ABSTRACT

This study reviews the nutrition claims and the liking of the quinoa granola product developed by lab section three unit three. The rationale was to create a high protein and nutritious breakfast/ snack. The objective is to create an appetizing quinoa granola for consumers. The nutrition claim is that the granola is high in fiber and is a complete protein. The quinoa granola is high in omega 6 fatty acids which could be beneficial to third world country nutrition implementation programs. The research shows that the quinoa is 50.2% omega 6 and has antioxidant activity. The dependent variables that were tested in the study were texture, sweetness, flavor, appearance, taste, and moisture level. The independent variables were the brown sugar, brown rice syrup, maple syrup, and honey. The quinoa started out raw in the product and we determined it to be much better cooked and then broiled to establish the desired crunch. Rolled oats, slivered almonds, dried cranberries and yogurt were also independent variables. The data analysis methods that were used were SPSS, T-test, water activity, and the hedonic scale. Appearance mean: 1.31 and the p-value are .62. Sweetness mean: .60, p-value: .282. Texture mean: .24, p-value: .681. The appearance for the granola without cranberries was the highest with a mean at 9.88. The mean of 3.50 was the highest of the liking test; however none of the data that was found was significant. The conclusions that can be drawn from this experiment would be that another grain should be used to boost the protein content of the product. Also the oil content should be considered in order to reduce the fat content. The texture was also something that should be considered based on the responses from the consumer testing. At the end of the testing period the flavor and sweetness level was at a desired level but our group had not established a perfect texture.
INTRODUCTION

Our food product over the past semester has been challenging at times but overall we enjoyed the process and the consumers enjoyed our product. We created a quinoa granola with dried cranberries and almonds. Our objective of the study was to create an appetizing quinoa granola for consumers. The idea was for it to be served as either a breakfast food or snack served with vanilla yogurt. Over the course of the semester the main things we altered was the appearance, sweetness, and texture. Our nutrition claim is that the granola is high in fiber and is a complete protein. This project was significant because we created an easy, affordable snack that is a complete protein. This food item can be used in third world countries because it is also high in omega 6 fatty acids that are very beneficial to the diet. In this paper we will discuss the methods and materials used, reported results and a discussion of the project.

LITERATURE REVIEW

A current trend in nutrition includes foods with high fiber content and consuming foods with good nutritional value. Quinoa does not have a relatively high protein content in comparison to other grains; however it has a balanced composition of essential amino acids (Jacobson, 2003). The protein is comparable to that in milk and is easily accessible with a better shelf life. Quinoa has the potential to provide essential amino acids to hungry people in desperate situations that is
sustainable and easily prepared. By incorporating this super grain into our granola, we are increasing the nutritional content and value.

The article citing the nutritional value of Quinoa sheds light on the high oil content in the grain. More than half of this oil contains Omega 6 fatty acids, which is heart healthy and is helpful in reducing hypertension. Omega 6 fatty acids maintain cell membrane fluidity and are also helpful with certain skin diseases and neuropathy. (Johnson, 2003) Quinoa is a high fiber grain because when cooked the whole grain, including the germ, is incorporated in consumption. Fiber is currently a growing trend due to its cholesterol lowering capabilities and digestion regularity. The fiber will increase satiety and prolongs the full feeling, which is a great benefit for breakfast or snacking foods. Adding Quinoa to granola increased the fiber content dramatically and it contains 12% of Daily Value in every serving. Also, “quinoa is high in calcium, magnesium, iron, copper and zinc” (Johnson, 2003).

Granola has gained popularity in the past decade, and Americans are consuming granola more and more. There are many kinds of granola and we added to the variety by incorporating quinoa into this product. The NY times provides excellent granola recipes and provided us with some ideas during the methods process. Schulman advised us to add oats and granola, increasing texture, likability and appearance.
MATERIALS AND METHODS

In an experiment, the dependent variable is what is being measured and the element that is being affected. Throughout our food product development project we dealt with a handful of different dependent variables. Texture, sweetness, flavor, appearance, taste, and mouth-feel were our dependent variables. An independent variable is a factor that can be varied or manipulated in an experiment. It is usually the element, or in our case, the ingredient that will affect the dependent variable.

