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F&N 453

Special Project

November 15, 2005

*Effect of Various Salts on Chocolate Chip Cookies*
TITLE:
Effect of Various Salts on Chocolate Chip Cookies

ABSTRACT:
It is the position that salt has many effects that could act adversely on the human body and positively on food related manners. An article from BBC News called ‘Salt’ explains that if sodium levels are too high, the body retains too much water and the volume of bodily fluids increases; excess salt in the diet is also linked to high blood pressure, or hypertension, which in turn is linked to a greater risk of coronary heart disease and stroke. In many food components, salt is a flavor component, but a person on a low sodium diet would need to decrease their amount of salt intake. Tests were conducted to distinguish whether salt, salt and it’s substitute, or just it’s substitute affect the texture, water activity, or taste of the final product in chocolate chip cookies. It was concluded that the product made completely with the salt substitute had the highest texture analyzer value, the highest water activity value, and was ranked best by a sensory panel in taste alone!! Salt substitutes have not been linked to any negative affects on chocolate chip cookies.
INTRODUCTION:

Chocolate chip cookies have been a favorite snack for many years. Each recipe for chocolate chip cookies contains a different amount of ingredients and most likely differs in the amount of salt per batch of chocolate chip cookies! Drantch and Kreisman state in the Cereals-and-Bakery-Products (2003) that chocolate chip cookies are comprised, in addition to flour, sugar, salt and moisture, there is greater than or equal to 1 fat selected from: a single fractionated fat; a double fractionated fat; cocoa butter; or mixtures of single and double fractionated fats and cocoa butter.

Even though the popularity of chocolate chip cookies is relatively high, there are some drawbacks to the delicious treat!! According to an article from BBC News called ‘Salt’, it explains that if sodium levels are too high, the body retains too much water and the volume of bodily fluids increases; excess salt in the diet is also linked to high blood pressure, or hypertension, which in turn is linked to a greater risk of coronary heart disease and stroke.

The original hypothesis for this study stated that salt substitute will have no effect on the flavor, texture, and water activity on chocolate chip cookies. Salt substitute will be the independent variable while flavor, texture, and water activity will be the dependent variables. The study was to determine if salt substitute will change the taste, texture, and amount of water present in chocolate chip cookies compared to using regular salt.
METHODS:

Overall Design

Variable 501 will be standard chocolate chip cookies made with all regular salt.

Standard Chocolate Chip Cookies
186.19 grams butter flavored shortening 258.75 grams all-purpose flour
150 grams white sugar 6.33 grams baking soda
150 grams brown sugar 6.81 grams salt
2 eggs 2 cups milk chocolate chips
9.28 grams Mexican vanilla extract

Directions
1 Preheat oven to 350 degrees F (175 degrees C). Grease cookie sheets.
2 In a large bowl, cream together the butter flavored shortening, brown sugar and white sugar until light and fluffy. Add the eggs one at a time, beating well with each addition, then stir in the vanilla. Combine the flour, baking soda and salt; gradually stir into the creamed mixture. Finally, fold in the chocolate chips. Drop by rounded spoonfuls onto the prepared cookie sheets.
3 Bake for 8 to 10 minutes in the preheated oven, until light brown. Allow cookies to cool on baking sheet for 5 minutes before removing to a wire rack to cool completely.

*This recipe was found on Allrecipes, Submitted by Nicole Faust Hunt

Variable 731 will be chocolate chip cookies made with half regular salt and half salt substitute. (.5 tsp regular salt / .5 tsp Nu Salt)

186.19 grams butter flavored shortening 258.75 grams all-purpose flour
150 grams white sugar 6.33 grams baking soda
150 grams brown sugar 3.21 grams salt
2 eggs 2.5 grams NuSalt
9.28 grams Mexican vanilla extract 2 cups milk chocolate chips

Directions
1 Preheat oven to 350 degrees F (175 degrees C). Grease cookie sheets.
2 In a large bowl, cream together the butter flavored shortening, brown sugar and white sugar until light and fluffy. Add the eggs one at a time, beating well with each
addition, then stir in the vanilla. Combine the flour, baking soda, regular salt, and NuSalt; gradually stir into the creamed mixture. Finally, fold in the chocolate chips. Drop by rounded spoonfuls onto the prepared cookie sheets.

