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The Effect of Dietary Sodium Levels on Consumer Appeal

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Introduction

Hypertension is a common condition in the United States in which the blood pressure in the arteries is chronically elevated. Blood pressure is determined by both the amount of blood the heart pumps and the amount of resistance to blood flow in the arteries. The more blood the heart pumps the narrower the arteries become, and the higher the blood pressure. Uncontrolled hypertension may lead to serious health problems such as: heart attack, stroke, aneurysm, heart failure, and metabolic syndrome. Research indicates that hypertension results from both environmental and genetic factors.(1) There is one particular environmental factor that has been proven to be associated with hypertension and that is dietary sodium.(1,2,3) Research has confirmed that high dietary sodium intake can lead to increased diastolic and systolic blood pressure as well as wave reflection which results in an increased risk of hypertension.(3) The American Heart Association and The Culvert Chronicles support reducing salt consumption to help manage high blood pressure.(4) The current recommendation is 2,300 milligrams of salt per day and 2,000 mg for people suffering from hypertension or congestive heart disease.(4) The American Heart Association and the Nigerian Food Journal also recommend eating a diet that contains food sources rich in monounsaturated oleic acid such as avocados to decrease the risk of heart disease and hypertension.(5) The sodium recommendations are the most difficult for Americans because salt is present in most American foods. Salt occurs naturally in very small quantities in meats, vegetables and fruit. Salt is often added to processed foods like pickled foods, snack foods, and other convenience foods. Salt has been used for hundreds of years because of its ability to preserve and flavor foods. The benefits of a low sodium diet included: lowered blood pressure, lowered risk of heart related diseases, increase potassium, magnesium, calcium, and fiber from increased fruit consumption, and limited processed foods. Research also proves that hypertensive individuals can increase the effectiveness of their blood pressure medications and may even reduce the amount of medication needed by following a low sodium diet.(6) Is the perceived flavor benefit enough to outweigh the detrimental health implications associated with a diet high in dietary sodium and the health benefits of a diet low in dietary sodium? Presently, there is no research that specifically examines the flavor difference between high sodium and low sodium variations where the only difference in a recipe is the amount of salt used.

The overall objective was to compare and contrast the effect of dietary sodium levels on consumer appeal through the manipulation of sodium content. The research hypothesis was: that

there will be a difference between guacamole made with no added dietary sodium and guacamole made with added dietary sodium. The null hypothesis was: that there will be no difference between guacamole made with no added dietary sodium and guacamole made with added dietary sodium.

Materials and Methods

The guacamole prepared in this research contained many controlled variables. The independent and dependent variables are listed below.

The independent variables of this experiment were the amount of sodium used. The dependent variables were the color, firmness/softness, overall flavor, and viscosity.

The first step was to combine the ingredients: diced avocado, black beans, ground cumin, lime juice, chipotle chili pepper, diced canned tomatoes, and onion powder into a medium glass bowl. Five clockwise stirs were used to incorporate all the ingredients.

The experimental recipe for this experiment is as followed.

Experimental Recipe

- Diced avocado 250 grams
- Black beans 50 grams
- Ground cumin .1 gram
- Lime juice 5 mL
- Chipotle chili pepper .1 gram
- Canned tomatoes 100 grams
- Onion powder 1 gram

[7] Healthy Recipes. Recipe Guacamole. Mayo Foundation for Medical Education and Research. 20013.

The next step was to separate the mixture into three separate samples, 130 grams each into small glass bowls. The last step in preparation was to add 4 grams of sodium into one of the samples, add 2 grams of sodium into another one of the sample, and add no sodium into the last sample. To incorporate the sodium into the samples, each sample was stirred with a spoon 5 times in a clockwise motion. This created three different sodium samples for testing purposes: a high sodium sample, a control, and a no sodium sample.

Objective Measurements

In this experiment two different objective tests were performed. The procedures for both tests are detailed below.

Experiment 1: Penetrometer

The first step was to lift the handle attached to the dial gauge to its maximum height. Next the rod holding the cone was pushed upward until it contacted the end of the bar connected with the dial gauge. The three samples were then individually and separately placed into position on the stand. The next step was to lower the apparatus until the cone touched the surface of the sample. The assembly was then tightened into that position and the cone was released for 10 seconds. Measurements were then taken to determine the distance the cone had penetrated the sample.

