1-1-2012

The role of vegetarian options in campus dining: Acceptability of vegetarian burgers

James D. Roche
Eastern Illinois University

THESIS MAINTENANCE AND REPRODUCTION CERTIFICATE

TO: Graduate Degree Candidates (who have written formal theses)

SUBJECT: Permission to Reproduce Theses

An important part of Booth Library at Eastern Illinois University's ongoing mission is to preserve and provide access to works of scholarship. In order to further this goal, Booth Library makes all theses produced at Eastern Illinois University available for personal study, research, and other not-for-profit educational purposes. Under 17 U.S.C. § 108, the library may reproduce and distribute a copy without infringing on copyright; however, professional courtesy dictates that permission be requested from the author before doing so.

By signing this form:

- You confirm your authorship of the thesis.
- You retain the copyright and intellectual property rights associated with the original research, creative activity, and intellectual or artistic content of the thesis.
- You certify your compliance with federal copyright law (Title 17 of the U.S. Code) and your right to authorize reproduction and distribution of all copyrighted material included in your thesis.
- You grant Booth Library the non-exclusive, perpetual right to make copies of your thesis, freely and publicly available without restriction, by means of any current or successive technology, including but not limited to photocopying, microfilm, digitization, or Internet.
- You acknowledge that by depositing your thesis with Booth LIbrary, your work is available for viewing by the public and may be borrowed through the library's circulation and interlibrary departmenst or accessed electronically.
- You waive the confidentiality provisions of the Family Educational Rights and Privacy Act (FERPA) (20 U.S.C. § 1232g; 34 CFR Part 99) with respect to the contents of the thesis, including your name and status as a student at Eastern Illinois Univerity.

Petition to Delay:

I respectfully petition that Booth Library delay maintenance and reproduction of my thesis until the date specified and for the reasons below. I understand that my degree will not be conferred until the thesis is available for maintenance and reproduction.

Date:

Reasons:

Author's Signature

5/17/12

Date

This form must be submitted in duplicate.

The Role of Vegetarian Options in Campus Dining

Acceptability of Vegetarian Burgers

(TITLE)

BY

James D. Roche

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Family and Consumer Sciences: Dietetics

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

2012

YEAR

I HEREBY RECOMMEND THAT THIS THESIS BE ACCEPTED AS FULFILLING
THIS PART OF THE GRADUATE DEGREE CITED ABOVE

Karla Kennedy-Hagan 6/7/2012
THESIS COMMITTEE CHAIR — DATE

6/7/12
DEPARTMENT/SCHOOL CHAIR OR CHAIR'S DESIGNEE — DATE

6/7/12
THESIS COMMITTEE MEMBER — DATE

THESIS COMMITTEE MEMBER — DATE

Carla Haselman 6/18/2012
THESIS COMMITTEE MEMBER — DATE

THESIS COMMITTEE MEMBER — DATE

Abstract

Title: The Role of Vegetarian Options in Campus Dining: Acceptability of Vegetarian Burgers

Authors: J. D. Roche, BS; K. Kennedy-Hagan, PhD, RD; C. Honselman, PhD, RD; J. E. Painter, PhD, RD

Objectives: Although there are many healthy varieties of meats and sustainable methods of raising livestock, there are still environmental and health concerns regarding meat production and consumption. This study examines the acceptability of garden burgers as a replacement for beef burgers in a university dining center by comparing appearance, taste and overall acceptability of these two products. The study also looked to determine whether there were any differences in sensory ratings for the vegetarian burgers between different genders and participants with varying levels of exposure to vegetarian burgers.

Methods: A convenience sample of 39 university students completed an anonymous survey that asked for demographic information and responses to the sensory properties of beef and vegetarian burger samples on a four point hedonic scale.

Results: Although there were no major differences in ratings for the appearance of the two samples, the taste and overall acceptability were rated higher for the vegetarian burgers than the beef burgers. There were no significant differences for the sensory properties between sub-groups with different levels of exposure to vegetarian burgers and there was not a large enough male population to make significant comparisons between genders.

Conclusions: A larger sample size is needed for more substantial results, but the findings of the study offer direction for future studies. These results suggest that with advertising, promotion and placement of vegetarian burgers in appealing locations, vegetarian burgers have the potential to become an acceptable, if not more acceptable, alternative to beef burgers.

Dedication Page

To Grandma & Grandpa and Nonno & Nonna for the guidance and to the hills of Southern Wisconsin for the motivation.

Acknowledgements

Through all of the mishaps, trials and successes that occurred during this project, I would like to express my appreciation to Dr. Honselman, Dr. Kennedy-Hagan & Dr. Painter for their guidance and criticism of my work. Their comments were not always easy to receive, but ultimately they greatly improved the quality of this project.

To my uncle Jim, for sparking interest in vegetarian proteins which ultimately inspired me to base my thesis on this topic.

I would also like to my parents for their guidance and Kelly for her support throughout this entire process. Without these people, all of the work put into the thesis would not have been possible.

Table of Contents

List of Tables

Chapter 1

Introduction

The implementation of replacing meat proteins with soy and other vegetarian proteins provides dietitians and food service professionals with a tremendous opportunity to make a positive, large-scale environmental and dietary impact. Studies have shown that the consumption of a properly balanced vegetarian diet has positive implications in reducing the incidence of cancer, diabetes, hypertension and cardiovascular disease (Andersson, Nydahl & Simunamiemi, 2009). Proper adherence to a vegetarian diet requires emphasizing fruits, vegetables, whole grains, nuts and lean protein sources while monitoring total fat and minimizing saturated fat (Hart, 2009).

The target population in this study was comprised of university students. This population makes up a unique age group given their fast-paced lifestyle and unique living environment. When they enter university life, the majority of students are surrounded by lifestyle and dietary practices that are different from what they have been previously exposed to (Iao et al., 2010). This new environment as an academic setting, may promote student awareness of healthy dietary patterns. Despite their busy schedules, individuals between the ages of 18 and 24 make up the population most likely to follow a vegetarian diet (Barnard, Cohen, Jenkins, Katcher & Turner-McGrievy, 2009).

Although the university student population is diverse, Dobson & Ness were able to classify university students into three distinct categories based on their attitudes to time and shopping, food preparation skills and financial situation (2009). The groups are: females who enjoy grocery shopping and have sufficient time and resources to do so,

males who do not shop frequently and are more likely to purchase convenience foods, and females who enjoy shopping and food preparation but are unable to do so frequently given their time and economic constraints (Dobson & Ness, 2009). Other types of shoppers in this age group exist, but the results of the study by Dobson and Ness did not have enough individuals with similar grocery shopping characteristics to make up any more groups. These data provide grocery establishments and campus dining centers with a clearer picture of the specific needs of university students. Using this information, these businesses can effectively market and sell healthier options to university students. If this information was made available to local practitioners, dietitians, grocery centers and community health professionals, vegetarian options could become effectively marketed and more widely available (Dobson & Ness, 2009).

Statement of the Problem

As a strong source of protein, iron and B12, meat has very positive dietary implications. However, meat consumption has increased significantly over the past few decades in developed nations (Cross, Daniel, Koebnick & Sinha, 2011). Excess meat intake is associated with high consumption of total fat, saturated fat, cholesterol, sodium and calories with negligible amounts of fiber. A high intake of these specific nutrients has been associated with chronic diseases such as diabetes, heart disease, certain cancers and hypertension (de Bree et al., 2009) (Allen et al., 2009) (Brinegar, Haddad, Lee, Singh & Vangh, 2007).

Through increased space, feed and care requirements, raising livestock for meat production poses an environmental concern (Chakravorty, Fisher & Umetsu, 2007).

Trampling that occurs from grazing has been shown to cause soil degradation and denser, compact soil. Compacted soil inhibits water infiltration and may induce water pooling above the soil (Bender & Wezel, 2004) (Horn, Pietolla & Yli-Halla, 2005). Introducing livestock to land also has been shown to reduce the number of native plant species, impair root development of plants and alter the microorganism environment (Boeken & Golodets, 2006) (Hobbs, 2001) (Mackay et al., 2010). Major greenhouse gas emissions occur from ammonia, methane and nitrous oxide production and nitrogen loss into the soil (Alvan et al., 2009) (Burtraw et al., 2009) (EPA, 2007). To produce sustainable agriculture within these limits, agricultural systems in more developed areas have come up with a number of initiatives to reduce the effects of livestock. Manure and emissions have been converted to energy to sustain the operations of some farms. Agricultural businesses have manipulated feed to improve digestion of food and therefore reduce emissions. Also, most agribusinesses ensure that rotational grazing occurs to allow soil and land to recover from damage induced by livestock. However, a report by the Food and Agricultural Organization in 2009 noted that due to an increasing worldwide population, a greater demand for meat and livestock's high resource requirement, livestock production is an environmental problem in both developed and undeveloped nations (FAO, 2009).

Purpose for the Research

The purpose of this study is to determine the extent to which vegetarian protein can replace meat protein in a university environment.

Research Questions or Objectives

1) To compare appearance of garden burgers to the appearance of beef burgers.

2) To compare taste of garden burgers to the taste of beef burgers.

3) To determine the overall acceptability of garden burgers as they compare to the overall acceptability of beef burgers.

4) To determine whether vegetarian and garden burgers would be an effective substitute for beef burgers.

Significance of the Study

The data provided from this study will help food service professionals and food manufacturers determine the place of vegetarian food options in university food service. If the vegetarian foods are acceptable, they may be provided more frequently in dining centers. If unacceptable, food manufacturers can adjust recipes for vegetarian burgers until they become more acceptable. Due to the soil degradation, greenhouse gas emissions and impact on biodiversity associated with meat production, transitioning from meat to vegetarian protein may have positive economic and environmental implications. Vegetarian meat substitutes may also help students improve their dietary behavior and reduce their future risk for chronic disease.

Delimitations of the Study

The overall goal of this study was to compare traits relating to the overall acceptability of garden and meat burgers when reviewed by university students. The study was a one-time test that did not track changes in attitudes or behaviors over time.

The results are not designed to provide any correlations between characteristics of the population and their responses outside of their affiliation as a university student. Attitudes to cost, time, environment, morals and religious backgrounds were also not considered.

Assumptions

- Participants in the study provided honest answers that reflect their true attitudes and opinions.
- The different burgers provided were cooked in a way that their taste qualities are reflective of these types of burgers.
- The responses of the students involved in the study provided an accurate reflection of students' dietary behavior and tendencies.

Definition of terms

A *Vegetarian Diet* is an eating pattern that excludes meat from the diet. Within vegetarian diets, there are subclasses that exclude or include certain foods. However, all vegetarian diets exclude the meat of animals other than fish (Batech et al., 2011).

Lacto Vegetarian Diet–a vegetarian diet that includes milk products (Batech et al., 2011).

