chocolate, potato chips, and marshmallows), a Hedonic Ranking Test, and a Hedonic Paired Comparison Test. The participants are provided with a score sheet to download or print ahead of time and told to be familiar with each test beforehand. Each test was presented one at a time on screen with all participants muted as Christine Zoumas read directions out loud. Each score sheet had the exact same image of each sample with a randomized number, but each score sheet was identical for each participant. Although the tests were following traditional protocol, the in-person aspect was lost as well as the randomized order of each sample. Unfortunately, participants were not properly trained before evaluation and results were forced to be randomized which resulted in poorly constructed data, however through analysis and insight there is value that can be extracted.

Introduction

Around the second half of the twentieth century, sensory evaluation began to grow. Sensory evaluation uses a set of techniques to accurately invoke a person's senses in reaction to a sample presented. By these techniques, a certain attribute of the sample is able to be isolated to further research and bring about useful information to manufacturers. Sensory evaluation is important to consumers and product development. (Lawless and others 2010). Each of the senses does not work in isolation. They all connect and interact with one another in what is known as cross-modality (Peleterio 2016). How a sample is seen affects how it will taste and feel or the way a product smells will trigger how your brain will perceive its taste. This is all important to manufacturers when they are trying to produce a market product. Sensory evaluation is not limited to just the food or beverage itself. The packaging also plays a huge role in development and invoking a consumer's senses (Krishna 2012). A Hershey's Kiss for example. The product is a small teardrop shaped chocolate wrapped with foil like a present and has a plume attached (Hershey's). Before even tasting, touching, or smelling the product, it is already bringing about how the consumer will perceive the product (Krishna 2012). Chocolate is a solid at room temperature and melts in the mouth giving us an elegant treat (Muñoz 2015).

Food evaluation contains two categories: sensory evaluation and objective evaluation. Sensory evaluation is more expensive and time consuming while solely relying heavily on human opinion. Objective evaluation is reliable and inexpensive utilizing machines and/or objects. The tests presented here are all fall into the category of sensory evaluation which consists of two methods: Analytical tests and Affective tests. An Analytical test detects the difference in a sample and is more objective. This test is usually done by trained personnel and asks the question, "Are there any differences, if so, what or how much?" An affective test, also

known as acceptance or preference tests, asks participants to rank samples based on an attribute or state if a participant likes/dislikes a product. This is usually done with untrained consumers.

Analytical methods include discrimination and descriptive analysis while affective methods include liking and preference. Each method is of equal importance. The objective of analytical discrimination testing is to determine at what level a difference can be recognized. The typical panel size for this test is about 25 people, but more or less may be used. The tests that would be used with this method are the Triangle Test, the Duo-Trio Test, Ranking, and the Paired Sample Test. The analytical descriptive tests would have an ideal panel size of about 12 or fewer and is used to detail a specific flavor, texture, aroma, or consistency of a product. As mentioned, the participants are preferably trained individuals and can sometimes be given a card with terms that may be used. Affective tests include: Hedonics, which asks, "How well do you like the product?", personal preference tests asking, "Which product do you prefer?", and affective tests which detects preference.

There are a few key settings that must be considered when administering sensory tests. A typical sensory analysis testing site includes a kitchen separate from the testing area. The participants are given private testing booths which are separated by walls usually. The room sometimes includes red or green lights in order to mask differences (Sensory Laboratory n.d.). The server brings the tray to the booth from the kitchen through a small door in the wall. A typical tray setup will include napkins, utensils (if necessary), unflavored water, unsalted crackers, the samples, a score sheet, and pen. The food samples will contain equal amounts of the product with no difference in appearance and each sample will be labeled, for example: #112, #361, #529, etc. and placed in a random order for each participant. The sample numbers remain the same, but are in a randomized order for each participant, for example: Sample A then Sample

B for one participant and Sample B then Sample A for another (Sensory Analysis 2017). Doing so provides greater evidence for statistical significance by eliminating bias that may arise from being given A first then B since that is not the purpose of this experiment. We are conducting randomized controlled trials for our study.

The Triangle test is set up with 3 samples lined up for a trained panel. Two of the samples are similar and one is different. The participants are to start from left to right and identify which is the odd one out. Through this test, the manufacturers gain feedback through statistics on how well or how poorly their chosen attribute was masked. The higher the percentage of correctly identifying the different sample, the bigger the difference.

The Paired Comparison Test determines which way a distinctive sensory characteristic differs between two samples. Two identical samples are prepared, for example, Sample A and Sample B. Some participants will be presented Sample A then Sample B and some participants will be presented Sample B followed by Sample A. A trained panel is preferred. The participants are then told to taste each sample from left to right and fill their score sheet out to determine which is closer to the attribute being tested for. As with the Triangle Test, the analysis of the statistics will reflect on the products' differences. If participants can spot the difference easily, the manufacturer will need to change the product.

The Ranking test is set up with 3 or more samples lined up on the tray in a randomized order. The samples are to be tasted and ranked in order of intensity or degree of a specific attribute. For this test, the consumer knows there is a difference but not how much of a difference. A trained panel is preferred for this test. Because of the number of samples and the task being requested, one of the drawbacks for this test is fatigue, therefore unsalted crackers and unflavored water are of high importance.

The Descriptive Test is an analytical test that is designed to detail specific flavor or textures of food or beverage. A list of appropriate terms may also be generated for the participants ahead of time on a score card or told ahead of time. Descriptive tests can be qualitative and quantitative and are preferably done with a trained panel from about 5-100 people. The test is performed if the manufacturers want a more detailed specification of a single product, need to compare products, or to troubleshoot customer complaints.