The texture, mouth-feel, and appearance of the product started out not looking like something one would call granola. It was very grainy and was quite unappealing. After adding a few ingredients and removing some others, the product had more of a typical granola look to it with varying shapes and textures gave it more depth and a significantly more appealing appearance. The sweetness, flavor and overall taste of our product were less than favorable during our first week of trials. The granola had too much of an earthy, bird-seed-like taste and the sweetness was not at the level we wanted. By trying different mixtures of sweeteners and different methods for prepping our ingredients, we were able to come up with a well-liked appealing product.
<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trial 1</td>
<td>Trial 2</td>
<td>Trial 1</td>
<td>Trial 2</td>
<td>Trial 1</td>
<td>Trial 2</td>
</tr>
<tr>
<td>Red Quinoa</td>
<td>1/2 cup</td>
<td>1/2 cup</td>
<td>1/2 cup</td>
<td>1/2 cup</td>
<td>1/2 cup</td>
<td>1/2 cup</td>
</tr>
<tr>
<td>Ground Cinnamon</td>
<td>1/2 tsp</td>
<td>1/2 tsp</td>
<td>1/2 tsp</td>
<td>1/2 tsp</td>
<td>1/2 tsp</td>
<td>1/2 tsp</td>
</tr>
<tr>
<td>Olive Oil</td>
<td>1/2 Tbs</td>
<td>1/2 Tbs</td>
<td>1/2 Tbs</td>
<td>1/2 Tbs</td>
<td>1/2 Tbs</td>
<td>X Tbs</td>
</tr>
<tr>
<td>Whole Flax Seeds</td>
<td>1/8 cup</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ground Flax Seeds</td>
<td>X</td>
<td>1/8 cup</td>
<td>1/8 cup</td>
<td>1/8 cup</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Maple Syrup</td>
<td>2 Tbs</td>
<td>X</td>
<td>1 Tbs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Brown Rice Syrup</td>
<td>X</td>
<td>2 Tbs</td>
<td>1 Tbs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Brown Sugar</td>
<td>X</td>
<td>X</td>
<td>1 Tbs</td>
<td>1/8 cup</td>
<td>1/8 cup</td>
<td>1/4 cup</td>
</tr>
<tr>
<td>Rolled Oats</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1/2 cup</td>
<td>1/2 cup</td>
</tr>
<tr>
<td>Slivered Almonds</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1/4 cup</td>
</tr>
<tr>
<td>Honey</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>2 tsp</td>
</tr>
<tr>
<td>Dried Cranberries</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1 tsp</td>
</tr>
<tr>
<td>Vanilla Yogurt</td>
<td>10 oz</td>
<td>10 oz</td>
<td>10 oz</td>
<td>5 oz</td>
<td>5 oz</td>
<td>7 oz</td>
</tr>
<tr>
<td>Plain Yogurt</td>
<td>5 oz</td>
<td>5 oz</td>
<td>5 oz</td>
<td>5 oz</td>
<td>3 oz</td>
<td>3 oz</td>
</tr>
</tbody>
</table>
In order to make our product more appealing, we tried different cooking methods to find our desired texture and mouth-feel.

Week 1 (both trials): Uncooked quinoa. Baked at 350 degrees for 15 minutes, stirring every 5 minutes.

Week 2 (both trials): Uncooked quinoa Baked at 350 degrees for 15 minutes, stirring every 5 minutes.

Week 3 (trial 1): Pre-cooked quinoa. Baked at 350 degrees for 15 minutes, stirring every 5 minutes.

