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# Consumer Preferences: The Role of Food Emotions in Food Choice

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CONSUMER PREFERENCES: THE ROLE OF FOOD EMOTIONS IN FOOD  
CHOICE

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A Thesis  
Presented to  
the Graduate School of  
Clemson University

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In Partial Fulfillment  
of the Requirements for the Degree  
Master of Science  
Food, Nutrition, and Culinary Sciences

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by  
Jessica Elspeth Glass  
August 2009

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Accepted by:  
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## ABSTRACT

The purpose of this study was to determine the driving factors in food choice. The Flavor Pyramid, introduced by Steven Kaun, indicates that the foundation of consumer food choice is emotional (Kaun, 2005). This study serves as a preliminary means to validate the role of the emotional component of food choice in today's market. Four gingerbread formulas, one from 1430, 1861, 2004, and a new product, were evaluated in a sensory panel in order to collect preliminary data on the role that food emotions play in consumer preference. Nearly sixty-six percent of all panelists chose the 2004 recipe as the preferred product. The 2004 recipe also received the highest hedonic scores for texture, flavor, and appearance, while the 1430 recipe received the highest scores for aroma. Panelists were also asked what emotions were evoked when consuming gingerbread, and the most popular answer was holiday/Christmas memories, followed by happiness. These findings can be used to develop a new product which maintains the characteristics of the 2004 recipe, while incorporating different, healthy ingredients, available through advances in technology and discoveries through the years.

## DEDICATION

This thesis is dedicated to my Mom and Dad – my wonderful, supporting parents, and two of my best friends. Thank you for all of your love and support through the years. I couldn't have done it without you!

## ACKNOWLEDGMENTS

Many people are behind the completion of this work. Dr. Condrasky – thank you for your support, ideas, and opportunities through my two years at Clemson. Your guidance has been much appreciated. Dr. Coffee – without you, I would not know gingerbread as I do. Thank you for everything – I hope you know how much your leadership and support means to me. Dr. Grubb – thank you for stepping outside your department to take part in my committee. Your expertise in food history continues to amaze me! Thank you to the Center of Gerontology at the University of Georgia for participating as my preliminary panel, and to all of those individuals in Clemson who took time out of their day to participate in my sensory panel – without you this study could not have been completed. Thank you to Dr. Julia Sharp for assisting me with my data analysis. Dr. McGregor – thank you for opening my eyes to the world of dairy. Without you, I would not be able to claim (a tiny bit of) fame in the cottage cheese world. I would also like to thank my co-workers at Jittery Joe’s, Drew Warmin, Brad Ballieu, and Mike Nigh for supporting me each and every day.

## TABLE OF CONTENTS

	Page
TITLE PAGE .....	i
ABSTRACT .....	ii
DEDICATION .....	iii
ACKNOWLEDGMENTS .....	iv
LIST OF TABLES .....	vii
LIST OF FIGURES .....	viii
CHAPTER	
I.    INGREDIENT INVESTIGATION AND REVIEW AND APPLICATION OF CURRENT LITERATURE RELATED TO FOOD EMOTIONS .....	1
Abstract .....	1
Introduction .....	2
The Flavor Pyramid .....	3
Gingerbread History .....	6
Allspice .....	9
Almond Meal .....	9
Butter .....	11
Cinnamon .....	11
Eggs .....	13
Flax Seed Meal .....	14
Flour .....	15
Ginger .....	16
Honey .....	17
Milk .....	19
Molasses and Treacle .....	20
Pepper .....	22
Saffron .....	23
Splenda® Brown Sugar Blend .....	23
Sugar .....	24
Discussion .....	25
References .....	26

II. METHODS AND MATERIALS FOR DATA COLLECTION AND DATA ANALYSIS.....	31
Abstract.....	31
Introduction.....	32
Research Questions.....	35
Methodology.....	35
Results.....	38
Discussion.....	42
Conclusion.....	45
References.....	47
APPENDICES.....	48
A: Letter of Consent.....	49
B: Sensory Panel Survey.....	50
C: Gingerbread Formulas and Nutrition Facts.....	55
D:Panelist Comments from Preliminary and Main Sensory Panels.....	59

## LIST OF TABLES

Table		Page
2.1	Preliminary Panel Preferences .....	38
2.2	Main Panel Preferences.....	39

## LIST OF FIGURES

Figure		Page
2.1	Characteristics By Sample .....	40
2.2	Emotions Associated with Gingerbread.....	40
2.3	Gingerbread Preferences .....	41

## CHAPTER ONE

### INGREDIENT INVESTIGATION AND REVIEW AND APPLICATION OF CURRENT LITERATURE RELATED TO FOOD EMOTIONS

#### Abstract

This review serves as a collection of the information available regarding the role that food emotions play in consumer choice. Aromas or even the thought of a food is often tied to a pleasant memory or a bad experience, and these food emotions continue to play a role in consumer food preference throughout an individual's life. The Flavor Pyramid indicates that the foundation of food choice is formed by the emotional component, followed by appearance, aromatics, texture, sensations, and basic tastes (Kaun, 2005). Information is also included on the history and health benefits of the main ingredients that make up the four formulas used in this research, as historical and religious use play a role in emotional ties to foods.

## Introduction

Just as learning about history helps prepares us for the future, for food scientists studying foods of the past may help us understand the foods of today. By having an understanding of the foods of our past, not only can we learn more about the foods of today, but we may even find new ways to incorporate old ideas. There are very few baked goods still available that date back in history further than the 15<sup>th</sup> century gingerbread. Fruitcake became popular starting in the 16<sup>th</sup> century, cream puffs in the 17<sup>th</sup> century, and muffins not until the 18<sup>th</sup> century (Oliver, 1999). When gingerbread made its first appearance in England in the early 15<sup>th</sup> century, it was a honey cake, eaten primarily for its medicinal properties. As the availability, price, and preferred cooking methods have changed through the years, the food choices and preferences have changed accordingly. However, emotions have also influenced the food selections of many individuals.

The purpose of this study is to determine the most important factor in consumer choice – emotional aspects versus new product availability due to advances in technology. By asking consumers what emotions they associate with gingerbread and providing varying samples of gingerbread, we can determine whether the acceptance levels of the products or food choice is based on emotional attachments. To begin with, literature regarding the actions that go into making a food choice as well as research involving food emotions were reviewed. Additionally, an investigation of the history of the availability and use of the major ingredients of the gingerbread products used for this study was completed so that the product variances could be understood.

## The Flavor Pyramid

The Flavor Pyramid, a concept introduced by Steven Kaun, is an excellent representation of the process through which individuals make food choices (Kaun, 2005). The emotional component of the pyramid incorporates both memories of a food from childhood as well as events and shared food experiences. Eating is a ritual, often shared with family or friends, and is most often thought of as a joyful time. Food is consumed at parties and when traveling, and certain foods are often associated with specific types of events. When a bite is taken of a favorite food that Mom used to make or an attempt is made to eat a food disliked in the past, many times an individual will be taken back briefly to his or her childhood or a previous experience. Other factors incorporated into the emotional level are culture, traditions, family background, and personal behaviors. Throughout life, as new foods are tasted, usually an individual will have a vague idea of what the food might taste like since we associate flavors with colors and types of food already experienced (Kaun, 2005).

Appearance is when the dining experience truly begins. The first glimpse of a meal allows the consumer to begin making assumptions as to how he or she will like it. A variety of bright colors indicates that the food is fresh and anticipation builds for the dining experience. Dull, bland colors give low expectations of the food that is about to be consumed. The portion size of the meal presented and plate size also come into play. Foods that are flat across the plate appear less appealing than foods that have some height on the plate. Just as the experiment with fruit flavored beverages being dyed different colors indicated, hints are taken from the appearance of food as to the flavors and textures

that should be expected (DuBose, 1980). A red colored beverage can fool a consumer into thinking it is cherry flavored, simply based on color (Kaun, 2005).

The next part of the dining experience comes from the aromatics of food. As food enters the mouth, the aromas of the food enter the nasal passage as the food is being tasted. The smell of a food can put the consumer off, even before tasting it. The aromas a consumer may experience fall under acidic, spicy, sweet, sulfury, terpenic, lactonic, esters, and woody/smoky. The best way to understand the importance of aroma is to think about eating while having a head cold. The perception of flavor is greatly reduced since the aromatics cannot be appreciated (Kaun, 2005).

After the emotions, appearance, and aromas have been analyzed, the next level is texture. Common textures are soft, mushy, crispy, crunchy, smooth, and creamy. If a food is expected to be crunchy, like a piece of broccoli, but instead turns out to be mushy, it is likely the rest of the broccoli will remain uneaten. Texture is one of the most important elements associated with food. There is not one “right” texture, however each individual food has a “right” texture. It has been found that texture is most appreciated at dinner, while the most restricted meal for texture is breakfast, since easy to chew foods are most desired at this time of day (Bourne, 2002). Texture is sometimes a difficult concept, as it is something that cannot be added to food, but it can be taken away. When a dish uses layered textures, it gives the diner a more developed flavor (Kaun, 2005).

The next level on the pyramid is sensations, such as numbing, fullness, cooling, pungency, and tingling. This level represents the reactions a person has to what he or she is eating. When a spicy food is consumed, an individual may begin sweating and feeling

a burning sensation in the mouth. Consuming a glass of milk after spicy food gives a cooling effect as the basic milk calms the burn. Similarly, eating a sour food causes a puckering reaction. These sensations are triggered by the tongue and cause the body to react (Kaun, 2005).

The top of the pyramid represents basic tastes. Certain areas on the tongue are understood to taste different basic tastes most strongly. The tip of the tongue tastes sweet and salty the best. The sides of the tongue taste sour the best, and the back of the tongue has the strongest taste buds for bitter. Umami, the fifth basic taste, is a meaty or savory taste. By incorporating the basic tastes, a chef can build a complex flavor (Kaun, 2005).

