

THE EFFECT OF DIETARY SODIUM LEVELS ON CONSUMER APPEAL

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**Why do we care about
dietary sodium?**

HYPERTENSION

- **Chronic high blood pressure**
 - 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. ⁽¹⁾
- **Hypertension is a common condition in the United States.**
- **Research indicates that hypertension results from both environmental and genetic factors.** ⁽²⁾

HYPERTENSION

- Uncontrolled hypertension can lead to:
 - Heart attack
 - Stroke
 - Aneurysm
 - Heart failure
 - Weakened and narrowed blood vessels in the kidneys & brain
 - Metabolic syndrome

ENVIRONMENTAL RISK FACTORS FOR HYPERTENSION

- Risk factors: diet high in sodium, diet low in potassium, obesity, alcohol, stress, and lack of physical activity. ⁽²⁾
- There is one particular environmental factor that has been proven to be associated with a high risk of hypertension and that is dietary sodium. ^(3,4,5)
- 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. ⁽⁵⁾

BENEFITS OF A LOW SODIUM DIET

- Lowers blood pressure
- Lowered risk of heart related diseases
- High in fruits, vegetables, fiber, and protein
- High in potassium, magnesium, and calcium
- Limited processed foods
- Increases the effectiveness of medications and may reduce the amount of medication needed ⁽⁶⁾

WORTH THE RISK?

- Is the perceived flavor benefit of sodium enough to outweigh the 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 the recipe is the amount of salt used.

MY RESEARCH

PURPOSE & HYPOTHESIS

- 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.

TREATMENTS

- **Sample One: High Sodium**
 - 4 grams of sodium was added to the experimental recipe
- **Sample Two: Control**
 - 2 grams of sodium was added to the experimental recipe
- **Sample Three: No Sodium**
 - No sodium was added to the experiment recipe

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.

OBJECTIVE & SUBJECTIVE TESTING

■ Objective Testing

- Penetrometer
 - Firmness/Softness
- Line Spread
 - Viscosity/Consistency

■ Subjective Testing

- Samples were evaluated twice by a six member subjective panel.
 - Color
 - Firmness
 - Overall Flavor
- The samples were served with unsalted saltine crackers as a carrier.

SUBJECTIVE FINDING

- **High Sodium Sample**
 - Ranked last in every category besides overall flavor where it came in second.
- **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.
- **No Sodium Sample**
 - Ranked first in firmness and overall flavor.
 - Received the second ranking in color.

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

OBJECTIVE FINDINGS

- 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 consistent because the high sodium sample was ranked as the lowest in firmness in subjective testing and resulted in the highest penetrometer measurement.

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

OBJECTIVE FINDINGS

- In the line spread test the high sodium sample measured at 1.4 ^{1/8}'' which indicates that the 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 consistent with the results of the penetrometer and subjective testing because the high sodium sample was proven to be the softest and most viscous in all testing procedures.

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CONCLUSIONS

- The research hypothesis was correct
 - There were differences between guacamole made with no added dietary sodium and guacamole made with added dietary sodium.
- The null hypothesis was false
- 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.

IMPLICATIONS

- 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 incorrect 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.

FUTURE STUDIES

- Salt substitutes
 - Color, firmness, and overall flavor differences
- Amount of dietary sodium to reduce
 - <2000 mg/day vs. 1500 mg/day vs. ≤500 mg/day ⁽¹⁾
- Population that would benefit the most from a low sodium diet
 - Salt-sensitive vs. normal
- Duration of dietary sodium reduction
 - Years vs. months
- Low sodium diet effect on blood lipid panels
 - <500 mg/day

POSSIBLE CHANGES

- Subjective Panel
 - Diversify
 - Age, economic background, ethnicity, gender
 - Complete four subjective testing panels
- Substitute Carrier
 - Crackers do contain some dietary salt
- Add garlic to the experimental recipe
 - Comment left on multiple subjective panel evaluations

REFERENCES

- (1) Academy of Nutrition and Dietetics. Academy of Nutrition and Dietetics Hypertension Evidence-Based Nutrition Practice Guideline, Chicago (IL): Academy of Nutrition and Dietetics, 2015.
- (2) Jian-Wei Gu, Amelia Bailey, Wei Tan, Megan Shparago, Emily Young. Long-term high-salt diet causes hypertension and decreases renal expression of vascular endothelial growth factor in Sprague-Dawley rats. *Journal of the American Society of Hypertension* 2(4) (2008) 275–285.
- (3) Jian-Wei Gu, Amelia Bailey, Wei Tan, Megan Shparago, Emily Young. Long-term high-salt diet causes hypertension and decreases renal expression of vascular endothelial growth factor in Sprague-Dawley rats. *Journal of the American Society of Hypertension* 2(4) (2008) 275–285.
- (4) Small weight and salt reductions yield big gains in hypertension control. *Geriatrics*. Advanstar Communications. 1998; 53 5-25.
- (5) Starmans-Kool, Mirian, Stanton. et al. High dietary salt intake increases carotid blood pressure and wave reflection in normotensive healthy young men. *Journal of applied physiology* 1985; 2:468.
- (6) Jing Wang, Bo Qiu, Jian-Lin Du, Song-Bai Deng, Ya-Jie Liu, Qiang She. The effects of a low-salt diet on the efficacy of different antihypertensive drug regimens. *The Journal of Clinical Pharmacology*. Volume 55, Issue 12, pages 1362–1368, December 2015.
- (7) Schantz, Rhoda. *Experimental Foods*. University of Wyoming. Spring 2016
- (8) McWilliams, M. 2012. *Foods Experimental Perspectives*, 6th edition. Prentice Hall, Upper Saddle River, New Jersey.