What Consumers Really Want

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NUTR205- Food Science
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ABSTRACT
The use of descriptive and difference tests on consumer acceptance are the building blocks of the food and beverage industry and the products they develop. The desired objective in this experiment was to obtain data on specific products through panelist evaluation based on the relevant characteristics of appearance, aroma, flavor, texture, and consistency. Analytic and affective experimental methods were used to determine differences in the amounts of citric acid content with subjective evaluation of San Diego State University Nutrition 205 students. Differences between beverage samples were compared using a paired comparison test, triangle test, ranking test, duo-trio test, and scoring test with reference samples when necessary. Light yellow and dark yellow beverages resulted in a 73% consumer preference among all panelists (n=89) when compared to chartreuse, dark chartreuse, and emerald beverages. Panelists were extremely aware of the presence of citric acid and the variability between them all with resulting percentages of 90% or higher. The addition of citric acid (1%-10% addition) to a beverage was detectable conclusively according to the amount added. The color of different beverages had an absolute influence on their perception and likability of the product which correlated with the percentage of panelists who believed that light yellow and dark yellow were also the most natural beverages compared to the most artificial beverage emerald green. The evaluation of the different characteristics between raisins, almonds, marshmallows, and goldfish gave the SDSU student nutrition majors experience on how to properly administer sensory tests.
INTRODUCTION

Studying the different properties of food and how it affects the quality are the building blocks to puzzling out what people want. This type of puzzle piecing has been used for many years and continues to grow in popularity and specificity. Sensory evaluations are the study of the chemical and physical properties found in food that influences the foods’ quality through components including preparation and type of storage (Brown 2011). It is said that sensory tests began with a focus on the army. During the 1940’s, sensory evaluation methods started to gain interest by the U.S. Army Quartermaster Food and Container Institute that researched food preference for the armed forces (Stone and others 2012). Their goal was to make sure the army was well fed and well nourished to make sure they were at full potential for war. Years later in the 1960’s and through to the 1970’s, the importance of sensory evaluations for food became undermined. With the impact of the “War on Hunger” program funded by the government, acceptance attributes seem to be put on the back-burner (Stone and others 2012). During this time period, anger arose as product after product was denied by the people because of its lack of acceptability. Luckily for the consumers, sensory testing was revamped a few years later.

Today, sensory evaluation methods are the core of the consumer industry. The industry relies on these studies in order to create food products that will be accepted and favored. There is a general understanding that these practices are absolutely necessary for introduction of a successful product. These studies have been applied in research to assess product matching, improvement, process changing, quality control, and more (Brown 2011). The most crucial part of these studies are to find the specific and
measured quality differences in food. These can be assessed with different measurement tools such as a Brix refractometer to measure concentration, or a penetrometer to get the exact measurement size. Along with objective measurements of quality, we also must focus on the subjective differences. In order to some how quantify these, criterion is used to rate and distinguish characteristics such as appearance, texture, taste, aroma, and overall “likability” using a sample of individuals who have the certain requirements to become a panelist (Brown 2011).

Appearance is one aspect of color perception, and is one that we used in this lab. The objective of measuring color perception is to see whether or not color influences the judgment of a product. This is illustrated in the study, “Color of low-fat cheese influences flavor perception and consumer liking,” by Wadhwani and Mcmahon from the Western Dairy Center at Utah State University. This article sorts through the ways in which different low-fat cheese receive different levels of acceptability. What they found is that “translucent white” cheese is less favorable than “opaque white or yellow” cheese. In our experiment, color perception was that of products that included goldfish, raisins, almonds, and marshmallows. Other aspects of appearance include shape, size, and condition of the outside surface (Brown 2011).

Along with appearance, flavor is another important aspect for evaluation. Flavor is the total sensory impression when food is eaten and is a combination of taste, aroma, and mouthfeel (Brown 2011). Flavor profiles have been highlighted in many studies including one featuring the affect of flax addition in bagels. In the article, “Effect of Flax Addition on the Flavor Profile and Acceptability of Bagels” it is explained that bagels with flax showed a lower amount of flavor acceptability compared to bagels without flax (Aliani
and others 2012). It is important to note that studies such as this one are contributors to the bread industry. A report done about the different flavor profiles of yogurt was also examined by Hoppert and others at the Institute of Food Technology and Bioprocess Engineering in Germany. The study, “Integrating sensory evaluation in adaptive conjoint analysis to elaborate the conflicting influences of intrinsic and extrinsic attributes on food choice,” goes into depth on how different factors such as fat and sugar content contribute to a high acceptance levels. It is explained that the flavor profiles of these yogurts can be easily manipulated by changing the composition in the food. The mouthfeel aspect of flavor is one that is unique in that the sensation is actually “felt”. Mouthfeel can include the chemethesis phenomenon and other detected stimulations.