The base of the pyramid, emotions, plays the primary role in food selection. Foods that evoke positive emotions, like a childhood memory, are generally chosen over those foods which evoke a memory of a bad experience due to the emotional response of the individual. The odor memory is one of the first to be aroused at birth (Wright, 2006). Once formed, an aroma memory can trigger an emotional response later in life. Since many foods associated with holidays are strong aromatic foods, they are a way for individuals to connect the past and the present. The holidays are generally thought of as happy times, which as a result bring happy memories to the surface. Studies have indicated that food aromas bring forth memories of events, while fragrances, such as lotions or perfumes, evoke memories of personal relationships (Wright, 2006). The emotional response of people around us also influences the food choices made by consumers. When a person is offered a food while seeing a person showing disgust, the

desire to eat the food is decreased significantly (Barthomeuf, Rousset, & Droit-Volet, 2009)

### Gingerbread History

The term ‘gingerbread’ covers a vast assortment of products which have developed over the past 600 years. Gingerbread began in England as ‘honey cakes,’ which were a relatively dense product and eaten mainly as a medicinal food due to the nature of the ingredients. By the 1500’s gingerbread had developed into the spicy, crisp cookie which is still popular today. It was also around this time that chemical leavening agents became available and shortly after a new cake-like gingerbread emerged. When gingerbread first started out, it was most commonly the craft of a master baker and in some European countries gingerbread bakers were known as a small subunit of the baker’s guild (Horander, 2008). Gingerbread can be traced back through the 11<sup>th</sup> century Crusades along with the spiced honey cakes found in the Middle East. Gingerbread was becoming popular in Medieval England and Germany about the same time; however, this research will focus solely on those recipes developed in England in order to maintain consistency. The majority of English gingerbread formulas use treacle to replace the honey in medieval recipes. Originally, spices were used as a way to mask spoiled flavors or staleness, rather than to flavor foods, however foods were often eaten for “medicinal value” or to balance out the four humours. (Bloom, 1995).

Meals in medieval times were meant to be healthy, just as health foods are sought after today, however ‘healthy’ had a totally different meaning. In medieval times, it was

thought that the body was made up of a unique combination of four ‘humours.’ Humoral physiology rests on the idea that there are four major fluids dominating the body: phlegm, choler, black bile, and blood. Each of these fluids is composed of two elements: phlegm is cold and moisture, choler is heat and dryness, black bile is cold and dryness, and blood is heat and moisture. Physicians would prescribe certain foods based on their classification in order to restore health. In a healthy individual the four humours were in balance, and an unbalanced system was thought to result in sickness. It was also believed that each individual had his or her own unique balance of the four humours.

Consequently, it was believed that each food had a makeup of these elements that would interact with an individual’s humoral balance. If an individual suffered from a cold, the opposite element was prescribed, in this case, hot and dry (The Cambridge World History of Food, 2000). The 1430 gingerbread formula chosen for this research was made of ingredients that were considered ‘hot and dry’ and may have been prescribed for someone with a cold. The product may also have been eaten at the conclusion of a meal, as it was believed that spices would aid in digestion, so this would have been a popular sweet in medieval times. It was until about the 18<sup>th</sup> century that food was eaten as medicine, when scientists discovered that blood circulated through the body (Civitello, 2007). Saffron was probably used in this recipe to give the gingerbread a gold color, which was a symbol of status (Civitello, 2007).

The 1861 formula, from Mrs. Beeton, was chosen due to the role Ms. Beeton played in British home making. She is known for writing *Mrs. Beeton’s Book of Household Cookery*, which is the most famous cook book written in British history.

Isabella Mary Mayson married Samuel Orchard Beeton, a publisher of both books and magazines, and she began writing articles for his publications in household management and cooking. Her works were put together and published in 1861, as *Mrs. Beeton's Book of Household Cookery* which gave information on almost all aspects of running a household in Victorian Britain (MrsBeeton.com, 2007). This book was one of the first cookbooks ever published, and Mrs. Beeton's name is still iconic and known in England today, similar to how Betty Crocker is known in the United States.

The 2004 formula was chosen from a current British cookbook, and was representative of the most common recipe of today. It is very similar to that of a gingerbread mix one might find in the grocery store. The new product developed for this research sought to incorporate ingredients that would showcase ingredients that have been developed as technology has advanced. For these reasons, the three documented recipes should have some emotional ties.

As a favorite worldwide sweet, there are endless gingerbread formulas, varying in color, spice level, texture, and flavor. Via sensory panel analysis, this research will examine how advances in technology through the years have changed the recipe and how this has impacted the product the consumer of today prefers. It is understood that food emotions play an important role in consumer preference, but does this aspect play a larger role than that of newly developed products? All of the recipes used in this research were chosen to be of the cake-like nature to provide some consistency, while at the same time representing a wide range of products representing over five centuries of new discoveries in ingredients, transportation, and technology.

## Allspice

### Background

Allspice is the dried unripe fruit of the *Pimenta dioica* plant, which is a small shrub-like tree. Allspice got its name from the English, who thought the spice was reminiscent of the combined flavors given by pepper, clove, cinnamon, and nutmeg. The spice is mainly grown in Jamaica and was used more frequently in the past than it is today (Raghavan, 2006).

### Health Benefits

Allspice has been considered a therapeutic spice, as it is an aromatic stimulant and helps to relieve gas and stimulate digestion. It has also been used as a mild anesthetic and pain reliever. Allspice also contains a low level of eugenol, a volatile oil, which is thought to be a mild anti-microbial agent (Raghavan, 2006).

## Almond Meal

### Background

Almonds are a stone fruit from deciduous trees native to hot, dry regions of western Asia, but were introduced to Greece and West Africa very early on. The seed of the fruit is the edible part and has a sweet flavor. Almonds are the most abundant fruit planted in California and grown widely in the Mediterranean region (World's Healthiest Foods, 2009).

## Health Benefits

The consumption of nuts has been associated with lower incidence of diabetes, cardiovascular disease, and some types of cancer, and as a result nuts have become part of the recommended dietary guidelines in several countries. The flavonoids found in almonds are bioavailable and function as antioxidants, which increases the resistance of LDL cholesterol to oxidation and lowers the level of oxidative damage on DNA (Li, et al., 2007). Studies observing the consumption of almonds have indicated that almonds help to significantly reduce risk factors for coronary heart disease. This reduced risk is associated with the high levels of dietary fiber, protein, and lipids rich in oleic acid. Almonds have a higher amount of protein and  $\alpha$ -tocopherol (vitamin E) than other tree nuts (Mandalari, et al., 2008). A serving of almonds is low in both cholesterol and saturated fats. California almonds contain approximately 20-30% proteins, 45-55% fats (with over 90% of that being unsaturated fatty acids), 10-15% dietary fibers, and many minerals, sterols, tocopherols, and vitamins (Jia, Kim, Huang, & Huang, 2008). The amount of antioxidants in one serving of almonds is equivalent to that of a serving of black or green tea. Additionally, almonds improve satiety, which aids in weight management (F & H Porter Novelli, 2008).

## Butter

### Background

Traditional butter, made from pasteurized cream, is 80% milk fat. In Europe, from the Renaissance through the industrial revolution, butter was made by churning (or agitating) cream to make butter in a wooden barrel on rockers. Now, mechanical means, or continuous churns, are used most often and were commercialized by the middle of the 20<sup>th</sup> century (WebExhibits, 2009). Today, butter is labeled under a U.S. governmental grading system based on its color, flavor, body, and salt content. Unsalted butter was used in all of the formulas, which contains no added salt in order to help control the salt level in a food product (Dairy Management Inc., 2009).

### Health Benefits

Butter is a source of vitamin A. One tablespoon of butter contains about 100 calories (Dairy Management Inc., 2009). Butter is high in saturated fats and cholesterol, so intake should be relatively infrequent. It is recommended that only 7% of the fat eaten in a day should come from saturated fats (Jegtvig, 2009).

## Cinnamon

### Background

Native to Sri Lanka, cinnamon is a dried tropical tree bark with a sweet, mild, woody flavor. Cassia, native to southeast Asia, Indonesia, and Southern China, is a close cousin of cinnamon but has thicker bark and a more pungent odor (Adamson, 2004). Both cinnamon and cassia are sold under the name cinnamon, and are often mixed together

when sold in the ground form (Viestad, 2007). Most recently, research has been done to determine the characteristics of cinnamon's antimicrobial properties. A recent study indicates that cinnamon may aid in the prevention of food spoilage when used in packaging. Essential oils are significant sources of terpenes and phenols which act as strong antimicrobial agents. Cinnamaldehyde has proven to have the strongest antimicrobial properties of the essential oils added to the packaging film and prevented the growth of *Rhizopusstolonifer*, which is black bread mold. It is also possible that cinnamon could be used as a food preservative (Rodriquez, Nerin, & Batlle, 2008). Cinnamon was one of the first exotic spices to be imported to Europe. In ancient Egypt, it was used as embalming powder and in Greece and Rome it was used as an aromatic. Early physicians classified cinnamon as hot and dry and it was prescribed as a digestive (Adamson, 2004). Medieval Chinese medicine has used cinnamon for its warming qualities, which relieved symptoms of the flu or a cold.