Experiment 2: Viscosity (Line Spread)

The first step was to spoon 60 grams of each sample separately into metal rings which were centered onto three different grids. After the samples were individually spooned into the metal rings, the metal rings were removed and 2 minutes was allowed for spreading. Then each of the four axes of the grid was used to determine the average spread of each sample.

Subjective Measurements

The three samples were prepared for subjective testing by taking a small cookie scoop and portioning out each sample into individual 2 ounce plastic portion cups. All three 2 ounce plastic portion cups were then plated and labeled. The samples were served with unsalted Saltine crackers as a carrier. Color, firmness, and overall flavor were then evaluated by a six member subjective panel.

Results

The objective results of this experiment and the data collected are detailed below.

Table 6.1 Objective Comparison of Dietary Sodium Levels

Treatments (sodium in grams)	Viscosity (1/8”)	Penetrometer (1/10 mm)
High (4 g)	1.4	292
Control (2 g)	1.2	270
No (0 g)	0	224

The subjective results of this experiment and the data collected are detailed below.

Table 6.2 Subjective Comparison of Dietary Sodium Levels

Treatments (sodium in grams)	Color	Firmness	Overall Flavor
High (4 g)	0	0	2
Control (2 g)	1	2	0
No (0 g)	2	1	1

Discussion

In this experiment, the difference between treatments was reflected in the data collected. The subjective testing was performed twice by a six member subjective panel. The objective testing was performed four times on four different days. In subjective testing, the high sodium sample was ranked last in every category besides overall flavor where it came in second. The control sample received the highest ranking in color and the lowest ranking in overall flavor. The control sample also received the second ranking in firmness. The no sodium sample was ranked first in firmness and overall flavor. The no sodium sample received the second ranking in color. In the objective testing, the penetrometer measured the high sodium sample at 292 $^{1/10}$ mm which means the high sodium sample was the softest of the three samples because the control sample measured at 270 $^{1/10}$ mm and the no sodium sample measured at 224 $^{1/10}$ mm. In this instance the objective and subjective results are consistence because the high sodium sample was ranked as the lowest in firmness in subjective testing and resulted in the highest penetrometer measurement. In the line spread objective test, the high sodium sample measured at 1.4 $^{1/8''}$ which means that this sample did spread. This measurement also showed that the high sodium sample was the most viscous when compared to the other samples. The control sample had a line spread measurement of 1.2 $^{1/8''}$ and the no sodium sample had a line spread measurement of 0 $^{1/8''}$. The results of the line spread test are consistence with the results of the penetrometer and subjective testing because the high sodium sample has proven to be the softest and more viscous in all testing procedures. The average deviation of the line spread test was .44; this shows that there was no significant difference between the samples in the line spread test. The average deviation of the penetrometer test was 25; this shows that there was a significant difference between the samples. The results of both subjective and objective testing prove that the no sodium sample had a higher overall consumer appeal when compared to both the high sodium sample and the control sample. This study proves that the perceived flavor benefit associated with higher levels of dietary sodium is erroneous because consumers actually preferred the no sodium sample in this study. This study ultimately proves that a diet low in added dietary sodium will provide multiple health benefits without the loss of flavor.

Conclusions

In conclusion, the research hypothesis was correct. There were differences between guacamole made with no added dietary sodium and guacamole made with added dietary sodium. This also proves the null hypothesis false. Additionally, this proves that the overall objective set for this experiment was met because the data and calculations support that there were differences between guacamole made with no added dietary sodium and guacamole made with added dietary sodium.

Appendix I

The scorecard used in both subjective testing panels is attached below.

Date:			
Sample	**Color**	**Firmness**	**Overall Flavor**
571			
427			
386			
Comments:			

Please place a ▲ in the corresponding column box of the sample that you find the most appealing in each of the three categories: color, firmness, and overall flavor.

Please place a △ in the corresponding column box of the sample that you find the second most appealing in each of the three categories: color, firmness, and overall flavor.

The key code used to identify the samples in both subjective testing panels is attached below. This key code was not included on the scorecard presented to the taste panel at the time of evaluation.

Sample Code Key:
386- No Sodium Sample
571-High Sodium Sample
427-Control Sample

References

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