Week 3 (trial 2): Pre-cooked quinoa. Baked at 350 degrees for 15 minutes, stirring every 5 minutes, broiled for 3 minutes after baking.

Week 4 (trial 1): Pre-cooked quinoa. Baked at 350 degrees for 15 minutes, stirring every 5 minutes, broiled for 3 minutes after baking.

Week 4 (trial 2): Pre-cooked quinoa. Baked at 350 degrees for 10 minutes, stirring every 5 minutes, broiled for 5 minutes after baking, stirring every minute.

Week 5 (trial 1): Pre-cooked quinoa. Baked at 350 degrees for 10 minutes, stirring every 5 minutes, broiled for 5 minutes after baking, stirring every minute

Week 5 (trial 2): Pre-cooked quinoa. Pre-toasted rolled oats and slivered almonds together on the stove. Baked at 350 degrees for 10 minutes, stirring every 5 minutes, broiled for 3 minutes after baking, stirring every 30 seconds.
Week 6 (both trials): Pre-cooked quinoa. Pre-toasted slivered almonds in the oven. Baked at 350 degrees for 10 minutes, stirring every 5 minutes, broiled for 3 minutes after baking, stirring every 30 seconds.

The rationale in selecting the different treatments for our product had to do with our group and consumer’s taste and texture preferences in comparison to the two trials prepared each week. Our first focus was to improve the sweetness/taste/flavor of the product and as we worked on that we fine-tuned the texture/mouth-feel/appearance. The original recipe called for maple syrup and whole flax seeds; and in our first prototype we used brown rice syrup and ground flax seeds. Both of these intended sweeteners did not provide enough the amount of sweetness for our product and the brown rice syrup actually made our product taste more like rice instead of granola. We also found the whole flax seeds were very difficult to chew and tended to get stuck in our teeth.

In our second week we tried a mixture of the maple syrup, brown rice syrup, and brown sugar for one trial, and brown sugar simple syrup for the other. We were surprised to find that the brown sugar simple syrup, even though it was a bit difficult to work with (it seized up as soon as we removed it from the stove), gave a more appealing sweetness to the granola. We stuck with the ground flax seeds because it made the granola easier to eat. In week three we decided to cook the quinoa on the stove prior to baking it with the rest of the granola. These made the product significantly easier to eat and helped get rid of the birdseed type of feel the product had in previous weeks.
For week three’s first trial we stuck to the better-liked prototype from the week before, which included just brown sugar as a sweetener and ground flax seeds. Trial two included an increase in the amount of brown sugar, the removal of the ground flax seeds, and the addition of rolled oats. We also broiled this trial after it was done baking to get a little bit of extra crunch into the oats. The group that sampled the product enjoyed the changes in the second trial and thought that the appearance was much more appealing with the rolled oats added in.

Week four brought very minimal changes to the product. Our trial one was the same as the week three’s trial two. Trial two had slivered almonds added to the product to give it a nuttier flavor. With the addition of nuts, we cut down the baking time to ten minutes and rose the broiling time to five minutes. The nuts were well received and gave our product higher ratings than the week before from our consumers.

We used week four’s trial two as our control sample for trial one in week five. For trial two we pre-toasted the oats and almonds on the stove, which gave the finished product a hint of burnt flavor. We also removed the oil in this trial and added honey in hopes that it would give the product more of an appealing texture and appearance. The honey and pre-toasting made the product look much more like a traditional granola, but the changes made the texture have a soggy feel to it, which was not received well.

To fix this problem, in week six we used less honey and brought the oil back into the recipe. Instead of toasting the oats and almonds on the stove, we toasted only the almonds in the oven prior to combining the ingredients and baking them
together. For our two trials there was only one difference: the addition, or lack thereof, dried cranberries. We also found that baking each for ten minutes, stirring halfway through then broiling for only three minutes, stirring every thirty seconds provided the perfectly cooked quinoa granola.