Ovo Vegetarian Diet—a vegetarian diet that includes eggs (Batech et al., 2011).

Pesco Vegetarian Diet—a vegetarian diet that includes fish (Batech et al., 2011).

Vegan Diet –a vegetarian diet that excludes all animal products such as eggs, dairy and fish (Batech et al., 2011).

Vegetarian-Based Diet–a dietary pattern that emphasizes vegetarian foods to provide all necessary nutrients, but does occasionally include some meat products.

Chapter 2

Review of Literature

Current Dietary Problems in the United States

Despite the warnings, educational outreach and government programs designed to promote nutritional health and well-being in the United States, there is a disparity among Americans between dietary practices and dietary guidelines. With 1/3 of all U.S. adults having a Body Mass Index (BMI) that falls within the obese range, more Americans are experiencing complications associated with excess body fat than ever before (Carroll, Curtin, Flegal & Ogden, 2010). Unfortunately, the obesity epidemic is not limited to adults—1/3 of U.S. children are currently overweight and nearly half of these overweight children are obese (USDA, 2010).

Dietary imbalances that lead to obesity are at the heart the United States' current health issues. Among the top causes of death in the United States, heart disease, diabetes, cancer, respiratory complications and cerebrovascular disease have all been linked to an imbalanced diet or excessive energy intake (USDA, 2010). One of the primary causes for the high incidence of chronic disease is low consumption of fruits, vegetables and whole grains (CDC, 2010). Specifically, eating sufficient levels of these foods has been proven to aid in reducing the risk of cardiovascular disease, cancer and overall mortality (Andersson et al., 2009). One explanation of this protective property is connected to antioxidant functions of specific nutrients in foods. When intake of fruits and vegetables is lower than the recommendations outlined by the national guidelines, oxidative damage goes unchecked and is more likely to initiate development of chronic diseases (Barnard et

al., 2009). A report from the Centers for Disease Control and Prevention (CDC) showed that the majority of Americans are not meeting national recommendations for fruit and vegetable consumption. As of 2009, the study showed that about 32.5% of the adult population was consuming at least two fruits daily and 26.3% was consuming at least three vegetables daily (CDC, 2010). Current guidelines by the United States Department of Agriculture (USDA) recommend that most Americans get around two fruits and three vegetables per day (USDA, 2011).

Despite initiatives to promote fruit and vegetable consumption by various health organizations, an analysis of the studies performed by Centers for Disease Control and Prevention (CDC) compiled by Denny et al. (2004) showed that fruit and vegetable consumption decreased slightly in the United States from the early 1990's to 2000. Not only were Americans eating fewer fruits and vegetables, they were consuming a greater portion of their fruits, vegetables and starches from fruit juice and fried potatoes (Denny et al., 2004). Preparation and storage of fruits, vegetables and grains are important because fried options and fruit juice contain less nutritional value than less processed forms. More recent data from the 2009 study by the CDC show similar consumption of fruits and vegetables. Only 23.5 % of all United States citizens studied consumed five or servings of fruits and vegetables daily (CDC, 2009).

U.S. citizens may not be getting adequate intake because they are simply confused about national dietary recommendations (Aljadir, Cotugna, & Plesko, 2000). Lack of proper dietary education and past eating behaviors are other factors that are still preventing Americans from achieving dietary health (Chen & Wang, 2012). Even with the simplified guidelines and availability of practical information, many people still feel

overwhelmed with information and do not feel prepared to follow healthy dietary practices (Kirk & Packman, 2000).

By not meeting the daily recommendations for fruit and vegetable consumption and consuming less dietary fiber as a result, the United States' population may have greater difficulty controlling appetite and avoiding an excessive caloric intake. Excess energy intake has been shown to cause higher levels of insulin, blood sugar and blood lipids (Brinegar et al., 2007). As insulin increases to meet needs of higher blood nutrient levels, there is a greater chance of impaired insulin production or function. Over time, people with these complications have a greater chance of developing diabetes (Brinegar et al., 2007). Other potential complications associated with excessive calorie intake and improper dietary balance include higher susceptibility to arthritis, gallstones, breathing difficulties and high blood pressure (USDA, 2010).

Elements of a Healthy Diet & Lifestyle

To reduce the chance of obesity and obesity-related health complications, individuals should follow the dietary guidelines highlighted by the USDA. Recommendations include consuming six to eight ounces of grains, two to three cups of vegetables, one and a half to two cups of fruit, three cups of milk, five to six and a half ounces of lean meat and beans and five to seven teaspoons of healthier oils on a daily basis (USDA, 2011). In addition to a well-balanced diet, 30 minutes of moderate to intense physical activity is recommended every day (USDA, 2011).

To combat such changes, there needs to be a heightened awareness of the role of lifestyle and diet in disease prevention. One study from the Behavioral Risk Factor

Surveillance System showed that 21% of Americans met physical activity guidelines (Denny et al., 2004). While more research is needed, a healthy diet may promote greater physical activity by improving the mental state of the individual and providing improved sources of energy to sustain exercise.

As a part of a balanced diet, individuals must include healthful sources of dietary fat. Given its public association with adiposity, fat has been portrayed negatively and is often inaccurately associated with excess weight gain (de Bree et al., 2009). The focus of both media and consumers should be redirected towards the nutritional value and health implications of the fat consumed. High levels of saturated fats, which are most commonly found in fatty meats, are more likely to cause cardiovascular strain and have atherosclerotic properties that impede blood flow in the arteries (Anand et al., 2008).

Complications Associated with Meat Intake

High consumption of processed and red meats has been correlated with many of the diseases currently present in the United States. Schectman (2009) classifies red meat as beef pork, bacon, cold cuts and sausages. Processed meats include bacon, red and white meat sausages, luncheon meat, cold cuts and hot dogs (Schectman, 2009). These meats have higher levels of saturated fat, which has been correlated with higher rates of chronic disease (de Bree et al., 2009).

Cancer. A 10-year longitudinal study showed that consumption of red and processed meat was correlated with death from cancer, death from cardiovascular disease and higher overall mortality rates (Schectman, 2009). To provide a deeper look into the correlation between meat intake and cancer levels, de Bree et al. (2009) analyzed the

prevalence of specific types of cancer. Their study showed that participants' meat intake was strongly correlated with higher rates of stomach, ovarian and bladder cancer. The strongest correlation was found between meat intake and hematopoietic cancer. Allen et al. (2009) noted that higher consumption of red and processed meat was correlated strongly with colorectal cancer and correlated moderately with esophageal, stomach, pancreatic, lung, endometrium and prostate cancer. Researchers recorded a significantly lower incidence of cancer in vegetarians and pescaterians when compared to omnivores (Allen et al., 2009).

Diabetes. A study among Seventh Day Adventists showed that just moderate consumption of meat was associated with a 30% increase in the diagnosis of diabetes (Barnard et al, 2009). Another study noted that individuals who regularly consumed meat were 74% more likely to develop diabetes than vegetarians (Brinegar et al., 2007). On a global scale, countries with lower beef intake have significantly lower rates of diabetes (Brinegar et al., 2007).

Bone Health. Outside of the correlation with excess energy intake and disease prevalence, meat intake has been associated with poor bone health. A study done among over 1000 women over the age 65 examined the role of diet in various dimensions of bone health. The researchers found that the women who had higher ratios of meat to vegetarian protein intake and a higher total protein intake lost bone mass more rapidly at the femoral neck despite having a higher intake of calcium. These women also displayed greater overall incidences of hip fracture than women with low ratios of meat to vegetarian protein (Cummings, Sebastian, Sellmeyer, & Stone, 2001). Although older research suggested that a high intake of dietary protein was more likely to cause calcium

loss, more recent research has shown that protein may assist in calcium absorption (Evans & Thorpe, 2011).

Role of Vegetarian Food Options & Diets in Achieving Dietary Health

A properly planned vegetarian-based diet has a number of health properties that promote optimal health. Plant-based diets are generally lower in saturated fat and calories than meat-based diets (Hart, 2009). Even plant-based foods that were once considered unhealthy are now being modified to improve their dietary quality and have been made available in developed countries. Certain brands of margarines, oils and butters now include higher amounts of polyunsaturated fatty acids, omega 3 fatty acids, omega 6 fatty acids, vitamin A and vitamin D (de Bree et al., 2009). Soft margarines have also been shown to be effective in reducing low density lipoprotein (LDL) levels (de Bree et al., 2009). Regular foods such as soybean oil, canola oil, sunflower oil, olive oil, nuts and seeds are other healthy sources of fats (de Bree et al., 2009). These foods provide a variety of healthy fat sources to balance out the generally high carbohydrate consumption associated with vegetarian-based diets. Diets with high levels of plant-based foods contain high amounts of vitamins, minerals, fiber and phytochemicals. Additionally, these foods have anti-inflammatory and anti-carcinogenic properties that work against the spread and onset of various diseases (Hart, 2009).

Vegetarian-based diets that emphasize fruits and vegetables are high in carbohydrates, vitamins, fiber, potassium and antioxidants (Dwyer et al., 2006). After analyzing dietary quality of Americans based upon the 2005 Dietary Guidelines for Americans, researchers found that the highest quality diets were high in carbohydrates,

fiber, Vitamin C, Vitamin E and potassium (Dwyer et al., 2006). The similarities between the components of a vegetarian-based diet suggest that this eating behavior promotes not only healthy eating, but also weight management and disease prevention. With proper education and balance, vegetarian diets could become instrumental in overcoming some of the United States' health complications.

Properly planning a vegetarian-based diet helps ensure that there is an adequate intake of dietary protein and other essential micronutrients. Vegetarian-based diets that are low in protein are also often deficient in Vitamin B12, Vitamin D, calcium, iron and zinc (Johnston & Kniskern, 2011). Soy and other vegetarian proteins provide protein without high amounts of dietary fat and saturated fat. Lower intake of these two nutrients helps to prevent atherosclerosis and heart disease (Anand et al., 2008). Vegetarian proteins also have plant sterols which may play a role in reducing lipids, total cholesterol and LDL cholesterol (Moore, 2011).

Bone Health. The majority of literature available covering bone health reviews the role of calcium and Vitamin D. There is also some data available that focuses on the role of acid/base balance in bone formation and strength. A study performed by Campbell, Fraser, Macdonald, New and Reid (2005) correlated lower amounts of dietary acid with improved bone health. To decrease decrease dietary acid by increasing intake of foods with high alkalinity, researchers recommend consuming high amounts of plant-based foods. Their results show that diets low in meat proteins and high in vegetarian foods promote greater bone density and decreased bone resorption. More specifically, a higher intake of potassium has been correlated with reduced acid levels (Campbell, Fraser, Macdonald, New & Reid, 2005).