Texture is also commonly used in sensory evaluations and has a heavy affect on whether or not the food is enjoyable to the consumer. The tactile senses are responsible for this physical characteristic and are influenced by the structure and resistance to forces applied by the teeth, tongue, roof of the mouth, knife, and fork (Brown 2011). In a study on olives, “Sensory Properties and Consumer Acceptance of Imported and Domestic Sliced Black Ripe Olives,” results showed that there is a need for a more appealing texture and flavor for table olives in order to gain a larger acceptance for consumers in the U.S. Texture of these olives had a large impact on the consumers here in the United States because of the large difference in texture to what they are used to in other conventional foods. A food that gets a lot of attention on texture profiles is cheese. Cheese was assessed in, “Monitoring of sensory attributes used in the quality payment system of Trentingrana cheese,” and found that the time of year and location of the dairy highly correlated with the different textures identified by the panelists. This is just
another example of how sensory evaluations of things such as texture allow for product innovations and reviews. Another cheese study, “Consumer acceptance and sensory evaluation of Dauni Meridionali Caciocavallo cheese,” takes a look at the different protocols from varied cheese factories that may contribute to the textures. With the help of a taste panel, the experimenters obtained data to show that between the six cheeses from different factories, some of them actually had totally different biochemical features.

Groups interested in conducting sensory evaluations are not limited to just descriptive, analytic tests such as the ones mentioned above. There are other difference tests that can be used to simply differentiate one sample from another (or group of others) based on one selected attribute. Some commonly used tests, and ones that were used in this lab, include paired comparison tests, triangle tests, ranking tests, duo-trio tests, and scoring tests. Each of these tests have the objective to identify differences in samples, to identify differences compared to a standard, or to rank a series in order of intensity and preference. For example, the Triangle test was used in the report, “Sensory acceptability of raw and extruded bovine rumen protein in processed meat products” to assess similarities and differences between soy protein and rumen protein used in processed meats. This test shed light on the sensory profiles of each protein in order to decide whether or not bovine rumen protein is a sensible replacement for soy protein. In this experiment, we use all five of these tests for the particular characteristic of sourness for apple juice with different amount of citric acid in them.

Since the San Diego State University Nutrition 205 students had never completed sensory evaluations before, one of the main objectives was to teach them how to properly administer sensory testing protocols.
METHODS

Panelists

The panelists consisted of all of the San Diego State University Nutrition 205 students present the day of testing. All students fit between the ages of 19-31 years old except for one 35 year old. The majority of students were of 22, 20, 21, 23, and 19 years of age.

A total of 89 students (n=89), all between four sections, were used. Gender included ten males and 79 females. Marital status included 83 single, five married (6%), and one divorced individual. One hundred percent of all students were Foods & Nutrition majors. Furthermore, 65 of the students were studying undergrad while the other 24 were graduate level. The living situations of these individuals included 54 living with 2 roommates, 24 living with 1 roommate, and the other 11 students lived alone.

All students were non-smokers except for one and nine of the students had some type of food allergy such as shellfish (2), preservatives (1), salmon (1), gluten (2), cinnamon (1), vanilla (1), mayonnaise (1), dairy (1), eggs (1), and soy (1). All other 80 students did not have any food allergies that they were aware of. (See Appendix A for demographics questionnaire)

Environment

The room for testing was conducted in the culinary lab room at San Diego State University. The room was very open and had a good amount of airflow. The air was
crisp and slightly cool. The desks were about two feet apart from each other and centered in the middle of the room. The light in the room was fluorescent as usually found in a classroom setting. All the materials in the room were very organized in a specific spot and all tables were clear from any objects. Noises in the room consisted of the overhead lights buzzing softly, people shuffling there feet on the ground, and our lab instructor make few short noises with papers and lab equipment. A few students had sighed or yawned during the testing as well. The room smelled very sanitized and free from any bad odor.