#### Health Benefits

The eugenol and cinnamic aldehyde found in cinnamon and cassia are reported to be active as microbial components. The volatile oil in cinnamon is made up of 8% eugenol and 75% cinnamic aldehyde, together making up about 0.5 – 1.0% of cinnamon as a whole. Cinnamon oil was found to be lethal to anthrax spores. In 1939 it was found that cinnamon and cloves were two of nine spices tested which had antimicrobial activity. Cinnamon was only slightly inhibitory at a 1:50 dilution, cloves inhibited *Bacillus subtilis* at 1:100 and *Staphylococcus aureus* at 1:800 (Branen & Davidson, 1983). A single teaspoon of cinnamon has 6 calories and 0.56 g fiber, 6 IU Vitamin A, 1 mg

Vitamin C, 0.9 mg iron, 28 mg calcium, 1 mg magnesium, and 11 mg potassium (Stevens, 2005). This means one teaspoon of cinnamon has the same amount of calcium as a cup of milk. There is research that indicates that cinnamon may also have some anti-inflammatory and anti-clotting characteristics. Cinnamaldehyde, cinnamyl, cinnamyl alcohol, and cinnamyl acetate, which are the active components in the essential oils are believed to contain the healing properties. Research is also being done to determine whether or not cinnamon aids blood sugar levels in patients with diabetes. The proanthocyanidin in cinnamon seems to mimic insulin in the body by activating the insulin receptors. This activation is what patients with Type II diabetes are missing, and following this activation, whether by insulin or by proanthocyanidin, the chemical reactions required to convert sugar to energy for the cell to use occur. Recent studies in Pakistan following 60 individuals with Type II diabetes found that one teaspoon of cinnamon twice a day not only significantly lowered the blood sugars, but also the triglycerides, LDL cholesterol, and total cholesterol. It is believed that there may be a toxic dose of cinnamon, but small doses of cinnamon are not harmful (Khan, Safdar, Muzaffar, Khan, & Anderson, 2003).

## Eggs

### Background

Eggs have been consumed by humans since the beginning of human existence. They are relatively easy to obtain, are an excellent source of protein, and can be used in a wide variety of recipes. Many different types of eggs are available, however ostrich and

chicken eggs are the most commonly eaten (Olver, 2008). Eggs can be found in many forms on today's market, including frozen, dried, and as egg whites, yolks, or whole eggs (American Egg Board, 2009). Whole eggs were used in these recipes.

### Health Benefits

One egg has about 70 calories, 4.5 grams of fat (1.5 grams saturated fat, 0.5 grams polyunsaturated fat, and 2.0 grams monounsaturated fat), and 6 grams of protein. An egg contains Vitamin A, calcium, iron, thiamin, riboflavin, Vitamin B-6, folate, Vitamin B-12, phosphorus, and zinc. One egg also has 210 milligrams of cholesterol. The yolk of an egg contains all of the fat and about half of the protein of the whole egg. Egg yolks are also one of the few foods that contain naturally occurring vitamin D. The protein found in eggs helps to promote satiety and is the highest quality of protein that can be found in food (American Egg Board, 2009).

### Flax Seed Meal

#### Background

Flaxseed, also known as linseed, comes from an annual herb thought to have originated in Egypt. The plant does best in moist soils, made up of sand, clay, and silt. The seeds are small and oval shaped, and contain the plants oil. The plant is made up of fiber, lignans, protein (about 20%), and essential fatty acids (35% of flaxseed is oil, and of that, 55% is alpha-linolenic acid) (University of Maryland Medical Center, 2007). It is used for nutritional and medicinal purposes as well as for things like fishnets and clothes due to its high fiber content. Since flax is so high in fiber and mucilage, a gummy

material, flax has often been used as a laxative. Flaxseed oil is also used as a drying agent in paint and varnish.

### Health Benefits

Flax seed and flax oil are also high in alpha-linolenic acid (ALA) which is an omega-3 fatty acid that appears to help with heart disease, arthritis, and inflammatory bowel disease. Diets with a balance of omega-3 and omega-6 fatty acids are associated with lower incidence of heart disease, diabetes, cholesterol, arthritis, and some cancers (University of Maryland Medical Center, 2007). Recent studies have been completed to assess whether or not flaxseed can be used in the treatment of hot flashes in post-menopausal women. This would be especially helpful for women with a history of breast cancer who would like to avoid the use of estrogen in post-menopausal treatments. Preliminary results indicate that hot flash rates were reduced by about 50% (Pruthi, et al., 2007).

### Flour

#### Background

Grains are one of the oldest food staples in history. The majority of flour is made from the wheat kernel. Flour has two main proteins, glutenin and gliadin, which are responsible for the elastic gluten network that forms when flour is mixed with water. This network proves helpful in trapping the gases produced by yeast in bread baking. When flour was first made in prehistoric times, the kernels were simply ground between two stones (How Products Are Made, 2007). Today, wheat processing is a highly refined

process that consists of five basic steps: breaking, purifying, reducing, sifting, and classifying. Many different types of flour are produced and are classified based on the level of protein they contain. The most common type of flour is all-purpose which has a protein level of about 11% (Hui, 2006). Flour is important in the structure, flavor, and texture of baked goods.

### Health Benefits

It is believed that a diet rich in whole grains may help reduce the risk of several chronic diseases. Whole grains have a minimal processing of the grain, and are found in foods like whole wheat flour, oatmeal, and brown rice. Whole grains are high in fiber, which is associated with a reduced risk of coronary heart disease. Whole grains are also a good source of the B-vitamins and iron (United States Department of Agriculture, 2008).

### Ginger

#### Background

Ginger is a tropical plant from the Zingiberaceae family, known for its natural medicinal qualities. Ginger most likely originated in India, although it was cultivated early on in East Africa. Ginger was one of the first spices to be imported into Europe by Arab traders (Bloom, 1995). It is a rhizome and has a very pungent, tangy, fresh flavor and a wide range of medicinal value. Fresh ginger has a knobby shape and is firm with a creamy or white fibrous flesh. It is best kept in a cool, dark place. Ginger is good for neutralizing off flavors in dishes. Dried ginger has a sweeter, lemony aroma and can be

quite spicy. The best ground ginger is from Kerala, India (Viestad, 2007). In Ancient Rome and medieval Europe, ginger was used both as a drug and a food.

### Health Benefits

Physicians described ginger as extremely hot and moderately humid and it was thought to heat the body more slowly than pepper, but it shares similar medicinal properties, stimulating the appetite and aiding in digestion (Adamson, 2004). Today, ginger is used to treat a variety of conditions associated with inflammation. The related molecules to [6]-gingerol appear to at least inhibit 5-lipoxygenase (5-LOX), thromboxane synthetase, COX-1, and COX-2, but it works in quite a different way than NSAIDS or COX-2 inhibitors function. Many studies have been done to evaluate the benefits of ginger extract for patients suffering from arthritis pain, and the results place ginger extract second only to ibuprofen in relieving pain (Tapsell, Hemphill, Cobiac, Fenech, Patch, & Sullivan, 2006). Additionally, the herb is thought of as a digestive stimulant, antimicrobial, diaphoretic, antiemetic, and spasmolytic. For these reasons, ginger can be used to treat both inflammation as well as other symptoms in a patient (Yarnell & Abascal, 2006). Additional medicinal uses of ginger include aiding in circulation, boosting the immune system, and helping to alleviate indigestion (Viestad, 2007).

### Honey

#### Background

Honey has been enjoyed by both animals and humans since prehistoric times. Honey was very expensive in ancient Egypt. It was used by Romans in mustard and as a

preservation tool for fruit and meats, due to its natural antimicrobial properties, partially attributed to its low pH of 3.9. Honey, originally gathered from wild bee colonies, was eventually replaced by sugar in upper class homes as sugar became readily available. Sugar was preferred, as it did not darken food and drink like honey (Adamson, 2004). Honey is mainly made up of the monosaccharides glucose and fructose, followed by water on the component list. It is the nectar excreted by honey bees after they have collected nectar from the flower pollens. Honey is removed by centrifugation of the comb cells in a beehive, where the bees store the honey. A mild heat treatment (140-160°F) is used to pasteurize the honey, which destroys the osmophilic yeast and slows the rate of crystallization. There are more than 150 varieties of honey available, which vary based on the floral source used for pollination. The average composition of honey is around 82.4% sugar, with 25.2 – 44.4% fructose, 24.6 – 36.9% glucose, 1.7 – 11.8% maltose, and 0.50 – 22.9% sucrose. The water content is 12.2 – 22.9% (Hui, 2006). The honey used in the 1430 recipe was a raw English Sanfoin honey, as it is more like what would have been used, and it held the product together more effectively than a processed honey.

### Health Benefits

Physicians in medieval times described honey as moderately warm and dry in nature, and as a mild diuretic and laxative. Honey was recommended for older people and those with a cold temperament. For a brief period, it was believed that consuming honey after wine would avoid inebriation (Adamson, 2004). Honey has small amounts of niacin and ascorbic acid and varying levels of minerals. Honey has been used to treat the

common cold for individuals over the age of 1 year, as well as to treat allergies (The National Honey Board, 2005).

## Milk

### Background

Most milk in the United States comes from dairy cows; however, milk from goats, reindeer, and water buffalo is also used around the world. Milk likely became a common beverage around the time of domestication of animals, sometime around 8000 B.C., mainly in Ancient Greece and Rome. Cattle were first brought to the United States around 1600. It wasn't until around 1790 that dairy products were produced large scale and sold in growing cities. Today, the machinery for dairy processing has become highly advanced. In processing, raw milk can become a variety of milk products, including skim, 1% milkfat, 2% milk fat, and whole milk, as well as many dairy products, such as yogurt, butter, and cheese (How Products Are Made, 2007).

### Health Benefits

Milk has a high level of calcium, so the milk and milk products are beneficial for building strong bones as well as aid in reduction of cavities when combined with brushing and flossing. It is also known to help with sleep, muscle rebuilding, and hair, nail, and skin growth, due to the protein, lipid, calcium, Vitamin A, and biotin levels in milk (California Milk Processor Board, 2008).