Calcium intake is supported through the intake of fruits and vegetables, which promotes calcium absorption and prevents bone resorption. Through high potassium levels and high alkalinity, fruit and vegetable consumption helps maintain a less acidic state within the body. In a study by Appel et al. (1997), participants who increased fruit and vegetable intake from an average of 3.6 to 9.5 servings per day with a 1.3% increase in dietary protein decreased urinary calcium excretion by 33%. Unfortunately, the findings and correlations for acidity and bone health are controversial and therefore more research is necessary before more clear conclusions can be drawn (Oh & Uribarri, 1996).

Soy and vegetarian protein has minimal effects on bone strength and development. Some studies have shown that there is a very minor positive correlation between bone density and soy intake, especially at the spine and femoral neck (Verbruggen, Xing-Yi, Yan-Bin, & Yi-Xiang, 2006). Meanwhile, other studies show no correlation between these two variables (Chiaffarino, Cipriani, Malvezzi, Parazzini, & Ricci, 2010).

Diabetes. The regular intake of vegetarian fats such as legumes, soy products, whole grains, nuts and avocados have all been associated with lower incidences of diabetes (Brinegar et al., 2007). Multiple studies have shown that vegetarian-based diets are effective at preventing diabetes by increasing insulin sensitivity (Barnard et al., 2009). There has also been an association with improved glycemic control, blood lipid levels and improved weight control among individuals that follow a vegetarian based diet (Hart, 2009).

Some studies have suggested that vegetarian diets may be more effective than national dietary guidelines at preventing the onset of diabetes (Barnard et al., 2009). This conclusion may be related to intake of foods high in fiber, which promote spreading energy intake throughout the day and minimizing high calorie intake at one sitting. In order to benefit from a vegetarian diet, the diet should emphasize a variety of fruits, vegetables, legumes, whole grains and nuts (Hart, 2009).

One study placed a group of 20 diabetic patients on a 9% fat, 70% carbohydrate, 65 gram fiber and 65 milligram cholesterol diet. At the end of the testing, 9 participants did not require insulin and the other 11 averaged a reduction of 26 units of insulin per day (Barnard et al., 2009). The results of this study are supported by a number of other studies that have displayed a reduction in or elimination of insulin use among diabetic patients following a vegetarian diet (Barnard et al., 2009). Some studies have suggested that vegan diets may promote better blood control than vegetarian diets alone (Barnard et al., 2009). These findings may be related more so to lower energy intake or lower fat intake that is common with vegan diets. Although soy intake appears to reduce some of the risk factors for diabetes, there is little evidence to suggest that consuming soy and vegetarian proteins have a significant effect on blood glucose control (Kolonel, Maskarinec, Morimoto, & Steinbrecher, 2011).

Heart Disease. In addition to improved blood glucose control and diabetes prevention, vegetarian diets are effective at combating risks for heart disease—the leading cause of the death in the United States. Properly planned vegetarian diets that are low in total fat, but high in monounsaturated and polyunsaturated fatty acids, have been shown to be effective at reducing the incidence of heart disease (Barnard et al., 2009).

After implementing a vegetarian diet among patients with significant atherosclerosis, these patients showed an average of an 82% plaque reduction (Barnard et al., 2009). This result suggests that a properly controlled vegetarian diet may be effective at preventing cardiovascular disease and reversing some of the symptoms.

Soy isoflavones, plant-derived chemicals that behave like estrogen, are the properties of soy products that have been correlated with reducing atherosclerosis (Drake, Duncan, & Higdon, 2009). Little other information is available on soy's role in promoting heart health. Outside of the benefits of isoflavones, the majority of the literature on soy's role on blood flow suggests that soy has minimal impact on blood circulation to the heart (Collins, Hayward, Ilsley, Mason & Webb, 2008). The preventative role of soy lies in its ability to reduce blood cholesterol and atherosclerotic development (Barnard, Ferdowsian & Kottler, 2009). Consumption of moderate amounts of soy protein has been shown to lower overall cholesterol and improve the high density lipoprotein (HDL) to LDL ratio in hyperlipidemic patients (Drake et al., 2009).

Cancer & Other Diseases. The majority of research investigating the effect of vegetarian protein consumption on cancer development is related to breast cancer. As is the case with other diseases, the findings on the topic are somewhat mixed. A moderate to high intake of soy isoflavones has been shown to reduce the prevalence of breast cancer in women (Qingyuan, Shi, Shuhuai, Xinmei, & Xu, 2010). In a study that looked at the development of breast cancer in 35,000 Chinese women, researchers found that participants that had above the median intake of soy were 18% less likely to develop breast cancer (Koh, Lee, Wang, Wu, & Yu, 2008). Soy isoflavones have also been

correlated with a significant reduction in the reappearance of cancer (Kim, Kim, Kong, Nam, & Ryu, 2008).

Other types of cancer have received attention based on their influence from soy intake, but not to the same extent as breast cancer. Incidence of prostate cancer in individuals susceptible to the disease was significantly reduced in patients with high soy consumption; however isoflavones did not appear to have any impact on prevention (Hamilton-Reeves, Kurzer, Rebello, Slaton, & Thomas, 2008). Risk for colorectal cancer was also shown to decrease with soy consumption, but only for women (Bosland, Lin, & Spitznagel, 2010).

The low fat, high antioxidant and moderate calorie intake associated with properly planned vegetarian diets has shown some benefits in preventing other chronic diseases. Hypertension is another one of the major causes of death that has been shown to be less prevalent among people that follow a vegetarian diet (Barnard et al., 2009). The anti-carcinogenic properties of the antioxidants found in fruits and vegetables make the vegetarian diet an effective tool in fighting cancer (Hart, 2009). Fortunately, research has shown that with proper education, people prescribed vegetarian and vegan diets are likely to stick with them for two to five years (Barnard et al., 2009). The research did not examine whether patients could follow these diets for longer periods of time. However, two to five years is a sufficient amount of time to develop dietary patterns that can be sustainable for a lifetime (Brinegar et al., 2009).

Precautions for a Vegetarian Diet

A vegetarian-based diet is characterized by high levels of carbohydrates, fiber, magnesium, Vitamin C and copper (New, 2004). If properly balanced, the diet will contain low to moderate amounts of fat, saturated fat and calories in addition to high levels of phytochemicals, vitamins and minerals. However, without the necessary care and preparation, those who eat largely vegetarian products can be at risk for a variety of deficiencies and dietary related complications.

Deficiencies common in vegetarians include low levels of B12, riboflavin, calciferol, calcium, zinc and iron (Hahn, Koschizke, Leitzmann, & Waldmann, 2004). New (2004) adds that studies have also found low levels Vitamin D, protein and calories in people who consume mostly vegetarian foods. As a result of these deficiencies, stages of growth may be interrupted as drastic complications resulting in acid-base imbalances, low oestrogen, low BMI and low bone mineral densities (Byles et al., 2008).

Iron. The bioavailability of iron makes this mineral of specific concern to vegetarians. Two different types of iron exist—heme and non-heme. Heme is found in meat and is readily absorbed during the digestive process. On the other hand, non-heme iron is not as well absorbed unless the food is consumed with a significant quantity of Vitamin C. In a study that compared iron levels among vegan and omnivorous women, 40% of the vegans were iron deficient while only 12% of omnivorous women were iron deficient. Even more alarming is that the vegan women were consuming levels of iron above the RDA (Hahn et al., 2004). When dietary behavior emphasizes plant-based

foods, Vitamin C must be consumed in conjunction with iron to ensure that the iron is effectively absorbed.

Vitamin B12. Because Vitamin B12 is largely found in meat products, Vitamin B12 is another nutrient of concern for people adhering to a largely vegetarian diet. This vitamin is responsible for preventing megaloblastic anemia, neuropathies and cognitive dysfunction while also maintaining proper levels of homocysteine (Geisel & Herrmann, 2002). A study examining Vitamin B12 and homocysteine levels among German and Indian vegetarians and non-vegetarians found that Vitamin B12 was significantly lower and homocysteine significantly higher among vegetarians of both populations. Indian vegetarians had homocysteine levels 170% greater than Indian non-vegetarians while German vegetarians had homocysteine levels 134% greater than their non-vegetarian peers. Because of the greater bone turnover, researchers correlated the low B12 and high homocysteine with an increased risk for fracture (Ali et al., 2009).

As a more economically developed country, German citizens have access to an improved food supply. While the results show that Vitamin B12 may be more difficult to consume when following a vegetarian-based diet, proper education and access to a quality food supply may help make vegetarian diets less B12 deficient. Additionally, there are many vegetarian products supplemented with high levels of Vitamin B12 in order to fight against high homocysteine levels and related complications.

Iodine. Consuming adequate levels of iodine can be another challenge for people on a vegetarian-based diet. Vegetarian products contain significantly less iodine than meat products. Also, amounts may vary depending on the vegetarian source; iodine content of vegetarian foods is dependent on levels of iodine found in the soil which it

grows (Buckova, Klimes, Krajcovicova-Kudlackova, & Sebokova, 2003). Insufficient consumption of this nutrient has been correlated with growth, mental and psychomotor abnormalities as well as impaired thyroid function and enlargement (Delange, 1994). A study examining iodine intake found that iodine deficiency was present in 80% of vegans, 26% of vegetarians and 9% of non-vegetarians. Severe deficiencies were found in 27% of vegans, 10% of vegetarians and 0% of omnivores (Buckova et al., 2003). These results suggest that significant levels of iodine are found in milk products and eggs and can help vegetarians take in sufficient iodine levels. However, people on a vegetarian-based diet should be mindful of intake and if a large percentage of their diet is comprised of plant sources, they should look into supplementing iodine into their diet.

Dietary Fat. Although vegetarian diets are typically low in fat, vegetarians can still be at risk for consuming excessive fat. The dietary changes that have occurred in China over the past few decades demonstrate how people on a vegetarian-based diet may be at a greater risk for consuming excess dietary fat. Despite these changes, the Chinese population did not significantly decrease their high vegetable consumption (Cui et al., 2005). Dietary problems were evident as the overweight and obesity rate jumped from 14.6% to 21.8% over a period of no more than 30 years (Ge, Mi, Shan, Wang, & Wang, 2007). When analyzed further, researchers found that fat intake had increased to more than 30% of total calories during this time period. After conducting a dietary analysis of all the diets, researchers determined that the most influential factor in the weight gain was an increase in oil used for preparing vegetables (Byles et al., 2008). While research has shown that oil has numerous health benefits, excess consumption will provide excess calories and increase adiposity stores. The above instances and complications offer

evidence that vegetarian-based diets require proper knowledge, education and implementation to ensure dietary sufficiency.