**Color Association/Perception of Beverages**

All 89 students were included for this test. This test included 5 Pyrex measuring glasses that each included a different color of liquid. The different colors were labeled light yellow (Mountain Dairy Lemonade), dark yellow (Xtremo Citrico Vibrante Gatorade), chartreuse (350mL Lemon Lime Gatorade + 150mL Green Squall Powerade), dark chartreuse (Green Squall Powerade), and emerald (Watermelon Gatorade) with the respective colored liquid in each glass. Each glass was covered with plastic wrap and sat about 8 inches apart from each other. All papers needed for the test was handed out to us before starting. Prior to testing, the students were asked to fill out a beverage questionnaire. The test began when the lab instructor took the glasses out and placed them on the counter in the front of the room. At that time, the students were asked to observe them and choose within the attributes of “sweetest”, “most sour”, “most artificial”, “most natural”, “prefer the most”, and “dislike the most”. At the end of each section of attributes, we had to report our answer to the lab instructor with a raise of hands. After this short break, the rest of the tests were resumed. Panelists were than
asked to choose which drinks they would consume at what temps consisting of “cold”, “hot”, “warm”, and “tepid”. At the end of each of these sections, there was a break for each student to report their answers to the instructor with a show of hands. Lastly, the students were asked if they would drink each beverage with a yes or no answer (maybe was not an option). The instructor, with a show of hands, recorded these results as well. (See beverage questionnaire in Appendix B)

**Difference Tests**

*Evaluation of Food Products Using Descriptive Terms*

These tests were analytic and used to characterize the quality, appearance, flavor, taste, aroma, and texture of a food. Before beginning, two of each sample of goldfish, raisins, almonds, and marshmallows were placed into small tasting cups. The first person in each row gathered enough samples for each person in their row, and distributed them. After everyone in the room had received their sample, the testing began. All participants were given a list of words they could use to describe each of the 6 categories: appearance, aroma, flavor, texture, consistency, and mouthful. The list of words are shown in Appendix C.

Between each sample, the participants were told to take a drink of the DI water given to them at the beginning of testing in order to cleanse the palate. After evaluation of each of the four products, the instructor recorded by a raise of hands the word chosen for each characteristic by each individual. After recording each of the categories, this test was complete. No talking, moving, or facial expressions were allowed during this test.

*Paired Comparison Test*
This test was used to compare differences between two liquid products according to the sour characteristic. The two similar liquids were given a sample code in order to keep their names neutral. As for the previous tests, the person at the beginning of each row was in charge or grabbing enough samples of each liquid sample for all the people in their row. It was also their responsibility to make sure the two samples do not get mixed up. After distributing them to each participant in the row, the test began. On their own terms, participants tasted sample 635T1 (0% citric acid) and sample 573T2 (1% citric acid). Between each sample, the participants were told to take a drink of the DI water given to them at the beginning of testing in order to cleanse the palate. After tasting, panelists were asked to determine which sample had lesser or greater sourness. The instructor following the taste tests recorded all results. This test did not allow any talking, moving, or facial expressions.

**Triangle Test**

This test was used to differentiate one sample from the other two samples. In this case, two samples were the same while the third one was different. Each was given a sample code: 777C1 (0% citric acid), 542E2 (0% citric acid), 112H9 (1% citric acid). The first person in each row was responsible once again for obtaining all of the samples without confusion, and than distributing them to the participants. All samples were given at the same time. After each participant tasted each of the samples, they were asked to differentiate the odd one of the three. Between each sample, the participants were told to take a drink of the DI water given to them at the beginning of testing in order to cleanse the palate. Results were recorded immediately after everyone was finished identifying. No talking, moving, or facial expressions were allowed during this test.
**Ranking Test**

This difference test was used to rate five samples for most intense to less intense level of sourness with an ending preference test. As before, the first person in each row was responsible for retrieving all the sample cups and keeping them in order by sample codes. The sample codes used were 555D7 (10% citric acid), 192L3 (5% citric acid), 695F8 (2.5% citric acid), 543K8 (1% citric acid), and 495P2 (0% citric acid). Test did not begin until everyone was quiet and had received each of the sample cups. All together, the test began and the participants tested at their own pace. Between each sample, the participants were told to take a drink of the DI water given to them at the beginning of testing in order to cleanse the palate. Number one was given to the sample with the highest intensity of sourness and a number five was given to the sample with the least intensity of sourness (and the numbers in between corresponded accordingly). A number one was also given in the preference category for the sample they preferred the most and a number five was given to the sample they preferred the least (and numbers in between corresponded accordingly). After ranking, results were immediately recorded by the instructor as soon as everyone was finished. No talking, moving, or facial expressions were allowed during testing.