## Molasses and Treacle

### Background

Molasses was a very popular sweetener until about 1900, as it was less expensive than refined sugar. Molasses, a heavy bodied, viscous solution, is usually a byproduct of sugar refining, but it can also be a primary product of sugar production (open kettle molasses). Open kettle molasses is a primary product produced when sugar cane juice is concentrated directly, no sugar is removed and artificial preserving or clarifying agents are added until crystallization occurs. The drained concentrated juice that is removed is open kettle molasses. If molasses is aged properly, it will develop a rum-like flavor due to limited fermentation caused by the yeast strain *Torula*. Open kettle molasses is a darker molasses because no bleaching occurs during processing. The finest type of molasses is unsulfited molasses imported from the West Indies. It is the whole cane juice clarified and evaporated to a heavier consistency. Unsulfited molasses has a light, clear color with a delicate, sweet flavor because it contains all the sugars of the original cane (Hui, 2006). Blackstrap molasses is another type of molasses made from the third boiling of the sugar syrup (World's Healthiest Foods, 2009). Molasses is usually used for its flavor and sweetness but also gives a nice color to crumb and crust in bakery products. It also has acidity which assists chemical leavening agent, helping provide great texture to cookies after reacting with baking soda. The sucrose and invert sugars are a good source of energy for yeast in fermented baked goods. Color produced in baked goods, flavor, sugar content, solids content, ash, and product uniformity should be considered when using molasses in a product (Hui, 2006). Treacle is produced in the same fashion as

molasses, but is somewhat lighter in color. Historically, it has been known to serve as a medicinal compound and was formerly in wide use as a remedy against poison.

Technically treacle is a generic word in Britain for any syrup made in the process of refining sugar cane, and it can range from very light to very dark; however in practice, it is the lighter syrup which is produced when the sugar cane juice is first boiled which is called light treacle or golden syrup. The second boiling of the sugarcane produce a much darker syrup, which British cooks call treacle or dark treacle, and in the United States is known as molasses. The third boiling produces what both Americans and Europeans know as blackstrap molasses, which is very dark and somewhat bitter, and which health-food advocates think is heaven on earth, although it is more often used to feed cattle (OChef, 2006).

#### Health Benefits

Unlike sugar, blackstrap molasses contains many valuable minerals which provide some nutritional benefit to using this sweetener. It is an excellent source of manganese and copper and a very good source of iron, calcium, magnesium, and potassium.

Blackstrap molasses also contains vitamin B6 and selenium (World's Healthiest Foods, 2009). Molasses is recommended as a source of calcium for individuals who cannot, or choose not to, drink milk (Lange-Collett & Schumann, 2002).

## Pepper

### Background

Pepper is known as “the king of spices.” Black, white, and green peppercorns are all the fruit or berries of the same plant, which originated in southern India. White peppercorns are matured before picking. The husks are removed before drying by rubbing or soaking in water. White pepper has pungency, but not the same earthy flavor of black pepper, as the husk is missing from the white pepper (Viestad, 2007). Pepper is thought to be the most common spice in medieval Europe, both for its spiciness and its ability to cover up a lack of freshness (World's Healthiest Foods, 2009).

### Health Benefits

Pepper is extremely hot and dry in nature, and in ancient times was thought to stimulate appetite and aid indigestion. Pepper was also thought to “dissolve wind in the stomach and intestines, and to remove phlegm from the chest” (Adamson, 2004). It seems that when black pepper enters the mouth it stimulates the taste buds in a way that causes an increase in hydrochloric acid production, which in turn aids in digestion. Additionally, black pepper is known as a *carminative* (it reduces intestinal gas), a *diaphoretic* (promotes sweating), and a *diuretic* (promotes urination). Black pepper seems to also have some antibacterial and antioxidant capabilities (World's Healthiest Foods, 2009).

## Saffron

### Background

Saffron is an orange-red coloring agent in food found on the stigma of crocus flower. It originates from either Europe or Asia Minor. Saffron is known as the world's most expensive spice since each plant only has three stigmas, it takes close to 100,000 stigmas to make one pound of saffron. On average, about one third of the dishes served in the European upper class dining during the Middle Ages included saffron, due to the golden color it adds to food (Adamson, 2004). The flavor and color of real saffron are so strong generally that only a pinch or up to ½ a gram is needed. It has an earthy flavor and is slightly dry and bitter. It is believed the best saffron comes from Iran, Kashmir, or Spain (Viestad, 2007). If used in excess, it can be overpowering and cause headache or nosebleed.

### Health Benefits

Medieval medicine classified saffron as hot and dry and “praised it for comforting the heart and liver and for aiding digestion.” It was also believed to induce sleep, give headache, and speed up childbirth (Adamson, 2004).

## Splenda® Brown Sugar Blend

### Background

Splenda® brown sugar blend is a combination product with Splenda® brand artificial sweetener (sucralose) and real brown sugar. Sucralose is 600 times sweeter than sugar and was approved by the FDA in 1999 as a food additive (U.S. Food and Drug

Administration, 2006). Since the product is sweetened both by brown sugar and sucralose, one half cup of Splenda® brown sugar blend can be substituted for one cup of regular brown sugar. The process for synthesizing sucralose is a patented multi-step process, which replaces three hydroxyl groups from sugar with chlorine ions, making the molecule very stable and non-reactive as it travels through the body. Sucralose is a free-flowing, water soluble molecule, which gives it the ability to pass freely through the body with minimal absorption (McNeil Nutritionals, LLC, 2009).

### Health Benefits

By making a blended product, the calorie amount is cut in half. The product does not promote weight loss, but for individuals limiting calories, it is a good way to still enjoy sweets while having a reduced calorie product (McNeil Nutritionals, LLC, 2009).

## Sugar

### Background

Sugar is the disaccharide made up of glucose and fructose and comes from either sugarcane or sugar beets. In manufacture of sucrose from sugarcane, clarification with lime and treatment of the juice with sulfur dioxide take out a lot of the impurities from the syrup used for sucrose crystallization (Hui, 2006). Sugar cane is most likely native to New Guinea. It was first cultivated in Asia and the process of refining sugar was substantially improved by the 7<sup>th</sup> century AD. Originally, most sugar was imported to Britain, even while efforts were being made to refine it within the country. Sugar began to be considered superior to honey because it did not cause thirst or itching and was

gentler on the stomach (Adamson, 2004). Additionally, sugar could be used to sweeten foods or beverages without altering the color of the product. It was not until 1700 that sugar became an everyday product instead of a luxury in Europe and America (Kiple & Ornelas, 2000).

### Health Benefits

Sugar is an excellent source of energy due to the glucose and fructose. Sugar intake should be monitored, however, to keep from spiking blood glucose levels, which may lead to a drop in energy levels as glucose leaves the blood (Clark, 2009).

### Discussion

As the literature indicates, emotions play an important role in the food choices made by consumers. In the past, recipes have been made based on the medicinal value food was believed to hold, and this played into the food choices made by individuals in medieval times. The recipe written by Mrs. Beeton would likely still trigger an emotional response, particularly in Britain. The purpose of this research is to collect preliminary data in order to understand the role that emotions play in food preference. By using gingerbread recipes, spanning six centuries, a wide range of products which share common characteristics will be available, with the expectation that at least one recipe will tie into the panelists' past experiences. Additionally, as the health benefits of the major ingredients indicate, gingerbread has the potential to be a very healthy product. If, in the future, a product could be developed using an emotionally favorable recipe while

incorporating new ingredients to improve the nutritional aspect of the recipe, this would be a victory in product development.

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## CHAPTER TWO

### METHODS AND MATERIALS FOR DATA COLLECTION AND DATA ANALYSIS

#### Abstract

A sensory panel was used to collect data regarding the emotions tied to gingerbread, as well as to determine the consumer preference of four gingerbread samples. Holiday/Christmas memories and happiness were the most popular responses to the question regarding emotions evoked by gingerbread. Nearly sixty-six percent of panelists chose the 2004 recipe as their first preference. The 2004 formula also received the highest scores for appearance, flavor, and texture, while the 1430 recipe received the highest scores for aroma. By understanding the tie to the 2004 recipe that links to the emotions of consumers, in the future a new recipe could be developed to incorporate the emotional ties with new, healthy ingredients, such as flax seed meal.

## Introduction

Four gingerbread formulas were chosen for this research and are dated 1430, 1861, 2004, and as well as a new product. The 1430's formula uses dried bread crumbs, honey, white pepper, cinnamon, and saffron. It is believed that the scribe forgot to include ginger in the recipe, as the formula was labeled gingerbread (Matterer, 2009). Preliminary investigation of the 1430's recipe was done by a Creative Inquiry team (undergraduate research initiative) at Clemson University. The team ran trials to determine the most appropriate way to produce the Manchet bread, and to make bread crumbs from the stale loaves. Research was completed on the kitchen utensils that were available in the British kitchen, and this knowledge was used to make bread crumbs of the appropriate size. At first, bread crumbs were produced by hand, and once the size was determined, the crumbs were produced using several short pulses in a food processor. Next, the team used the bread crumbs in the original recipe, as well as in a modified version of the original recipe which incorporated ginger. Four trials were completed, using varying levels of spices and honey, as well as comparing products made with processed, store bought, clover honey and an unprocessed, English Sanfoin honey. Once the desired product was achieved, preliminary sensory work was completed. Panelists were asked to rank the intensities of honey, cinnamon, ginger, and pepper levels, as well as to indicate their overall acceptance for both products (Fuller, Glass, & Hiller, 2008).