During all six weeks we were working with different brands and flavors of yogurt to serve the granola over. We started with Yoplait low fat vanilla yogurt, which was very sweet and overpowered the granola. Week two brought in Yoplait non-fat vanilla yogurt. This was a bit better, but the sweetness and flavoring of the yogurt masked the flavor of the granola. In week three we tried to do a half plain, half vanilla yogurt mixture to tone down the strength of the flavor. Unfortunately, the mix of Mountain High plain yogurt and Yoplait non-fat vanilla yogurt did not complement each other well and left the group that testes the product with puckered lips from the sour plain yogurt. In week four we thought that switching the brand of vanilla yogurt to Mountain High would better complement the plain Mountain High yogurt. Luckily it was a bit better and we did not get as many complaints about the yogurt flavor. Weeks five and six ended in a slightly higher than 2:1 ratio of vanilla yogurt to plain yogurt. This gave the consumers just enough sweetness to overpower the sour taste of the plain yogurt, but not too much to where it would overpower the granola itself.

Consumer testing was week seven of our food product development process. Consumers were invited to taste products and had the choice to attend or not attend the tasting. Multiple products were available to be sampled, so consumers also had the choice of what products they wished to taste. The consumers that were
interested in our product were given two sample cups, each with one tablespoon of yogurt and one tablespoon of granola. The two recipes we used were both from week six. The variation they were able to see and taste was from the absence or presence of dried cranberries. Each sample had a three-digit number assigned to it for identification. The consumers were given a score sheet to fill out before during and after they sampled the product. They first had to rate their interest in the product after reading our concept for it. Then they moved onto the appearance of the products, where they marked on a hedonic scale how appealing the granola and yogurt were. They then tasted one sample, and rated their initial liking amount on a scale of one to five. They then rated the sweetness and texture of the product on a Just-About-Right scale. After this, they were asked again to rate their liking of the product after looking at it a bit more in depth, again on a one to five scale. Sample two was then tasted, using the same scales. When the consumer was finished tasting the samples, we asked them to write a comment comparing the two and giving a reason for which of the two they preferred more. We were able to reflect their comments to the actual numbers they wrote down for each of the samples.
RESULTS AND DISCUSSION

The first table shows the results of the consumer testing when we asked the consumers what specifically they liked about our product. GWC stands for granola with cranberries and GWOC stands for granola without cranberries. Besides the cranberries the granola was prepared in the same way.

**TABLE 1**

<table>
<thead>
<tr>
<th></th>
<th>Appearance GWC</th>
<th>Appearance GWOC</th>
<th>Sweetness GWC</th>
<th>Sweetness GWOC</th>
<th>Texture GWC</th>
<th>Texture GWOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>10.12</td>
<td>9.88</td>
<td>6.57</td>
<td>5.96</td>
<td>8.85</td>
<td>7.54</td>
</tr>
<tr>
<td>Median</td>
<td>10.50</td>
<td>9.80</td>
<td>7.00</td>
<td>7.00</td>
<td>7.20</td>
<td>7.00</td>
</tr>
<tr>
<td>Mode</td>
<td>15.00</td>
<td>15.00</td>
<td>7.00</td>
<td>7.00</td>
<td>7.00</td>
<td>7.00</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>3.59</td>
<td>3.70</td>
<td>2.96</td>
<td>2.27</td>
<td>4.03</td>
<td>2.90</td>
</tr>
</tbody>
</table>

From Table 1 we can see that the GWC got a better score for appearance, sweetness, and texture compared to the GWOC. The score sheets given the consumer were on a hedonic scale and we measured them with a metric ruler and the number were 1-14 with 7 being the middle number, 1 being didn’t like and 14 being liked a lot. Looking at the p-values we found there was no significance between the GWC and the GWOC for appearance, sweetness, or texture.