The Ranking (Hedonic) Test evaluates the consumer's preference. Samples are lined up in a randomized order and participants are asked to taste the samples from left to right and rank them from least favorite to favorite on a scale. This is usually done with untrained personnel and simply used for marketing purposes.

The Paired Comparison (Hedonic) Test is similar to the Analytical Paired Comparison Test, however this test assesses preference rather than attribute. Two samples are given to the participants in a randomized order and they are to choose which sample they prefer. This test may be done to a target group for marketing purposes such as a protein bar for student athletes where the panel may be set up at a gym. This test is used on untrained individuals.

The tests presented in this study are the Triangle Test, the Paired Comparison Test, the Ranking Test, 3 Descriptive Tests (chocolate, potato chips, and marshmallows), the Hedonic Ranking Test, and the Hedonic Paired Comparison Test. The first four tests presented are more focused on product development, while the final two tests are geared toward marketing. The purpose of this study is to show the importance of sensory evaluation through a variety of tests.

Methods

Environment

Due to the global pandemic caused by COVID-19 these sensory tests were not administered the traditional way. The tests were done virtually via Zoom (a video application) rather than a quiet in-person lab setting. Although this way of testing is not ideal, the tests were administered in a very specific and controlled environment.

An ideal testing set-up would be in a quiet lab with no distractions and preferred participants being trained or semi-trained individuals. The participants would be given unflavored water and unsalted crackers to cleanse their palate.

Participants

The Participants included 12 untrained students from Grossmont College in California and proctored by Professor Christine Zoumas with the assistance of Professor James Arens. Of the 12 students who participated, 10 gave ages, which ranged from age 20 to 40 with the average being 27 years of age. 83% participants were female and 17% were male.

Participant ID	Age
1	20
2	21
3	22
4	24
5	25
6	26
7	27
8	29
9	36
10	40
11	No Response
12	No Response
Average Age	27

Figure 01: Chart listing the ages of the participants

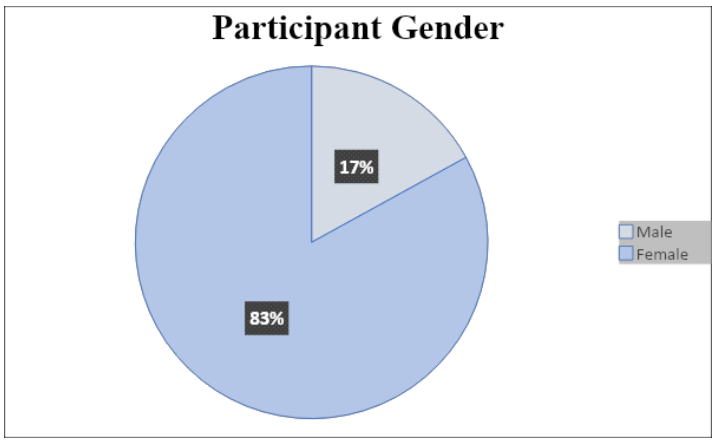

Figure 02: Percentage breakdown for the gender differences of the participants

Sensory Tests

The administered setting and arrangement for this sensory evaluation is not ideal. For each of the tests presented, the participants are given a score sheet the morning of the evaluation and are told to be present at 3:30pm in a scheduled Zoom meeting. Participants were also told to be familiar with types of evaluations to have a better understanding of what was to be expected in order to mitigate some of the "untrained" aspects. Sample codes were in a randomized order, however, sample images and the score sheet were identical for each participant which does not follow the general protocol of the samples being in randomized order for each individual. Professor Zoumas visualed each test one by one on screen as she read the directions out loud as well as described what item we are sampling. She did not rush any of the tests and answered any questions the participants had. After reading directions out loud she would tell the participants to fill in their sheet. The participants were all muted and had their personal screens off, so they were not able to communicate with each other and the Professors were not able to see them as well. It is unknown if participants had purchased samples ahead of time in order to actively participate for their own benefit, but even then, the results would be distorted. Although

encouraged to do so, it is unknown whether or not each participant did this as Professor Zoumas read directions or chose to do it on their own time.

Triangle Test

The Triangle Test score sheet instructed participants to taste all three samples from left to right then mark the one that is different. The samples on the screen were 3 identical cubes of cheese numbered, from left to right, 24, 42, and 15. It was mentioned that two samples are identical, and one is different. An example was given to the participants and this was that the test is to sample a low-fat cheese. Participants were unable to sample the cheese and instead instructed to randomly choose one that is different. Data from this test is collected and used to determine if there is a difference between samples. If data shows a high percentage of participants chose the same sample, then that means there is a big difference in the products visually. Since this data was virtual and randomized, the results will not be as accurate as a traditional test would be.

Paired Comparison Test

The Paired Comparison Test instructed participants to taste two samples from left to right and circle which sample is sweeter. The example given was an Oreo cookie and the participants are told that it was to test which Oreo cookie was sweeter. The score sheet included two identical pictures of Oreo cookies and each score sheet was identical for each participant. The numbers under the samples were 84 and 76. Panelists were told to randomly circle one of the samples. The Paired Comparison Test is used to differentiate an attribute between two samples, therefore if one sample has a high percentage, then the manufacturer may want to reconsider that sample. Because this test was virtual, the data will not reflect an actual attribute.

Ranking Test

The Ranking test instructed participants to taste each sample from left to right then rank them in descending order of sour intensity. The one that is most sour would be labeled #1. The score sheet for this Ranking Test included four pictures of solutions in a sample cup. The example used for this test were solutions of citric acid and participants were told to randomly number each sample from 1 to 4. The Ranking Tests evaluate how much of a difference there is in samples. If participants are choosing a high percentage of a certain sample, then the manufacturer may want to rethink their product. This test was randomized but is unable to reflect an actual product's attributes.

