Chicken Gumbo Recipe:

Modification of Sodium and Fat Content and the Effect on Viscosity, Acceptance, And Sensory Attributes

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Abstract

This study was conducted in an effort to provide an acceptable and enjoyed healthy recipe using okra. According to the Farmer's Market Survey, okra has been tried, tasted, and is recognized by most people, but they have not cooked with it. We chose a chicken gumbo recipe and modified the type of fat content and sodium content to provide four different treatments. We conducted tests to determine viscosity between treatments, acceptance, and sensory attributes of the treatments. Our hypothesis was that participants would prefer the chicken gumbo made with regular chicken broth and bacon fat. Statistical results of the QDA showed that the low fat, low sodium treatment had consistently lower scores in all attributes, and was the least viscous according to our objective method test using the consistometer. The low fat, high sodium treatment was the most preferred treatment according to a 9-point hedonic scale given to 49 untrained panelists. Overall, our hypothesis was disproven.

Introduction

Okra is a product that is recognized and has been tasted, but the majority of people have not cooked with it. People may have not cooked with it either because they do not know how, or because they did not enjoy it in the foods in which they tried it. Our objective is to come up with a healthy and tasty recipe so people can learn to cook and enjoy okra.

Our hypothesis was that participants would prefer the chicken gumbo made with regular chicken broth and bacon fat.

In the fall of 2009, nutrition students at Chico State University conducted a survey at the local Farmer's Market in Chico, California. Results of this survey point out that 60% (n=137) have tried or tasted okra before, 67% have not prepared or cooked with okra before, and only

30% have been able to recognize it in its uncooked form (Phillips J. Consumers' perceptions of ethnic produce sold at farmers' markets. Unpublished data). People support farmers who sell ethnic produce and have also shown an interest in wanting to sample ethnic produce.

The significance of this study is that it promotes the produce of local farmers, increases the knowledge of the public about ethnic foods, and proves that using healthy alternatives doesn't devalue the original taste and texture of our chicken gumbo recipe.

Many studies have been done to assess the nutritional status of okra, which contains such nutrients as iodine, phenolic compounds, fiber and other vitamins and minerals (1,3). Okra also is used as a thickener in soups and other composed dishes (2,3). As researchers, our group wanted to take all of these positive attributes of okra and create a healthy dish that many people can cook and enjoy.

One study that we found in the Journal of Food Science, *Effects of Rice Batter on Oil Uptake and Sensory Quality of Coated Fried Okra*, used okra as a reference sample in fried foods to determine the uptake of oil by the batter. The three treatments that were used were frying batter that was made with wheat flour, rice flour, and a mixed rice flour batter containing 5% pregelatinized rice flour (PGRF).

The research first started with testing the viscosity of the different batters using a RVA-3D analyzer. The batter with the total rice flour was the least viscous, and the batter with rice flour and 8% PGRF was most viscous. The uptake of oil after frying was highest in the wheat batter and lowest in the rice flour batter mixture with 5% PGRF.

This study also conducted Sensory evaluation using three different batter formulations with the okra. Ten panelists were screened and trained in the concept of descriptive analysis. The

attributes that were measured were based on appearance, surface attributes, first bite, chew down and after swallowing, all on a scale of 0 to 15. Of the five appearance/visual properties, only the color description resulted in a statistically significant difference. And of the two surface texture properties, roughness was the only on to have a statistical significance. All three of the first bite attributes were statistically significant, as well.

Another study that we reviewed is *Emulsifying properties of three African food hydrocolloids: okra (Hibiscus esculentus), dika nut (Irvingia gabonensis), and khan (Belschmiedia sp.)*. This study explores the emulsion and thickening properties of these three African foods that are commonly used as thickeners and flavorings in soups.

Grinding and de-fatting these three foods started this study, and then emulsions were combined. Through scientific studies and tests, it was found that khan was the best emulsifier, where okra and dika nut are good thickeners.

The commonality of these two studies was okra used as an ingredient. The first study, okra was the ingredient being used to test healthy oil alternatives, and used sensory evaluation. The second study used okra in a scientific study to determine certain physical properties. The main difference between the studies is that one only studies the okra properties and the other studies the perception and acceptance of okra.