Table 2 is looking how the consumers liked either the GWC or GWOC before testing the product and after tasting the product. Looking at Table 2 results and comparing them to Table 1 we find something we weren’t expecting. The GWC was liked less then the GWOC before and after trying the product. If looking back at table 1 we saw that most of the consumers liked the texture, appearance, sweetness of the
GWC over the GWOC. When looking at the overall likeness of each it seems that the consumers liked the GWOC better overall. Looking at the p-value there was no significance in the liking between the GWC and the GWOC before and after trying the product.

Table 2

<table>
<thead>
<tr>
<th></th>
<th>GWC Liking</th>
<th>GWOC Liking</th>
<th>GWC Post Analysis Liking</th>
<th>GWOC Post Analysis Liking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.19</td>
<td>3.48</td>
<td>3.24</td>
<td>3.50</td>
</tr>
<tr>
<td>Median</td>
<td>3.00</td>
<td>4.00</td>
<td>3.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Mode</td>
<td>3</td>
<td>4</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>.879</td>
<td>.893</td>
<td>.859</td>
<td>.820</td>
</tr>
</tbody>
</table>

When comparing the data we collected to what are hypotheses were throughout the semester it seems to show that we did well on getting our hypotheses right. One of our hypotheses was trying to figure out what would give us the best sweetener for our product. WE tried maple syrup, brown rice syrup, brown sugar, and honey. In our final product we used brown sugar and then added honey to help with clumping. Looking at the results almost half of the consumers liked the sweetness. Another hypotheses we had was texture, we tried whole flax seed, ground flax seed, rolled oats, broiled almonds, and cooked quinoa. In our final product we cooked the quinoa, took out the flax seeds, broiled almonds, and added rolled oats to get the best texture we thought. Looking at the results more then half
of the consumers liked the texture we had for our product. Another hypotheses we had been trying to figure out the best yogurt to go with a product that wasn’t too sour but didn’t take about from the quinoa granola. We tried regular vanilla Yoplait yogurt, low fat vanilla Yoplait yogurt, and then ½ vanilla yogurt and half plain yogurt. This process took us a few tries to come up with a yogurt we liked best and we thought the ½ vanilla and ½ plain from the mountain high yogurt gave us a good yogurt that wasn’t too sour and didn’t take away from the quinoa granola.

### Quinoa Granola

Number of Servings: 4 (62.68 g per serving)
Weight: 250.7 g

#### Nutrition Facts

<table>
<thead>
<tr>
<th>Serving Size</th>
<th>63g</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th>Calories 190</th>
<th>Calories from Fat 50 % Daily Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Fat</td>
<td>6g</td>
<td>9%</td>
</tr>
<tr>
<td>Saturated Fat</td>
<td>0.5g</td>
<td>3%</td>
</tr>
<tr>
<td>Trans Fat</td>
<td>0g</td>
<td>0%</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>0mg</td>
<td>0%</td>
</tr>
<tr>
<td>Sodium</td>
<td>0mg</td>
<td>0%</td>
</tr>
<tr>
<td>Total Carbohydrate</td>
<td>32g</td>
<td>11%</td>
</tr>
<tr>
<td>Dietary Fiber</td>
<td>3g</td>
<td>12%</td>
</tr>
<tr>
<td>Sugars</td>
<td>17g</td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>4g</td>
<td></td>
</tr>
<tr>
<td>Vitamin A</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Vitamin C</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>6%</td>
<td></td>
</tr>
</tbody>
</table>

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

<table>
<thead>
<tr>
<th>Calories</th>
<th>Total Fat</th>
<th>Saturated Fat</th>
<th>Cholesterol</th>
<th>Sodium</th>
<th>Total Carbohydrate</th>
<th>Dietary Fiber</th>
<th>Calories per gram</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,000</td>
<td>Less than</td>
<td>Less than</td>
<td>Less than</td>
<td>2,400mg</td>
<td>30g</td>
<td>25g</td>
<td>Fat 9 Carbohydrate 4 Protein 4</td>
</tr>
<tr>
<td>2,500</td>
<td>Less than</td>
<td>Less than</td>
<td>Less than</td>
<td>2,400mg</td>
<td>30g</td>
<td>25g</td>
<td></td>
</tr>
</tbody>
</table>
Our nutritional claim was high in fiber and a complete protein. Our product was a complete protein because it contains all the essential amino acids as shown below.