**Duo-Trio Test**

This test was used to differentiate one vanilla wafer cookie sample from the other. The two brands of wafers used were Nabisco Nilla Wafers and First Street (Smart and Final) Vanilla Wafers. All cookies were given sample codes. A separate paper included a space for the panelists to conduct their results (see the paper in Appendix D). When the
room was quiet and everyone was in their seats, the lab instructor had the first person of each row collect enough samples of the standard cookie for their row. After all the panelists had the standard cookie. After trying the standard cookie, two lab technicians passed out the other two cookies separately. One lab technician started on the left side of the room while the other did vise-versa. As soon as we were handed the next cookie, instructions were given to compare the cookies relative to the standard. Each cookie had to be followed with a drink of distilled water in order to cleanse the pallet. All panelists reported their results on a sheet given by the instructor. After documenting results, the instructor recorded all the results from the panelists with a show of hands.

**Scoring Test**

This test’s objective was to rate the intensity of sourness in relation to a reference sample. As in the other tests, the first panelists in each row obtained enough small white cups for everyone in their row but this time, also filled it with the liquid found in the glass beakers. It was their responsibility to make sure that each liquid was labeled correctly when given to the other panelists. There were three liquids that were each given a sample code. The first liquid with sample code 1001 and was 2.5% citric acid was the reference for the test. After tasting of the reference, panelists were instructed to cleanse our pallet with DI water. Than it was up to the panelists which liquid to try next. The other two included sample code 420M with 1% citric acid and S723 with 5% citric acid. After sampling all liquids, the panelists rated them compared to the reference on a scale of one to seven. Number one being the most sour and seven being the least sour. Panelists were told to rate the reference sample as a four in order for comparison. The instructor recorded all results by a raise of hands.
Statistical Analysis

Data was analyzed with the use of percentages and graphs. Percentages were taken of the full sample size of 89 students (n=89). Each category had a calculated percentage used to compare which results had the highest number of people vote for that specific descriptive words/sample. Graphs have also been used in order to demonstrate the relative differences in percentages for all tests using Microsoft Excel.

RESULTS

Color Association/ Perception of Beverages

For the attribute “sweetness”, Emerald had the highest score with 44% of votes followed by Light Yellow with 26%, and Dark Yellow with 19%. Dark Chartreuse and Chartreuse had only a few votes as shown in Figure 1.

![Figure 1: Subjective Evaluation of the Sweetest Sample in the Color Association/ Perception of Beverages Test by NUTR205 Panelists](image-url)
The “most sour” attribute had majority of votes for Light Yellow with 45% of votes followed by Dark Yellow with 18%. Chartreuse, Dark Chartreuse, and Emerald had much fewer votes shown below in Figure 2.

The “most artificial” attribute resulted that Emerald had the highest percentage of 81% followed by Dark Yellow with only 9%. All other beverages had fewer than eight votes as shown in Figure 3.
The “most natural” attribute was voted very highly for Light yellow with 97% of votes followed by Dark Yellow with 2% and Chartreuse with only 1% as shown in Figure 4. All other samples received no votes.

For the “prefer the most” option, Light Yellow was voted the most with 69% of votes followed by Chartreuse with 13%. Dark Chartreuse, Emerald, and Dark Yellow had less than ten votes as shown below in Figure 5.
The attribute “dislike the most” was voted highest for Emerald with 60% of votes, followed by Dark Yellow with 27%. Dark Chartreuse, Light Yellow, and Chartreuse had less than ten votes as shown below in the Figure 6.

![Figure 6: Subjective Evaluation of the Most Disliked Sample in the Color Association/Perception of Beverages by NUTR205 Students](image)

With regard to the temperature at which the panelists would drink each sample, Light Yellow had the most votes for panelists who would drink it cold with 94% of votes. Dark Yellow was also voted highest for cold with 94% votes. Chartreuse was voted highest for cold as well with 94% and Dark Chartreuse was also voted highest for cold with 96%. Lastly, Emerald was voted highest for cold with 94% of votes.

Panelists recorded whether or not they would drink each beverage. Light Yellow received 97% saying “yes” and Dark Yellow received just about a split result with 51% for “yes” and 49% for “no”. Chartreuse received 63% for “yes” while Dark Chartreuse received 61% for “no”. Emerald received 74% for “no”. These results are shown for comparison in Figure 7.
**Evaluation of Food Products Using Descriptive Terms**

The first assessment was completed for Goldfish. Appearance for goldfish was favored for “golden brown” with a 38% vote and “dry” with a 27% vote. “Symmetrical”, “grainy”, and “rough” all were voted with 7% of votes. All others made up the other 14% of votes. The top three votes are shown below in Table 1.