As noted previously, meals in medieval times were meant to be healthy, but were eaten more for medicinal value than food today. Foods were chosen based on their

composition of the four humours, and eaten in order to balance an individual's unique combination of the 'humours.' Each of these humours are composed of two elements: phlegm is cold and moisture, cholera is heat and dryness, black bile is cold and dryness, and blood is heat and moisture. Food was prescribed by physicians based on their classification in order to restore health (The Cambridge World History of Food, 2000). The 1430 gingerbread formula chosen for this research was made of ingredients that were classified as 'hot and dry' and may have been prescribed for someone with a cold. The product may also have been eaten at the conclusion of a meal, as it was believed that spices would aid in digestion, so this would have been a popular sweet in medieval times. It was up until about the 18<sup>th</sup> century that food was eaten as medicine, when scientists discovered that blood circulated through the body (Civitello, 2007). Saffron was probably used in this recipe to give the gingerbread a gold color, which was a symbol of status (Civitello, 2007).

The 1861 formula was from Ms. Beeton, one of the most prominent individuals in British home making. The 1861 formula, from Mrs. Beeton, was chosen due to the role Ms. Beeton played in British home making. She is known for writing *Mrs. Beeton's Book of Household Cookery*, which is the most famous cook book written in British history. Isabella Mary Mayson married Samuel Orchard Beeton, a publisher of both books and magazines, and she began writing articles for his publications in household management and cooking. Her works were put together and published in 1861, as *Mrs. Beeton's Book of Household Cookery* which gave information on almost all aspects of running a household in Victorian Britain (MrsBeeton.com, 2007). This book was one of

the first cookbooks ever published, and Mrs. Beeton's name is still iconic and known in England today, similar to how Betty Crocker is known in the United States. The 1861 formula has a low level of brown sugar and a high level of all-spice, giving this cake a very dry, pungent nature.

The 2004 formula was chosen from a current British cookbook, and was representative of the most common recipe of today. It is very similar to that of a gingerbread mix one might find in the grocery store. The 2004 formula had a balanced spice profile and a higher level of brown sugar. The new product used almond meal, whole wheat flour, flax seed meal, and Splenda® brown sugar and excluded eggs and butter. The purpose of this formula was to make a product that highlights how far technology has come as well as trying to produce a healthier product.

These four formulas provide a sample of the vast range of gingerbread products that have appeared throughout history. It is likely that the majority of individuals who spent most of their childhood in the United States will identify the strongest with the 2004 recipe. In general, this recipe is representative of the recipes that would have been prepared in homes during the era when most of the participants in the sensory panel were adolescence. It is understood that emotions play an important role in consumer preference, however the emotional component of food still has not been completely identified. The purpose of this research was to collect preliminary data to understand food emotions.

## Research Questions

The purpose of this study is to determine the emotional response triggered by samples of gingerbread in order to better understand the role that food emotions play in consumer preference. The following research questions outline the objectives of this study:

1. What emotions are brought forth with the smell or taste of gingerbread?
2. What factors drive consumer preference?
3. Do emotions drive consumer preference? If so, is it the most important factor in consumer preference?
4. Can a new recipe be developed highlighting products that have become available through advances in food technology through the years?

## Methodology

### Recipe Preparation

Recipes were prepared as indicated by the written formulas, which can be seen in Appendix C. The 1430's recipe was increased fivefold, while the 1861 and 2004 recipes were doubled. The new product recipe was produced as written. The first three formulas were prepared and baked off late one and a half days before the panel, while the new product was made the day before the panel. All four products were cut into  $\frac{3}{4}$ " x  $\frac{3}{4}$ " squares and placed in two ounce cups with lid. Each cup was given a label with a randomized three digit code assigned to each product. The codes for the panels were assigned randomly.

## Sensory Panel

Prior to the panels, an Institutional Review Board application was submitted and accepted for the study. The preliminary panel (n = 17) took place between 10am – 12pm at the Center for Gerontology at the University of Georgia. After panelists indicated they were food allergy free, the subject tasted the four gingerbread samples and filled out a preference survey. The survey asked gender, age, if the individual enjoys sweets, if sweets (more specifically gingerbread) are purchased for the household, if the individual ate gingerbread as a child, and what type of product does the individual identify as gingerbread. Survey materials were altered prior to the main sensory panel in order to collect more data related to gingerbread use. The new survey inquired about gender, age, the country where the majority of the individual's childhood was spent, the frequency of gingerbread consumption, the types of gingerbread products liked most, whether or not the individual liked sweets or had gingerbread as a child, as well as the emotions associated with gingerbread. The main panel (n=64) occurred over two days, Day One from 10am – 4pm and Day Two from 6:30am-8:30am. Day One of the panel was held in the sensory testing area of the Poole Agriculture Center on Clemson University's campus. Day Two of the panel occurred at a local coffee shop in Clemson, SC. Panelists were recruited by word of mouth and via email.

The morning of the panel on campus, the panel booths were set up with water, water cups, forks, napkins, and pencils. When panelists entered the testing area, they were asked to sign in and then have a seat at a testing booth. The panelist was first given an allergy form and an information letter. Once the allergy form was completed and it

was indicated that there were no allergies to any of the ingredients, the panelist was given a survey and the four gingerbread samples. Panelists were told to fill out the gingerbread survey and then to taste the four samples in the order presented, giving each sample a hedonic score of 1 (don't like it at all) to 9 (love it) for flavor, aroma, appearance, and texture. Finally, the panelist was asked to rank the four samples in order of preference. Panelists were instructed to have some water and unsalted cracker in between samples to cleanse the palate. Surveys were collected upon completion and panelists were offered a treat for participating. At the coffee shop, panelists were seated at separate tables, given the allergy form and information letter, and they were asked to fill out the survey, having water and unsalted cracker in between samples. Again, the surveys were collected upon completion.

#### Data Analysis

The surveys were collected, and the data was input into an Excel spreadsheet. The hedonic scores, 1 through 9, for each product for aroma, appearance, texture, and flavor were compared. Responses to the emotions question were grouped accordingly. All comments were documented. An expected counts test was run with SAS (9.1) on the samples to determine if the proportion of times each sample was selected as a first choice was equal.

## Results

All rankings for the four products for both the preliminary panel and the main sensory panel can be seen in Tables 2.1 and 2.2 below. The 2004 recipe was chosen as the first choice by 65.6% of the panelists. As seen in Figure 2.1, the 2004 recipe also scored highest on the hedonic scale for appearance (7.18), texture (7.04), and flavor (6.44), while the 1430's recipe scored highest for aroma (5.79). The most common response regarding the emotions associated with gingerbread was holidays/Christmas (33%), followed by happy (24%), warm (10%), and home (9%). Other responses are noted in Figure 2.2. Nine individuals indicated that the majority of their childhood was spent somewhere other than the United States. Of these nine people, 56% chose the 2004 recipe as their first choice, while 33% chose the recipe from 1861 as their first choice. Of the 55 people who grew up in the United States, 67% chose the 2004 recipe as their favorite product and 14.5% chose the 1861 recipe as their first choice. Overall rankings from the main panel are shown in Figure 2.3.

Table 2.1

*Indicates preferences of consumers participating in the preliminary panel.*

<b>Preliminary Panel Preferences</b>				
n = 17	<b>1st Choice</b>	<b>2nd Choice</b>	<b>3rd Choice</b>	<b>4th Choice</b>
<b>1430</b>	2	3	3	9
<b>1861</b>	4	4	4	5
<b>2004</b>	10	4	2	1
<b>New Product</b>	1	6	8	2

Table 2.2

*Indicates preferences of consumers participating in the main sensory panel.*

n = 64	Main Panel Preferences			
	1st Choice	2nd Choice	3rd Choice	4th Choice
<b>1430</b>	10	15	16	22
<b>1861</b>	11	17	16	21
<b>2004</b>	42	12	10	0
<b>New Product</b>	1	20	22	21

Forty-one percent of panelists indicated that they enjoy sweets ‘very much,’ while 59% said they enjoy sweets ‘somewhat.’ Forty-two percent of panelists indicated that they had gingerbread as a child. 81% of the panelists indicated they had gingerbread at holidays, 8% eat gingerbread monthly, 5% have it weekly, and 6% of panelists never have gingerbread. Forty-six percent of panelists stated that gingersnaps are the preferred form of gingerbread, while gingerbread cake was close behind at 39%.

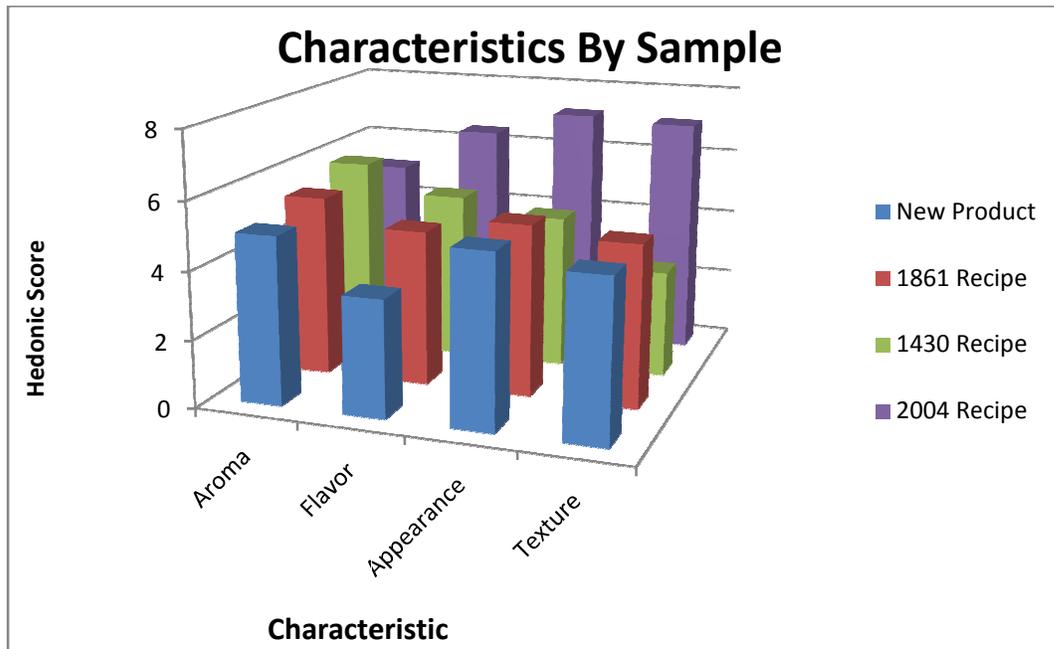


Figure 2.1. This chart shows the hedonic scores for all four samples, for each of the four characteristics.