Attitudes towards Vegetarian Food Options

Attitudes towards vegetarian products vary depending on dietary background and the level of previous exposure to vegetarian products. A study done by de Bruycker & de Houwer (2007) showed that vegetarians and non-vegetarians have different attitudes towards meat and vegetarian products. The study not only examined the explicit attitudes of the participants, but also used the Implicit Association Test to determine subconscious attitudes that differed between the two groups. Results showed that vegetarians had more negative subconscious attitudes towards meat while non-vegetarians had more negative attitudes towards fruits and vegetables (de Bruycker & de Houwer, 2007). These results imply that non-vegetarians are inclined to be unwilling to try vegetarian options that are labeled vegetarian. Also, non-vegetarians that eat vegetarian products are more likely to consider these foods unacceptable (de Bruycker & de Houwer, 2007)

Other studies have shown that meat eaters still have positive attitudes towards vegetarian foods. Barnes-Holmes, Barnes-Holmes, Murtagh and Stewart (2010) designed a study with the intention of measuring the implicit attitudes of omnivores and vegetarians using two different implicit tests. Results from both tests showed that even though non-vegetarians positively rated vegetables positively, their results were still less positive than vegetarians. The data analysis determined that the implicit tests were more accurate than explicit tests (Barnes-Holmes, Barnes-Holmes, Murtagh & Stewart, 2010).

Acceptability of Soy & Vegetarian Protein

Relatively little information is available on the acceptability of vegetarian proteins in the United States. Much of the information available is from overseas and even that research is limited. The research available has shown that consumption and acceptability varies significantly among populations of different cultural, ethnic and socioeconomic conditions. People who have been previously exposed to vegetarian proteins are more likely to find these products acceptable (Shork, 2000). The majority of individuals that regularly eat vegetarian protein products say that they would consume these foods more often if they were more available (Badham et al., 2009). This information suggests that if individuals are introduced to the foods or are forced to consume vegetarian protein out of economic necessity, they will be willing to do so.

Another potential motivator to consume vegetarian protein products is their nutritional value (Hinze, Karg, Mohamed, Steyn & van Zyl, 2004). Given that over half of the United States population is aware of these benefits, vegetarian proteins have significant marketing potential (Chan & Wansink, 2001). However, knowledge of health benefits has mixed effects on a product's acceptability. While knowledge of health benefits has a minimal impact on acceptability, it has been shown to positively correlate with consumption (Cheney, Wansink & Westgren, 2005). When examined further, the type of knowledge over the nutritional content of foods has varying effects on overall acceptability. People who only know the nutritional content of vegetarian protein and not their health implications are just slightly more likely to consume vegetarian protein when compared to individuals that have no knowledge of these benefits. Those who understand the implications of the nutritional content are three times more likely to

consume vegetarian protein (Cheney et al., 2005). These data suggest that understanding the correlation of the nutritional content makes consumers more likely to consume vegetarian protein. For those unaware of the nutrition implications, taste is the most influential in the consumption and acceptability of these products (Cheney et al., 2005).

For individuals less knowledgeable over the nutritional facts and implications of foods, advertising and food labeling may play a greater role in improving the acceptability of vegetarian proteins. In fact, the front of the label has been shown to be more influential on a consumer's decision to purchase a food item (Derby, Levy & Roe, 1999). Although this may not initially increase the acceptability of the product, it may lead to increased acceptability of the product. By grabbing consumer attention, consumers will give a product deeper thought (Hasler, Sonka & Wansink, 2004). Doing so has shown to increase the chances of a food item being purchased and consumed, leading to increased exposure. Again, exposure is one of the most influential factors in determining a product's acceptability (Hasler et al., 2004) (Badham et al., 2009). To attract consumer interest, nutritional messages on the front of the label should be kept relatively short and to the point; excess information may turn people away (Hasler et al., 2004).

Terms associated with vegetarian proteins have been shown to decrease the acceptability and consumption of these foods. Studies have shown that by placing the word soy on a food label, consumers are more likely to find soy-based foods less acceptable regardless of taste (Wansink, 2003). One experiment had two of the same products with different labeling—one was incorrectly labeled as a soy product and the other had no soy label. Despite there being no differences between the two products, the

one labeled soy was rated significantly less acceptable than the product without the soy label (Morganosky, Park, Sonka & Wansink, 2000). Therefore, improving taste is unlikely to cause any significant change in behavior and attitude for individuals who are not used to eating soy products (Chan & Wansink, 2001). Effective advertising designed to overcome this stigma may be more effective than improving taste of these products.

Overall, there is a need for further testing to determine the effect of nutrition labeling and nutrition information on acceptability. Some studies suggest that nutrition information has no impact on a product's acceptability (Camire, Dougherty & Teh, 2007). Other research has provided more specific results, showing that nutrition information and health claims are effective only for people who are health conscious (Wansink, 2003). However, it is difficult to determine the role of the health benefits for vegetarian protein on increasing acceptability because studies have shown that 2/5 of the United States population is unaware of any of the benefits associated with vegetarian protein (Chan & Wansink, 2001).

A study in South Africa showed that different ethnicities accounted for different levels of consumption of soy products (Badham et al., 2009). Consumption also varies among socioeconomic classes. Soy products are very popular among countries of lower socioeconomic status that do not have the agricultural system to produce mass quantities of meat (Huang et al., 2004). At the same time, health conscious individuals in more developed nations are more likely to consume soy and vegetarian protein (Bernstein, Ottenfeld, & Witte, 2008). Regardless of the economic situation, consumption is likely to increase if prices of soy can be reduced. Soy products such as soy milk and tofu will become a more viable option if demand increases and competition drives prices down

(Badham et al., 2009).

Characteristics of College Student Dietary Patterns

The student population is promising because it is one that is entering a new stage in life in which there is high exposure to lifestyle changes and new experiences. At this stage in life, students are willing to try new things and experiment with their health and diet. The college student population in the United States is also more likely to be interested in health and willing to follow a healthy diet (Aljadir et al., 2000). More specifically, 4-year university students have demonstrated the most healthful dietary practices when compared to 2-year university students and nonstudents of the same age by consuming lower-fat options and more nutrient-dense foods (Barr-Anderson, Larson, Nelson, Neumark-Sztainer, & Story, M, 2009).

Eating practices during university years have shown to strongly influence dietary behavior after graduation. College graduates also report higher levels of healthy eating than peers that did not attend college (Edwards & Meiselman, 2003). These findings suggest students in the university environment are open to healthy eating practices and are interested in the role of diet in overall health.

University status does not always translate to healthy eating practices. There are a number of different segments and elements of university life that affect the nutritional content of students' diets. College students are divided by living status into those who live in campus housing and have meal plans and students who live off campus and are responsible for their own meal production (Edwards & Meiselman, 2003). Food preparation requires more time and planning for shopping and production. In order to

adequately adhere to a vegetarian diet, this population must also have food preparation skills and shop frequently to prevent food spoilage (Edwards & Meiselman, 2003). Students who live on campus and have a meal plan have greater access to a wider variety of foods. While this may promote healthier eating for many, this group is also usually exposed to large quantities of unhealthy food options. These foods are often less expensive and more appealing to consumers—therefore the higher availability of foods may inhibit positive dietary practices (Edwards & Meiselman, 2003).

The number of different priorities for students immersed in university life often makes nutrition a minor concern. Students' money and energy are not always focused on food and students are not always equipped to prepare their own meals (Edwards & Meiselman, 2003). While healthy diets require a balance of different foods and sources of macronutrients, alcohol may account for up to 15% of college students' dietary intake (Edwards & Meiselman, 2003). Additionally, while vegetarian options can be simple to prepare, many students are unaware of how to incorporate healthy ingredients into their meals. When asked to describe barriers to fruit and vegetable consumption in a study, only 37% of 109 students said that it was easy to regularly consume fruits and vegetables (Aljadir et al., 2000). Results from the same study showed that while 90% of students were aware of the benefits of fruits and vegetable consumption, only 20% were aware of the daily requirements (Aljadir et al., 2000). The results from these studies suggest that knowledge does not always translate to a change in dietary behavior for students. Factors that influence dietary patterns among young adults include "nutrition knowledge, physiological needs, body image, food preferences, parental practices, peers, media, social norms, fast foods, and personal experiences" (Pirouznia, 2001, 127). Food

providers can do their best to control these factors by providing a positive image of vegetarian foods and making these foods as available as possible.

Based on differences in attitude towards diet, students can be classified into different marketing segments. These different segments are related to time, cost and previous dietary influences. Dobson & Ness (2009) classified students into three groups that included "hedonistic, succession-planning, past secure females", "futuristic, spontaneous, male convenience seekers" and "methodological, value-seeking time-pressured females" (655-656). These researchers examined student attitudes towards time, money, shopping and cooking (Dobson & Ness, 2009). Although researchers did not examine these groups in further depth, the characteristics provided give applicable information for businesses looking to target this age group.

The Environmental Impact of Meat

Recently, significant increases in meat consumption among all sectors of the United States' population have presented environmental concerns. These issues are related to livestock intensification which is correlated with significant soil degradation, greenhouse gas emissions and impaired biodiversity (Boland et al., 2010). Raising livestock requires more resources for feed, water, land and waste management than producing vegetarian proteins (Mackay, 2008). Grazing by heavier livestock removes rocks and plants native to the land and condenses soil to prevent adequate water filtration (Hobbs, Norton & Yates, 2000). Heavily grazed land may require up to six years for soil restoration; when livestock graze in more arid climates, time required for soil restoration may be longer (Fu et al., 2008) (Eik, Moe & Yayneshet, 2009). Through emissions,

trampling and manure runoff, livestock alter the ecosystems of native microbiota, land plants, terrestrial animals, birds and aquatic life (Allaire, Doyen, Jiguet, Leger & Mouysset, 2011) (Buttler, Gillet, Gobat, Hamelin & Kohler, 2005) (Hobbs, 2001). Not only do livestock impair the growth and development of native species, but their presence also fosters their replacement by non-native plants, insect, animals and microorganisms (Mackay et al., 2010) (van Elsas, Salles & van Veen, 2004) (Hobbs et al., 2000). With regards to emissions, livestock produce carbon dioxide, methane, nitrous oxide and ammonia in great quantities (Casey, Gates, Pescatore, Wheeler & Xin, 2008). Comprising 18% of total U.S. emissions, livestock production is the top contributor to greenhouse gases related to dietary behavior (FAO, 2009).

The livestock industry has developed a number of ways to improve their sustainability and the United States is far ahead of most countries in this department (Fu, Pei & Wan, 2008). Rotational grazing, feed manipulation, appropriate waste management, manure conversion to energy and temperature control of livestock are practiced, researched and advanced among United States' agribusinesses to improve operating efficiency (Fu et al., 2008) (Callan et al., 2003) (Casey et al., 2008) (Groom, 2008). Despite the effectiveness of these practices, the sheer amount of meat consumed in the United States is still high enough to cause the environmental concern (FAO, 2006). Although university dining centers make up a relatively small percentage of domestic meat consumption, a gradual transition from their emphasis on meat to vegetarian proteins such as vegetarian burgers would reduce schools' environmental and potentially economic cost ('Super Soy', 2002). Environmental benefits, although not visible directly from operations at dining centers, would be related to fewer greenhouse gas emissions,

lower resource requirements, less soil degradation and a reduced impact on biodiversity by agribusinesses that produce the food (Nepstad & Stickler, 2006) (Reijnders & Soret, 2003). By providing students with more vegetarian protein options of high biological value, university dining centers can operate with a reduced environmental impact without sacrificing their students' dietary quality.