Descriptive Test – Chocolate, Potato Chips, Marshmallows

For the Descriptive Tests mentioned, Professor Zoumas chose three foods that are well known in order to make sure the participants as familiar as possible with the attributes. The chosen foods were chocolate, potato chips, and marshmallows. No list of attributes was given for these tests. For these 3 descriptive tests the data is a bit more generalized. The products chosen are well known to the participants, but it is unknown what type of product each participant was describing when providing answers.

Descriptive Test – Chocolate

The participants were instructed to imagine chocolate or have chocolate in front of them and write down their attributes on a score sheet. The score sheet included a picture of chocolate and had a column labeled: Appearance, Aroma, Flavor, Texture, and Consistency. Participants were given about 2 to 3 minutes for this test.

Descriptive Test – Potato Chips

For this test, participants were told to visualize or sample their own potato chips. The score sheet for this test included a picture of a stack of potato chips with a column labeled: Appearance, Aroma, Flavor, Texture, and Consistency. Participants were given about 2 to 3 minutes for this test.

Descriptive Test – Marshmallows

For this test, the score sheet contained a picture of a pile of marshmallows with the same labeled columns of Appearance, Aroma, Flavor, Texture, and Consistency. Professor Zoumas explained the difference between texture and consistency for those that were confused. Participants were also given 2 to 3 minutes for this test.

Ranking Tests – Hedonic

The example given for this test was a solution of citric acid. The score sheet contained a picture of 4 cups of citric acid solution. Each sample cup was labeled with a number of 162, 123, 113, or 145. Participants were asked to taste each of the following from left to right and rank them in ascending order of preference with #1 being the most preferred. The participants were given enough time to rank before moving on. This test is solely based on preference and is used mainly towards marketing a product. The higher the percentage of the data, the more likeable (or unlikeable) it is. Because this was randomized and virtual, the data does not reflect an actual product.

Paired Comparison - Hedonic

The score sheet for this test contained instructions for participants to taste two samples from left to right and circle the preferred sample. The images on the score sheet is two identical Oreo cookies with the numbers 84 and 76. Each score sheet per participant was identical and no randomized ordering was present. Like the Ranking Test, the Paired Comparison Test is used to

show a participant's preference of a certain product and because this was done in a virtual setting, the results do not reflect an actual product.

Results

Sensory Tests

The data for each test was compiled into one excel sheet by Professor James Arens and given to each participant.

Triangle Test

The Triangle Test included 3 samples. Sample 24 (Regular Fat), Sample 43 (Reduced Fat), and Sample 15 (Regular Fat). 58% of participants chose Sample 24 (Regular Fat), 33% chose Sample 43 (Reduced Fat), and 8% chose Sample 15 (Regular Fat). Of the 12 participants, only 33% were able to tell the difference in fat.

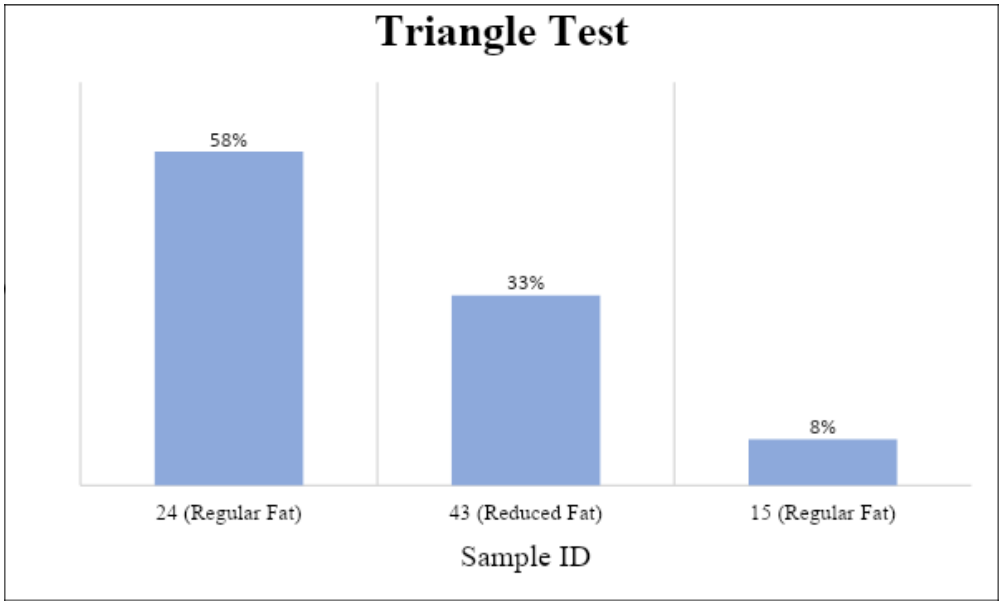

Figure 03: Percentage of participants choosing each of the three samples in the Triangle test

Paired Comparison Test – Analytical (Sweetness)

Samples for the Paired Comparison – Analytical Test included Sample 84 (Regular Sugar) and Sample 76 (Reduced Sugar). As shown in Figure 04, of the 12 participants, 75% of participants chose Sample 84 (Regular Sugar) and 25% of participants chose Sample 76 (Reduced Sugar).