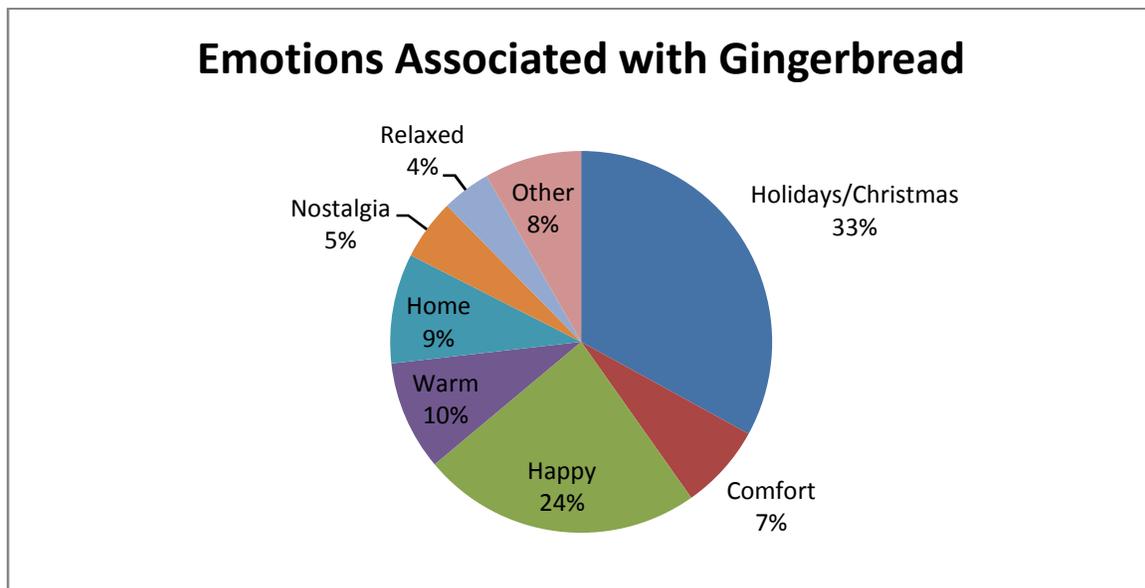
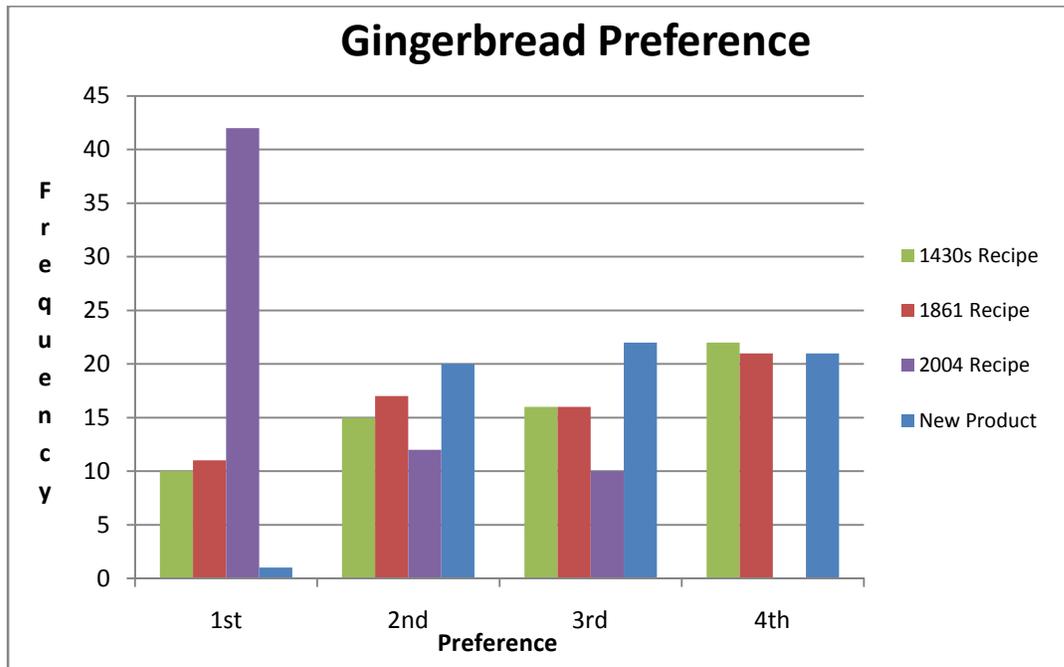


Figure 2.2. This pie chart shows the responses to the question “What emotions do you feel when you smell gingerbread?”



*Figure 2.3.* This is a graphical representation of the preferences indicated in the main sensory panel.

## Discussion

The data shows conclusively that the 2004 recipe was the most preferred product. Since nearly 86% of the panelists grew up in the United States, the majority would have had a similar gingerbread product to that of the 2004 recipe if gingerbread had been eaten during childhood. Only 56% of panelists who spent the majority of their childhood outside of the United States chose the 2004 recipe as their first choice, compared to 67% of those growing up in the United States. The lower percentage of panelists choosing the 2004 recipe is likely due to the familiarity associated with one of the other products. One preliminary panelist, from Armenia, indicated she had never had gingerbread before and stated that the 1430's recipe was chosen as the favored recipe because it was reminiscent of desserts and sweets from home. Similarly, an individual from Costa Rica noted that the 1861 recipe was more like the product that would be eaten in Costa Rica. These two instances are excellent demonstrations of the role that emotions play in food choice. A full list of panelist comments is located in Appendix D.

After this data collection, each recipe was examined through the flavor pyramid, based on panelist responses. The 1430's recipe evoked fewer emotions among panelists than the 2004 recipe, although as seen by the comment made by the panelist from Armenia, it did strike an emotion among some panelists. Next, in the pyramid is the product's appearance, which for the 1430's recipe was a light brown colored, crumbly product. Due to the cinnamon on top, the product was a little darker on top. Several individuals commented on the difficulty of tasting the product, as it was so crumbly. The next level on the flavor pyramid is the aromatics, which is where the 1430's recipe

received the highest score of all four products. The aroma was that of a light, sweet, floral honey note, followed by the pungency of the cinnamon. The texture of this formula was crumbly and grainy. Sensations associated with this recipe were mainly from the pungency of the cinnamon, and since the formula has so much honey, sweet was the basic taste that stood out.

The 1861 recipe also had an emotional response, as the individual from Costa Rica indicated in her response. This sample appeared as a very dark, somewhat dry cakey product. This product had a pleasant, spicy aroma, although many panelists indicated they were surprised by the flavor after noting the aroma, and that the two did not match. The product had a cake-like, spongy texture, although it was a little dry. Due to the high level of allspice, this product produced a very pungent sensation that burned the throat. Again, sweet was the only basic taste identified with this recipe, although the product was not overly sweet.

As noted, the 2004 recipe elicited the largest emotional response. The majority of the panelists identified most closely with this formula. The sample was a golden to dark brown, and appeared very moist. The product did not have an overly powerful aroma, but the flavor was a nice, balanced blend of sweet and gingerbread spice, where no one spice stands out over the others. The texture was that of a moist cake, soft in the mouth. The sensations experienced from this formula were minimal, as all the flavors were well balanced. Sweet was the basic taste identified in this formula.

The new product initiated no emotional response, as it was very different from the products in the market. This sample was a dark brown, relatively dense cake. The

product had a very faint aroma, and a relatively bland taste. The product used in the sensory panel did not turn out quite as the recipe had been developed; however, due to time constraints the product was used. The formula as originally developed was a little grainier and more crumbly, but had a light, sweet, spicy flavor that carried through nicely. The product used in the panel had a smooth texture, and invoked no sensations, as the flavor was relatively bland.

It is possible that many of the emotional responses indicated by these gingerbread recipes rely on the response triggered by any sweet food. In future studies, it would be beneficial to collect sensory data in different countries. By collecting sensory data on the same four products in several different countries, more concrete conclusions could be drawn. Based on food availability, familiarity with recipes, and even name identification (like Mrs. Beeton), different emotional responses would be collected. Additionally, questions could have been asked as to whether the nutritional information (which can be found in Appendix C) for the four products would have played a role in preference selections.

Another option in future studies would be to try to work flax seed meal into the 2004 recipe. By using flax in the recipe chosen based on its emotional connection, it is possible a successful new product could be developed. This would be a valuable product in the food industry. As food trends are constantly changing, being able to ‘update’ a product from the past is a crucial step for companies to get new products to the market. Since psychology is a factor in this research, it is hard to definitively determine from this

data that emotions are the number one factor in consumer preference. However, this data does show that emotions play a significant role.

It should also be noted that the preparation of the new product was not exactly the same for the preliminary panel and the main panel. During the preparation for the main panel, the recipe was slightly altered, by error (too much molasses was added). This gave the product the bland flavor indicated by the main sensory panel. Due to time constraints, the product was used, although future testing using the proper new product is needed. The recipe included is that of the original new product, which had a less dense texture, a slightly lighter color, and a spicier, sweeter flavor. The original new product formula was liked more by the preliminary panel than the incorrectly prepared new product was liked at the main panel.