Summary of Literature

The impact on health and environment that meat has in the United States requires further examination by dietetic and agricultural professionals. While meat consumption alone is not the cause of dietary problems in the United States, the intake of certain meats has been shown to have negative health consequences (Schectman, 2009). The underlying etiologies of diseases and health complications are related to high intake of animal protein in conjunction with lower intake of fiber and reduced physical activity (Denny et al., 2004). Deeper investigations show that heavy meat consumption is strongly correlated with susceptibility to heart disease, cancer, diabetes and hypertension (Schectman, 2009) (Brinegar et al., 2007) (de Bree et al., 2009) (Barnard et al., 2009).

Adoption of a vegetarian diet does not automatically translate into dietary and environmental health. However, a properly balanced vegetarian diet does have many positive implications and has been shown to reduce risk for many chronic diseases. The reduced risk is related to lower saturated fat, cholesterol and calorie intake and higher vitamin, mineral, phytochemical and dietary fiber intake (Dwyer et al., 2006) (Hart, 2009) (New, 2004). Emphasizing dietary fiber and nutrient dense foods has shown to be beneficial in promoting weight management and energy balance.

University and college students have a variety of different lifestyle factors and needs unique from other population segments. While university and college students are generally more interested in health, a large percentage of this population does not prioritize health and nutrition (Dobson & Ness, 2009) (Kirk & Packman, 2000).

University students in the United States are more likely to be interested in health and willing to follow healthy dietary practices (Aljadir et al., 2003). However, most university students still lack the skill and knowledge set required to prepare foods that coincide with a healthy diet (Edwards & Meiselman, 2003). With this background, the researcher hopes to further explore variables that may influence students to choose vegetarian options.

Familiarity and nutritional content are two of the major factors researchers have focused on in determining what makes vegetarian proteins acceptable to consumers. Nutritional value has shown to have a greater impact on consumption than acceptability, but this has only been for individuals who understand both the nutrition facts and health implications associated with eating vegetarian protein products (Cheney et al., 2005). People who do not understand health implications of the nutritional content of vegetarian proteins are not likely to consume to consume these products for health purposes (Cheney et al., 2005). This population would be more likely to consume vegetarian protein products if they had greater exposure to these foods (Shork, 2000). People who have more exposure to these products or consume them out of economic necessity are more likely to find them acceptable (Shork, 2000) (Badham et al., 2009). By increasing awareness of health benefits, availability of and exposure to vegetarian protein products,

it is highly probably that individuals' consumption and acceptability will also increase (Shork, 2000) (Cheney et al., 2005).

As the world population continues to grow and advance economically, the question of the agricultural sustainability becomes a larger issue. With worldwide food insecurity and increasing land requirements for agricultural use, the stability of the future worldwide food supply comes into question. However, amidst the complications there exists a sense of equilibrium. Data show that as environmental conditions deteriorate, more influential nations are stepping in and implementing practices that make agricultural intensification more efficient and less taxing (Allaire et al., 2011). As time passes and these systems become more efficient, these techniques can be transferred to countries facing more serious environmental conditions. Additionally, agricultural intensification has a limit to its profitability and after production reaches a certain amount, economic returns begin to diminish (King et al., 2010). Given these conditions, economic potential may be the driving force behind the eventual establishment of sustainable global agriculture.

Chapter 3

Methodology

Research Design

The study design was a quantitative questionnaire measuring student responses to the sensory properties of garden and beef burgers. This design was chosen for its relative simplicity and ease at which it can be distributed in a large classroom setting. Data collection from a large number of participants increased the reliability of the results of the experiment. The design provided each participant with sufficient time and privacy for students to effectively evaluate the sensory properties of the food products. The quantitative design facilitated an easy transition of the data to the graphs and charts so that the results could be effectively communicated.

Sample

The study was comprised of graduate and undergraduate college students currently attending a small mid-western university. Participants included in the study were both from health and non-health related fields of study. The students that were sampled were enrolled in various courses of which the designated professors approved their involvement in the study.

Instrumentation

The questionnaire was created by the researcher and was comprised of questions asking for basic demographics such as age, major, year in school and gender. Participants were given options to choose from to determine how frequently they

consume beef and garden burgers. The remainder of the questionnaire asked students to rate sensory properties of the burgers. A 4-point hedonic scale (4-very satisfied to 1-very dissatisfied) was used to measure appearance, texture and overall acceptability of each of the products. The questionnaire can be viewed in Appendix A.

Pilot Study

The researcher piloted the questionnaire to a group of five undergraduate students at a Midwestern state university. The questionnaire was administered in a classroom. This setting was comparable to the one that was used for the experiment.

Of the five participants in the pilot study, two were dietetics majors and the other three were business, information technology and public administration majors. Two of the participants had significant prior exposure to the garden burgers while the other three had very limited exposure. The participants who had been exposed to garden burgers rated the sensory properties for the garden burgers higher than the beef burgers. The participants with limited prior exposure to the garden burgers all responded 'very dissatisfied' to the overall acceptability of the garden burgers, but either responded 'satisfied' or 'very satisfied' to the overall acceptability of the beef burgers.

The study's validity was partially proven because the results from the survey were able to answer some of the research questions. The questionnaire effectively evaluated the texture and appearance of the food products. However, some of the participants mentioned that they did not feel that texture was an effective sensory property to measure overall acceptability. Therefore, the questionnaire did not accurately measure the overall acceptability of the food products.

The study's reliability was proven because similar results were found among participants with different levels of exposure to garden burgers. The participants with significant previous exposure to garden burgers were more likely to be satisfied with the garden burgers while the participants with minimal previous exposure to garden burgers were more likely to be dissatisfied with the garden burgers. Despite the small sample population, these results were relatively consistent.

Based on the results and comments from the pilot study, the researcher determined that texture was not an optimal factor for measuring overall acceptability. Therefore, texture was replaced with taste for the experiment. All other elements of data collection remained the same for the experiment.

Procedure & Data Collection

The main ingredients of this study were garden and beef burgers. Both of these burgers were precooked and packaged and therefore, only needed to be microwaved. The burgers remained refrigerated until 30 minutes prior to the experiment. At that time, the samples were set in the microwave on a browning grill. Beef burgers were cooked on each side for three minutes while the garden burgers were cooked on each side for one and a half minutes. After the samples were microwaved, each patty was cut into six pieces and placed on a tray that was set in a warmed oven. Right before class, these samples were removed from the oven, placed in a sealed container to keep items warm and then transferred to the classroom.

The researcher began the experiment by outlining the study, explaining the general guidelines and informing participants that participation in this project was

voluntary and that they did not have to participate if they chose not to. The researcher also noted any allergens that were present in either the beef or garden burger. Each participant then received an informed consent document that they reviewed and signed prior to participating. Then, each participant received a questionnaire. The questionnaire was briefly explained by the researcher and then one sample of each burger was passed out to each member of the class that chose to participate. Each participant received a plate with the two burger samples—no buns or condiments were provided. When each participant received their sample, they began tasting the sample and rated their responses. Each participant was provided two minutes to taste and rate each burger. Once completed, participants dropped their evaluation sheets off at the front of class. The estimated time of the entire experiment was eight minutes.

Hazard Analysis and Critical Control Points

The Hazard Analysis and Critical Control Points are instituted to maximize safety in the food service industry. For this specific study, there are various precautions that needed to be taken to ensure a safe food product for both the researchers and test panel. Such precautions were taken during all times when researchers were dealing with burger preparation, cooking and sampling. These measures are listed in Table 1.

Table 1. Hazard Analysis and Critical Control Points

Use beef and vegetarian patties that are not out of date.
Keep these foods refrigerated prior to use.
Always wash hands before preparing the procedure.
Use the beef immediately after removed from refrigeration.
Clean the surface area before starting the procedure.
Conceal the burger in a warm, temperature controlled climate after preparation
When transferring the patties, keep them in a concealed container.

Statistical Analysis

Once collected, the data were organized into frequency counts and percentages. From these results, the researcher examined correlations between demographics, familiarity with vegetarian burgers and their ratings of each product.

Chapter 4

Results

Demographic Data

A description of the population sampled can be viewed in Tables 1 through 3. Of the 39 students that were sampled in the study, 34 (87.2%) of the students were female and 5 (12.8%) were male. There were three (7.7%) sophomores, one (2.6%) graduate student and no freshman students. A total of 35 (89.7%) participants were juniors or seniors, with 18 (46.2%) juniors and 17 seniors (43.6%). There were 33 (84.6%) participants between the ages of 20 and 22. Within this age group, 11 (28.2%) were 20 years old, 17 (43.6%) were 21 years old and 5 (12.8%) were 22 years old. Of the remaining six, two (5.1%) were 23 years old, one (2.6%) was 27 years old, one (2.6%) was 31 years old, one (2.6%) was 32 years old and one (2.6%) was 36 years old.

The majority of the students had majors in the Family & Consumer Sciences department, although the specific concentrations of the participants varied. Of the 38 (97.4%) participants with a Family & Consumer Sciences major, 11 (28.2%) students had a Family Services focus, 11 (28.2%) students were general Family & Consumer Sciences majors, 3 (7.7%) students had a Career and Technology Education focus, 3 (7.7%) students had an Apparel, Textile & Design focus, 1 (2.6%) student had a General Studies focus, 1 (2.6%) student had an education focus, 4 (10.3%) had a Merchandising focus, 1 (2.6%) had a Consumer Studies focus and 3 (7.7%) had a Fashion Merchandising focus. The 1 (2.6%) participant who was not a Family & Consumer Sciences major was pursuing a degree in Psychology.