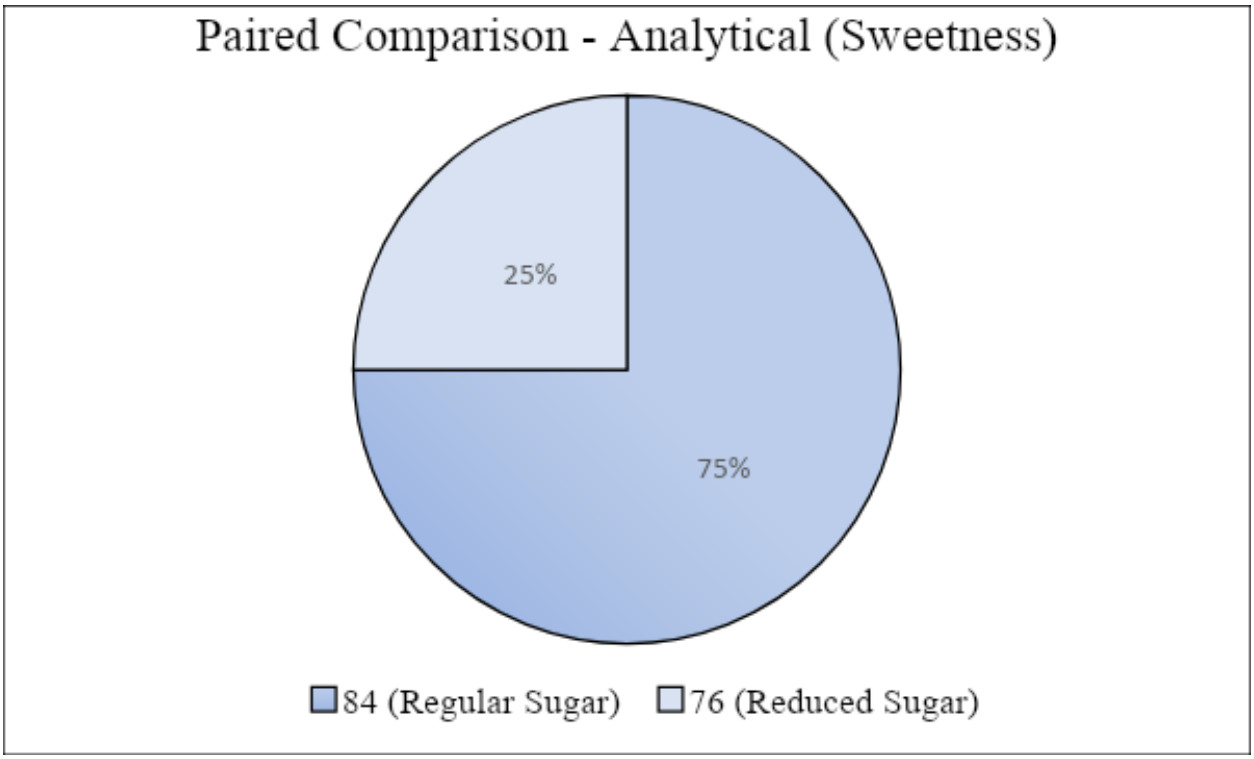

Figure 04: Percentage of participants choosing each option for the Paired Comparison test

Ranking Test – Analytical (Sourness)

The Ranking Test included 4 samples of citric acid solution. The samples included were Sample 145 (12% Solution), Sample 162 (9% Solution), Sample 123 (6% Solution), and Sample 113 (3% Solution). Participants were to rank in descending order from 1-4 with the most sour being labeled 1. Shown in Figure 05 are each participant's ranking. The average rating for each

solution (out of 4.0) are as follows: 2.50 for Sample 162 (9% Solution), 2.50 for Sample 123 (6% Solution), 2.75 for Sample 113 (3% Solution), and 2.25 for Sample 145 (12% Solution).