3 Bake for 8 to 10 minutes in the preheated oven, until light brown. Allow cookies to cool on baking sheet for 5 minutes before removing to a wire rack to cool completely.

*This recipe was found on Allrecipes, Submitted by Nicole Faust Hunt*

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Variable 909 will be chocolate chip cookies made with all Salt Substitute(no regular salt)

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>186.19 grams butter flavored shortening</td>
<td>258.75 grams all-purpose flour</td>
</tr>
<tr>
<td>150 grams white sugar</td>
<td>6.33 grams baking soda</td>
</tr>
<tr>
<td>150 grams brown sugar</td>
<td>5.02 grams NuSalt</td>
</tr>
<tr>
<td>2 eggs</td>
<td>2 cups milk chocolate chips</td>
</tr>
<tr>
<td>9.28 grams Mexican vanilla extract</td>
<td></td>
</tr>
</tbody>
</table>

**Directions**

1 Preheat oven to 350 degrees F (175 degrees C). Grease cookie sheets.

2 In a large bowl, cream together the butter flavored shortening, brown sugar and white sugar until light and fluffy. Add the eggs one at a time, beating well with each addition, then stir in the vanilla. Combine the flour, baking soda, and NuSalt; gradually stir into the creamed mixture. Finally, fold in the chocolate chips. Drop by rounded spoonfuls onto the prepared cookie sheets.

3 Bake for 8 to 10 minutes in the preheated oven, until light brown. Allow cookies to cool on baking sheet for 5 minutes before removing to a wire rack to cool completely.

*This recipe was found on Allrecipes, Submitted by Nicole Faust Hunt*
Sensory Scorecard

Absolutely the Best Chocolate Chip Cookies!!

Rate sample 501 by filling in the appropriate dot:

- Dislike extremely
- Dislike very much
- Dislike moderately
- Dislike slightly
- Neither like nor dislike
- Like slightly
- Like moderately
- Like very Much
- Like extremely

Rate sample 731 by filling in the appropriate dot:

- Dislike extremely
- Dislike very much
- Dislike moderately
- Dislike slightly
- Neither like nor dislike
- Like slightly
- Like moderately
- Like very Much
- Like extremely

Rate sample 909 by filling in the appropriate dot:

- Dislike extremely
- Dislike very much
- Dislike moderately
- Dislike slightly
- Neither like nor dislike
- Like slightly
- Like moderately
- Like very Much
- Like extremely
Detailed Methods

The ingredients used in this experiment were bought at a local grocery store. The salt substitute was distributed by Nu Salt. Derrien and Fontvieille (2004) stated in an article called ‘Dietetic composition in the form of a salt substitute for table salt’ state, “a salt substitute for table salt is described, and contains by wt.: 40-50% of KCl; 15-25% of NaCl; 15-25% of <greater than or equal to>1 calcium salts; and 8-15% of <greater than or equal to>1 magnesium salts.” The standard salt was produced by Norton Salt Company.

Nine batches of chocolate chip cookies were all carefully created by weighing each ingredient and placing it in either 501(1), 501(2), 501(3), 731(1), 731(2), 731(3), 909(1), 909(2), or 909(3) respectively. 6.81 grams of Norton Salt was added to each trial 1, 3.21 grams of Norton Salt and 2.5 grams of Nu Salt were added to trial 2, and 5.02 grams of Nu Salt was added to trial 3.

With all nine batches, the oven was first preheated to 350 degrees F and the cookie sheets were sprayed with non-stick cooking spray. The 186.19 grams of butter shortening, 150 grams of brown sugar, and the 150 grams of white sugar were creamed together using an electric hand mixer for a total of 1 ½ minutes. Then, the eggs were added, one at a time, with 30 seconds of electric hand mixing between each addition. The 9.28 grams of vanilla extract was stirred in by hand mixing 5 complete revolutions. The 258.75 grams, 6.33 grams of baking soda, and the different variations of salt were mixed together in a separate bowl. Finally, the two mixtures were creamed together by completing 10 full revolutions. The chocolate chips were added to each batch by stirring
15 complete revolutions. Each cookie was dropped onto the greased cookie sheet by using a tablespoon. The trials were baked at 350 degrees F for a total time of 9 minutes, and then cooled for 10 minutes on their baking sheets.