Table 1

Ages of Participants (n = 39)

Age	20	21	22	23	27	31	32	36
Results	11 (28.2%)	17 (43.6%)	5 (12.8%)	2 (5.1%)	1 (2.6%)	1 (2.6%)	1 (2.6%)	1 (2.6%)

Table 2

School Year of Participants (n = 39)

School Year	# of the participants
Freshman	0
Sophomore	3 (7.7%)
Junior	18 (46.2%)
Senior	17 (43.6%)
Graduate Student	1 (2.6%)

Table 3

Majors of the Participants (n = 39)

Major	# of the participants
Family Services	11 (28.2%)
General FCS	11 (28.2%)
Psychology	1 (2.6%)
Career & Technology Education	3 (7.7%)
Apparel, Textile & Design	3 (7.7%)
General Studies	1 (2.6%)
Education	1 (2.6%)
Merchandising	4 (10.3%)
Consumer Studies	1 (2.6%)
Fashion Merchandising	3 (7.7%)

Exposure to and Consumption of the Beef & Vegetarian Burgers

The participants had varying levels of exposure to the beef and vegetarian burgers prior to the experiment. There were three (7.7%) vegetarians in the study and these three were the only participants that reported never consuming beef burgers. Every other

participant (92.3%) reported eating a beef burger at least once per month; 17 (43.6%) participants reported eating a beef burger once per month, 14 (35.9%) reported eating beef burgers once per week and 5 (12.8%) participants reported eating beef burgers more than once per week.

Participant exposure to garden burgers was significantly lower. There were 32 (82.1%) participants who reported that they never consumed vegetarian burgers. Only six (15.4%) participants reported consuming a vegetarian burger once per month and one (2.6%) of the participants reported consuming a vegetarian burger more than once per week. None of the participants reported consuming a vegetarian burger once per week. Even among vegetarians, only one (33.3% of vegetarians) participant reported consuming vegetarian burgers more than once per week. The other two (66.7% of vegetarians) reported consuming a vegetarian burger once per month. The frequency of consumption of both vegetarian and beef burgers can be viewed in Table 4.

Table 4

Frequency of consumption questions for beef and vegetarian burgers (n = 39)

	Never	Once per month	Once per week	More than once per week
Beef Burger	3 (7.7%)	17 (43.6%)	14 (35.9%)	5 (12.8%)
Vegetarian Burger	32 (82.1%)	6 (15.4%)	0	1 (2.6%)

* 3 of the participants did not sample the beef burger.

Sensory Ratings of the Beef & Vegetarian Burgers

The three vegetarian participants did not sample the beef burger and therefore the sensory results for the beef burger are based on the responses of 36 participants. Meanwhile, all of the participants in the study sampled the garden burgers. While there

were variations between the responses to the taste and overall acceptability of the two samples, the attitudes towards the samples' appearances were similar. For appearance of the beef burger, 11 (30.6%) participants were very satisfied, 19 (52.8%) were satisfied, 5 (13.9%) were dissatisfied and 1 (2.8%) was very dissatisfied. For the appearance of the garden burger, 10 (25.6%) were very satisfied, 23 (59.0%) were satisfied, 3 (7.7%) were dissatisfied and 3 (7.7%) were very dissatisfied.

Participants provided higher ratings for the taste of the garden burger than they did for the beef burger. Nevertheless, most of the participants that sampled the beef burger were still either satisfied or very satisfied with its taste. For the taste beef burger, 8 (22.2%) participants were very satisfied, 16 (44.4%) were satisfied, 10 (27.8%) were dissatisfied and 2 (5.6%) were very dissatisfied. For taste of the garden burger, 19 (48.7%) participants were very satisfied, 17 (43.6%) were satisfied, 2 (5.1%) were dissatisfied and 1 (2.6%) was very dissatisfied.

Attitudes towards the overall acceptability of the beef and garden burgers correlated strongly with the attitudes towards taste of the two samples. Although most participants were either very satisfied or satisfied with the overall acceptability of both samples, more participants responded favorably to the overall acceptability of the garden burgers. For the overall acceptability of the beef burgers, 10 (27.8%) participants were very satisfied, 15 (41.7%) were satisfied, 9 (25.0%) were dissatisfied and 2 (5.6%) were very dissatisfied. For the garden burgers, 17 (43.6%) participants were very satisfied, 20 (51.3%) were satisfied, 1 (2.6%) was dissatisfied and 1 (2.6%) was very dissatisfied. Results for the participants' ratings of appearance, taste and overall acceptability for both the beef and garden burgers can be found in Tables 5 and 6.

Table 5

Responses to the Sensory Properties of the Beef Burgers (n = 36)

	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	11 (30.6%)	19 (52.8%)	5 (13.9%)	1 (2.8%)
Taste	8 (22.2%)	16 (44.4%)	10 (27.8%)	2 (5.6%)
Overall Acceptability	10 (27.8%)	15 (41.7%)	9 (25.0%)	2 (5.6%)

Table 6

Responses to the Sensory Properties of the Garden Burgers (n = 39)

	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	10 (25.6%)	23 (59.0%)	3 (7.7%)	3 (7.7%)
Taste	19 (48.7%)	17 (43.6%)	2 (5.1%)	1 (2.6%)
Overall Acceptability	17 (43.6%)	20 (51.3%)	1 (2.6%)	1 (2.6%)

* 3 of the participants did not sample the beef burger.

Sensory Ratings Based on the Consumption of Vegetarian Burgers

Participants that Never Consumed Vegetarian Burgers.

Most people in the study reported that they never consumed vegetarian burgers. Of the 39 total participants, 32 (82.1%) reported that they never consumed vegetarian burgers. They were more likely to rate the beef burger positively than negatively, although the sensory results for the beef burger were still lower than the sensory results for the garden burger. For the appearance of beef burgers, 10 (31.3%) participants in this group were very satisfied, 16 (50.0%) were satisfied, 5 (15.6%) were dissatisfied and 1 (3.1%) was very dissatisfied. For taste, 6 (18.8%) were very satisfied, 15 (46.9%) were satisfied, 9 (28.1%) were dissatisfied and 2 (6.3%) were very dissatisfied. For the overall

acceptability of the beef burger, 8 (25.0%) participants were very satisfied, 13 (40.6%) were satisfied, 9 (28.1%) were dissatisfied and 2 (6.3%) were very dissatisfied.

The results of this group for the sensory properties of the garden burgers were significantly more positive than they were for the beef burgers. For the appearance of the garden burgers, 9 (28.1%) were very satisfied, 19 (59.4%) were satisfied, 2 (6.3%) were dissatisfied and 2 (6.3%) were very dissatisfied. For taste, 17 (53.1%) participants were very satisfied and 12 (37.5%) participants were satisfied while 2 (6.3%) participants were dissatisfied and 1 (3.1%) was very dissatisfied. For the overall acceptability of garden burgers, 14 (43.8%) participants were very satisfied, 16 (50.0%) was satisfied, 1 (3.1%) was dissatisfied and 1 (3.1%) was very dissatisfied.

Participants with Exposure to Vegetarian Burgers.

There were a total of seven participants that reported regular consumption of vegetarian burgers. Of these seven, six (85.7%) reported consuming vegetarian burgers once per month and one (14.3%) reported consuming vegetarian burgers more than once per week. No participants reported consuming vegetarian burgers once per week. Within this group, there were three vegetarians so only four participants with exposure to vegetarian burgers sampled the beef burger. The participants in this group positively rated the beef burgers; no participants reported being dissatisfied or very dissatisfied with their appearance or overall acceptability. Only one (25.0%) participant reported being dissatisfied and no participants were very dissatisfied with the taste of the beef burger. For the appearance, three (75%) participants were satisfied and one (25.0%) was very satisfied. For taste, two (50.0%) were very satisfied, one (25.0%) was satisfied and one

(25.0%) was dissatisfied. For overall acceptability, two (50.0%) were very satisfied and two (50.0%) were very satisfied.

There was not a significant difference in the results for the sensory properties of the garden burgers for this group. While one (14.3%) participant was dissatisfied and one (14.3%) was very dissatisfied with the appearance of the garden burger, none of these participants negatively responded to the taste or overall acceptability of the vegetarian burger. For appearance, one (14.3%) participant was very satisfied and four (57.1%) were satisfied. For taste, two (28.6%) participants were very satisfied and five (71.4%) were satisfied. For the overall acceptability of the garden burger, three (42.9%) were very satisfied and four (57.1%) were satisfied.

Sensory Ratings Based on the Consumption of Beef Burgers

Participants that Never Consumed Beef Burgers.

All of the vegetarian participants who reported never consuming beef burgers did not test the beef burgers so there were no sensory data for the beef burgers for this group. However, all three (100%) of these participants reported being at least satisfied with all of the sensory properties of the garden burger. Of this group, one (33.3%) of the participants was very satisfied and two (66.7%) were satisfied with the appearance of the garden burger. Regarding taste, one (33.3%) participant was very satisfied and two (66.7%) were satisfied. For the overall acceptability of the garden burger, two (66.7%) participants were very satisfied and one (33.3%) participant was satisfied.

Participants that Consumed Beef Burgers Once per Month.

There were a total of 17 (43.6%) participants in the study that reported consuming beef burgers once per month. Their responses for the sensory properties of beef burgers were more satisfactory than unsatisfactory, but more evenly distributed than were the responses to the garden burgers. For the appearance, 4 (23.5%) were very satisfied, 9 (52.9%) were satisfied, 3 (17.6%) were dissatisfied and 1 (5.9%) was very dissatisfied. For taste of the beef burger, 3 (17.6%) participants were very satisfied, 9 (52.9%) were satisfied and 5 (29.4%) were dissatisfied. None of these participants were very dissatisfied with the taste of the beef burger. For overall acceptability, 4 (23.5%) participants were very satisfied, 8 (47.1%) were satisfied, 4 (23.5%) were dissatisfied and 1 (5.9%) was very dissatisfied.

These participants were more likely to be satisfied or very satisfied with the sensory properties of the garden burgers than they were with the beef burgers. With only 2 (11.8%) participants very dissatisfied with appearance, 2 (11.8%) participants dissatisfied or very dissatisfied with taste and 1 (5.9%) participant very dissatisfied with overall acceptability, levels of dissatisfaction for the garden burger were low for this group. Meanwhile, 6 (35.3%) were very satisfied and 9 (52.9%) were satisfied with appearance. For taste, 8 (47.1%) were very satisfied and 7 (41.2%) were satisfied. For overall acceptability of the garden burger, 5 (29.4%) were very satisfied and 11 (64.7%) were satisfied.

Participants that Consumed Beef Burgers Once per Week.

There were 14 participants that reported consuming beef burgers once per week. The survey responses for the beef burgers among this group were distributed more evenly. For appearance, 4 (28.6%) were very satisfied, 8 (57.1%) were satisfied and 2 (14.3%) were dissatisfied. No participant was very dissatisfied with the appearance of the beef burgers. For taste, 3 (21.4%) participants were very satisfied, 6 (42.9%) were satisfied, 4 (28.6%) were dissatisfied and 1 (7.1%) was very dissatisfied. For overall acceptability of the beef burger, 3 (21.4%) participants were very satisfied, 7 (50.0%) were satisfied and 4 (28.6%) were dissatisfied. None of these participants were very dissatisfied with the overall acceptability.