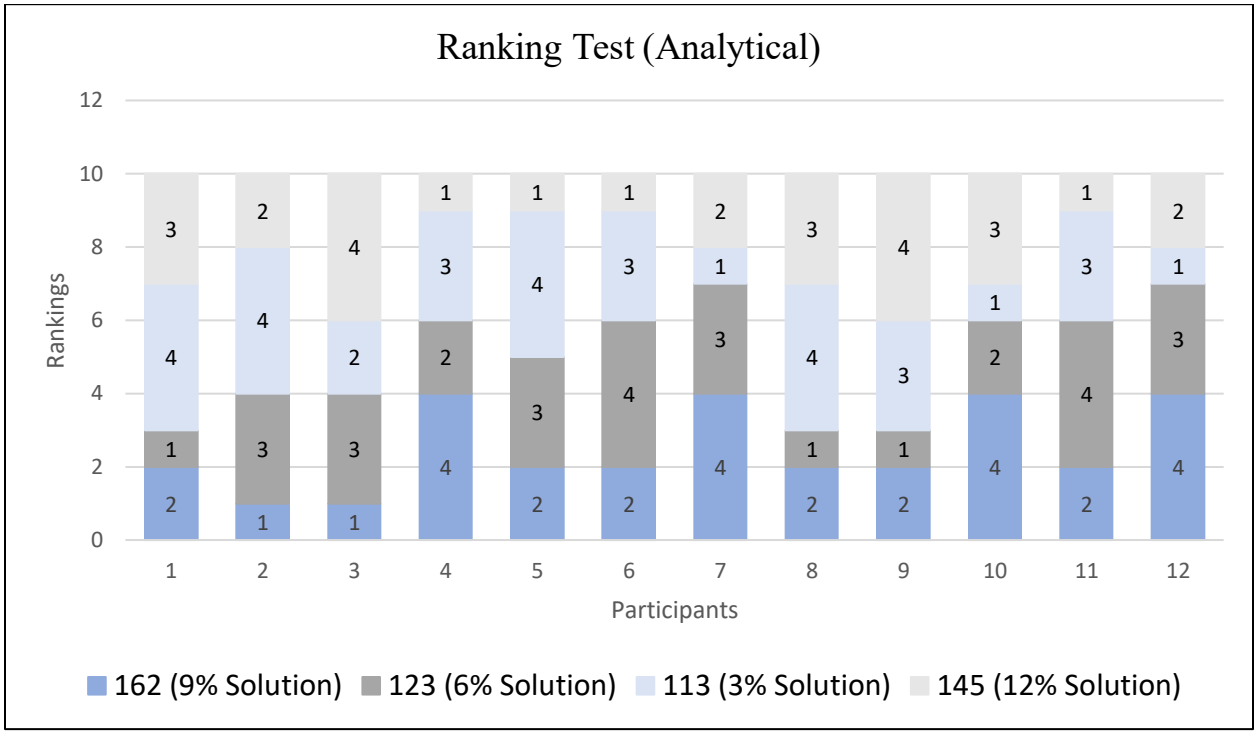

Figure 05: Breakdown on the rankings for each of the four solutions for each participant

Descriptive Test – Chocolate

Participants were told to provide a at least one attribute for the chocolate's appearance, aroma, flavor, texture, and consistency. As shown in Figure 06, a majority of the responses received were brown for appearance, sweet and cocoa for aroma, sweet for flavor, smooth for texture, and creamy for consistency.

Chocolate

Appearance	Attribute	# of Responses
	Flat	1
	Squared	3
	Chunky	1
	Brown	7
	Shiny	3
	Symmetrical	2
	Dark	5
	Auburn	1
	Sticky	1
	Smooth	2

Aroma	Attribute	# of Responses
	Sweet	5
	Sugary	1
	Vanilla	1
	Cocoa	5
	Nutty	3
	Strong	1

Flavor	Attribute	# of Responses
	Overpowering	1
	Rich	2
	Chocolatey	1
	Sweet	9
	Milky	2
	Nutty	1
	Bittersweet	2

Texture	Attribute	# of Responses
	Silky	1
	Smooth	7
	Waxy	1
	Lumpy	1
	Semi-Hard	2
	Grainy	1
	Soft	2

Consistency	Attribute	# of Responses
	Creamy	5
	Smooth	3
	Thick	3
	Buttery	3
	Velvety	2

Figure 06: Recorded responses for the attributes relating to chocolate

Descriptive Test – Potato Chips

Participants were told to provide a at least one attribute for the potato chip's appearance, aroma, flavor, texture, and consistency. As shown in Figure 07, a majority of the responses received were yellow for appearance, earthy for aroma, salty for flavor, crispy for texture, and crunchy for consistency.

Potato Chips

Appearance	Attribute	# of Responses
	Dry	1
	Greasy	2
	Bland	1
	Thin	3
	Fragile	3
	Round	4
	Yellow	5
	Golden	1

Aroma	Attribute	# of Responses
	Earthy	6
	Salty	4
	Oily	3
	Spicy	1
	Baked	1

Flavor	Attribute	# of Responses
	Savory	3
	Salty	9
	Fried	3
	Baked	1

Texture	Attribute	# of Responses
	Crispy	8
	Crunchy	5
	Fatty	1
	Rough	1
	Delicate	1

Consistency	Attribute	# of Responses
	Rough	1
	Crumbly	1
	Crunchy	5
	Hard	1
	Greasy	2

Figure 07: Recorded responses for the attributes relating to potato chips

Descriptive Test Marshmallows

Participants were told to provide a at least one attribute for the marshmallow's appearance, aroma, flavor, texture, and consistency. As shown in Figure 08, a majority of the responses received were white for appearance, sugary for aroma, sweet for flavor, soft for texture, and chewy for consistency.

Marshmallows

Appearance	Attribute	# of Responses
	Squared	1
	Bland	1
	White	10
	Fluffy	3
	Cylindrical	1
	Delicate	2
	Dry	1

Aroma	Attribute	# of Responses
	Sugary	8
	Doughy	1
	Vanilla	2
	Fruity	1

Flavor	Attribute	# of Responses
	Vanilla	1
	Sweet	6

Texture	Attribute	# of Responses
	Spongy	3
	Rubbery	1
	Soft	4
	Chewy	1
	Dry	2
	Pasty	2

Consistency	Attribute	# of Responses
	Mushy	2
	Silky	1
	Gooey	5
	Smooth	2
	Chewy	6

Figure 08: Recorded responses for the attributes relating to marshmallows

Ranking Tests – Hedonic

The Ranking Test included 4 samples of citric acid solution. The samples included were Sample 145 (12% Solution), Sample 162 (9% Solution), Sample 123 (6% Solution), and Sample 113 (3% Solution). Participants were to rank in ascending order from 1-4 with the most preferred being labeled 1. Shown in Figure 09 are each participant's ranking. The average rating for each solution (out of 4.0) are as follows: 2.58 for Sample 162 (9% Solution), 2.17 for Sample 123 (6% Solution), 2.67 for Sample 113 (3% Solution), and 2.58 for Sample 145 (12% Solution).