**TABLE 1: Top 3 Descriptive Words for Appearance, Flavor, Texture, Aroma, Consistency, and Mouthfeel of Goldfish Rated by SDSU Nutr. 205 Students**

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Flavor</th>
<th>Texture</th>
<th>Aroma</th>
<th>Consistency</th>
<th>Mouthfeel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golden Brown</td>
<td>Salty- 78%</td>
<td>Crunchy- 51%</td>
<td>Nothing- 54%</td>
<td>Brittle- 48%</td>
<td>Crisp- 45%</td>
</tr>
<tr>
<td>Dry- 27%</td>
<td>Stale- 7%</td>
<td>Crisp- 37%</td>
<td>Burnt- 29%</td>
<td>Cheesy- 24%</td>
<td>Crunchy- 37%</td>
</tr>
<tr>
<td>Symmetrical- 7%</td>
<td>Sharp- 6%</td>
<td>Flaky- 3%</td>
<td>Spicy- 9%</td>
<td>Thin- 13%</td>
<td>Gritty 11%</td>
</tr>
<tr>
<td>Grainy- 7%</td>
<td>Other- 9%</td>
<td>Gritty- 3%</td>
<td>Other- 8%</td>
<td>Other- 15%</td>
<td>Other- 7%</td>
</tr>
<tr>
<td>Rough- 7%</td>
<td>Other- 6%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other-14%</td>
<td></td>
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</tr>
</tbody>
</table>

Results for raisins had a more even distribution of votes. Top three for appearance were “sunken” with 24% of votes, 18% for “glossy”, and 17% for “dark”. Flavor’s top three descriptive words were “sweet” with 52%, “fruity” with 35%, and flowery with 7%. Texture was voted highest for “chewy” with 43% of votes, “gummy”
with 25%, and “rubbery” with 13%. All others were less than ten votes. Aroma was voted highest for “fruity” with 43% followed by “sweet” with 39%, and a tie between “flowery” and “nothing” with 8% of votes. Consistency had 47% votes for “chewy”, 25% of votes for “gummy”, and 22% of votes for “rubbery”. Mouthfeel had most votes (62%) for “sticky”, 12% of votes for “slimy”, and 11% of votes for “smooth”. All of this is shown in Table 2.

TABLE 2: Top 3 Descriptive Words for Appearance, Flavor, Texture, Aroma, Consistency, and Mouthfeel of Raisins Rated by SDSU Nutr. 205 Students

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Flavor</th>
<th>Texture</th>
<th>Aroma</th>
<th>Consistency</th>
<th>Mouthfeel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunken- 24%</td>
<td>Sweet- 52%</td>
<td>Chewy- 43%</td>
<td>Fruity- 43%</td>
<td>Chewy- 47%</td>
<td>Sticky- 62%</td>
</tr>
<tr>
<td>Glossy- 18%</td>
<td>Fruity- 35%</td>
<td>Gummy- 24%</td>
<td>Sweet- 39%</td>
<td>Gummy- 25%</td>
<td>Slimy- 12%</td>
</tr>
<tr>
<td>Dark- 17%</td>
<td>Flowery- 7%</td>
<td>Rubber- 13%</td>
<td>Flowery- 8%</td>
<td>Rubber- 22%</td>
<td>Smooth- 11%</td>
</tr>
<tr>
<td>Other- 41%</td>
<td>Other- 6%</td>
<td>Other-20%</td>
<td>Nothing- 8%</td>
<td>Other-6%</td>
<td>Other- 15%</td>
</tr>
<tr>
<td>Other- 6%</td>
<td>Other-2%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Descriptive words for Almonds varied as well. Appearance was described as “dry” with 27% votes, “golden brown” with 27% votes, and “light brown” with 26% votes. Flavor was described as mostly “nutty” with 81% of total votes followed by “flat” with 12% of votes and “stale” with only 3% of votes. Texture was almost equally described with the words “hard”, “crunchy”, and “firm”. Aroma was largely taken over by the description “nothing” meaning there was no aroma. Consistency had majority of votes for “thick” with 56% followed by “chewy” with 35% and a tie between “thin” and “rubbery” with only 3% of votes each. Lastly, mouthfeel had most votes for “crunchy” with majority 62% of votes followed by “gritty” with 21% votes and “crisp” with 8% votes. Table 3 shown below summarizes the top three descriptive words for each category.
TABLE 3: Top 3 Descriptive Words for Appearance, Flavor, Texture, Aroma, Consistency, and Mouthfeel of Almonds Rated by SDSU Nutr. 205 Students