Results for the vegetarian burgers were slightly more favorable. While none of the participants were very satisfied with the appearance of the garden burger, 10 (71.4%) were satisfied, 3 (21.4%) were dissatisfied and 1 (7.1%) was very dissatisfied. For taste, 6 (42.9%) were very satisfied, 7 (50.0%) were satisfied, 1 (7.1%) was dissatisfied and none were very dissatisfied. For the overall acceptability of the garden burger, 5 (35.7%) participants from this group were very satisfied, 8 (57.1%) were satisfied and 1 (7.1%) was dissatisfied. None of these participants were very dissatisfied with the sample's overall acceptability.

Participants that Consumed Beef Burgers > Once per Week.

Of the 39 participants, only 5 reported that they consumed beef burgers more than once per week. As was the case with the rest of the groups evaluated, this group was less likely to positively rate the sensory properties of the beef burger than the garden burgers.

There were three (60.0%) participants of this group that were very satisfied and two (40.0%) that were satisfied with the beef burger's appearance. Meanwhile, no participants were dissatisfied or very dissatisfied with appearance. For taste, two (40.0%) participants were very satisfied, one (20.0%) was satisfied, one (20.0%) was dissatisfied and one (20.0%) was very dissatisfied. For overall acceptability of the beef burger, three (60.0%) of these participants were very satisfied, one (20.0%) was dissatisfied and one (20.0%) was very dissatisfied. None of these participants were satisfied with overall acceptability.

All of the participants in this group provided positive responses for the sensory properties of the garden burger. For appearance, three (60.0%) participants were very satisfied and two (40.0%) were satisfied. For taste, four (80.0%) were very satisfied and one (20.0%) was satisfied. For overall acceptability of the garden burger, all five participants (100%) were very satisfied with the overall acceptability. None of the participants in the study were dissatisfied or very dissatisfied with any of the sensory properties for the garden burger.

Sensory Ratings Based on Gender

Responses to Beef Burgers.

Of the total 39 participants in the study, only 5 of them were male students. There was one male vegetarian that did not sample the beef burger; this left only four evaluations for the beef burger among male participants. Of these four participants, one (25.0%) was very satisfied, two (50.0%) were satisfied and one (25.0%) was dissatisfied with appearance of the beef burger. For taste, one (25.0%) was very satisfied, one was

dissatisfied (25.0%) and two (50.0%) were very dissatisfied. For overall acceptability of the beef burger, one (25.0%) male participant was very satisfied, two (50.0%) were dissatisfied and one (25.0%) was very dissatisfied.

Although there were 34 female participants in the study, 2 were vegetarian and did not sample the beef burger. Because these 2 did not sample the beef burger, the results for the beef burger are based on 32 participants. The female participants were significantly more likely to be satisfied or very satisfied with the taste and overall acceptability of the beef burgers than the male participants. For appearance, their results were similar to male participants. There were 10 (31.3%) that were very satisfied, 17 (53.1%) that were satisfied, 4 (12.5%) that were dissatisfied and 1 (3.1%) that was very dissatisfied. For taste, 7 (21.9%) females were very satisfied, 16 (50.0%) were satisfied and 9 (28.1%) were dissatisfied. None of the female participants reported being very dissatisfied with the taste of the beef burgers. For the overall acceptability among female participants, 9 (28.1%) were very satisfied, 15 (46.9%) were satisfied, 7 (21.9%) were dissatisfied and 1 (3.1%) was very dissatisfied. The responses for the sensory properties of beef burgers can be viewed in Tables 7 and 8.

Table 7

Male Responses to the Sensory Properties of the Beef Burger (n = 4)

	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	1 (25%)	2 (50%)	1 (25%)	0
Taste	1 (25%)	0	1 (25%)	2 (50%)
Overall Acceptability	1 (25%)	0	2 (50%)	1 (25%)

* One of male participants did not sample the beef burger.

Table 8

Female Responses to the Sensory Properties of the Beef Burger (n = 32)

	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	10 (31.3%)	17 (53.1%)	4 (12.5%)	1 (3.1%)
Taste	7 (21.9%)	16 (50%)	9 (28.1%)	0
Overall Acceptability	9 (28.1%)	15 (46.9%)	7 (21.9%)	1 (3.1%)

* Two of the female participants did not sample the beef burger

Responses to Garden Burgers.

All five of the male participants sampled the garden burger. Male responses to the sensory properties of the garden burgers were more likely to be positive than female responses. Only one (20.0%) male participant was dissatisfied with the appearance of the garden burger. No other male participants were dissatisfied or very dissatisfied with the taste and overall acceptability of the garden burger. For appearance, one (20.0%) male participant was very satisfied and three (60.0%) participants were satisfied with the garden burger. For taste, three (60.0%) participants were very satisfied and two (40.0%) were satisfied. For overall acceptability of the garden burger, three (60.0%) were very satisfied and two (40.0%) were satisfied.

All female participants sampled the garden burger. Despite being slightly less likely to positively rate the taste and overall acceptability of the garden burger than male participants, the majority of female participants were still either satisfied or very satisfied with the garden burgers' sensory properties. For appearance of the garden burger, 9 (26.5%) female participants were very satisfied, 20 (58.8%) were satisfied, 2 (5.9%) were dissatisfied and 3 (8.8%) were very dissatisfied. For taste, 16 (47.1%) were very satisfied, 15 (44.1%) were satisfied, 2 (5.9%) were dissatisfied and 1 (2.9%) was very

dissatisfied. For overall acceptability, 14 (41.2%) female participants were very satisfied, 18 (52.9%) were satisfied, 1 (2.9%) was dissatisfied and 1 (2.9%) was very dissatisfied. Responses to the sensory properties of garden burgers by male and female participants can be viewed in Tables 9 and 10.

Table 9

Male Responses to the Sensory Properties of the Garden Burger (n = 5)

	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	1 (20%)	3 (60%)	1 (20%)	0
Taste	3 (60%)	2 (40%)	0	0
Overall Acceptability	3 (60%)	2 (40%)	0	0

Table 10

Female Responses to the Sensory Properties of the Garden Burger (n = 34)

	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	9 (26.5%)	20 (58.8%)	2 (5.9%)	3 (8.8%)
Taste	16 (47.1%)	15 (44.1%)	2 (5.9%)	1 (2.9%)
Overall Acceptability	14 (41.2%)	18 (52.9%)	1 (2.9%)	1 (2.9%)

Chapter 5

Discussion

The overall results show that participants in the study were more likely to positively rate the sensory properties of the garden burger. In comparison to the beef burger, the garden burger received more positive ratings for taste and overall acceptability. Sensory ratings for appearance were similar between both samples. Although there was a correlation between appearance and overall acceptability of the samples, ratings for taste were more likely to correlate with ratings for overall acceptability. To demonstrate, 92% of the participants were either satisfied or very satisfied with the taste of the garden burger and 95% were either satisfied or very satisfied with its overall acceptability. Meanwhile, 67% of the participants that rated the beef burger were either satisfied or very satisfied with its taste and 69% of these participants were either satisfied or very satisfied with its overall acceptability.

Making up 88% of the sample population, the high percentage of females may have been a factor contributing to the high ratings for the sensory properties of the garden burgers. Females are more likely to be health conscious and engage in behaviors that promote health (Deeks, Lombard, Michelmore & Teede, 2009). Since vegetarian proteins such as soy are considered functional foods, females may be more inclined to try these products (Cheney et al., 2005). Because greater exposure to vegetarian proteins is positively correlated with their acceptability, these findings imply a potential female inclination to more positively rate vegetarian burgers (Hasler et al., 2004) (Badham et al., 2009).

On the other hand, there is limited available data on variations between males and females regarding the acceptability of vegetarian proteins. Additionally, individuals who are health conscious are not necessarily more likely to consume vegetarian proteins more frequently and find their sensory properties acceptable. People concerned with health are only more likely to consume vegetarian proteins if they are also aware of the health benefits of these products (Wansink, 2003). Therefore, while females may be more likely to be aware of the health benefits of vegetarian proteins because they are more likely to seek out health information, there is not research that shows a direct correlation to support this hypothesis (Deeks et al., 2009).

In contrast to what was expected, male participants in the study were more likely to be either satisfied or very satisfied with the sensory properties of the garden burger. Every male participant in the study was either satisfied or very satisfied with the taste and overall acceptability of the garden burger. Meanwhile, 75% of the male participants were either dissatisfied or very dissatisfied with the taste and overall acceptability of the beef burgers. However, the male population only consisted of five participants which comprised only 13% of the total sample population. Also, one of the male participants was vegetarian and did not sample the beef burger, bringing total number of male participants that sampled the beef burger down to four.

Participant history and familiarity with vegetarian burgers was another variable that did not provide clear correlations. Past studies have shown that individuals with limited exposure to vegetarian proteins are more likely to find these products unacceptable (Hasler et al., 2004) (Badham et al., 2009) (Shork, 2000) (Cheney et al., 2005). Since the majority of participants in the study reported limited consumption of

vegetarian burgers, they would have been more likely to have been exposed to the negative connotations, instead of the taste of the vegetarian sample (Wansink, 2003). This mindset may have biased the attitudes of the participants against the garden burger, making them more likely to rate this sample negatively (Wansink, 2003). However, the sample population was significantly more satisfied with the sensory properties of the garden burger. No major differences were found between groups with different levels of consumption of the vegetarian burger.

Of the total sample, 83% reported that they never consumed vegetarian burgers. These participants were significantly more likely to be satisfied or very satisfied with the taste and overall acceptability of the garden burgers than they were with the beef burgers. Of the 32 students that reported never consuming vegetarian burgers, only 2 participants were dissatisfied or very dissatisfied with the overall acceptability of the garden burger compared to the 11 that were dissatisfied or very dissatisfied with the overall acceptability of the beef burger. Results were similar for the products' taste overall acceptability.

These results refuted the prediction that sensory ratings for the garden burgers would be low. Of the seven participants who consumed vegetarian burgers with some regularity, six reported consuming vegetarian burgers once per month. Of these seven, there were three of the vegetarian participants. Only one reported consuming vegetarian burgers more than once per week. The sensory results for the garden burger provided by this group were similar to the sensory results provided by the participants that reported no consumption of vegetarian burgers. The participants with some exposure were all either satisfied or very satisfied with the taste and overall acceptability of the garden burger.

They were somewhat more likely to positively rate the sensory properties of the beef burger than the participants who had no exposure to vegetarian burgers. Only one participant in this group was dissatisfied with the taste, but none were dissatisfied or very dissatisfied with this product's overall acceptability.