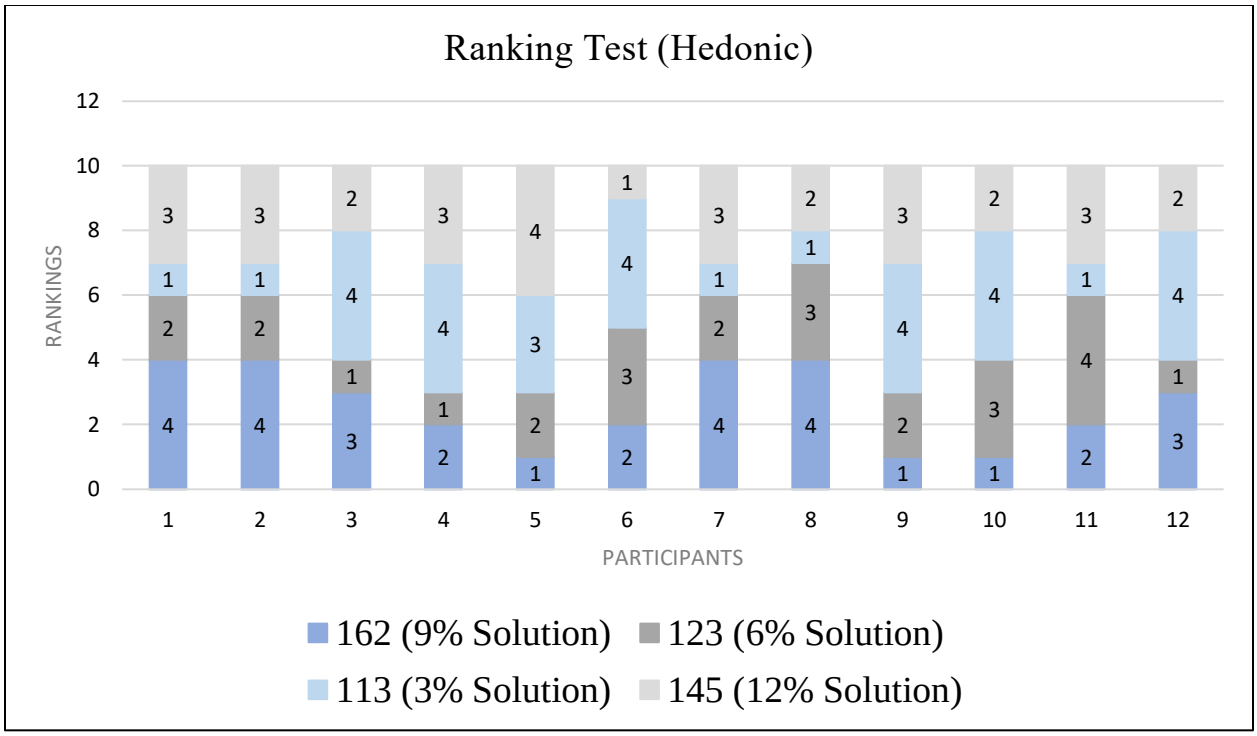

Figure 09: Breakdown on the rankings for each participant in the Hedonic test

Paired Comparison – Hedonic

Samples for the Paired Comparison - Hedonic Test included Sample 84 (Regular Sugar) and Sample 76 (Reduced Sugar). As shown in Figure 09, of the 12 participants, 50% of participants chose Sample 84 (Regular Sugar) and 50% of participants chose Sample 76 (Reduced Sugar).