Both of these studies have similarities to our experiment and evaluation of okra. The first study, however, is more closely related to our experiment and procedure then the second study. We used sensory evaluation, using different attributes, but a similar procedure. We also measured viscosity of the gumbo, hypothesizing that maybe the okra had an influence on the thickness of the soup.

Methods and Materials

Treatment Characteristics: Table 1

	HS/HF	**LS/HF**	**HS/LF**	**LS/LF**
Broth	711 mL	711 mL	711 mL	711 mL
Fat	30 mL	30 mL	30 mL	30 mL
Chicken	454g	454g	454g	454g
Onion	237 mL	237 mL	237 mL	237 mL
Garlic	1 clove	1 clove	1 clove	1 clove
Salt	5mL	5mL	5mL	5mL
Pepper	2.5mL	2.5mL	2.5mL	2.5mL
Bay Leaf	1 leaf	1 leaf	1 leaf	1 leaf
Sage	.63 mL	.63 mL	.63 mL	.63 mL
Red Pepper Flakes	1.25mL	1.25mL	1.25mL	1.25mL
Thyme	1.25mL	1.25mL	1.25mL	1.25mL
Tomatoes	237 mL	237 mL	237 mL	237 mL
Frozen Okra	237 mL	237 mL	237 mL	237 mL
Bell Pepper	237 mL	237 mL	237 mL	237 mL
Flour	59mL	59mL	59mL	59mL
Rice	474 mL	474 mL	474 mL	474 mL

KEY

HF= HIGH FAT LF=LOW FAT

HS= HIGH SODIUM LS= LOW SODIUM

Rationale for Sensory and Objective Methods

For the objective methods, the consistometer test was selected to determine the viscosity of the different treatments.

A nine point hedonic scale test was administered to 49 random people to test the likeability of each treatment.

Experimental Food Preparation Procedures

The procedure for each treatment of the gumbo was the same, except for the independent variables, the chicken stock and bacon fat/canola oil. Each person in our unit was responsible for preparing certain ingredients in the recipe to maintain consistency. The vegetables (diced), chicken, stock, oil, fat and spices were cut and carefully measured out and separated for each treatment. Four pots were labeled and placed on the stove over medium heat to start cooking the stock and chicken. Following the recipe directions, we mixed the proper amount of chicken in each pot with the proper amount of chicken broth for each treatment. The broth, made from bouillon, was placed in each pot (1422mL). On medium heat, we added 908 g of chicken to each pot. That mixture was brought to a boil, and then we added the water, onion, garlic, salt pepper, bay leaf, sage, red pepper flakes and thyme (amounts are double of that listed in table one). We stirred those ingredients in and let simmer, partially covered for approximately twenty minutes.

We then stirred in the tomatoes, green peppers and okra, and continued to simmer. While the soup was simmering, in separate pans we combined the canola oil or bacon fat with the flour. We used 60mL of oil or fat and 118mL of flour. We cooked these until they were golden brown and bubbly. Then we removed approximately 1/3 of the stock from each pot and added it to the corresponding flour/fat mixture. That was stirred until it was a smooth consistency, and then added back into its corresponding gumbo pot. Those were all thoroughly mixed in so no lumps

were present. The gumbos were then partially covered, and set to medium heat to simmer for thirty more minutes. They were stirred occasionally.

While the gumbos were cooking, in a separate pot, 948 mL of white rice was cooked with 944mL of water. This we set to medium low heat, and cooked covered for 30 minutes.

Objective Method Procedures

The same food preparation procedure still applied.

Three people conducted the consistometer test. One person was in charge of administering the gumbo into two consistometers. They made sure each sample was the same consistency; one sample didn't have more broth than another. Two others trained in using a consistometer were in charge of operating the consistometers and recorded the results. Each sample was measured the same way.

Sensory Evaluation Procedures

9 Point Hedonic

49 untrained panelists came into the lab and were seated in a room with cubicles and red lighting to ensure their results were confidential and so they couldn't tell the physical difference between treatments. We placed the trays in front of them with the four treatments on them and a piece of paper to mark their acceptability results (9 point hedonic test). We randomly placed each treatment on the tray but instructed the panelists to begin tasting from the top left corner and move clockwise. We also instructed them to take a drink of water between each treatment so they had a clean palate each time they tasted. Then they marked the likeability of each treatment on the paper on a scale of "extremely dislike" to "extremely like". The trays were cleared then they moved on to tasting recipes from other lab groups.

QDA

Quantitative descriptive analysis was conducted using seven trained panelists. They first picked sensory attributes of the soup (aroma, taste, and texture), then rated the attributes on a scale of 1-10. Discrepancies between the panelist's ratings were discussed to make uniform results. The panelists then tasted all four treatments and rated them based on aroma, taste, and texture.

Statistical Analyses Procedures

We used excel to determine the mean and standard deviation of our data. To determine whether there was a significant difference between treatments (P-value < .05), we used the "single factor" ANOVA test in Excel. If there was a significant difference, we performed the "T-test -two sample assuming equal variances". This test functions to determine the variance between attributes within the different samples.

Results and Discussion

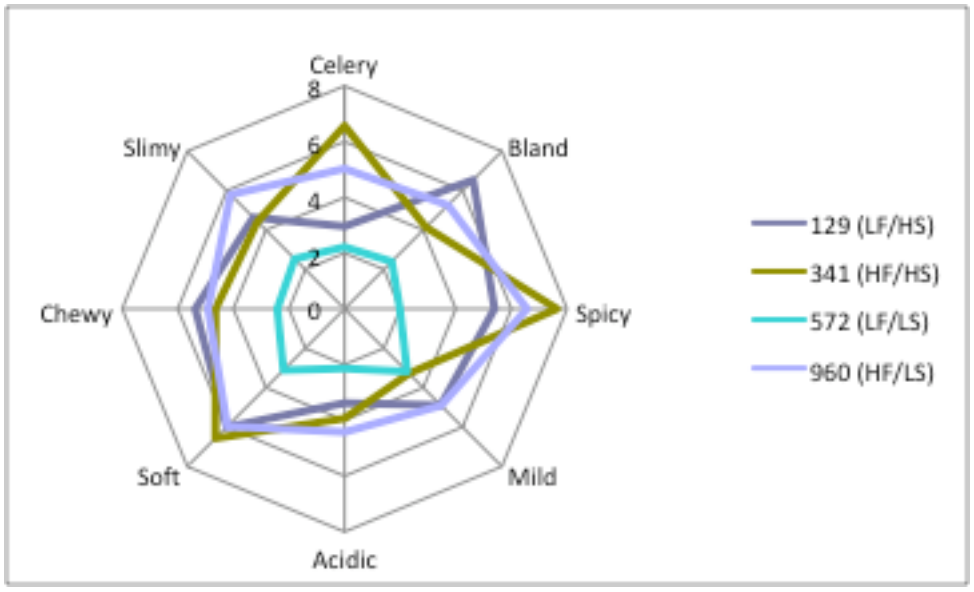
Objective Method

Table 2: Consistometer measurements using 1/4 cup for 10 seconds, mean, SD

	Sample 1			Sample 2			Sample 3			Mean	SD
LS/LF	9 cm	9.25 cm	9.5cm	9.75cm	9.5cm	9cm	9cm	8.5cm	8.5cm	9.11cm	0.44
LS/HF	13.5 cm	14cm	14cm	15cm	15cm	14cm	11.5cm	12cm	13cm	13.56cm	1.21
HS/LF	16 cm	16.25cm	15.25cm	12.5cm	15.5cm	17cm	13cm	13.5cm	15cm	14.89cm	1.55
HS/HF	13.5 cm	15.5cm	16cm	14.25cm	15cm	15cm	13.5cm	14.5cm	15cm	14.69cm	0.85

The consistometer test results conclude that the high sodium, canola oil treatment was the most viscous with an average measurement of 14.89 centimeters. The second most viscous treatment was the high sodium, bacon fat treatment with a measurement of 14.69 centimeters. The next most viscous treatment was the low sodium, bacon fat treatment with a score of 13.56 centimeters. Lastly, the low sodium, low fat treatment was the least viscous with a score of 9.11 centimeters. Our hypothesis was that the high sodium, bacon fat treatment would be the least viscous while the low sodium; canola oil would be the most viscous. Because the same amount of other ingredients remained the same and we were consistent in using the consistometer (e.g. the same person poured samples into both consistometers and the same two people who were trained using the consistometer used the consistometer), our standard deviation remained small so we know that our results are accurate and precise.