### Conclusion

While it is apparent that the 2004 recipe was chosen as the most preferred product, this study serves as a preliminary analysis in the exploration of the emotional component of food choice. The product represents the type of gingerbread most of the panelists would have grown up with, and shows that the emotional ties an individual forms with a particular food continue to play a role in food choices throughout life. Today's consumer is becoming more health conscious, so being able to incorporate ingredients into a familiar product to increase the health benefits will be valuable. In March 2009, Carlos Barroso, Vice President of Global Foods R&D, PepsiCo, spoke at the Research Chefs Association annual conference about the vision of PepsiCo.

Especially as their market has spread into areas outside of the United States, he indicated that the emotions tied to certain foods are the key to developing and introducing a successful product (Barroso, 2009). If flax meal and whole wheat flour could be incorporated into the 2004 recipe, it is likely that a new product could be developed that would be healthier, but still reminiscent of past gingerbread experiences.

There are several different options for continuation of this research. The most beneficial would be to create a new product using the 2004 recipe and making alterations to include flax seed meal and whole wheat flour. Following creation of this product, sensory panels could be done to determine if the two products induced a similar emotional response, as well as survey questions to determine whether or not the health aspect of the products would come into play when choosing a product.

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## APPENDICES

## Appendix A

### Letter of Consent

#### **Information Concerning Participation in the Sensory Evaluation of Gingerbread**

You are invited to participate in a research study conducted by a graduate student from the Department of Food Science and Human Nutrition under the mentorship of Dr. Margaret Condrasky. The purpose of this research is to determine how advances in technology through the years has affected consumer preferences as seen through six centuries of gingerbread recipes. Participants will be selected on their interest in participating and being consumers of gingerbread. Individuals with colds, sinus conditions or allergy to a specific ingredient will not participate.

During the panel, you will be provided with four samples of gingerbread and a survey to complete. You will be asked to evaluate the samples to determine which sample you prefer and why. The evaluation will require about 5-10 minutes, depending on your speed of tasting. Testing will occur in room B219 in the Poole Agricultural Center on Clemson University campus in Clemson, SC as well as around the community.

Except for persons having food allergies, risks associated with this study are negligible. The ingredients consumed are commercially available. There are no known benefits to you that would result from your participation in this research.

Any information obtained in connection with this project and which could be identified with you will be kept strictly confidential. Summary results and statistical data will be used for further research; however, individual panelist's responses will be maintained in confidence. Participation in this study is voluntary. Your decision whether or not to participate will not affect your present or future relationship with Clemson University. If you decide to participate, you are free to withdraw at any time.

If you have any questions, please do not hesitate to ask. If you think of questions later, please feel free to contact Jess Glass of Clemson University at [jeglass@clemson.edu](mailto:jeglass@clemson.edu). If you have any questions or concerns about your rights as a research participant, please contact the Clemson University Office of Research Compliance at 864.656.6460.

Appendix B

Sensory Panel Survey

## Gingerbread Preference Survey

**Gender:**  Female  
 Male

**Age:**  Under 18  
 18 – 25  
 26 – 45  
 46 – 65  
 65+

**In what country did you spend the majority of your childhood?**

**How often do you consume gingerbread products?**

Daily  2-3 times per week  Weekly  Monthly  Holidays  Never

**What type of gingerbread products do you like most?**

- Gingerbread Cake
- Gingerbread Cookies
  - Ginger Snaps
  - Ginger Crisps
- Other: \_\_\_\_\_

**Do you enjoy baked goods?**  Very Much  
 Somewhat  
 Not at all

**Did you eat gingerbread as a child?**  Yes  No

**What emotions do you feel when you smell gingerbread?**

**There are four samples in front of you. Please taste each one in the order they are presented from left to right and answer the following questions about each sample as you go.**

**Please taste SAMPLE 134 and rank it for texture, appearance, flavor, and aroma, using a scale from 1 to 9, where 1 = did not like at all and 9 = loved it.**

	<b>134</b>
<b>Texture</b>	
<b>Appearance</b>	
<b>Flavor</b>	
<b>Aroma</b>	

Please have some water in between samples to cleanse your palate.

**(Next page)**

Please taste **SAMPLE 755** and rank it for texture, appearance, flavor, and aroma, using a scale from 1 to 9, where 1 = did not like at all and 9 = loved it.

	<b>755</b>
<b>Texture</b>	
<b>Appearance</b>	
<b>Flavor</b>	
<b>Aroma</b>	

Please have some water in between samples to cleanse your palate.

**(Next page)**

Please taste **SAMPLE 687** and rank it for texture, appearance, flavor, and aroma, using a scale from 1 to 9, where 1 = did not like at all and 9 = loved it.

	<b>687</b>
<b>Texture</b>	
<b>Appearance</b>	
<b>Flavor</b>	
<b>Aroma</b>	

Please have some water in between samples to cleanse your palate.

**(Next page)**

Please taste **SAMPLE 435** and rank it for texture, appearance, flavor, and aroma, using a scale from 1 to 9, where 1 = did not like at all and 9 = loved it.

	<b>435</b>
<b>Texture</b>	
<b>Appearance</b>	
<b>Flavor</b>	
<b>Aroma</b>	

Please rank the samples in order of preference.

**1<sup>st</sup>** \_\_\_\_\_

**2<sup>nd</sup>** \_\_\_\_\_

**3<sup>rd</sup>** \_\_\_\_\_

**4<sup>th</sup>** \_\_\_\_\_

**Comments:**

**Thank you** for your participation!

## Appendix C

### Gingerbread Formulas and Nutrition Facts

#### Manchet Bread (for use in 1430's recipe)

- 1 packet yeast
- 1 C warm water
- 2 ½ C white whole-wheat flour
- 1 C All-Purpose Flour
- 1 tsp salt
- 4 Tbs softened butter

#### 1430 - Medieval Gingerbread Recipe (Cole, 2006)

*Gyngerebrede 1430. British Library in London, Reference Harleian Ms 279*

Take a quart of hony, & seth it, & skeme it clean; Safroun, powdir Pepir & throw ther-on; take gratyd Brede & make it so chargeaunt that it wol be y-lechyed; then take poudre – Canelle & straw ther-on y-now; then make yt square, like as thou wolt leche yt; take when thou lechyst hyt an cast Box leves a –bouyn, y-styked ther-on, on clowys. And if thou wolt have it red, colour it with Saunderys y-now.

<b>Nutrition Facts</b>	
Serving Size (75g)	
Servings Per Container	
<b>Amount Per Serving</b>	
<b>Calories 220</b>	Calories from Fat 20
<b>% Daily Value*</b>	
<b>Total Fat</b> 2.5g	<b>4%</b>
Saturated Fat 1.5g	<b>8%</b>
Trans Fat 0g	
<b>Cholesterol</b> 5mg	<b>2%</b>
<b>Sodium</b> 110mg	<b>5%</b>
<b>Total Carbohydrate</b> 50g	<b>17%</b>
Dietary Fiber 2g	<b>8%</b>
Sugars 34g	
<b>Protein</b> 3g	
Vitamin A 2%	• Vitamin C 0%
Calcium 0%	• Iron 6%
<small>*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:</small>	
	<small>Calories: 2,000 2,500</small>
Total Fat	Less than 65g 80g
Saturated Fat	Less than 20g 25g
Cholesterol	Less than 300mg 300 mg
Sodium	Less than 2,400mg 2,400 mg
Total Carbohydrate	300g 375g
Dietary Fiber	25g 30g
<small>Calories per gram:</small>	
<small>Fat 9 • Carbohydrate 4 • Protein 4</small>	

#### Translated

##### Gyngerebrede

Take a quart of honey (2 pints in modern English imperial measure) boil it, skim it clean; take Saffron, powdered pepper; take grated bread mix it all to a stiff consistency and press (or roll) it flat; make it into a square or any shape you like; then take powdered cinnamon and strew it on it (sprinkle it on the top). When you are ready cast box leaves about it, stick it with cloves. And if you would like it to be red, colour it with Saunderys (a red sandalwood from India).

Amounts used (as determined by the Creative Inquiry Team:

- Dry bread crumbs from Manchet bread- 123g
- sanfoin honey - 149g
- cinnamon - 1g
- saffron threads - 40
- white pepper - 0.5g



2004 – Gingerbread (Lawrence, 2004)

"This is a nicely moist, dark and dense gingerbread that keeps well".

- 1/2 cup milk
- 1 3/4 sticks (6 ounces) (175 grams) unsalted butter
- 1 scant cup (175 grams) dark muscovado sugar
- 3 tablespoons black treacle
- 2 3/4 cups (325 grams) plain flour (all purpose)
- 2 heaped teaspoons ground ginger
- 1/2 teaspoon mixed spice
- 1 heaped teaspoon bicarbonate of soda (baking soda)
- 1 large egg

Preheat oven to 300 degrees F (150 degrees C) and butter and line a 2 lb. loaf tin.

Place the milk, butter, sugar and treacle in a pan and place over a low heat, stirring, until melted.

Sift the flour, ginger, mixed spice and baking soda into a large bowl with a pinch of salt.

Leave the melted mixture to cool for about 10 minutes, then beat the egg into it. Pour this into the flour mixture, stirring gently but thoroughly.

When well mixed, tip into the prepared tin, leveling off the surface. Bake for 65 - 75 minutes or until a skewer inserted into the centre comes out clean. Leave in the tin until cold, then invert on to a wire rack.