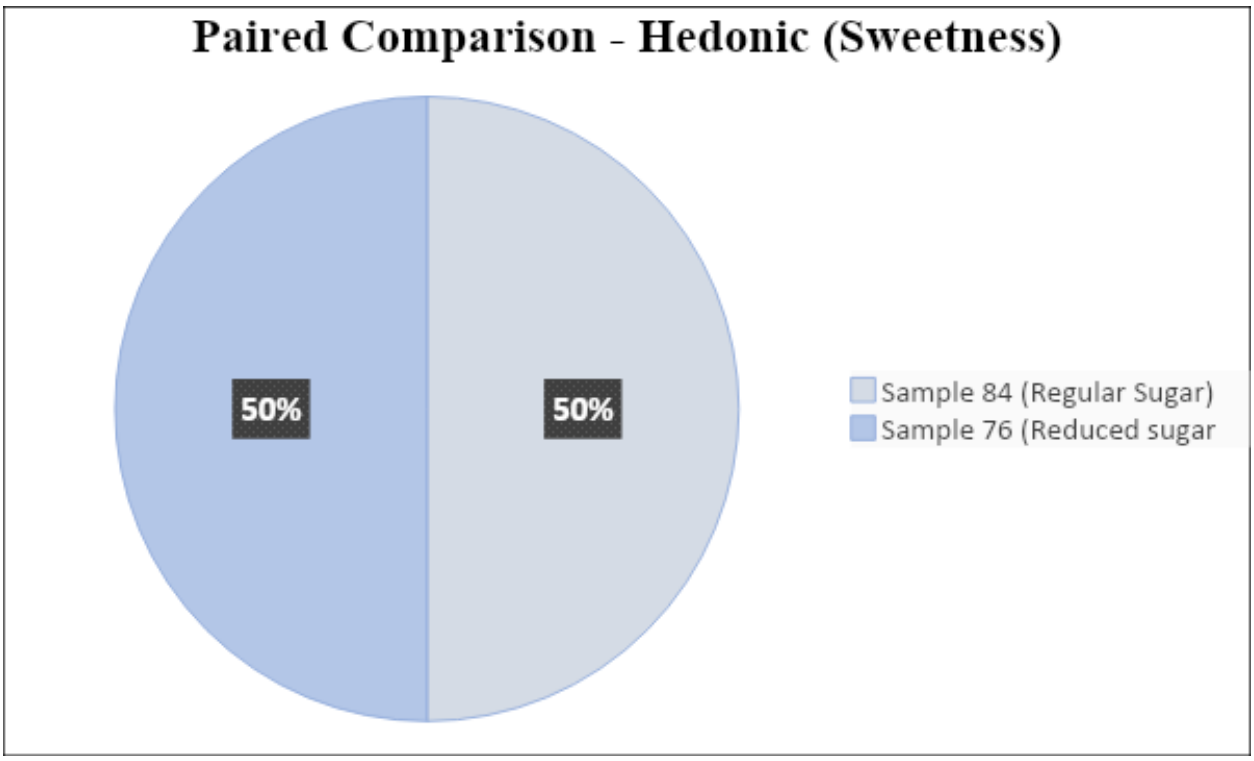

Figure 10: Percentage of participants choosing each sample in the Hedonic test

Discussion

Due to the global pandemic of COVID-19, students at Grossmont College in San Diego, California were not able to fully participate in a traditional sensory lab setting. Instead, the students were asked to participate virtually via Zoom, an interactive video meeting application. No samples were given to each student and the students were untrained for the tests presented. Due to not having an in person setting, much of the sensory evaluation experience was lost. Students were not able to taste, smell, or touch the samples. However, the samples were shown virtually, and students were able to randomly choose samples on their respective score sheets. Each score sheet was identical which is a drawback because usually samples are given in a randomized order. For the triangle test, the professors chose ahead of time which sample is different from the other two and the participants were unaware. This is the same case for each of the other tests presented. Because there was no actual sample to test from, the results are

distorted and unfortunately do not reflect on an actual sample. The triangle test showed that only 33% of participants were able to identify the different sample, which shows that either the product is indistinguishable or rather that administering tests such as these virtually proves to be difficult in capturing insightful results. In a regular lab setting, the results for the analytical paired comparison test on sweetness would show that there is in fact a difference in sweetness between the two samples. 75% of the participants were able to distinguish the regular sugar sample as sweeter versus the reduced sugar sample. Besides the fact that the sample choices were randomized, if the data was based on a real product, this would show that the products have a great difference, which proves to be important if the manufacturer was aiming towards the reduced sugar product to be similar in sweetness as the regular sugar sample. Data for the analytical ranking test sample for the sourness of citric acid shows that there were about the same level of sweetness for each sample. The sample averages ranged from 2.25-2.75 on a 4.0 scale. The 3% solution of citric acid had the highest average, while the 12% had the lowest. Again, this was based on random choice, but if the sample were true samples the data shows that either sample of the citric acid sample is good for the product. The participants were untrained on vocabulary for the descriptive tests. A large percentage of the choices for chocolate stood out such as brown, sweet, smooth and creamy. For potato chips, salty had a high percentage of being the descriptive word. Marshmallows followed the same pattern; many described the product as white and sugary. Since the participants were untrained there were many descriptive words that were low in percentage. The hedonic ranking test results were in between 2.17 and 2.67 on a 4.0 scale. Each sample, like that of the analytical ranking test were about the same. The last test, which is the hedonic paired comparison test shows a 50/50 result for the sweetness of the oreo cookie. The data for this was random, but from a marketing standpoint it would be hard for the

manufacturer to decide which product to release. In conclusion, these tests are extremely important and beneficial in order to truly gain a better understanding of consumer preference from a broad range of perspectives, however the current virtual settings prove to be a difficult feat to overcome in being able to gather substantially statistically significant findings in relation to these tests.

JANEZA BRIDGES
SENSORY SCORE SHEET
MAY 1, 2020 · 04:05 PM

AGE: 27 · GENDER: FEMALE

Triangle Test (LOWER-FAT CHEESE)

1. Taste all three samples from left right.
2. Mark the one that is different with an X

(24) 43 15

Paired Comparison (OREO COOKIE)

1. Taste the two samples from left right.
2. Circle the number of the one that is sweeter

84 (76)

Ranking Tests (SOLUTIONS)

1. Taste each of the following samples from left to right
2. Ranking them in descending order in **sour intensity**. The one that is most sour should be labeled #1

#1 #3 #2 #4

Descriptive Tests - Chocolate

Appearance	Aroma	Flavor	Texture	Consistency
SMOOTH, SHINY, CREAMY, BROWN, SQUARE, SYMMETRICAL	WARM	MILKY, SWEET	SMOOTH, THICK	SMOOTH

Descriptive Tests – Potato Chips

Appearance	Aroma	Flavor	Texture	Consistency
ASYMMETRICAL, GREASY, OVAL	SALTY	SALTY	ROUGH, CRISP, GREASY	CRISPY, CRUNCHY

Descriptive Tests - Marshmellows

Appearance	Aroma	Flavor	Texture	Consistency
SYMMETRICAL, WHITE, DRY	Sweet	Sweet	DRY	SPONGY

Ranking Tests - Hedonic

1. Taste each of the following samples from left to right
2. Ranking them in ascending order of preference. #1 being the most preferred and #4 being the least preferred

Paired Comparison - Hedonic

1. Taste the two samples from left right.
2. Circle the number of the one that you like best

Participant data provided by Professor James Arens:

Demographics

Participated in lab: 12

Age (10 responded) = Average Age was 27 (data below)

Ppt ID	Age
1	20
2	21
3	22
4	24
5	25
6	26
7	27
8	29
9	36
10	40

Gender: 2 Male (17%) and10 Female (83%)

Ranking Test (Sourness)

Samples (% citric acid solution): 145 (12%), 162(9%), 123 (6%) 113 (3%)

Results

	162	123	113	145
	2	1	4	3
	1	3	4	2
	1	3	2	4
	4	2	3	1
	2	3	4	1
	2	4	3	1
	4	3	1	2
	2	1	4	3
	2	1	3	4
	4	2	1	3
	2	4	3	1
	4	3	1	2
Average Score	2.50	2.50	2.75	2.25