The same oven, hand mixer, and scale were all used for each batch. My taste panel of six tasted the cookies 30 minutes once they were done baking. They tasted half of a cookie out of each batch. They recorded their results according to what experiment number they were observing. Once the cookies came out of the oven, I waited 48 hours to test the results on a texture analyzer and the water activity machine. The Stable Micro Systems Texture Analyzer was set to the knife probe (for breaking strength, cutability) on the cookie setting with each variation.

**Replications, Randomization, and Sampling**

The same procedure was repeated three times for a total of three trials. When the taste panel tasted the different variations, I gave the cookies to them in a random order each time. To make the test more random I choose to give them trial three on a different day than trial one and two.

**RESULTS AND DISCUSSION**

**Calculations**

No calculations were used in this research.
**Results and Discussion**

Table 1 and Figure 1 show the data for experiment 501 and the texture analyzer results. Experiment 501 was the standard chocolate chip cookie with 6.81 grams of Norton Salt. As seen in Figure 1, trial 1 had the highest texture analyzer value of 435.9. The combined mean for experiment 501 was 277.6.

Table 2 and Figure 2 show the data for experiment 731 and the texture analyzer results. Experiment 731 was the chocolate chip cookie made with half Norton Salt and half salt substitute. As seen in Figure 2, trial 2 had the highest texture analyzer value of 673.7. The mean texture analyzer value for 731 was 617.

Table 3 and Figure 3 show the data for experiment 909 and the texture analyzer results. Experiment 909 was the chocolate chip cookie made with all salt substitute. As seen in Figure 3, trial 2 had an exceptionally high texture analyzer value of 690 while the mean was only 403.6. There could have been some experimental error that occurred with trial two in experiment 909.

Comparing the average texture analyzer results between the three experiments as shown in Figure 4, it is seen that experiment 731 had the highest mean and experiment 501 had the lowest mean value. Wilhelm stated in the Food Quality Journal (2000) that measurements of rheological and textural properties of foods are discussed in relation to development of efficient food manufacturing processes and improved understanding of food systems, leading to formulation of products with good consumer acceptance. Movement of food materials, quality control of end-products, shelf-life studies, and sensory testing instruments are used to measure physical properties of foods. Such instruments include the texture analyzer manufactured by Stable Micro Systems (UK).
with uses including textural evaluation of baked products, spreadability measurements
and determination of textural effects of specific ingredients such as various salts.

Looking at results obtained by the study, it is seen that by the Stable Micro
Systems texture analyzer average results for experiment 731 showed it was the hardest in
strength. By getting an average value of 617 it showed that this experiment set of
cookies needed the most force to attain a given deformation; provided as the final peak of
the texture profile analysis (TPA) curve. With the average texture analyzer results for
experiment 501 equaling 277.6 this means that this experiments set provides the softest,
chewiest cookie. The chewiest cookie requires energy to masticate a semisolid sample to
a steady state of swallowing (Daniel, Weaver 2003). Average results shows that a
mixture between a hard cookie and a chewy cookie would be best palatable.

Water activity is discussed by Bone (1973) as the development of shelf-stable
intermediate moisture foods. In research done by Chawla, Chander, and Sharma in 2006
they washed lamb intestines and treated them with common table salt to reduce water
activity to 0.80 ± 0.02. This research combined shows that a product with regular salt
should have a reduced water activity than its comparison.

By looking at Table 1 and Figure 5, it is seen that experiment number 501 (which
was the experiment done by using 6.81 grams of Norton Salt) had a mean water activity
of 0.49.

Comparing Chawla, Chander, and Sharma’s results, one must also look at the
other comparisons to see if their results from washed lamb compares to chocolate chip
cookies. If you refer to Table 2 and Figure 6, one can see that the experiment made with
half regular salt and half salt substitute had a mean water activity of 0.48. This number is
just slightly lower than the results obtained from experiment 501. This could be because there are other sources of salt and possibly other chemical reactions going on in the chocolate chip cookies rather than the product made with all regular Norton salt.

To compare the results even further, Table 3 and Figure 7 show the average water activity for the product made completely with salt substitute to be 0.54. This data is very relevant to Chander, and Sharma’s results. The chocolate chip cookie made with no regular salt did in fact have the highest mean value for water activity. This shows major result comparisons between washed lambs intestines effect on salt and water activity and chocolate chip cookies on salt and water activity. The washed lambs intestines treated with common table salt had reduced water activity by a factor of .02.