Our product was considered a good source of fiber because it contains 3 grams per serving. Some other nutritional benefits are that it has been proven to have some antioxidant activities and our product contains no sodium.

When comparing our results with published reports on quinoa, the reports say that, “Quinoa does not have an exceptionally high protein content compared with other grains.” This surprised us because before we did research we thought that our product would be really high in protein and it wasn’t. It also states that “Quinoa also has a high content of good-quality proteins, and they are additionally rich in vitamins and minerals, especially calcium, phosphorus, and iron.” This statement relates to our findings and from our nutrition label that if though it isn’t considered a high protein food it is still considered to be a good quality because it
does contain all the essential amino acids. Also, quinoa has a lot provides us with some calcium and iron.

The confounding factors we came across during our study is that it was a small sample size when testing our product with consumers. Also, we were unable to train our panelists in testing our product. Another confounding factor is we didn’t even know if our consumers liked granola, yogurt, or quinoa, or if they had ever heard of quinoa before. Another confounding factor we came across was some consumers were either lactose intolerant, had a gluten allergy, had a nut allergy, and were unable to try our product. Some of the limitations to our product was lack of necessary products such as getting the correct brand of yogurt, or using the same brand of certain products. Another limitation was the temperature for the oven when broiling and cooking our products. We had some incidences of burning our product or undercooking our product due to the oven and not being able to determine its accuracy for cooking our product each time.

CONCLUSION AND RECOMMENDATIONS

We determined that our product was well liked by the consumers and that it met the nutrition claim as being a “good source” of fiber. The quinoa granola is a complete protein but is not a good source of protein. We recommend adding another whole grain to boost the protein content. Adding another grain could potentially benefit the texture as well, which is something that the consumer desired. The fat content was surprisingly high which may be something that could be worked on. Perhaps the next time trying a different kind or nut rather than almonds and substituting the
olive oil for something else would be a good idea. The product can be marketed as vegan and if manufactured in the right conditions gluten free. This product could most definitely be sold in a natural food store such as Chico Natural or WholeFoods. If this project would be repeated hopefully we could find some other kind of product that would give us the desired clumping factor that we did not quite achieve. Our results showed that there was a good appearance and sweetness to the product but the overall texture could have been improved.
REFERENCES


Quinoa Granola

Concept:
To create an appetizing, high in fiber and protein granola that can be served as a yogurt topper.

Now that you've read the concept, how interested are you in trying the product.

1 2 3 4 5 6
Not at all Slightly Moderately Interested Very Extremely interested

Rate the appearance of the product:

Not at all Appealing Very Appealing
Appealing

After your first taste of the product, how much do you like the product?

1 2 3 4 5
Not at all Slightly Moderate Very Extremely

Rate the sweetness of the product:

Too Just about Too Weak Right Strong

Rate the texture of the product:

Too Just about Too Weak Right Strong

After analyzing the product, how much do you like it?

1 2 3 4 5
Not at all Slightly Moderate Very Extremely

Please explain why you gave these answers:
Rate the appearance of the product:

Not at all
Appealing
Very Appealing

After your first taste of the product, how much do you like the product?

1
2
3
4
5
Not at all
Slightly
Moderate
Very
Extremely

Rate the sweetness of the product:

Too
Just about
Too
Weak
Right
Strong

Rate the texture of the product:

Too
Just about
Too
Weak
Right
Strong

After analyzing the product, how much do you like it?

1
2
3
4
5
Not at all
Slightly
Moderate
Very
Extremely

Please explain why you gave these answers:

Please compare the two samples: