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Buss, Stacie R. ***Ginger Effects on Appetite and Food Intake***

Abstract

As people age their taste and smell slowly decline, which leads to a lower desire to eat and prepare food. This can lead to the older persons becoming underweight and malnourished. This research evaluated the effect of fresh ginger juice added to cinnamon applesauce on appetite and subsequent food consumption in older persons. Sixty-one participants between the ages of 50 and 90 years of age participated in this study. The participants were randomly given either the applesauce with ginger juice or applesauce plain. Prior to eating the applesauce, the participants were asked to rate the level of perceived hunger. After consuming the applesauce, the participants were allowed to consume food from a buffet, circling on a sheet what foods and how much of each food was eaten. At the end of the meal, the participants were then asked to rate the level of perceived fullness. The results showed that the participants who consumed the meal with the applesauce plain consumed significantly more calories, ounces, and grams of fiber, carbohydrates, fat and protein than the participants who consumed the applesauce with ginger juice. Although ginger has been reported to increase appetite, it did not appear to do so in this study. These conclusions should be made cautiously, however, as the participants in the two groups were not equal prior to the study. Additional studies might be undertaken to determine if ginger, when provided in a different food, would increase appetite.

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Chapter I: Introduction

The Department of Economic and Social Affairs, Population Division (2001) gave evidence that the life expectancy of individuals, globally, has increased by almost twenty years. In 1955, the life expectancy was 46.5 years and increased to 66.0 years in 2005. By 2050, the projected life expectancy is expected to increase by another ten years and be 76 years (Department of Economic Social Affairs, Population Division, 2001).

The increasing age and number of older persons in the world leads to an increasing need for nutrition care and education. According to the American Dietetic Association (2010), now known as the Academy of Nutrition and Dietetics, the main concern of nutrition care for older adults is to consume enough food to prevent under nutrition and weight loss. As people age, a decrease in appetite occurs as the result of changes in taste and smell. Chronic disease, such as cancer, diabetes, and dementia, can lead to changes in appetite, metabolism and weight. As a result of changes in appetite, older adults can be more vulnerable to loss of muscle mass and nutritional deficiencies (ADA, 2010).

Studies have demonstrated that the taste perceptions of older adults are lower than that of younger populations. Kremer et al. (2007) conducted a study using elderly persons, with an average age of 71 years, and younger persons, with an average age of 22 years, to determine whether or not the elderly required a larger increase in stimulus concentrations to experience a difference in the taste of food than the younger participants. The results of the study showed that the younger participants perceived a significant change in flavor intensity of custards, while the elderly subjects did not (Kremer et al., 2007). Another study evaluated 40 elderly and 40 young subjects on differences in stimulus concentration, and found that the elderly perceived both the creaminess and the thickness of soups as less intense than the younger participants (Kremer et

al., 2005). In an analysis of dietary consumption conducted by Bartali et al. (2003) men and women 20-60 years old were sampled randomly and showed that the daily intakes of energy and selected nutrients including lipids, protein, and carbohydrates were lower in the older age groups. The only food where intake was not different was in the foods that were easy to chew and that did not require a great deal of cooking, such as soup and toast. These data indicate that, as a person ages, they may have difficulty in consuming the same types of foods as the younger population due to diminishing sensory characteristics and dental properties (Bartali et al., 2003).

One issue that arises is that many older adults are placed on restrictive/therapeutic diets to lessen the severity of various conditions. For example, a patient who has heart disease may be placed on a diet that contains low fat, low cholesterol and no added salt to prevent the onset of a heart attack or blood clots. This restrictive diet, however, can lead to the foods tasting bland and unappealing to the patient.

When older adults are placed on restrictive diets to lessen the severity of various conditions such as hypertension or diabetes, it is important to find alternative ways to increase the sensory properties of food without drastically changing the taste or adding additional sodium or calories. Bozcko and McKeon (2010) conducted an eight-week intervention and found that the addition of red pepper flakes and no-salt mixed seasonings to the older person's cooked lunches led to an overall improvement of meal satisfaction (Bozcko & McKeon, 2010). Henry et al. (2003) conducted a similar study in Hong Kong to determine whether the addition of natural flavor ingredients, such as rice wine, ginger, garlic, oyster sauce, and sesame oil, would increase the food intake of older persons in a hospital setting. The results showed that the flavor additions led to an increase in food intake, with oyster sauce, ginger and garlic being the most effective (Henry et al., 2003). These data indicate that when older persons are able to taste and

enjoy their food, the amount of calories and nutrients they consume increases, putting them at a lower risk for under nutrition and weight loss.

Ginger (*Zingiber officinal*), a spice commonly used to treat nausea (Ghosh, Banerjeee, Mullick, & Banerjee, 2011), has also been shown to improve the appetite and food consumption in animals. Immanuel et al. (2009) showed that the tilapia fish species fed a basic diet with 1% ginger extract added showed a significant increase in growth compared to the tilapia fed the control diet. In shrimp fed different concentrations of ginger added to their meals, it was found that the shrimp fed the highest concentration of ginger produced the highest weight gain compared to the shrimp fed the control diet (Venkatramalingm, Godwin-Christopher, & Citarasu, 2007; Chang et al., 2011). Additionally, Wadikar and Premavalli (2011) showed that rodents given an appetizer containing 12% ginger juice thirty minutes prior to a meal ate significantly more food and weighed more after ten days than the rats not given the ginger juice appetizer. Furthermore, broiler chickens supplemented with 1% dried fermented ginger (DFG) (Incharoen & Yamauchi, 2009) and broilers supplemented with 1.5% red ginger (Herawati, 2010) gained more weight compared to the broilers not fed any ginger.

Forde and Delahunty (2004) commented that food has no nutritional value until it is chosen and consumed. The sensory character, which includes texture, taste, color and aroma, of a food is crucial when someone is planning a meal. As people age, taste, texture, and aroma sensory properties of a food may become less noticeable. One way to compensate for these losses is by adding additional seasonings to a component of the meal. These seasonings are meant to amplify the flavor of the food without adding additional calories or sodium, two aspects of an older person's diet that may be of concern if the person currently has conditions such as hypertension or cardiovascular disease. Currently, people are living longer, so it is critical that

they are able to take pleasure in the final years of their life, starting with a nutritious and satisfying meal.

Statement of the Problem

People aged 50 years and older experience a loss in taste and smell perception. This leads to a reduction and displeasure in the preparation and consumption of food. Adding ginger to foods has shown to increase appetite and food intake in several animal models. However, it is not clear if addition of ginger to a meal will increase appetite and food intake in humans similar to that observed in animal studies.

Purpose of the Study

The purpose of the study was to determine if there was a significant difference in subsequent food intake in older adults after consuming cinnamon applesauce with added fresh ginger juice in comparison to a control of cinnamon applesauce with no ginger juice addition.

Research Hypothesis

The hypothesis was that the participants who consumed the cinnamon applesauce that contained the addition of ginger juice would consume more food than the participants who ate the cinnamon applesauce without the addition of the fresh ginger juice.

Definition of Terms

The following terms have been defined to assist the reader in understanding the information and concepts of the paper.

Ad libitum. A Latin phrase meaning, "in accordance with desire" (Merriam-Webster, 2011). The act of eating without restriction.

Appetizer. A food or drink given before a meal that stimulates appetite (Merriam-Webster, 2011).

Capsaicin. Forde and Delahunty (2004) described capsaicin as a chemical irritant that produces a mild irritation in the back of the throat and a warming of the oral cavity.

Gavage. The introduction of a material into the stomach through a tube (Merriam-Webster, 2011).

Inosine-5'-monophosphate (IMP). According to the Center for Science in the Public Interest (2012), IMP is used to enhance the meaty flavor of soups and other foods. It is often used with monosodium glutamate (MSG) to enhance the potency of a food.

Monosodium glutamate (MSG). The Center for Science in the Public Interest (2012) describes MSG as the amino acid that brings out the flavor in many foods. Companies often use this product to reduce the amount of real ingredients in their foods, such as chicken in a chicken noodle soup.

Polypharmacy. Haijar, Cafiero, and Hanlon (2007) describe polypharmacy as the use of multiple medications, which is common among the elderly.

Preload. A food or drink given prior to a meal.

Umami. The Umami Information Center (2011) states that umami is a Japanese term that describes the savory taste that comes from glutamate, which naturally occurs in foods such as meat, fish, vegetables and dairy products.

Assumptions

It was assumed that the participants would be hungry before coming to the senior center for the study. It was also assumed that the participants would rate their level of hunger on a visual analogue scale, before consuming the cinnamon applesauce, to the best of their ability. In addition, it was assumed that the participant would eat the entire half-cup portion of the cinnamon applesauce and rate their liking of the sample on a visual analogue scale before eating

or drinking any of the food items that were offered. It was also assumed that the participant would record what foods were eaten by circling or writing in the food item on a sheet of paper that was given to them by the researcher. After eating the meal, it was assumed that the participants would rate their level of fullness and if they ate more food than they usually would eat in a meal on visual analogue scales. Also, it was assumed that the participant would be able to answer if they would be able to eat their favorite dessert after the meal. Additionally, it was assumed that the participants would write down what time they ate the applesauce and what time they started eating.

Limitations

One limitation of the study was that the participants were volunteers from the senior center and only represented a small portion of the population of older persons. Therefore, the results of the study cannot be generalized to the entire older adult population. Another limitation is that the amount of food the participants consumed was self-reported. As a result, these amounts may be under or over-reported, based on the perceptions of the individual.

Chapter II: Literature Review

This chapter contains many sections that will give a background and meaning to the research that was conducted. The first section discusses inadequate nutrient intake in older persons. This section explains the effect of aging on food choices and nutrition. The second section focuses on taste and smell and discusses the differences that occur between age groups and the consequences of a diminished sense of taste and smell. The final section focuses on foods that can help an older person ingest more energy and nutrients. This section provides information on techniques and foods that help to prevent an older person from becoming malnourished. The final section will specifically explain the use of ginger to improve appetite and food consumption.

Inadequate Nutrient Intake in the Older Age Groups

As stated in Chapter 1, the number of older persons in the world is increasing as is the life expectancy. With the increasing number of people comes an increasing need for a focus on nutrition to help people achieve a food intake to maintain healthy longevity. Yukawa and Suzuki (2003) conducted an eight-year study on the changes of food intake in elderly subjects living in Tokyo. Older persons, ages 65-79 years, living in urban communities were surveyed by dietitians on their food consumption through a three-day diet record. Eight years later, these same people were given the same survey and significant decreases in food consumption were seen for both males and females. Decreased food consumption can be detrimental to the older person because of risk of malnutrition. However, despite decreased food intake, the participants still consumed higher amounts than the recommended dietary allowances (RDA) (Yukawa & Suzuki, 2003). Although it was noted that weight and body mass index in females decreased

significantly with aging, along with decreased intake of protein, fat, and carbohydrate compared to baseline.

Marshall, Stumbo, Warren, and Xie (2001) investigated the diets of community-dwelling older persons, 65 years of age and older. A dietitian reviewed the three-day diet record of the participants at the beginning and end of the study. The results of the study showed that 60% of the participants did not meet their estimated needs for folate, vitamin D, vitamin E, calcium or magnesium. In addition, males consumed more total energy than females, but less energy per unit body weight. This indicates that the males consumed an inadequate amount of energy, based on their body weight compared to the women (Marshall et al., 2001). These data reveal that the amount of energy and nutrients consumed by older persons decreases with age.

Taste and Smell

An explanation to why people consume less energy and nutrients as they age may be a result of a diminished capacity to experience taste. Dangore-Khasbage et al. (2010) described taste as the body's ability to react to dissolved molecules and ions, which is referred to as tastants. Human taste is categorized into five descriptors: sweet, bitter, salty, sour, and umami (Japanese for "pleasant, savory taste"). A person can perceive hundreds of different tastes that are a combination of these five categories. The sense of taste plays a very important role in what foods a person prefers, hence, their nutritional status (Dangore-Khasbage et al., 2010).

Variation in taste and smell between age groups. Mojet, Christ-Hazelhof, and Heidema (2004) examined the five taste qualities in males and females divided into a young group with an average age of 24 years and an older group with an average age of 65 years. Each taste quality was represented by a product: salty (NaCl, KCl), sweet (sucrose, aspartame), sour (acetic acid, citric acid), bitterness (caffeine, quinine HCl) and umami. These compounds were

dissolved in water and added to tomato soup, a chocolate drink, mayonnaise, iced tea, and bouillon, respectively. The participants evaluated intensity from "very weak" to "very strong," on a 9-point scale, of the original products along with the products that contained the additional flavor compounds. The results of the study showed that the elderly liked the altered products more than the young (Mojet et al., 2004). These data suggest that older persons have a higher threshold for taste and that adding additional products to food to make the flavor more intense may assist older persons in the enjoyment of food.

Forde and Delahunty (2004) used a 3 (texture) x 3 (taste) x 2 (chemical irritation) factorial design to produce samples for males and females divided into a young group with an average age 26 years, and an older group with an average age of 71 years. The researchers chose to sample Tropicana Pure Premium® orange juice for its familiarity with both age groups and the ease of which the pulp content and flavor manipulations could be administered. Sweetness manipulation of the juice was administered using aspartame (50 ppm, 200 ppm, 400 ppm) and texture manipulation was administered by adjusting the concentration of the orange juice pulp (0%, 5%, 10% w/v pulp). As a chemical irritant, a low level (0.02 ppm) food grade capsaicin was added to the juice. The participants were asked to evaluate the samples using the labeled affective magnitude scale (LAM), with 0 mm representing greatest dislike imaginable to 200 cm representing greatest liking imaginable (Forde & Delahunty, 2004).

The results of the study administered by Forde and Delahunty (2004) showed the younger subjects significantly ($p < 0.001$) liked the juices with low levels of sweetness and no capsaicin more than the high sweetness and capsaicin juices. The younger subjects focused more on chemosensory differences in the samples, rather than textural differences. On the other hand, the older subjects placed more emphasis on the mouth feel and irritant properties of the juices. The

older subjects showed no significant liking for a single product and used a narrower range on the LAM scale, with more mid-point responses. In addition, a section of the older subjects preferred the higher levels of sensory stimulation in the samples. These data indicate that the additional textual and irritant sensory properties of the juices aided in compensating for the possible taste sensory loss the older persons were experiencing. Also, the older subjects were less able to distinguish the differences in taste between the samples, which may be why they focused more on the mouth feel and texture (Forde & Delahunty, 2004).

Changes in taste and smell. The American Dietetic Association (ADA), now known as Academy of Nutrition and Dietetics, previously acknowledged in a 2010 position statement that a decreased appetite, seen in older adults, can be a result of a decrease in taste and smell. A lower appetite can lead to a lower intake of energy and nutrients, which results in weight loss and an increased risk for illness and infection. Depression, polypharmacy, drug-nutrient interactions or medication side effects such as anorexia, nausea, or vomiting can lead to a diminished sense of smell and taste. In addition, oral or dental changes can affect older adults' chewing or swallowing ability. These physiological and psychological changes associated with aging can lead to food being less appealing and more challenging to consume. Furthermore, restrictive and therapeutic diets designed to improve health can aggravate food intake even more because of the food's limited variety and flavor, leading to unintended weight loss and under nutrition (ADA, 2010).

Sensory Efforts to Increase Food Consumption in Older Adults

As a result of a reduced sense of taste and smell in older adults, Best and Appleton (2010) examined the effects of adding seasoning and sauces to improve the palatability of meals. Male and female nursing home patients with an average age of 77 years were given three meals on

three separate occasions containing the same basic components: chicken, two types of vegetables, and mashed potatoes. On one occasion, seasoning was added to the meal; on the second occasion, sauce was added to the meal; and on the third occasion, neither sauce nor seasoning was added. The portions provided were twice the size of a normal adult's meal, and the food was weighed before and after consumption. The participants were asked to measure their hunger, desire to eat, pleasantness, and flavor intensity before and after the meals using a scale with one representing extremely hungry/not intense at all and ten representing extremely full/very intense (Best & Appleton, 2010).

The results of the study administered by Best and Appleton (2010) showed that the participants who ate the meals with seasoning and sauce consumed significantly greater total energy than the meals served plain with the seasoning group consuming an average of 409 kcals; the sauce group consuming an average of 443 kcals; and the plain group consuming an average of 342 kcals. The participants in the seasoning and sauce group also consumed significantly more protein than the participants who ate the meals plain with an average consumption of 41, 42, and 35 grams, respectively. These participants also consumed significantly more carbohydrates, fat and ounces than the participants who consumed the meals plain. The ratings for pleasantness resulted in higher scores for the meals served with sauce compared to the plain or seasoned meals. Also, the meals served with sauce and seasonings were rated to contain a more intense flavor than the meals served plain. These data indicate that the addition of seasoning and sauces to an older person's meal can lead to increases in energy, protein and fat intakes. Overall these additions can lead to increasing the palatability of meals to compensate for possible sensory losses in older individuals (Best & Appleton, 2010).

Laureati, Pagliarini, and Calcinoni (2007) evaluated whether enhanced meals can influence the taste of meals given to elderly patients. Male and female nursing home patients, with an average age of 80 years, and university students, with an average age of 24 years, were chosen for this experiment. The first part of the experiment involved only the elderly subjects given various first courses including either broth with pasta and vegetable puree, rice with butter, or pasta with tomato sauce, from the nursing home's monthly menu. The taste enhancers and flavors added to the meals, such as vegetable extract added to the pasta, were used to amplify the flavor intensity of the components already present in the meal. Also, ingredients were added that were not present in the original formulation, to enhance the overall taste and flavor of the meal without increasing the intensity of an individual flavor such as the addition of pesto sauce to the vegetable puree; sage and rosemary to rice with butter; and capers and oregano to pasta with tomato sauces. The participants were asked to rate their liking of the meals on a ten-point hedonic scale, with one representing "extreme dislike" and ten representing "extreme like."

The second experiment administered by Laureati et al. (2007) involved the evaluation of commercial peach juice modified in color, taste and flavor. Food dye was used to modify the peach color from yellow to red. Taste and flavor were modified by adding sucrose (262 g/L) and peach aroma (0.32 g/L). The elderly and young subjects evaluated the juice using the same 9-point hedonic scale used in the first experiment (Laureati et al., 2007). The results of the study administered by Laureati et al. (2007) showed the elderly subjects liking the enhanced meals much more than the meals with no added enhancements. The most significant addition was the enhanced rice with butter ($p < 0.001$) and vegetable puree ($p = 0.054$). The participants gave the enhanced buttered rice an average hedonic rating 7.6 and the plain rice a rating of 6.4. The enhanced vegetable puree was given a rating of 7.4, compared to rating of 6.6 for the plain

vegetable puree. The elderly subjects also liked the taste of the enhanced peach juice significantly more than the young subjects. The young subjects rated the taste of the juice as 4.8, while the elderly gave the juice a rating of 7.9. These data indicate that the additional flavor enhancements added to food leads to an increased liking in food consumption for the elderly (Laureati et al., 2007).

Preload Timing

There is conflicting research on the time a preload should be consumed before eating a meal. Davy, Dennis, Dengo, Wilson, and Davy (2008) studied the effects of consuming water before a meal with 24 overweight and obese adults between 55 and 75 years of age. For two days each participant randomly consumed either a preload of 500 mL cold bottled water or no preload 30 minutes before a breakfast meal. The results of the study showed that the participants who consumed the preload consumed significantly less energy, than the participants who did not consume the preload with a 74 ± 23 kcal difference which represents a 13% reduction in meal energy intake (Davy et al., 2008).

Silver, Dietrich and Niswender (2011) studied the effects of the consumption of a solid (grapefruit), liquid (grapefruit juice) and water preload before eating a meal. Eighty-five obese adults were instructed to consume the preload 20 minutes before eating the meal. All of the preloads showed a reduction in the caloric intake from the meals (Silver, Dietrich, & Niswender, 2011).

Willbond and Doucet (2011) observed whether the timing of high-protein preloads would have an effect on subsequent food intake. Ten adult males with stable weights were assigned to groups and were required to either consume no preload or a high-protein preload 15 minutes before lunch and dinner. The results showed no significant differences in total energy intake

between the two groups. The calories from the preload were included in this total (Willbond & Doucet, 2011).

Ginger

Ginger (*Zingiber officinale Roscoe)* is a spice that is commonly used around the world. Fuhrman, Rosenblat, Hayek, Coleman, and Aviram (2000) stated that the main components of ginger are the phenolics: gingerol, shagaol and zingerone. The spice also contains monoterpenes and sesquiterpenes (Fuhrman et al., 2000). Lee, Khoo, Halstead, Huynh, and Bensoussan (2007) explained that the main pungent components in ginger are phenolic ketones known as gingerols. The primary gingerol is 6-gingerol, while 8- and 10-gingerol occur in smaller quantities. These gingerols are unstable under high temperatures where they convert to 6-, 8-, and 10- shagaols. Shagoals are more pungent than gingerols and are mainly found in the dried ginger rhizome (Lee et al., 2007).

As reviewed by Ghosh, Banerjee, Mullick and Banerjee (2011) ginger was an important ingredient in traditional Chinese and Indian medicine. Nausea, asthma, cough, and loss of appetite are just a few conditions that ginger was used to treat. Ginger is still used as a popular home remedy, today, to suppress coughs and to treat gastrointestinal disorders. Recent studies show that some of these traditional remedies can be validated, specifically the use of ginger to improve appetite.

Wadikar and Premavalli (2011) stated that the active components gingerol and shagaol are traditionally used for their appetizing and digesting properties. Researchers Incharoen and Yamauchi (2009) found that the rhizome of ginger can stimulate digestive juices such as bile, salivary, gastric, pancreatic and intestinal secretions.

Red ginger is used as a natural feed additive to improve the productivity of broilers, as noted by Herawati (2010). This particular type of ginger (*Zingiber officinale Roscoe*) is slightly more pungent than *Zingiber officinale* but still contains the same components such as oleoresin and gingerol. Using ginger as an additive is beneficial to humans as it is safe for the health of the consumers (Herawati, 2010).

The use of ginger to enhance food consumption. Studies show that ginger can improve the growth of different species of animals. Immanuel et al. (2009) supplemented the basic diet of tilapia fish with 1% ginger extract and compared that to two other medicinal plants as well as to a control group of tilapia without plant extract added to the diet. After 45 days, all of the fish fed with the supplemental plant extract showed a significant increase in growth compared to those fed the control diet. The fish fed with the ginger extract had a growth of 40%, the highest of all the medicinal plants, compared to the control group (Immanuel et al., 2009). Venkatramalingam, Godwin-Christopher, and Citarasu (2007) added ginger powder at concentrations of 0, 25, 50, 75 and 100% to the rice bran fed to tiger shrimp. The shrimp fed the unenriched rice bran experienced the lowest weight gain, 74.8 mg. This was increased significantly to 90.3, 105.3, 118.0 and 130.8 mg in 25%, 50%, 75% and 100% in the shrimp that ate the rice bran ginger powder (Venkatramalingam, Godwin Christopher, & Citarasu, 2007). Additionally, Chang et al. (2011) found that Pacific white shrimp fed 1, 2.5, or 5 mg of ginger had a significantly higher weight than the shrimp fed without the ginger supplement.

Wadikar and Premavalli (2011) studied the effects of three different "ready to drink" appetizers on food consumption and weight gain in 24 adult male Wistar rats. The appetizers contained 12% ginger juice, 0.15% ajowan powder, and 12% karpurvalli juice, respectively. The traditionally known influences on appetite and digestion were a reason why the researchers

decided to examine these particular pungent spices. In this study, rats separated into groups, were fasted for four hours and then received for 10 days 2 mL of one appetizer gavage (introduction of food by tube into the stomach). The control group received 2 mL of water. Thirty minutes after receiving the appetizer, the rats were allowed to eat the feed *ad libitum.* At the end of each day, the leftover food was measured and recorded. Previous to the study, the initial weights of the rats showed no significant differences between each other. At the end of the ten-day period, the weights of the rats that consumed the ginger and karpurvalli experienced a weight gain of an average of 13.26% which was significantly higher than that of the control group which experienced a weight gain of 7.68%. In addition, the average amount of leftover food in the appetizer groups was 31.13% which was significantly less than that of the control, 43.11% indicating an increase in food intake (Wadikar & Premavalli, 2011).

Incharoen and Yamauchi (2009) examined the effects of dried fermented ginger (DFG) on the production performance of broilers, chicken specifically bred for meat production. The DFG was ground and mixed with Japanese Mugwort-Silage Juice (JMS), which has been shown to enhance meat production in chickens. The mixture was then dried for two days before being mixed with the feed for the broilers. Twenty-seven White Leghorn laying hens, with an age of 24 weeks, were assigned to either a control group, feed only, or a group supplemented with 1% or 5% DFG for 19 weeks. The broilers were allowed to eat and drink *ad libitum*. The results of the study showed that the broilers in the 1% DFG group ate significantly more food than the control (Incharoen & Yamauchi, 2009).

Herawati (2010) also examined the effects of ginger fed at different amounts on the food consumption of broilers, using red ginger that was dried for two days and then ground into a flour. Two hundred Hubbard strain broiler chickens at the age of five days were divided into

different feed treatment groups. The feed groups were the control feed without red ginger and four groups with feed containing 0.5, 1.0, 1.5, 2.0% red ginger. The chickens were allowed to consume the feed and water *ad libitum* for five weeks. The chickens were weighed weekly and feed intake was measured daily. The results of the study showed that the broilers fed the red ginger at a level of 1.5% had the highest level of weight gain. When the level of ginger was increased to 2.0%, the broilers showed lower weight gain (Herawati, 2010).

Even though there are many articles showing the effects of ginger on weight gain and food consumption, Nammi, Sreemantula, and Roufogalis (2009) found rats fed a high-fat diet with ginger had significantly less ($p < 0.001$) weight gain than rats fed a high-fat diet alone. These rats were given daily, by gavage, 100, 200, and 400 mg/kg of ginger for 6 weeks (Naami, Sreemantula & Roufogalis, 2009).

Measuring Feelings of Hunger and Satiety

Visual analog scales (VAS) are frequently used to assess feelings of hunger and satiety. Mattes and Cowart (2008) described these scales as providing the participants the ability to mark along a line the impression of what is being sampled such as "extremely hungry." The researcher then measures the distance from where the participant placed the mark and the anchor on the end of the line. This measurement then tells the researcher the magnitude of hunger/satiety of the participant (Mattes & Cowart, 2008).

Ginger has been used in animal studies to improve appetite and food consumption. However, little evidence exists on the effect of ginger in humans or aging humans. Chapter 3 provides the methodology using the juice of ginger root to test the effects of ginger on appetite of older persons utilizing the weight of food consumed and visual analog scales to assess hunger and satiety.

Chapter III: Methodology

This chapter discusses the methodology of the study on the addition of ginger to cinnamon applesauce and its effect on subsequent meal intake in older adults. The section includes a description and selection of the subjects. It also includes a description of the instrumentation used to collect the data; how the data were collected; and an analysis of this data. In addition, limitations and a summary of the methodology are explained in this section.

Description of Location

The L.E. Phillips Senior Center in Eau Claire, WI, was used for this study for multiple reasons. First of all, the center had a large population of males and females with ages ranging from 50 years to 90 years. Also, many of the participants had a range of educational backgrounds and were from the Midwest.

Subject Selection and Description

This research was approved by the Institutional Review Board of the University of Wisconsin-Stout (Appendix A). The director of volunteer services at the L.E. Philips Senior Center was contacted and the study was conducted during the center's planned Oktoberfest celebration, as a mass amount of people were expected to attend. Informational signs about the research study were posted throughout the center and participants were verbally notified about the details of the research study. The participants were selected on a volunteer basis to sample the cinnamon applesauce.

Instrumentation

Visual analog scales (VAS) were used to assess the level of hunger of the participants prior to consuming the applesauce and the fullness of the participants after consuming the meal. The scale was also used by the participants to rate the perceived taste of the applesauce. The

subjects were asked to place a vertical mark on a 13 or 14 mm line, anchored with words at each end representing opposite extremes, which corresponded to the feelings of the participant at that time. The perception of each participant was measured by using a metric ruler to record the distance in millimeters from the left end of the line to the vertical mark.

Data Collection Procedures

The data collection took place at the L.E. Phillips Senior Center in Eau Claire, WI. The day of the event, the researcher set up a table outside of the Oktoberfest celebration area. The researcher then asked people walking in for their willingness to participate in a research study. The volunteers at the center also encouraged people to participate in the researcher's study before eating the food that was offered.

Subjects underwent informed consent prior to paricipating in the study (Appendix B). The forms were written in a font size of 14 to make the forms easier for this age group to read. Before consuming the sample, the subjects were given a survey that asked for ratings of hunger, using a visual analog scale (VAS), and to specify their gender and age (Appendix C). The study was a single-blind experiment where the participants were randomly assigned to the control or the experimental group based on a code on the survey. Even code numbers indicated the participant would be consuming the experimental, cinnamon applesauce with added ginger juice, and the odd code numbers indicated the participant would be consuming the control, plain cinnamon applesauce.

The subjects were asked to consume the entire four ounce container of applesauce and to evaluate the taste of the applesauce by marking their perception using the VAS contained on the survey. The experimental applesauce contained the addition of fresh ginger juice in the amount of 3% (1.675 tsp.). This particular amount was given based partially on the 12% ginger juice

given to the rats in the study by Wadikar and Premavalli (2011). The amount of 12% ginger juice resulted in a significant weight and food consumption increase in the rats that consumed an appetizer with ginger juice than the rats that did not consume the appetizer (Wadikar & Premavalli, 2011). The researcher experimented and found that an amount of 12% ginger juice added to cinnamon applesauce did not give a pleasant taste and was much too different than the control. Through trial and error, the researcher found that an amount of 3% ginger juice was not very noticeable while the applesauce still maintained a satisfying flavor.

The cinnamon applesauce was purchased locally at a supermarket. The ginger juice was obtained from fresh ginger root purchased at the Hmong/Asian American grocery store in Menomonie, Wisconsin. The ginger juice was prepared in the food and nutrition research lab following strict sanitation guidelines. The experimental applesauce with the ginger juice addition was prepared in a research laboratory. Each four ounce serving of applesauce provided 90 kcals, 23 grams of carbohydrates, 2 grams of fiber, and zero grams of protein and fat.

After consuming the entire, or a porrtion, of the four ounces of either the control cinnamon applesauce or the experimental cinnamon applesauce, the subjects were allowed to immediately choose food to eat from a buffet at the Oktoberfest celebration that contained pre-measured portions of food. The participants were given a sheet that asked them to circle what foods were eaten and how much (Appendix D). After the subjects were finished eating, the participants were given an additional survey that asked them to rate their perceived level of fullness and how much was eaten compared to what is normally eaten, using a VAS (Appendix E). The survey also contained a question on whether ice cream could be eaten within 30 minutes after the meal to assess the fullness of the participant. During the meal, assistants to the researcher walked from table to table and asked to see the coding sheet to identify the treatment

group and asked three questions (see Appendix F for these questions). The answers to which were recorded either as experimental or control responses.

The food items on the buffet were planned and prepared by the senior center director and volunteers who had food safety training. The buffet was offered for four hours with replenishment of food so food was not sitting for longer than two hours. Subjects were allowed one trip to the buffet, as there was expected to be a mass number of people attending the event and the center needed to have enough food for everyone. If food was leftover at the end of the event, the subjects were welcome to have more food. When the final sheet was turned in, the participants' role in the study was over.

Data Analysis

The data were analyzed using IBM SPSS Statistics Grandpack 21 (November 12, 2012). A cross-tabulation (chi-square) analysis was used to evaluate if there were differences between the participants who consumed ginger and those who did not on their answer to if they would be able to consume ice cream after the meal. This method was also used to analyze, separated by the presence of ginger juice in the applesauce; the distribution of males and females; the amount of applesauce and ginger eaten previous to the study; and the amounts of applesauce consumed in the study. ANOVA was used to determine if there were significant differences in hunger before the meal and fullness after the meal between the subjects who consumed ginger and the subjects who did not. The amounts of food and nutrients consumed by each participant individually were calculated. ANOVA was also used to see if the amount (none, little/half, all) of applesauce made a difference in the amount of calories, ounces, protein, carbohydrates, fiber, and fat, between the participants who ate ginger and those who did not. In addition, t-tests were used to analyze whether participants who consumed ginger ate more calories, ounces, protein, carbohydrates,

fiber, and fat than the participants who did not consume ginger. These analyses were administered on the amounts consumed by the participants from the applesauce and meal and from the meal only. Values are reported as means ± standard deviation.

Limitations

One limitation to the study was that the participants were not trained on the use of visual analog scales. The participants not having experience with the visual analog scales may have skewed the data if the person marked either end of the line. Participants may not have fully understood the concept of the scale or been able to effectively evaluate their feelings. In addition, the amount of food that was eaten by the participants was self-reported as opposed to being physically measured.

Chapter IV: Results

The purpose of the study was to determine if a significant difference could be found in subsequent food intake in older adults after consuming cinnamon applesauce with added fresh ginger juice in comparison to cinnamon applesauce with no ginger juice addition. A total of 61 subjects completed the study. Thirty-one participants were randomly selected to consume four ounces cinnamon applesauce that contained 3% (1.675 tsp) ginger juice, and 30 were randomly selected to consume cinnamon applesauce that did not contain ginger juice.

Results from Survey Prior to Applesauce Consumption

A *t*-test analysis was done to compare the mean age of the participants who consumed the applesauce with ginger juice (ginger group) to the participants who consumed the applesauce plain (non-ginger group). Table 1 shows that the mean age of the participants in the non-ginger group (69.47 ± 8.42 years) was significantly lower ($p < 0.05$) than the mean age of the participants in the ginger group (74.43 years ± 9.64 years). The mean age of all of the participants was 71.9 ± 9.32 years. The age of the participants ranged from 43 to 96 years.

Table 1

Results of a t-*Test Comparing the Mean Age of the Participants in the Non-Ginger and Ginger Groups*

Group	N	Mean	SD	*t*	*df*	*p*
Non-Ginger	30	69.47	8.42	-2.13	58	0.038**
Ginger	30*	74.43	9.64			

*One participant did not answer the question.
**Statistically significant at a level of $p < 0.05$

A cross tabulation (chi-square) analysis was administered to compare the amount of males and females in the study and how many of each gender received applesauce with ginger juice. Table 2 shows that the number of males and females in the ginger group did not differ significantly from the number of males and females in the non-ginger group, χ^2 (1) = 0.35, p > 0.05. A total of fifty females and 11 males participated in the study.

Table 2

Chi-Square Distribution of the Ginger and Non-Ginger Groups Separated by Gender

Category	Groups		χ^2
	Ginger	Non-Ginger	
Number of Females	24	26	0.35
Number of Males	7	4	
Total	31	30	

A chi-square test was also used to analyze how often the participants consumed applesauce and ginger, prior to the study. Table 3 shows that the frequency of consumption of applesauce was not significantly different between groups, χ^2 (2) = 0.91, p > 0.05. Fifty of the participants reported eating applesauce never or only once a month, and 11 reported eating applesauce once a week. However, the frequency of consumption of ginger was significantly different between groups, χ^2 (2) = 0.04, p < 0.05. Seven of the participants in the non-ginger group reported eating ginger weekly, compared to one person in the ginger group. Sixteen participants in the ginger group had never eaten ginger, compared to nine in the non-ginger group.

Table 3

Chi-Square Distribution of the Ginger and Non-Ginger Groups Comparing How Often Participants Ate Applesauce and Ginger

Frequency of Consumption	Groups		χ^2
	Ginger	Non-Ginger	
Applesauce			
Never	6	5	0.91
Once a Month	19	20	
Once a Week	6	5	
Total	31	30	
Ginger			
Never	16	9	0.04*
Once a Month	14	14	
Once a Week	1	7	
Total			

*Statistically significant at a level of $p < 0.05$

Prior to eating the applesauce, level of hunger was marked by the participants on a 14 mm line with 0 representing “extreme hunger” and 14 representing “no hunger at all.” The results of an independent samples *t*-test comparing the perceived hunger of the participants are shown in Figure 1, separated by whether or not the applesauce contained ginger juice. The differences in hunger were not significantly different ($p > 0.05$) between groups.

Figure 1. Results of *t*-test comparing the perceived hunger, previous to applesauce, of the participants, separated by whether or not the applesauce contained ginger juice, t (59) = 2.81, $p > 0.05$
*Measurement on a 14 mm line (0 mm = "extremely hungry"; 14 mm = "not hungry at all")

Preload Timing

During the study, the researcher recorded the time the participants consumed the applesauce, and the participants were asked to record the time the meal was started. Table 4 shows a *t*-test comparing the difference in time between these two occurrences, separated by whether or not the applesauce contained ginger juice. The difference in time was not significant between groups, t (59) = 0.101, $p > 0.05$.

Table 4

Results of a t-Test Comparing the Difference in Time, in Minutes, the Participants Ate the Applesauce and when the Meal was Consumed

Group	N	Mean	SD	*t*	*df*	*p*
Non-Ginger	30	13.23	0.24	0.101	59	0.920
Ginger	31	13.22	0.19			

Results from Survey after Applesauce and Meal Consumption

Similar to before the study, after the participants ate the meal, the level of fullness was indicated on a slightly shorter 13 mm line with 0 representing "extremely full" and 13 representing "not full at all." Figure 2 shows a *t*-test comparing the perceived fullness of the participants, separated by whether or not the applesauce contained ginger juice. No significant difference was seen between groups, $t\ (58) = 0.957$, $p > 0.05$.

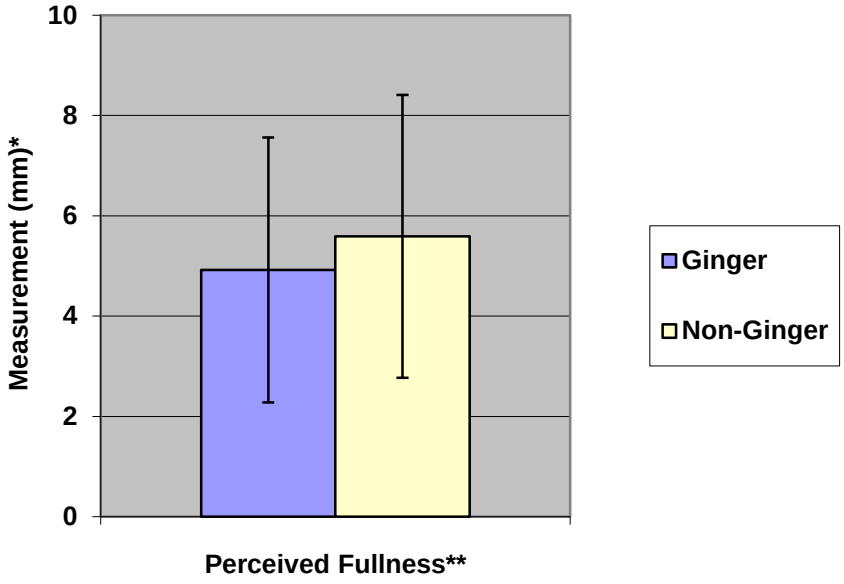

Figure 2. Results of *t*-test comparing the perceived fullness, after the meal, of the participants, separated by whether or not the applesauce contained ginger juice, $t\ (58) = 0.957$, $p > 0.05$
*Measurement on a 13 mm line (0 mm = "extremely hungry"; 14 mm = "not hungry at all")
**One participant did not answer the question

After the meal was eaten, perception of how much food was eaten compared to what was normally eaten outside of the senior center was recorded by the participants on a 13 mm line with 0 representing "less" and 13 representing "more." Table 5 shows a *t*-test of the responses of the participants, separated by whether or not the applesauce contained ginger juice. No significant difference was seen between groups, $t\ (57) = 1.679$, $p > 0.05$.

Table 5

Results of a t-Test Comparing the Perceived Amount of Food the Participants Consumed Compared to what was Normally Eaten

Group	N	Mean*	SD	*t*	*df*	*p*
Non-Ginger	29**	8.09	3.46	1.679	57	0.099
Ginger	30**	6.51	3.74			

*Measurement on a 13 mm line (0 mm = "less"; 13 mm = "more")
**Two participants filled out the first sheet (demographics) but not the other two sheets (meal, fullness)

As an indication of extreme fullness, the participants were asked if ice cream could be able to be eaten within 30 minutes of finishing the meal. Table 6 shows a chi-square distribution of the desire of the ginger and non-ginger groups to have ice cream after eating the meal. The responses of the participant in the ginger group did not differ significantly from the responses of the non-ginger group, χ^2 (1) = 0.42, $p > 0.05$.

Table 6

Chi-Square Distribution of the Ginger and Non-Ginger Groups to if Ice Cream could be Eaten within 30 Minutes of Meal Consumption

	Groups		
Room for Ice Cream	Ginger	Non-Ginger	χ^2
Yes	25	23	0.42
No	5	7	
Total	30*	30	

Applesauce

After eating the applesauce, the participants were asked to mark on a 14 mm line how the applesauce tasted with 0 mm representing "horrible" and 14 mm representing "delicious." Table 7 shows a *t*-test comparing the participants' responses, separated by whether or not the applesauce contained ginger juice. The participants that consumed the applesauce plain liked the applesauce significantly more (M = 11.30) ($p < 0.05$) than the participants who consumed the applesauce with ginger juice (M = 6.36).

Table 7

Results of a t-Test Comparing the Perceived Taste of the Applesauce by the Participants

Group	N	Mean	SD	*t*	*df*	*p*
Non-Ginger	30	11.30	2.97	5.035	59	0.001*
Ginger	31	6.36	4.51			

*Statistically significant at a level of $p < 0.05$

The researcher additionally collected qualitative data on the thoughts of the participants on the taste of the applesauce before it was known if the applesauce contained ginger or not. One man who consumed the applesauce with ginger juice commented that the taste was strong, but he liked it. A female who consumed the same applesauce thought that this applesauce was better than plain applesauce. Other women that consumed the applesauce with ginger juice commented that it was spicy and did not like it. Some of the women who consumed the applesauce with ginger wrote comments that the applesauce with ginger was very good.

Table 8 shows a chi-square distribution of the amount of applesauce the participants consumed, separated by whether or not the applesauce contained ginger juice. The groups were significantly different, χ^2 (2) = 0.003, $p < 0.05$. Eighteen participants ate the entire bowl of

applesauce when it was prepared with ginger juice. All of the participants, less one, ate the entire four ounces of applesauce when it was plain.

Table 8

Chi-Square Distribution of the Ginger and Non-Ginger Groups Comparing the Amount of Applesauce Eaten

Amount of Applesauce Eaten	Groups		χ^2
	Ginger	Non-Ginger	
A Couple Spoonfuls	7	1	0.003*
About Half	6	0	
Entire Bowl	18	29	
Total	31	30	

*Statistically significant at a level of $p < 0.05$

Nutrition Components ANOVA Analyses

Figure 3 depicts an ANOVA comparison that was ran to compare the average calories consumed from the applesauce and meal by the participants. The total calorie amounts were divided into three groups based on the amount of applesauce consumed: those that ate a little or half the applesauce with ginger juice; those that ate all of the applesauce with ginger juice, and those that ate the applesauce plain. Those that ate a little or half of the applesauce consumed significantly less calories ($p < 0.05$) than those who did not have ginger in the applesauce. The calorie amount of the group that consumed all of the applesauce with ginger was not significantly different ($p > 0.05$) than the other two groups.

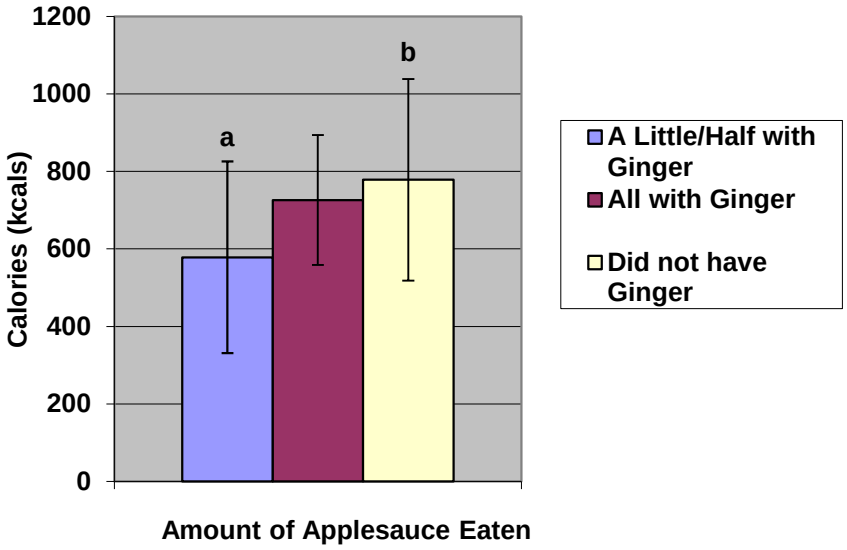

Figure 3. ANOVA results comparing the mean calories consumed from the applesauce and meal between groups based on the amount of applesauce, with and without ginger juice consumed. Means with different letters are significantly different ($p < 0.05$).

An ANOVA comparison was ran to compare the average ounces of food consumed from the applesauce and the meal of three groups: those that ate a little or half the applesauce with ginger juice; those that ate all of the applesauce with ginger juice; and those that ate the applesauce plain. Those that only ate part of the applesauce consumed significantly less ounces than those who did not have ginger (Figure 4). However, there was no significant difference seen with the group that consumed all of the applesauce with ginger.

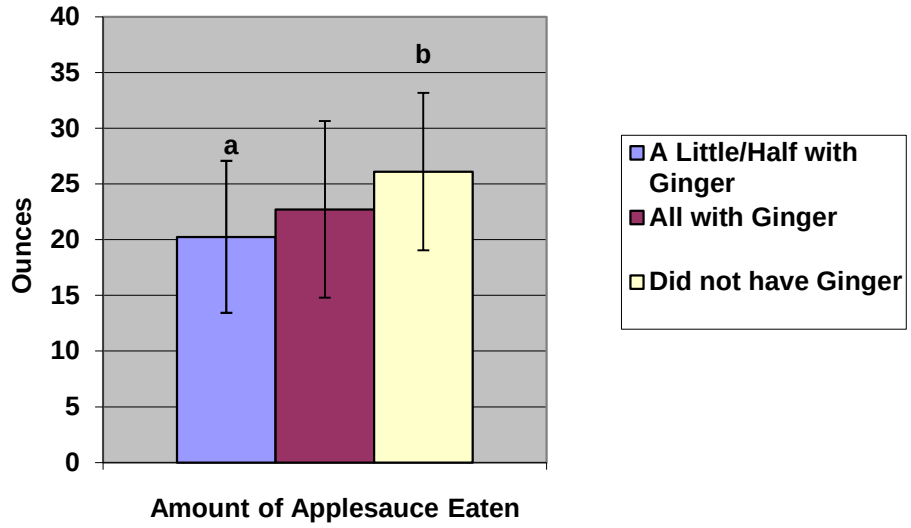

Figure 4.
ANOVA results comparing the mean ounces of food consumed from the applesauce and meal between groups based on the amount of applesauce, with and without ginger juice, consumed. Means with different letters are significantly different ($p < 0.05$).

Figure 5 shows an ANOVA comparison that was ran to compare the average grams of carbohydrates consumed from the applesauce and the meal by the three groups (those that ate a little or half the applesauce with ginger juice; those that ate all of the applesauce with ginger juice, and those that ate the applesauce plain). Those that ate a little or half of the applesauce consumed significantly less calories than those who did not have ginger in the applesauce. The group that consumed all of the applesauce with ginger was not significantly different than the other two groups.

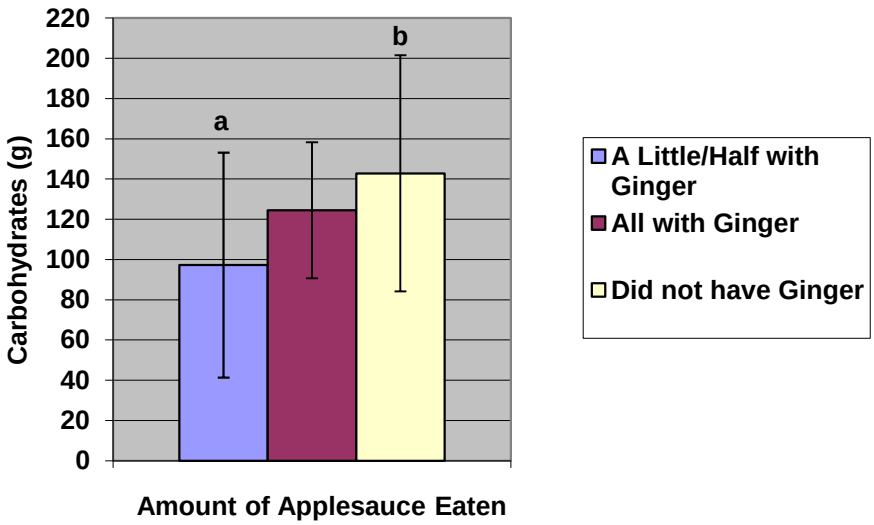

Figure 5. ANOVA results comparing the mean grams of carbohydrates consumed from the applesauce and meal between groups based on the amount of applesauce, with and without ginger juice, consumed. Means with different letters are significantly different ($p < 0.05$).

An ANOVA comparison was ran to compare the average grams of fiber consumed from the applesauce and the meal by the three groups which included those that ate a little or half the applesauce with ginger juice; those that ate all of the applesauce with ginger juice; and those that ate the applesauce plain. Figure 6 illustrates that those that ate a little or half of the applesauce consumed significantly less grams of fiber than those who did not have ginger in the applesauce. The group that consumed all of the applesauce with ginger was not significantly different than the other two groups.

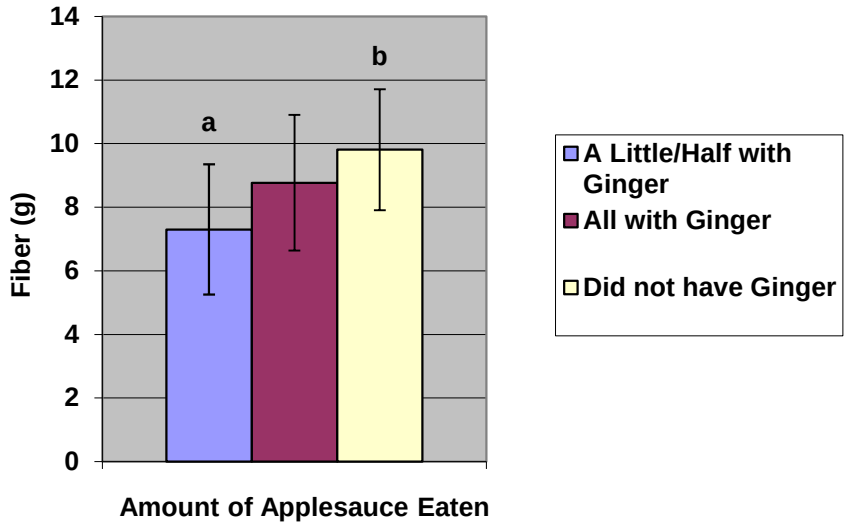

Figure 6. ANOVA results comparing the mean grams of fiber consumed from the applesauce and meal between groups based on the amount of applesauce, with and without ginger juice, consumed. Means with different letters are significantly different ($p < 0.05$).

The ANOVA ran comparing the mean grams of protein consumed from the applesauce and meal found no difference between those that partially consumed the applesauce with ginger, those that consumed all the applesauce with ginger, and those that had no ginger in the applesauce. The mean grams of protein eaten were 17.29 ± 7.42, 19.08 ± 4.42, and 21.78 ± 6.19 grams, respectively.

The ANOVA ran comparing the grams of fat consumed from the applesauce and the meal found no difference between those that partially consumed the applesauce with ginger, those that consumed all the applesauce with ginger, and those that had no ginger in the applesauce. The mean grams of fat eaten were 25.99 ± 12.57, 27.11 ± 6.95, and 32.44 ± 11.29, respectively.

Nutrition Components *t*-Test Analyses

Table 9 shows *t*-test analyses of the nutrition consumed from the applesauce and meal by the participants. The mean of the calories consumed from the applesauce and meal by the

participants who consumed the applesauce plain tended to be significantly higher, t (59) = 1.98, p = 0.054, than the participants who consumed the applesauce with ginger juice.

Ounces of food consumed by the participants from the applesauce and the meal were determined by weighing the plate of food, including the applesauce, versus what remained on the plate after eating. Table 9 shows that the mean ounces consumed from the applesauce and meal by the non-ginger and ginger groups were significant, t (59) = -2.38, $p < 0.05$. The non-ginger group consumed, by weight, 4.42 ounces more food than did the ginger group.

The mean of the grams of carbohydrates consumed from the applesauce and meal by the non-ginger and ginger groups was significant, t (59) = -2.21, $p < 0.05$. Table 9 shows that the mean grams of carbohydrates consumed by the non-ginger group were higher with a mean of 142.79 ± 58.71 grams versus 113.03 ± 45.65 grams consumed by the ginger group.

Similar to carbohydrates, the mean grams of fiber consumed from the applesauce and the meal by the non-ginger and ginger groups was significant, t (59) = -3.16, $p < 0.05$. Table 9 depicts the *t*-test result which shows a mean of 9.81 ± 1.90 grams of fiber for the non-ginger group versus the mean of the ginger group: 8.15 ± 2.19 grams.

Table 9 shows that the mean of grams of protein consumed by the non-ginger and ginger groups was significant, t (59) = -2.25, $p < 0.05$. The mean of the grams of protein consumed by the non-ginger group was 21.78 ± 6.19 grams versus the mean of 18.31 ± 5.93 grams by the ginger group.

The mean grams of fat intake were 32.44 ± 11.29 grams for the non-ginger group versus 26.64 ± 9.53 grams. The total grams of fat consumed from the meal by the non-ginger and ginger groups were significantly different, t (59) = -2.17, $p < 0.05$

Table 9

Results of a t-Test Comparing the Means of the Calories, Ounces, and Grams of Carbohydrates, Fiber, Protein, and Fat Consumed from the Applesauce and Meal by the Participants

Group	N	Mean	SD	*t*	*df*	*p*
Calories						
Non-Ginger	30	778.47	260.84	1.98	59	0.054
Ginger	31	658.20	212.54			
Ounces						
Non-Ginger	30	26.11	7.01	-2.38	59	0.021*
Ginger	31	21.69	7.46			
Carbohydrates						
Non-Ginger	30	142.79	58.71	-2.21	59	0.031*
Ginger	31	113.03	45.65			
Fiber						
Non-Ginger	30	9.81	1.90	-3.16	59	0.002*
Ginger	31	8.15	2.19			
Protein						
Non-Ginger	30	21.78	6.19	-2.25	59	0.028*
Ginger	31	18.31	5.83			
Fat						
Non-Ginger	30	32.44	11.29	-2.17	59	0.034*
Ginger	31	26.64	9.53			

*Statistically significant at level of $p < 0.05$.

The four ounce container of applesauce contained 90 kcals; 23 grams of carbohydrates; 2 grams of fiber; and zero grams of protein and fat (information taken from the nutrition facts label on the applesauce container). Table 10 illustrates the *t*-test results of the mean calories, ounces, grams of carbohydrates, fat, protein, and fiber consumed from the meal, not including the applesauce, by the participants. The results, with the exception of grams of fat and protein, showed no significance.

Table 10

Results of a t-Test Comparing the Means of the Calories, Ounces, and Grams of Carbohydrates, Fiber, Protein, and Fat Consumed Solely from the Meal by the Participants

Group	N	Mean	SD	*t*	*df*	*p*
Calories						
Non-Ginger	30	610.39	226.06	0.188	59	0.852
Ginger	31	599.44	229.77			
Ounces						
Non-Ginger	30	20.93	7.69	0.364	59	0.717
Ginger	31	20.24	7.13			
Carbohydrates						
Non-Ginger	30	110.46	52.86	0.361	59	0.719
Ginger	31	105.54	43.47			
Fiber						
Non-Ginger	30	7.08	2.17	-0.72	59	0.474
Ginger	31	7.46	1.92			
Protein						
Non-Ginger	30	21.78	6.19	2.25	59	0.028*
Ginger	31	18.31	5.83			
Fat						
Non-Ginger	30	32.44	11.29	-2.17	59	0.034*
Ginger	31	26.64	9.53			

*Statistically significant at level of $p < 0.05$.

The ANOVA results comparing the mean calories consumed from the meal, not including applesauce, between the groups of participants are shown in Table 11. The results were not significant. This was also the case with the ANOVA results for the mean ounces, grams of carbohydrates, fiber, protein, and fat.

Table 11

ANOVA Results Comparing the Mean Calories Consumed Solely from the Meal between Groups based on the Amount of Applesauce, with and without Ginger Juice, Consumed

Group	N	Mean	SD	F	*p*
A little/half with ginger	13	634.58	284.51	0.281	0.756
All with ginger	18	574.06	185.47		
Did not have ginger	30	610.39	226.06		
Total	61	604.82	226.12		

In summary, the participants who consumed the applesauce with the ginger juice consumed less calories, ounces, carbohydrates, and fiber from the meal than the participants who consumed applesauce plain. The significance of these results will be discussed in Chapter 5.

Chapter V: Discussion

With increasing age comes a decrease in the sense of taste. This often leads to a decrease in appetite and displeasure in the preparation and consumption of food. Studies with animals have shown that fresh ginger has the ability to increase appetite and food consumption. To the author's knowledge, no studies have been administered on humans involving ginger and appetite. The current study analyzed the addition of fresh ginger juice to cinnamon applesauce and its effect on the stimulation of appetite and subsequent food intake in an older population. Prior to eating the applesauce, the participants were asked to rate their level of hunger on a VAS scale. After eating the applesauce, the participants enjoyed a meal offered at the senior center and were asked to record the amounts of each food consumed. When the participants were finished with the meal, they were then asked to rate their level of fullness on another VAS scale. The ounces of food, calories, carbohydrates, fiber, protein, and fat consumed from the meal by each participant were analyzed. The results show that the participants who consumed the applesauce with ginger juice ate less ounces of food, calories, and fiber from the meal than the participants who consumed the applesauce plain.

Limitations

Prior to the start of the study, the participants in the ginger and non-ginger groups were not the same in all areas. The chi-square calculation shows that the number of males and females were the same, χ^2 (1) = 0.35, $p > 0.05$. However, the *t*-test comparing the age of the participants showed that the participants who consumed the applesauce with ginger juice were significantly ($p < 0.05$) older than the participants who consumed the ginger plain. As people age calorie needs decrease and usually food intake also decreases. This would mean that the older group who consumed ginger was pre-disposed to eating less than the younger group who consumed the

plain applesauce. Additionally, the amount of applesauce the participants consumed prior to the study was not significantly different, χ^2 (2) = 0.91, $p > 0.05$. However, the frequency of consumption of ginger consumed prior to the study was significantly different, χ^2 (2) = 0.04, $p > 0.05$. The random assignment of participants was such that the group assigned ginger was less familiar with ginger and its flavor than the group that was not assigned ginger. Not having familiarity with ginger could have led the participants to not want to eat the entire container of applesauce with ginger juice added. In addition, the reason the participants did not eat ginger often may be a result of a dislike for ginger. These differences could have contributed to the difference in the consumption of the applesauce between groups and the familiarity the participants had with ginger. If this study were to be repeated, the researcher must ensure that the participants in both the groups contained the equal characteristics as far as age and exposure to ginger to ensure the validity of the study. The age difference and exposure to ginger that was discovered in the ginger group are major limitations of this study.

One limitation of this study was that the subjects were not trained on the use of VAS. Prior to the study the subjects were unfamiliar with the scales and did not have experience using them. This could have skewed the data if a person marked either end of the line as result of not fully understanding the concept of the scale or not being efficient at interpreting feelings. Authors Mattes and Cowart (2008) commented that the main concern with the use of VAS scales is the level of skill of the participants. For example, at the end of the meal one participant indicated a fullness in the range of 12 to 14.99 mm, which is an indication of no fullness, while the rest of the participants chose 8.99 mm or less, an indication of somewhat full to extremely full. This particular participant may have choose that range because of confusion about which end of the scale was “extremely full.” This was implied by the response of “somewhat hungry”

that was given prior to the meal and most of the meal was eaten, including coffee that was followed by the end response of "no fullness." Also, a limitation was assuming that the participants could accurately estimate portion size. The researcher did place options such as "half" and "all" to make the forms simple to fill out, but participants may not have been able to accurately account for these results.

According Mattes and Cowart (2008) a typical sensory tasting facility contains individual booths for product sampling and to ensure privacy. Also, the environment should be free of distractions and odors (Mattes & Cowart, 2008). This type of environment would have been ideal for this study but was not accessible. The participants encountered many distractions while eating such as music and other people. These conditions may have limited the participants from correctly recording every item that was eaten during the meal. Also, food was available for a four hour time span. Therefore, there may have been a slight chance of the participants grazing on food items after handing in the post meal survey and not having the ability to record these other food items.

Another limitation to this study was that the applesauce was not screened for likeability prior to the beginning of the study. According to the qualitative results, a few participants did like the taste of the ginger, stating that it was "better than plain" and "strong, but good." While other participants did comment that the applesauce with ginger juice did not taste very good. The results of the *t*-test show that the participants who consumed applesauce plain liked the applesauce significantly more ($p < 0.05$) than the participants who consumed the applesauce with ginger juice. Even though this study was designed to use a single-blind experiment, the participants who consumed the applesauce with ginger juice could identify the taste of the

ginger, which may have affected the results. However, some of the participants who consumed the applesauce plain did think they were eating the applesauce with added ginger juice.

The amount of ginger juice contained in the applesauce may have also been a limitation to the study. The participants consumed 3% (1.675 tsp) of ginger juice with the cinnamon applesauce. This could have affected the taste of the applesauce, as 12 out of the 31 participants who consumed the applesauce with ginger juice did not finish the entire container. The amount of applesauce consumed may have affected the amount of ginger consumed and thus impacted food consumption. Incharoen and Yamuchi (2009) found that the food consumption in broilers fed 1% DFG was significantly more ($p < 0.05$) than the control. However, the broilers fed 5% DFG consumed more food than the control, but the results were not significant (Incaharoen & Yamuchi, 2009). The amount of ginger chosen to be added could have impacted subsequent food intake. Herawati (2010) also found that broilers fed up to 1.5% red ginger had a higher level of weight gain than the control group. When the level of red ginger was increased to 2%, the broilers showed a lower weight gain than the control (Herawati, 2010). On the other hand, when the ginger was fed to shrimp at different concentrations, the shrimp that ate the ginger consumed more feed and had a significantly higher weight gain than the shrimp that were not fed the ginger (Venkatramalingam, Godwin-Christopher, Citarasu, 2007; Chang et al., 2011). Even though these amounts of ginger may have led to increased food consumption and weight gain in animals, the same may not be true in humans. The mechanisms that ginger affects animals may be different than the mechanisms in animals. This is another limitation to this study.

The question: "would you be able to eat ice cream in the next 30 minutes?" was meant for the participants to indicate their extreme fullness. However, this was not a great indication for extreme hunger as there was no significant difference in whether or not the participants had

room for ice cream. One of the participants even commented, "I always have room for ice cream."

Additionally, many of the participants failed to record what time they ate the applesauce and the meal. The researcher was able to record their best estimate of the time, but it was not exact. Studies have shown difference in times of preloads of meals, ranging from 15 minutes (Willbond & Doucet, 2011) to 30 minutes (Davy et al., 2008; Wadikar & Premavalli, 2011). Due to the restrictions of the mass number of people, it was not appropriate to have them sit for any length of time before proceeding to the buffet. Given that the food that was offered during the study was free and offered to a mass amount of people, the members of the center only allowed one trip to the buffet per participant. Therefore, this may have limited the participants to eating to a level of fullness.

Furthermore, recruitment considerations were not made prior to accepting volunteers for the study. Authors Mattes and Cowart (2008) felt this is important because issues such as the recent diet, dentures, smoking, and the current health status of participants can greatly affect the results of the study. These considerations were not feasible for the researcher as a result of the participants being volunteers and the limited time available to test the subjects.

Conclusions

Unfortunately, there were two flaws to the assignments of the participants into the two groups even though there was an attempt to randomize the groups. The first flaw was that the group consuming the ginger was significantly older than the control group who did not consume ginger. Older individuals tend to consume less calories and this is accompanied by eating less food. The second flaw was that the frequency of consumption of ginger prior to the study was different between the groups such that the group assigned ginger was less familiar with ginger

and its flavor than the group assigned plain applesauce. These two flaws could well invalidate any differences that could have potentially been found between the two groups.

Thus conclusions based on results of study should be made cautiously. Based on the results of the study assuming that these flaws did not affect the results , it could be concluded that consuming fresh ginger juice prior to a meal may decrease subsequent intake in older individuals. However, the participants who consumed the applesauce with ginger had a significantly higher age and thus could be suspected of consuming less food and calories. The study was fairly large with 61 males and females. The participants who consumed the applesauce with ginger tended to eat less calories ($p = 0.054$) than the participants who consumed the applesauce plain, indicated by the *t*-test comparing the mean calories consumed from the meal by both groups.

Many of the participants were not extremely hungry before the study. The results of the *t*-test comparing the level of hunger of the participants showed that the hunger of the participants in the ginger group was not significantly different ($p > 0.05$) than the hunger of the participants in the ginger group. This is a benefit to the study because the researcher then knows that the participants are eating the amounts normally eaten, and not overcompensating for their hunger. Many of the participants indicated on the 13 mm line on the post-meal survey that what was eaten was close to what was normally eaten outside of the senior center. In addition, there was not a significant time difference ($p > 0.05$) from when the participants consumed their applesauce and when the meal was eaten between groups, as indicated by the *t*-test. This indicates that time was not a contributing factor in the effect of the ginger on appetite.

In the study performed by Wadikar and Premavalli (2011), the rats were fasted for four hours before being force fed by gavage, the ginger appetizer. The rats who consumed the ginger

appetizer weighed significantly more ($p < 0.001$) and consumed significantly more food ($p < 0.05$) than the control group (Wadickar & Premavalli, 2011). The fact that the rats were fed by gavage the ginger may have affected the results of this study, as the rats had no choice on how much ginger that was to be consumed. This also eliminates the likeability of the ginger because the rats were not allowed to taste the ginger juice. In the current study, the participants voluntarily consumed the ginger juice in applesauce. Twelve participants did not like the taste of the ginger juice and did not consume the entire container of applesauce. Therefore, these participants did not receive the same dose of ginger juice as the participants who consumed the entire container of applesauce with ginger juice (19 participants). Other studies show that the dose of ginger is important (Incharoen & Yamauchi, 2009; Herawati, 2010; Venkatramalingam, Godwin-Christopher, Citarasu, 2007; Chang et al., 2011).