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Flavor</th>
<th>Texture</th>
<th>Aroma</th>
<th>Consistency</th>
<th>Mouthfeel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry- 27%</td>
<td>Nutty- 81%</td>
<td>Hard- 26%</td>
<td>Nothing- 91%</td>
<td>Thick- 56%</td>
<td>Crunchy- 62%</td>
</tr>
<tr>
<td>Golden Brown- 27%</td>
<td>Flat- 12%</td>
<td>Crunchy- 25%</td>
<td>Burnt- 6%</td>
<td>Chewy- 35%</td>
<td>Gritty- 21%</td>
</tr>
<tr>
<td>Light-brown- 26%</td>
<td>Stale- 3%</td>
<td>Firm- 22%</td>
<td>Flowery- 2%</td>
<td>Thin- 3%</td>
<td>Crisp- 8%</td>
</tr>
<tr>
<td>Other- 20%</td>
<td>Other- 4%</td>
<td>Other- 27%</td>
<td>Other- 1%</td>
<td>Rubbery- 3%</td>
<td>Other- 9%</td>
</tr>
<tr>
<td>Other- 3%</td>
<td></td>
<td></td>
<td></td>
<td>Other- 3%</td>
<td></td>
</tr>
</tbody>
</table>

The last product assessed in this test were the marshmallows. Marshmallows were described as “puffy” for appearance with 83% of votes. Less than 10% of votes included “rounded”, “smooth”, “dull”, and all others. Flavor had majority vote for “sweet” with 69% of votes followed by “flowery” with 15% and Pasty with 12%. Texture was described almost equally with “springy”, “gummy”, and “velvety”. Aroma was highly vote for the descriptive word “sweet” while “nothing”, “flowery”, and all others were voted for less than 10% of votes each. Consistency was described “gummy” with 33% of votes followed by “chewy” with 27% and “thin” with 12%. Mouthfeel was considered “smooth” with 44% or votes along with “sticky” 29% and “slimy” 19%. Top three results for each category are shown below in Table 4.
TABLE 4: Top 3 Descriptive Words for Appearance, Flavor, Texture, Aroma, Consistency, and Mouthfeel of Marshmallows Rated by SDSU Nutr. 205 Students

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Flavor</th>
<th>Texture</th>
<th>Aroma</th>
<th>Consistency</th>
<th>Mouthfeel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puffy- 83%</td>
<td>Sweet- 69%</td>
<td>Springy- 22%</td>
<td>Sweet- 87%</td>
<td>Gummy- 33%</td>
<td>Smooth-44%</td>
</tr>
<tr>
<td>Rounded-7%</td>
<td>Flowery-15%</td>
<td>Gummy- 22%</td>
<td>Nothing-7%</td>
<td>Chewy-27%</td>
<td>Sticky-29%</td>
</tr>
<tr>
<td>Smooth-2%</td>
<td>Pasty- 12%</td>
<td>Velvety-17%</td>
<td>Flowery-3%</td>
<td>Thin- 12%</td>
<td>Slimy-19%</td>
</tr>
<tr>
<td>Dull-2%</td>
<td>Other- 4%</td>
<td>Other-39%</td>
<td>Other-3%</td>
<td>Other-28%</td>
<td>Other-8%</td>
</tr>
<tr>
<td>Other-6%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Paired Comparison Test

This test received a large majority vote of 99% for “greater” of sample 573T2 which was the 1% citric acid (n=89). Barely 1% of panelists voted that 573T2 was more sour than the other.

Triangle Test

This test reflected a large majority as well with 98% of votes identifying sample code 112H9 (1% citric acid) to be the odd product in comparison to the other two samples.

Ranking Test

On a scale of one to five with one being the most sour and five being the least sour, 555D7 (10% citric acid) had a 97% vote for being number one. Rank number two received an 89% vote for sample 192L3 (5% citric acid). Rank number three received 88% votes for sample 695F8 (2.5% citric acid). Rank number four was voted highest for sample 543K8 with 87% votes. Lastly, ranking number five for the least sour was voted the most for sample 495P2 (0% citric acid). Results are shown below in Figure 8.
**Duo-Trio Test**

This test resulted in a large majority vote for differentiating one sample from the standard. Sample 6104 belonging to the First Street Smart & Final brand vanilla wafers was chosen by 96% of students to be different from the standard. Along with differentiating, 57% panelists believed that the difference was due to the wafer having less vanilla. The other 43% consisted of panelists who thought that the wafer’s difference was due to the dryness or crunchiness. Figure 9 below shows the percent of panelists who thought the difference was due to one of the three options.
When panelists were asked if they drank apple juice regularly, 51% said they do while 24% said they did not.