Triangle Test:

Samples: 24 (regular fat), 43 (reduced fat) 15 (regular fat)

12 Subject (only 33% were able to detect which one was different)

Sample ID	# Picked sample	% Picked Sample
24	7	58%
43	4	33%
15	1	8%

Paired Comparison (Sweetness)

Samples: 84 (Regular), 76 (Reduced Sugar)

Sample ID	# Picked	% Picked
84	6	50%
76	6	50%

Ranking Test (Preference)

Samples (% citric acid solution): 145 (12%), 162(9%), 123 (6%) 113 (3%)

	162	123	113	145
	4	2	1	3
	4	2	1	3
	3	1	4	2
	2	1	4	3
	1	2	3	4
	2	3	4	1
	4	2	1	3
	4	3	1	2
	1	2	4	3
	1	3	4	2
	2	4	1	3
	3	1	4	2
Average Score	2.58	2.17	2.67	2.58

Paired Comparison

Samples: 84 (Regular), 76 (Reduced Sugar)

Sample ID	# Picked	% Picked
84	9	75%
76	3	25%

Descriptive Terms

Chocolate

Appearance- flat, squared, chunky, brown, shiny, symmetrical, dark, auburn
Aroma- sweet, sugary, vanilla
Flavor- overpowering, rich, chocolaty, sweet, milky, nutty, bittersweet
Texture- silky, smooth, waxy, lumpy, semi-hard, grainy
Consistency- creamy, smooth, thick, buttery, velvety

Chips

Appearance- dry, greasy, bland, thin, fragile
Aroma- earthy, salty, oily smelling
Flavor- savory, salty
Texture- crispy, crunchy, fatty, rough, delicate
Consistency- rough, crumbly, crunchy, hard, greasy

Marshmallows

Appearance-squared, bland, white, fluffy, cylindrical
Aroma- sugary, doughy, vanilla, fruity
Flavor- spongy, vanilla
Texture- rubbery, soft, chewy, dry, pasty
Consistency- mushy, silky, gooey

Chocolate

Appearance	Aroma	Flavor	Texture	Consistency
Flat-1	Sweet-5	Overpowering-1	Silky-1	Creamy-5
Squared-3	Sugary-1	rich-2	Smooth-7	Smooth-3
Chunky-1	Vanilla-1	Chocolaty-1	Waxy-1	Thick-3
Brown-7	Cocoa-5	Sweet-9	Lumpy-1	Buttery-3
Shiny-3	Nutty-3	Milky-2	Semi-Hard-2	Velvety-2
Symmetrica	Strong-1	Nutty-1	Grainy-1	
Dark-5		Bittersweet-2	Soft-2	
Auburn-1				
Sticky-1				
Smooth-2				

Chips

Appearance	Aroma	Flavor	Texture	Consistency
Dry-1	Earthy-6	Savory-3	Crispy-8	Rough-1
Greasy-2	Salty-4	Salty-9	Crunchy-5	Crumbly-1
Bland-1	Oily-3	Fried-3	Fatty-1	Crunchy-5
Thin-3	Spicy-1	Baked-1	Rough-1	Hard-1
Fragile-3	Baked-1		Delicate-1	Greasy-2
Round-4				
Yellow-5				
Golden-1				

Marshmallows

Appearance	Aroma	Flavor	Texture	Consistency
Squared-1	Sugary-8	Vanilla-1	Spongy-3	Mushy-2
Bland-1	Doughy-1	Sweet-6	Rubbery-1	Silky -1
White-10	Vanilla-2		Soft-4	Gooey-5
Fluffy-3	Fruity-1		Chewy-1	Smooth-2
Cylindrical-1			Dry-2	Chewy-6
Delicate-2			Pasty-2	
Dry-1				

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Sensory Report		
Criteria	**Ratings**	**Pts**
Mechanics • Use of correct spelling, grammar, and punctuation • Technical writing style is appropriate • Appropriate word choice • Text citations are correctly formatted in JFS format • References are cited correctly in JFS format • Good professional appearance and overall quality • All appendices are included		10.0 pts
Abstract • Clear purpose statement • Brief explanation of methods • Primary focus is on results • Conclusion is made about study • Appropriate length (<250 words) • Single-spaced, on a separate page, written in 3rd person		10.0 pts
Introduction • Includes background information on sensory testing • Explains different types of sensory tests • Primarily consists of research—paraphrases relevant literature on sensory testing and briefly states methods and results of each source and provides a conclusion • Includes research on difference tests • Statement of purpose included in the last paragraph • Contains no subheadings and is objective • Appropriate length		20.0 pts
Methods • Includes subheadings for panelists, environment, as well as each sensory test in a logical order • All panelist demographic information is reported in percentages • Detailed explanations of environment, materials used, and scales • Accurately explains statistical analysis		20.0 pts
Results • Includes subheadings for each sensory test in logical order • All results are accurately reported in text and displayed in either figures or tables • All figures/tables have descriptive titles and are numerically labeled • Figures have axis titles • Sample codes are explained both in text and on figures • Scales are explained both in text and on figures • Figures and tables are appropriate and data is clearly displayed		10.0 pts
Discussion Discussion • Detailed explanations on why results were observed • Primary focus is on comparing/contrasting results with the literature referenced in introduction • No new studies are introduced • Explanations of limitations/errors • Recommendations provided for future research • Conclusion provided • Contains no subheadings • Appropriate length		10.0 pts
		Total Points: 80.0