The participants who consumed the applesauce with ginger juice ate less calories from the meal than the participants who consumed the applesauce plain. One out of 30 participants did not consume all of the applesauce plain, while 12 out of 31 participants who consumed the applesauce with ginger did not eat all of their applesauce. The applesauce contained 90 kcals. This may be a reason why the participants who had the applesauce with ginger who did not consume all of the contents appeared to consume less calories than the participants who consumed the applesauce plain.

After analyzing the amount of ounces, calories, carbohydrates, protein and fat consumed from the meal and the applesauce by the participants, the question arose whether consuming or not consuming the applesauce was the sole impact on the meal results. Therefore, the researcher chose to do additional *t*-tests on these components without including the applesauce. The results produced no significant results for calories, ounces, grams of carbohydrates and grams of fiber

from the meal as the participants who consumed the applesauce plain. In the results for the *t*-tests comparing the mean grams of protein and fat consumed from the meal only by the participants, the participants who had ginger in their applesauce consumed significantly ($p < 0.05$) less grams of protein and fat than the participants who had the applesauce plain. When the applesauce is combined with the meal the results are significant for calories, ounces, fiber, carbohydrates, fat and protein. When the applesauce is separated from the meal, the results are not significant except for protein and fat which was increased in those who had plain applesauce. The applesauce the participants consumed before the meal contained zero grams of protein and fat. Here, again, the amount of applesauce that was consumed prior to the meal may have had an effect on the results of the study. The applesauce does not contribute protein or fat to the meal. Thus, it can be assumed that those who ate the applesauce plain did eat more fat and protein in the subsequent meal than those who had the applesauce with ginger.

Nammi, Sreemanutla, and Roufogalis (2009) found that rats fed a high-fat diet in conjunction with 100, 200, and 400 mg/kg of ginger experienced a significantly less ($p < 0.001$) weight gain than the rats fed the high-fat diet alone. The amounts of ginger given to these rats was higher than the amounts given in previous studies. The amounts of 100, 200, and 400 mg/kg are equal to 10, 20, and 40% of the rat's bodyweight, respectively. This shows that higher amounts of ginger given may lead to higher levels of satiety rather than hunger.

Recommendations

As illustrated in the study, many of the participants indicated a dislike for the taste of the applesauce with ginger. A flaw evident upon analysis of data was that the participants assigned to the applesauce with ginger group were less familiar with ginger which may have impacted and even invalidated the results even though an attempt was made to randomly assign the subjects. If

this study were undertaken again, familiarity with ginger would be a question answered by the participants before group assignment. And the researcher would then be assured that familiarity/unfamiliarty with ginger was represented in both groups Similarly, a question about age should be answered before group assignment. Again this would ensure that the ages were not significantly different in the two groups.

Future studies should focus on masking the strong pungency of the fresh ginger to result in a better liking for the taste. Many of the participants developed a liking for the plain applesauce. Therefore, applesauce could still be used as a great medium for the fresh ginger to be distributed in future experiments. Future studies are also needed on the mechanisms of ginger in the human body and what compound in ginger causes appetite regulation.

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Appendix A: Institutional Review Board Approval Form

7/19/2012

Stacie Buss
Food and Nutrition
UW-Stout

Title: "Ginger Effects of Appetite and Food Intake"
Subject: Protection of Human Subjects

Dear Stacie,

In accordance with Federal Regulations, your project, "Ginger Effects of Appetite and Food Intake" was reviewed on **7/18/2012,** by a member of the Institutional Review Board and was approved under Expedited Review through **7/18/2017.**

If your project involves administration of a survey or interview, please copy and paste the following message to the top of your survey/interview form before dissemination:

> **This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.**

Responsibilities for Principal Investigators of IRB-approved research:

1. No subjects may be involved in any study procedure prior to the IRB approval date or after the expiration date. (Principal Investigators and Sponsors are responsible for initiating Continuing Review proceedings.)
2. All unanticipated or serious adverse events must be reported to the IRB.
3. All protocol modifications must be IRB approved prior to implementation, unless they are intended to reduce risk.
4. All protocol deviations must be reported to the IRB.
5. All recruitment materials and methods must be approved by the IRB prior to being used.
6. Federal regulations require IRB review of ongoing projects on an annual basis.

Thank you for your cooperation with the IRB and best wishes with your project. Should you have any questions regarding this letter or need further assistance, please contact the IRB office at 715-232-1126 or email foxwells@uwstout.edu.

Sincerely,

Susan Foxwell

Susan Foxwell
Research Administrator and Human Protections Administrator,
UW-Stout Institutional Review Board for the Protection of Human Subjects in Research (IRB)

***NOTE: This is the only notice you will receive – no paper copy will be sent.**

Appendix B: Consent to Participate

Consent to Participate In UW-Stout Approved Research

Title: Ginger Effects on Appetite and Food Intake

Description:
You will be asked to taste and consume ½ cup of cinnamon applesauce or cinnamon applesauce with fresh ginger juice added. Before and after the tasting of the samples, you will be asked to rate your level of hunger on a scale from "extremely hungry" to "extremely full". Then you will consume food from a buffet. You will be asked to record the amount of food you ate minus any food thrown away. You will then complete the last questions on the survey and will turn in the survey.

Risks and Benefits:
There are minimum risks to participating in this experiment, unless you are allergic to applesauce or ginger. If you have consumed gingersnaps in the past, you are likely not allergic to ginger. The benefit of participating in this experiment is that you will be assisting in finding a product that stimulates appetite. This is very important with people who do not eat as a result of a diminished appetite and are at risk for malnourishment. An additional benefit to participating in this study is that you will receive food at no cost to you.

Time Commitment
You will be provided with the general expectation of the commitment for completing the research. The time of your participation in this study is dependent primarily on how much you chose to eat from the buffet and how long you take to consume the food. You are under no time limits.

Confidentiality:
Your name will not be included on any documents. We do not believe that you can be identified from any of this information. However, others who choose not to participate may be able to identify that you are participating because of the forms that are to be completed at the table. **We encourage no discussion of any aspect of your participation in the study with others.**

Right to Withdraw:
Your participation in this study is entirely voluntary. You may choose not to participate without any adverse consequences to you. Should you choose to

participate and later wish to withdraw from the study, you may discontinue your participation at this time without incurring adverse consequences.

IRB Approval:
This study has been reviewed and approved by The University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have questions or concerns regarding this study please contact the Investigator or Advisor. If you have any questions, concerns, or reports regarding your rights as a research subject, please contact the IRB Administrator.

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Statement of Consent:
By my signature below, I understand the scope of the study. By my signature below, I provide my consent to participate in the project entitled, "Ginger Effects on Appetite and Food Intake."

Signature

Appendix C: Pre-Meal Survey

Applesauce Taste-Test

Age in years:_____

Gender (circle one): Male Female

How often do you eat applesauce? (circle one)

Once a Week Once a Month Never

How often do you eat products that contain ginger? (circle one)

Once a Week Once a Month Never

How hungry are you? (mark the spot on the line below)
Example
◄_____X_____►
Extremely Hungry Somewhat Hungry Not at all Hungry

My level of hunger is marked below
◄_____►
Extremely Hungry Somewhat Hungry Not at all Hungry

You were asked to consume all of the applesauce. How much of the applesauce did you eat? (circle one)

A couple spoonfuls About half The entire bowl

How did the applesauce taste? (mark on the line below)
◄_____►
Horrible OK Delicious

Appendix D: Survey Completed During Meal

To be Completed during the Meal

Time Started Eating:_____

Indicate by circling the amount of food eaten.

Food	**1st trip amount**	**2nd trip amount (if there is food left)**
Mini Brat (plain)	A few Bites Half Portion All	A few Bites Half All
Mini Brat with bun	A few Bites Half Portion All	A few Bites Half All
German Potato Salad	A few Bites Half Portion All	A few Bites Half All
Baked Beans	A few Bites Half Portion All	A few Bites Half All
Soft Pretzel	A few Bites Half Portion All	A few Bites Half All
Black Forest Bread	A few Bites Half Portion All	A few Bites Half All
Beer Bread	A few Bites Half Portion All	A few Bites Half All
Butter or Margarine	1 tsp, 2 tsp, 3 tsp	1 tsp, 2 tsp, 3 tsp
Apple Dessert	A few Bites Half Portion All	A few Bites Half All
Pumpkin Dessert	A few Bites Half Portion All	A few Bites Half All
Beverage- please write drink here_____	1 cup, 2 cups, 3 cups	1 cup, 2 cups, 3 cups
Beverage-please write drink here_____	1 cup, 2 cups, 3 cups	1 cup, 2 cups, 3 cups
Other- please write food here_____		

Appendix E: Post-Meal Survey

Complete after your meal

How full are you? (mark the spot on the line below)

◄_____►

Extremely Full Somewhat Full Not full at all

How much did you eat today compared to what your normally eat? (Mark the spot below on the line)

◄_____►

Less Same More

Would you still be able to eat ice cream or your favorite dessert within the next 30 minutes?

(circle one) Yes No

Appendix F: Walk-Around Survey for Researcher

1. What did you think of the applesauce?

Men with Ginger	Women with Ginger
Men w/o Ginger	Women w/o Ginger

2. If you didn't finish/like the applesauce, why not?

Men with Ginger	Women with Ginger
Men w/o Ginger	Women w/o Ginger

3. Would you frequently eat the applesauce?

Men with Ginger	Women with Ginger
Men w/o Ginger	Women w/o Ginger