By viewing Figure 8, this gives a better comparison for the three experimental mean values for water activity content!! It clearly shows that the product made with no regular salt had by far the highest water activity!

It was discussed by Birks (2004) that the challenge presented to food manufacturers by current calls for the UK food industry it to reduce the salt content of processed foods in relation to: the adverse health effects of diets high in salt; use of low sodium salt alternatives; additives that replace the flavor and maintain the preservative effects of salt in meat products; and use of herbs and spices as salt replacers. This same challenge was posed with studying relational effects of various salts in chocolate chip cookies and a taste panel of 6. The results are shown in Tables 1, 2, and 3 and in Figure 9. By looking at this data, it is seen that the taste panel evaluated experiment number 909 to be the best by doing ranking resulting figures on a hedonic scale. Conclusions were
surprising because experiment 909 was the product made with all salt substitute. The experiment that was the case control, 501, was ranked the lowest!!

Results disprove the hypothesis of this experiment. The original hypothesis for this study stated that salt substitute will have no effect on the flavor, texture, and water activity on chocolate chip cookies. Indeed, the study revealed that the product made with salt substitute surprisingly received the best results from a taste panel, had the best texture analyzer mean value in comparison with the other variables, and had the highest water activity mean value.

Sources of Error

Sources of error in this experiment include getting the same amount on ingredients in each batch, errors in judgment when measuring the amount of raw cookie to place on the greased cookie sheet, errors in weighing materials, errors in mislabeling each batch, or even errors in the texture analyzer or water activity machine!

Take Home Message

Chocolate chip cookies made with 5.02 grams of salt substitute are linked to a higher water activity content, a mixture in texture between a hard, course cookie, and a soft and mushy cookie, and flavor that is just exquisite.
Suggestions for Further Work

Repeat this experiment using different brands of salt substitute.

Repeat this experiment using a different setting on the texture analyzer manufactured by Stable Micro Systems (UK).

Repeat this experiment by taking out the chocolate chips so you get results that are complementary of the dough alone!
REFERENCES


Daniel J. R. Weaver C. 2003. The Food Chemistry Laboratory Manual, Purdue University, West Lafayette, IN.


### Table 1  Experiment Number 501

<table>
<thead>
<tr>
<th>Trial</th>
<th>Texture Analyzer</th>
<th>Water Activity</th>
<th>Sensory Evaluation</th>
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<tr>
<td>1</td>
<td>435.9</td>
<td>0.566</td>
<td>6.5</td>
</tr>
<tr>
<td>2</td>
<td>230.7</td>
<td>0.588</td>
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<tr>
<td>3</td>
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<td>Averages</td>
<td>277.6</td>
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<td>6.6</td>
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### Table 2  Experiment Number 731

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<th>Trial</th>
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<th>Sensory Evaluation</th>
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<tr>
<td>1</td>
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<td>0.567</td>
<td>7.125</td>
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<td>2</td>
<td>673.7</td>
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<td>3</td>
<td>530</td>
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<tr>
<td>Averages</td>
<td>617.0</td>
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<td>7.0</td>
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### Table 3  Experiment Number 909

<table>
<thead>
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<th>Trial</th>
<th>Texture Analyzer</th>
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<th>Sensory Evaluation</th>
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<td>7.25</td>
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<tr>
<td>2</td>
<td>690</td>
<td>0.630</td>
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<tr>
<td>3</td>
<td>287.8</td>
<td>0.340</td>
<td>7</td>
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<tr>
<td>Averages</td>
<td>403.6</td>
<td>0.54</td>
<td>7.1</td>
</tr>
</tbody>
</table>
Figure 1. Trial 501 vs Texture Analyzer Value

Figure 2. Trial 731 vs Texture Analyzer Value
Figure 3. Trial 909 vs Texture Analyzer Value

Figure 4. Average Texture Analyzer Value for All Three Experiments
Figure 5. Trial 501 vs Water Activity Value

Figure 6. Trial 731 vs Water Activity Value
Figure 7. Trial 909 vs Water Activity Value

Figure 8. Average Water Activity Value for All Three Experiments
Figure 9. Average Sensory Evaluation Scores for Each Experiment