Sensory Methods



We performed ANOVA tests to determine whether there was a significant difference in consumer acceptability between treatments. Our results demonstrate there was only a difference between the LF/HS and the other three treatments (displayed in table 3). The LF/HS was the

most preferred treatment according to the 9 point Hedonic Test so this means they were able to distinguish the difference between the most liked (7.4 on 9 Point Hedonic Test) and even though there may be slight perceived differences in the others, the data shows it isn't significant ($p > .05$). This goes against our hypothesis because we thought the consumers would be able to tell more of a difference between the low fat and high fat treatments, and prefer the high fat.

The ANOVA test that determined whether there was a difference between treatments in the QDA characteristics shows there was a significant difference between the celery, bland, spicy, mild, soft, chewy, and slimy attributes, but not acidity. We then did T-tests within the 7 attributes there were differences between. These results demonstrate there was a significant difference between all the characteristics except for the mild taste (p-value > .05) for all treatments). We then chose the four attributes with the lowest p-value (spicy, bland, celery, soft) and created the table below to demonstrate the statistical differences between attributes.

Table 3: Descriptive Analysis Attributes

Treatment	Acceptance	Spicy	Bland	Celery	Soft
Control 341	6.6+/- 1.8 ^{a}	7.64+/-1.28^{a}	4.14+/-1.8^{ab}	6.57+/-2.17^{a}	6.57+/-1.59^{a}
LF/HS 129	7.4+/-1.2 ^{b}	5.39+/-3.32^{ac}	6.54+/-2.97^{b}	2.96+/-1.82^{bc}	6+/-2.35^{a}
HF/LS 960	6.6+/-1.8 ^{a}	5.39+/-3.32^{c}	5.26+/-2.41^{b}	5.03+/-2.09^{ac}	5.96+/-2.03^{a}
LF/LS 572	6.1+/-1.8 ^{a}	5.39+/-3.32^{b}	2.4+/-1.65^{a}	2.22+/-1.24^{b}	3.11+/-.07^{b}
	Acceptance from 1- extremely dislike to 9-extremely like				
	Spicy Score: 0= no spice, 10= very spicy flavor				
	Bland Score: 0=not at all, 10= very bland scent				
	Celery Score: 0=not at all, 10= strong celery scent				
	Soft Score: 0=not soft, 10= very soft texture				

This table expresses the most significantly different attributes of the descriptive analysis, showing the means and standard deviations. The superscript indicates the statistical differences in each category.

Literature Review

Comparing our study to the literature that was reviewed, the study done with the rice flour and okra has similar variables to our study, most likely because the study itself and the experiment done are similar to those that we did. The independent variable is the batter, including the amount of rice flour and water. The dependent variables are the viscosity of the batter, and the results of the sensory evaluations, and the oil uptake by the fried okra. Of five visual properties, only one, the color description, resulted in a significant difference (5). Four other properties resulted in significant differences, those are: roughness, hardness, cohesiveness, and crispiness. These properties are different from our experiment, clearly, because we made a gumbo soup and not fried okra, however, we did find some statistical differences with the sensory attributes. In our study, six of the eight attributes were statistically significant. The three predominantly significant attributes were soft (texture), celery (aroma), and spicy (taste). These attributes are very different from the rice flour study because of the different dishes that were prepared. Also, a main difference is between the trained panelists that completed the sensory evaluations.

The second study, although different in experiment method, still had similarities to our experiment. The main point being that it is a good thickener for soups (6). Although it did not directly measure viscosity like our experiment, it did show that okra contributes to thickening of soups. Going into the trial, we understood the general properties of okra and found that it might have some influence on the thickness of the soup. We did know, however, that that wasn't the primary thickening mechanism in our recipe. We prepared and added a roux (four and fat mixture) to each treatment to thicken the soup.