**Scoring Test**

Sample 420M (1% citric acid) was scored the highest relative to the reference sample with 61% of panelists to number six, lower of that of the reference sample. Sample S723 (5% citric acid) was scored mostly at number one with 58% of votes followed by number two score with 35% of votes. The arbitrary score for the reference sample was a four. Figure 10 below shows the percentage of panelists who give the respective ratings.

**DISCUSSION**

These tests have revealed information about products that may further help consumer acceptance. The Color Association/Perception of Beverages test revealed that color has a direct affect on whether or not the beverage seems too artificial, too sweet, too sour, or very natural. Color association for the perception of how sweet it is proved that the more pigmented the liquid seems to be, the more panelists thought it seemed more
sweet. Light yellow and emerald had the highest percentage of votes for sweetest beverage. This seems to correlate with the very yellow color and the deep green color of the two liquids. From the study previously mentioned on different low-fat cheese, it is apparent that the color of low-fat cheese is important and can even affect the perception of flavor (Wdhwani & McMahon 2012). This is exactly what happened in our study except instead of affecting flavor, it affected their perception of the flavor since the panelists never actually tasted these beverages.

Next was the “most sour” category. From light to dark color, the percentages seem to decrease. Light yellow and dark yellow were voted highest for the “most sour” beverages. It seems to be that the color yellow is associated with the “most sour” attribute. This may be because of the yellow color of food such as lemons or lemon drop candies that are understood to be sour when eating. These products may also be associated with other yellow beverages such as lemonade. The least voted beverages were dark chartreuse and emerald, which are a green color rather than yellow.

The beverages that were most artificial consisted mostly of just the emerald liquid. The emerald liquid is the most pigmented liquid and may be one reason why it was highly voted for this category. After consideration, these results could have stemmed from the translucent green color and it’s association with artificial food coloring. Some may think that the green color could be associated with vegetables such as spinach, broccoli, cucumber, and leafy greens. But, since this color is translucent and not opaque, it seems to stray away from the green association with vegetables. On the other hand, green food color that can be put into a liquid such as water and will not change the light absorbance of the water, but instead will just change strictly the color.
Research presented by Wdhwani and others (2012) found that adding titanium dioxide increases cheese opacity so it looks more like full-fat cheese. This full-fat cheese is more desirable to the consumer. Since or liquids are translucent, they are not associated with natural substances that may prove desirable to all of our Nutrition 205 majors.

On the other hand, light yellow largely took over the most natural category. Just as explained before, this may be due to the association of yellow with lemons. Lemons are found naturally compared to maybe that of the emerald green that can not be easily identified with any natural food we know of.

It is worth noting that the beverage that was preferred the most is the same beverage as the most natural and most sour. The most logical reasoning is the one explained before of lemons. Another reason the light yellow beverage was the most preferred may be because it reminds panelists of lemonade, a fountain drink often found in the United States. Vise versa, Emerald was the most disliked beverage which was also that most artificial. The correlation between the most disliked and most artificial may be due to the fact that all the panelist are health conscious individuals in the field of foods & nutrition. This seems to have made a strong influence on the acceptance of the two complete opposite beverages. This limitation seems to be the biggest of concerns that can further help future recommendations. Using a wider range of panelists can allow for more accurate data.

Evaluation of food products using descriptive terms showed the specific characteristics of non-alike products. It is seen that there was a larger range of answers compared to any other test. Because the panelists were given the same words to choose from, some of the answers may have been chosen for lack of other words. It is important
to note that some products had an overall understanding of how it *should* taste. For example, 81% of panelists chose that almonds have a nutty flavor. Before testing, this notion that almond is a nut may have influenced the reason why they chose that descriptive word. The study done by Hoppert and others (2012) found that a panelist’s intrinsic factors had a direct influence on food choice. They go on to conclude that information on choice factors can be achieved in a lab setting, but can be very difficult. Since it is deemed impossible to block out all extrinsic factors while doing subjective tests, all outside sources will more than likely affect perception.

Limiting the amount of words that the panelists were able to use is an obvious limitation. For future research, an option listed “other” could be noted and a place for the panelist to write their own interpretation. This may open up opportunities for data to recognize if there is an overall understanding of the way a product tastes without the use of a word bank. A study done on the acceptance of olives explains that the texture of foreign produced olives is unfavorable to consumers in the U.S. because the texture differs from any that we find in our foods (Lee and others 2012). Doing a descriptive test on these olives proved to be more difficult to explain because of the unfamiliar texture. Including this “other” option in future tests may give a better understanding of what consumers want.