Serves 8-10

<b>Nutrition Facts</b>	
Serving Size (75g)	
Servings Per Container	
Amount Per Serving	
<b>Calories</b> 280	Calories from Fat 110
% Daily Value*	
<b>Total Fat</b> 12g	<b>18%</b>
Saturated Fat 8g	<b>40%</b>
Trans Fat 0g	
<b>Cholesterol</b> 50mg	<b>17%</b>
<b>Sodium</b> 120mg	<b>5%</b>
<b>Total Carbohydrate</b> 38g	<b>13%</b>
Dietary Fiber 1g	<b>4%</b>
Sugars 17g	
<b>Protein</b> 4g	
Vitamin A 8%	• Vitamin C 0%
Calcium 6%	• Iron 15%
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:	
	Calories: 2,000    2,500
Total Fat	Less than 65g    80g
Saturated Fat	Less than 20g    25g
Cholesterol	Less than 300mg    300 mg
Sodium	Less than 2,400mg    2,400mg
Total Carbohydrate	300g    375g
Dietary Fiber	25g    30g
Calories per gram:	
Fat 9 • Carbohydrate 4 • Protein 4	

## New Product

<b>Nutrition Facts</b>	
Serving Size (75g)	
Servings Per Container	
<b>Amount Per Serving</b>	
<b>Calories 240</b>	Calories from Fat 90
% Daily Value*	
<b>Total Fat 10g</b>	<b>15%</b>
Saturated Fat 1g	<b>5%</b>
Trans Fat 0g	
<b>Cholesterol 0mg</b>	<b>0%</b>
<b>Sodium 110mg</b>	<b>5%</b>
<b>Total Carbohydrate 31g</b>	<b>10%</b>
Dietary Fiber 6g	<b>24%</b>
Sugars 3g	
<b>Protein 8g</b>	
Vitamin A 2%	• Vitamin C 0%
Calcium 10%	• Iron 10%
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:	
	Calories: 2,000    2,500
Total Fat	Less than 65g    80g
Saturated Fat	Less than 20g    25g
Cholesterol	Less than 300mg    300 mg
Sodium	Less than 2,400mg    2,400mg
Total Carbohydrate	300g    375g
Dietary Fiber	25g    30g
Calories per gram:	
Fat 9 • Carbohydrate 4 • Protein 4	

- 3 C almond meal
- 3 C whole wheat flour
- 4.5 t cinnamon
- 2 T ginger
- 1.5 t ground nutmeg
- 3/4 t ground cloves
- 1/3 C flax meal
- 3/4 t salt
- 2 T flax meal + 1/3 C water, let sit
- 2/3 C brown sugar Splenda®
- 2 T molasses
- 1 1/8 C milk

Combine 2 T flax seed with 1/3 C water and set aside. Combine all dry ingredients. All at once, add molasses, flax seed and water mixture, and milk. Mixture will be crumbly. Bake in a sheet pan at 325°F for 20 - 25 minutes.

## Appendix D

### Panelist Comments From Preliminary and Main Sensory Panels

Preliminary Panelist Comments – January 9<sup>th</sup>, 2009 (n = 10, 58.8% response)

where **394** = 1430 recipe

**278** = 1861 recipe

**983** = 2004 recipe

**723** = new product

- Sample 983 had a moist fluffy cake texture. It was preferred, by far. 278 could have been a winner if not as dense. Texture killed 394 and 723.
- Thanks ☺
- 394 is too sweet!
- Some responses may have to do with social class (lower middle class, not gourmet upbringing) and past experience (mainly with store-bought cookies). This was interesting and fun – I'd love to know which is the oldest recipe.
- I was interested in the great variety of textures and flavors. I really enjoyed the texture of 983 but preferred the more spicy flavors of 723.
- I really liked 723 – I would buy it – liked the flavor. Gingerbread is a relaxing food.
- What an interesting study! My first choice was very clear after the first tasting. I knew immediately that I didn't like #278. #723 and #394 were harder to determine how much I liked them.
- The sample of 394 appeared sort of crumbly in the cup but I liked the texture when I put it in my mouth. Also the taste had more zing/punch to it – spicier.
- 983 reminded me more of real gingerbread, while 394 and 723 didn't really look like traditional gingerbread.
- I liked the texture and taste of 983 and beyond the other samples.

Panelist Comments – February 10<sup>th</sup> and 11<sup>th</sup>, 2009 (n = 35, 54.6% response)

where **134** = 1430 recipe

**435** = 1861 recipe

**687** = 2004 recipe

**755** = new product

- 755: Although it wasn't what I typically associate with gingerbread, I liked the aroma of #755; but the flavor was not favorable
- 134: the product was very crumbly and difficult to get out of the cup. I could not pick it up with my fingers.
- 435 had a much stronger ginger aroma and flavor than the other 3. Someone who actually likes ginger would probably enjoy it. I don't really like gingerbread in general.
- Except that it did not have a strong smell, sample 687 was perfect.
- 687 was by far the best! Very delicious.
- 687 is the only one I would really eat all other I would not consume.
- 435 is a lot like the one we eat back in Panama.
- 755: "packy," 435: bitter taste, dry
- 755 – interesting texture, a bit bland
- 134 – difficult to pick up, not the best texture, doesn't remind me of gingerbread as much as the others
- 687 – like most things about it except the aroma
- 435 – had the best flavor, the only problem was with appearance, there were chunks of flour visible
- I really don't think that 755 has much flavor at all
- Never tasted gingerbread like any of these – none of them gave me that feeling I was looking forward to!
- If I would buy gingerbread or cake I definitely would decide to buy the product 687, because for me it was really good comparing to other bad and off flavors, textures, aromas, and appearance
- Good job!
- 687 – weak flavor, 435 – dry texture and dry looking, needed sweetness, was somewhat bitter, 134 – crumbly, lumpy, very good flavor and excellent aroma, 755 – condensed texture, compressed appearance, weak flavor and aroma. If texture and appearance of 687 were combined with flavor and aroma of 134 – would be excellent!!
- 435 – appearance: reminds me of a stale brownie with nuts, aroma: spice cake, texture: too dry, crumbly, flavor: lacking; aroma gives the impression that it would taste good. 134 – aroma: spicy, cinnamonly, appearance: crumbly – dry, flavor: matches aroma – spicy aftertaste, texture: taste a little like coconut, dry. 687 – aroma: breadly; mild spicy, eggy, very little aromatics, appearance: gingerbread (cake-type), texture: cakelike, smooth, flavor: mild spices, sweet; cannot tell if is gingerbread. 755 – aroma: interesting; sweet, mild aromatics, appearance: dry, chewy, flavor: bland (not sweet) mild ginger, with a ginger after,

where **134** = 1430 recipe  
**435** = 1861 recipe  
**687** = 2004 recipe  
**755** = new product

- reminds me of a granola bar that has been grounded and put back together,  
texture: like a grounded granola bar.
- Sample 435 is what I imagine when I think of gingerbread. Sample 687 was good as well, but not in the “traditional gingerbread” sense – or at least what’s “traditional” for me. Sample 134 was pretty spicy. I think the crumbly texture was the most difficult thing to deal with there. Sample 755 hardly had any taste. It looked like something a horse would eat – it looked “oaty.”
  - 134 was awful in every respect: ugly color for gingerbread, terrible texture and taste, it’s only redeeming feature was it’s aroma. Crumbly appearance ruled in it’s disfavor and it was dry. 435 has a nice dark color, dense texture, attractive appearance, and very nice flavor. 687 and 755 ranked about the same, though I liked the color and texture better of 687.
  - I really enjoyed the moist, cakey texture of 687. I did not enjoy the fudgy texture of 755 and 435. I was confused how to eat 134 until I realized that we had spoons. Also, I really liked 755’s aroma, it kind of reminded me of pumpkin bread/pie.
  - 435: a lot of flavor, not bad or good. 755: no flavor. 687: not much flavor. 134: it fell apart coconut/citrus tones.
  - I did not find that I would chose to eat any of the samples even though I usually like gingerbread. Samples with better texture had an unpleasant smell.
  - Loved #134!
  - Sample 134 was almost unbearably peppery. I think sample 687 would have a better aroma if it were a little stronger.
  - 435: doesn’t look very good, dry texture, smells and tastes like gingerbread should though. 687: looks good, smells good, like the subtle chocolaty flavor and aroma, real smooth texture; moist, might could use a little more spicyness to be like more traditional gingerbread. 134: looks and smells really good, not as much flavor as expected, a little too sweet as well; didn’t like that it fell apart or the grainy texture, doesn’t really make me think gingerbread. 755: great texture, subtle but still spicy flavor.
  - The flavor of 134 was the best but texture was lacking. 687 had almost perfect consistency and appearance but spices were not balanced. 755 and 435 came close to what I would expect for dog food.
  - Interesting survey. Gingerbread didn’t taste as good as I thought it would.
  - All were good enough to want more.
  - Didn’t detect a ginger smell in any but 435.
  - Thanks for the delicious!
  - They were good but I enjoyed 687 the best. Can you make me cookies for Christmas?

where **134** = 1430 recipe  
**435** = 1861 recipe  
**687** = 2004 recipe  
**755** = new product

- Cool study. 435 tastes GOOOOOD!!
- Yum yum
- 755: texture – fine and cake-like, heavy, appearance – dense, moist, appealing, flavor – molasses and cinnamon, not too sweet, aroma – molasses, sweetness. 435: texture – good moist/dry balance that allows for nice clean-up, appearance – dark color suggests deep flavors, more irregular internal structure, flavor – deep dark molassy, aroma – molasses/nutmeg. 134: texture – moist, chewy, granular, appearance – dense with irregular crumb, flavor – very strong clover/orange honey, aroma – honey with slight warm spice. 687: texture – light, but moist. Cleans up well, appearance – dark color, even texture, moist, flavor – very mild, but pleasant, aroma – cooked flour and molasses.
- 435: texture – dry/mouthfeel terrible, appearance – not appealing, flavor – tasteless, aftertaste, aroma – good. 755: texture – dense/mouthfeel gummy, appearance – look moist, flavor and aroma – poor. 134: texture – sponge/crumby/bad mouthfeel, appearance – moist, flavor and aroma – poor. Hard to eat. 687: texture – sponge/good mouthfeel, appearance – cake like, flavor – good, aroma – weak. This was difficult. None tasted as expected.