Limitations

There are several limitations to our study but the major ones are the sample size of 49 people and a limited age group of mostly college-age students. Other limitations were gender. All of the QDA trained panelists were female and the majority of the 49 untrained consumers were females as well. However, we were unable to get gender and age percentages on the consumers because most did not check those boxes on their survey sheet. There were also discrepancies among attributes within the trained panelists on the QDA test. This is likely due to time constraint, we didn't have much time to talk to the panelists and resolve the discrepancies before they did their final evaluation of the gumbo soup treatments.

Conclusion/Recommendations

Our study results disprove our hypothesis of the consumers being the most accepting of the high fat, high sodium treatment. Instead, they preferred the low fat, high sodium treatment. If we were to conduct this study in the future there are a few things we would change. First, we would choose a more traditional gumbo recipe that people would be likely to have access to. We found that even the unhealthier treatment was healthier than many traditional recipes. Also, having a larger scale recipe seemed to be beneficial. The gumbo soup characteristics seemed to be stronger when we made it for the 49 people and doubled the recipe versus splitting it in half. Having a larger sample size would be recommended as well, because the panelists may not have gotten a variety of ingredients in the small scoop that we poured over the rice. Lastly, in the future we would spend more time training panelists so that there would be closer agreement on the QDA attributes.

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Appendix A

Chicken Gumbo Soup Recipe
Yield: 6 servings

Ingredients

* 1 lb boneless, skinless chicken breast, diced
* 3 cups reduced-sodium, reduced-fat chicken broth, divided
* 3 cups water
* 1 cup chopped onion
* 1 clove garlic, minced
* 1 tsp salt

* 1/2 tsp pepper
* 1 bay leaf
* 1/8 tsp sage
* 1/4 tsp red pepper flakes
* 1/4 tsp thyme
* 1 cup chopped fresh tomatoes
* 1 cup diced green bell pepper
* 1 cup frozen okra
* 2 Tbsp canola oil
* 1/4 cup flour
* 2 cups cooked brown rice

Directions

1. Place the chicken in a large soup pot with 1 cup of broth. Bring to a boil.

2. Add the additional broth, water, onion, garlic, salt (omit this if you need to reduce total sodium), pepper, bay leaf, sage, red pepper flakes, and thyme and simmer for 20 minutes.

3. Add the tomatoes, bell pepper, and okra and simmer for 15 minutes.

4. In a separate pan, heat the oil and flour and stir until the flour and oil are golden brown and bubbly, stirring constantly. Add 1 cup of the soup broth to the mixture and whisk until smooth.

5. Add the mixture back to the soup pot and whisk until dissolved. Simmer 30 minutes. Stir in the rice the last 10 minutes of cooking.

Serving size: 1 cup

Nutritional Information (Per Serving)

Calories:	279
Protein:	23 g
Sodium:	720 mg
Cholesterol:	43 mg
Fat:	7 g
Carbohydrates:	31 g

Appendix B

High Sodium, Low Fat Chicken Gumbo

Serving size: 1 cup	
Amount per serving:	
Calories	214.5
calories from fat	72
Total Fat	8 g
Saturated Fat	1 g
Cholesterol	64 mg
Sodium	884 mg
Total Carbohydrates	11 g
Dietary Fiber	2 g
Sugars	2 g
Protein	25 g

Low Sodium Low Fat Chicken Gumbo

Serving size: 1 cup	
Amount per serving:	
Calories	217
calories from fat	72
Total Fat	8 g
Saturated Fat	1 g
Cholesterol	64 mg
Sodium	449 mg
Total Carbohydrate	11.5 g
Dietary Fiber	2 g
Sugars	2.5 g
Protein	25 g

High Sodium, High Fat Chicken Gumbo

Serving size: 1 cup	
Amount per serving:	
Calories	212.5
calories from fat	63
Total Fat	7
Saturated Fat	2 g
Cholesterol	68 mg
Sodium	884 mg
Total Carbohydrates	11 g
Dietary Fiber	2 g
Sugars	2 g
Protein	25 g

Low Sodium, High Fat Chicken Gumbo

Serving size: 1 cup	
Amount per serving:	
Calories	215.5
calories from fat	63
Total Fat	7 g
Saturated Fat	2 g
Cholesterol	68 mg
Sodium	449 mg
Total Carbohydrates	11.5 g
Dietary Fiber	2 g
Sugars	2.5 g
Protein	25 g