Another unfortunate drawback of limiting the words for description may be the possibility that another words fits the description better than any of the words listed, but because there are no similar ones, they choose one that they know doesn’t truly fit the product. This leads to inaccurate results and conclusions of products.
The paired comparison test seemed to be extremely accurate in the fact that 99% of votes were recorded for one answer. It is normally safe to say that with results such as these, that this product can be considered in the community as a standard. But, since our sample only consisted of 89 students, more research may be needed. Sample size can be a potential limitation of this study. A study done on bagels with the addition of flax helps explain the ability for consumers to notice differences in their everyday products (Aliani and others 2012). A very large percentage of panelists in this study were able to detect the presence of flax. Although their panelists were experts, this supports the fact that these sensory evaluation tests have true meaning. Aliana’s study also had a sample size of 89 consisting of 63 females and 26 males. They to, suggested that in future studies such as these, using descriptive terms should contain a larger sample size in order to give a more general conclusion.

When identifying an odd product as in the triangle test, it is important to note that the order in which the panelist tried the citric acid liquid. By tasting a more sour liquid before a milder one, the risk is increased for taste manipulation of the second one. Note that taste fatigue is an obvious limitation especially because four of the tests dealt with the different amount of citric acid. The triangle test was done right after the paired comparison test, which also involved sourness. This seems to be a theme among other studies such as the study done by Conti-Silva on raw and extruded bovine rumen protein in processed meats. Conti-Silva’s study conducted each separate test one after another with the same three sausages in each test.

Also, DI water was given to each panelist in order to cleanse the pallet between each liquid. An unfortunate drawback would be the responsibility of the panelist to
follow all protocols including cleansing the pallet. Not doing so can affect the way the next tasting will be perceived. The study done on Trentingrana cheese explained previously used only eight panelists, but all were experts on cheese. These experts have a much lower risk of error because of their background with sensory evaluations (Brittante 2011). Unlike this cheese experiment, our panelists were “first-timers” for sensory evaluations and therefore do not have the experience dealing with taste tests.

In the ranking test, all samples were just about accurately placed in the corresponding ranking numbers for most panelists in relation to the citric acid content. All results showed percentages of 85% or higher for each of citric acid beverage.

The duo-trio test showed interesting results for reasons why the Smart & Final vanilla wafer differed from the standard wafer from Nabisco. Although “less vanilla” received that most votes, “crunchiness” and “dryness” were not left in the dust. Some panelists may have thought the difference was a combination of all three options, but this was not an option for this test. There may also be different descriptive words that panelists wanted to use that were not one of the three given to us. Those are just a few limitations that could have altered results.

The scoring test had a criterion to follow by placing the reference sample at level four. This immediately influenced the way the other two beverages would be perceived. This gives an indirect reminder than one sample will be lower than a four and the other will be higher. This could have influenced decision making of scoring each sample.

Overall, more research is needed to make any generalizations about the products tested. In order to better understand consumer acceptance, a larger sample size is needed. Also, a more open-minded test may give more reasoning of consumer likings than just
the short amount of words given in this experiment. Luckily, we can draw from these experiments that the panelists education background can play a huge part in decision making. Nutrition majors are more willing to choose the more healthier options (or seemed healthier) than any other products seen otherwise. San Diego State University Nutrition 205 students now know the basics of properly administering sensory tests in a lab setting.
APPENDICES:

A- Demographic survey sheet
B- Beverage Questionnaire Sheet
C- List of Descriptive Words
D- Duo-Trio Test Paper
REFERENCES:


LABORATORY REPORT EVALUATION FORM  
Nutrition 205

Student Name  ________________________________

**MECHANICS**  (20 points)

- Spelling
- Grammatical Usage
- Technical writing style
- Word Choice
- Punctuation
- Text Citation
- List of references . . . form/format
- Professional appearance/overall quality
- Appendices

**CONTENT**  (100 points total)

- **Abstract**  (10 points)  ___________
- **Introduction**  (20 points)  ___________
  - Focus of review
  - Organization of review
  - Reference selection
  - Expansion beyond class material
- **Methods**  (20 points)  ___________
  - Clarity of description
  - Accuracy of description
  - Organization
- **Results**  (25 points)  ___________
  - Appropriate data reduction
  - Appropriate tables/figures
  - Clarity of tables/figures
  - Descriptive/numerical data distinction
  - Flow/development of the text
- **Discussion**  (25 points)  ___________
  - Comparison/contrast with the literature
  - Correct interpretation of findings
  - Identification of experimental error

**SUBTOTAL OF FINAL EARNED POINTS**

**MINUS ANY LATE PENALTY POINTS**

**FINAL TOTAL POINTS EARNED – POSSIBLE 120**