The ratings of the beef burger for participants with some exposure to vegetarian burgers can be easily misinterpreted. While there were seven participants who consumed vegetarian burgers, three of them were vegetarian and did not eat meat. Because they refused to sample the beef burger, the sample size of this group for ratings of the beef burger was brought down to four. Previous studies have shown that vegetarians are more likely than the rest of the general population to have negative attitudes towards meat; their responses may have been less satisfactory for the beef burger (Barker & Kenyon, 1998) (Conner, Povey & Wellens, 2001) (de Bruycker & de Houwer, 2007). Because the vegetarian participants would not purchase beef burgers, their sensory results for the overall acceptability of the beef burger would be dissatisfied or very dissatisfied for consumer purposes.

No major differences were noted between the overall acceptability of the garden and beef burgers based on consumption of the beef burger. For the overall acceptability of the beef burger, 70% of the participants with less frequent consumption of beef burgers (once per month) were either satisfied or very satisfied while 68% of participants with more frequent consumption (once per week or more than once per week) were satisfied or very satisfied. The results for all participants reported higher sensory ratings for the garden burger; there were no statistically significant differences for the garden burger between participants with varying levels of consumption of beef burgers. For the

overall acceptability of the garden burger, 95% of the participants with greater consumption of the beef burger (once per week or more than once per week) were either satisfied or very satisfied. Meanwhile, 6% of the participants with less frequent consumption of the beef burger (once per month) were satisfied or very satisfied with the overall acceptability of the garden. With only three students, the group that reported never consuming beef burgers was too small to make significant comparisons with other groups. Additionally, none of these participants sampled the beef burger so there were no results for this category to compare. Although there was little data to support or refute these results, more familiar foods are more likely to be rated acceptable. Based on this tendency and the overall negative attitudes towards vegetarian proteins among people with limited exposure to them, the results of this study were not expected (Wansink, 2003) (Chung & Vickers, 2007) (Crouch, Johnson & Meiselman, 2000).

Recommendations for Future Studies

Future experiments may benefit from comparing differences in attitudes towards beef and vegetarian burgers when they are accompanied with and without condiments. Low vegetarian burger consumption may be related to the public notion that vegetarian burgers are a replacement for beef burgers. As a replacement, vegetarian burgers would be more likely to be accompanied with condiments and bread typically used for beef burgers. The vegetarian burgers may be a poor complement to these condiments that may be related to a poor combination of taste or texture. If vegetarian burgers were rated lower when consumed with these condiments, then their recipes may need to be modified to better complement these condiments. However, if the products are marketed as

something other than as a burger, they may become sold and consumed at a higher frequency.

A more in-depth examination of participant history with vegetarian burgers may explain how prior exposure to vegetarian burgers affects consumption. Including a frequency of consumption response between 'once per month' and 'never' would provide a better indication of prior participant exposure to vegetarian burgers. Participants that consumed vegetarian burgers, but did so less frequently than once per month, may have incorrectly reported never consuming vegetarian burgers. These participants may have been more likely to find vegetarian burgers acceptable than those who had never consumed them. Participants that may have fallen into this category were not accounted for in this study.

Prior or regular consumption of other vegetarian proteins that replace animal-based products may be another factor predisposing participants to find vegetarian burgers acceptable (Chan & Wansink, 2001). Vegetarian-based dairy replacements and other meat replacements fall in this category. Current and previous consumption of these foods should be included in the section that records previous consumption of vegetarian burgers to determine whether exposure to any vegetarian proteins predisposes participants to find vegetarian burgers acceptable.

Participants should also be asked if they have any preconceived opinions regarding vegetarian proteins and meat replacements in addition to the origin of such notions. These attitudes may have been generated from other people's opinions or from the participant's own previous consumption. More negative attitudes developed from

other people's opinions may bias taste ratings before sampling the product, predisposing results to be more unsatisfactory. If this is true for the majority of students, an advertising campaign may have a greater effect on increasing the intake of vegetarian burgers.

Researchers may benefit from delving further into the role of appearance on overall acceptability. The results from this study did not show any significant correlations between appearance and overall acceptability of the beef and garden burgers. Both samples received similar ratings for appearance, but they received significantly different responses for overall acceptability. These findings suggest that the use of garnishes and appealing trays may have a greater influence on increasing intake than improving the appearance of vegetarian burgers.

The small sample population was another issue with the study that may have provided a poor reflection of the attitudes and responses of the entire university population. The majority of participants were female Family & Consumer Science majors that were either junior or senior undergraduates. Only five of the participants were male students and only one of the participants was a non-Family & Consumer Science major. Additionally, since the study is largely targeting students that would be eating in the dining halls, juniors and seniors may not be the most appropriate sample population. Freshmen and sophomores are more likely to live in the residence halls and therefore eat most of their meals in dining centers.

With only 39 participants, significant comparisons between subgroups with varying levels of consumption of vegetarian burgers were difficult to make. There were

only 7 participants that reported some consumption of vegetarian burgers compared to the 32 participants that stated that they never consumed vegetarian burgers. Additionally, six of the seven who consumed vegetarian burgers did so with limited frequency; these six reported consuming vegetarian burgers only once per month. Results from a larger sample of younger undergraduate students may provide more meaningful results for a study targeting campus dining.

Implications & Applications

These results show that there is a large gap between the consumption of vegetarian burgers and undergraduate student taste preferences. One potential explanation for this disparity may be related to the addition of seasonings in the garden burgers and the lack of seasonings in the beef burgers. If the garden burger did not have these seasonings, they may have been rated less favorably than the beef burgers. The beef burgers may also have been more acceptable if they had additional seasonings. Nevertheless, the researcher did not expect the vegetarian burger to be rated more satisfactory than the beef burger.

The disparity between the low consumption and high acceptability of the vegetarian burgers may also be related to environmental factors. The environment in which the burgers are served may influence whether an individual is more likely to consume and deem them acceptable. In one study, the exact same foods were served in a cafeteria, food science class and restaurant. Despite using identical recipes and presentation, the food in the restaurant received the highest ratings, the food in class received the next highest ratings and the food in the cafeteria received the lowest ratings

(Crouch, Johnson, Meiselman & Reeve, 2000). These results reinforce that a positive environment is very instrumental in making a food item desirable and influencing food choice (Herman, Vartanian & Wansink, 2008) (Koster, 2009). In a dining center, placing vegetarian burgers in a well-lit and highly traveled area with appealing pans and other kitchen items may help to improve their perceived value—a major determinant of food selection (Pidgeon, 2009).

Reducing cost and increasing availability of vegetarian proteins are other means of encouraging individuals to choose vegetarian proteins such as vegetarian burgers. However, the effect of these initiatives by themselves has proven to be somewhat limited; there must be additional environmental changes focused on product promotion that attract consumers to these foods. When cost is reduced in conjunction with improved lighting, appearance or overall presentation, consumers are more likely to choose promoted foods (Eisenberg et al., 1997) (Bere, Klepp & Veierod, 2005). Advertising and promotion of vegetarian proteins are additional methods of attracting students to these products, which may lead to increased consumption of and improved attitudes towards these products.

Advertisements may prove more effective if vegetarian meat replacements such as vegetarian burgers are promoted as something other than imitation meat products. Although sensory properties of vegetarian meat replacements were rated higher than meat in this study, consumers may find the taste or texture of meat replacements inappropriate compared to the meat products they replace and would be less likely to consume them. By avoiding labeling these vegetarian proteins with terms that are commonly used with or for meat products, vegetarian meat replacements would be less likely to be compared to meat products and their sensory properties would be less likely to be deemed

inappropriate. These initiatives may promote a more positive image of vegetarian proteins and bridge the gap between their high acceptability and low consumption in university dining centers.

Chapter 6

Conclusion

The comparison of the sensory properties showed that the vegetarian proteins not only have the potential to be an effective replacement for meat-based foods, but that they also may be more acceptable than meat. Although there was not much data that showed significant differences between the subgroups, the vegetarian burgers were significantly more acceptable than the beef burgers by the overall population. The higher ratings for taste and overall acceptability of the vegetarian burgers were more suggestive that vegetarian burgers could be an effective replacement for beef burgers. Overall, these results show that with proper environmental conditions, vegetarian-based proteins have the potential to be the preferred source of protein by undergraduate students.

The results from this study suggest that strategies designed to increase intake of vegetarian proteins can be effective. Advertising and promoting vegetarian proteins may create awareness and attract customers to these foods, increasing the likelihood of greater intake and acceptability. Improving their appearance and displaying these items in appealing containers may also help. Given the high acceptability of the garden burgers, establishing environmental conditions that encourage vegetarian protein consumption will likely provide positive exposure to these products that will lead to their increased intake and acceptability among students.

Designs of future studies can be improved to clarify these results and offer more resounding conclusions. The study lacked a large sample population with significant diversity that could have provided more significant comparisons between gender, age and

majors. The small sample size also limited the significance of comparisons among subgroups with varying levels of exposure to vegetarian burgers. Future research would benefit from a more in-depth examination of the correlation between exposure to vegetarian burgers, age, gender and major with each product's sensory properties.

A thorough examination over the findings and shortcomings of this study can provide direction for future research that can more effectively target influences on student attitudes regarding acceptability for vegetarian proteins. Results from these studies would be instrumental in increasing student intake of vegetarian proteins by dining services. Having more vegetarian protein options may help dining services reduce food costs, provide more low-fat, high-fiber proteins and operate with a reduced environmental impact. Ultimately, the proper focus of future research can provide university dining establishments with the tools to provide healthier and more environmentally friendly food options to their students.

References

Abensperg-Traun, M., Arnold, G. W., Sarre, S., Smith, G. T., & Steven, D. E. (1996). The effect of habitat fragmentation and livestock grazing on animal communities in remnants of gimlet Eucalyptus in the western Australian wheatbelt. *Journal of Applied Ecology, 33*(6), 1302-1310.

Abiola, A., Achari, G., & McDonald, T. (2008). Feasibility of increased biogas production from the co-digestion of agricultural, municipal, and agro-industrial wastes in rural communities. *Journal of Environmental Engineering and Science, 7*, 263-273.

Abouelenien F, Kitamura Y, Nakashimada Y, Nishio N. Dry anaerobic ammonia-methane production from chicken manure. *Applied Microbiology and Biotechnology, 82*(4), 757-764.

Agnew, R. E., Ferris, C. P., Gordon, F. G., Kilpatrick, D. J., Mayne, C. S., Patterson, D. C., Porter, M. G. & Yan, T. (2010). Mitigation of enteric methane emissions through improving efficiency of energy utilization and productivity in lactating cows. *Journal of Dairy Science, 93*(6) 2630-2638.

Ali, N., Geisel, J., Herrmann, M., Herrmann, W., Hubner, U., Obeid, R., Sand-Hill, M., & Schorr, H. (2009). Enhanced bone metabolism in vegetarians—the role of vitamin B12 deficiency. *Clinical Chemistry and Laboratory Medicine, 47*(11), 1381-1387.

Aljadir, L, Cotugna, N., & Plesko, M. (2000). Usefulness of a brief fruit and vegetable food frequency questionnaire in a college population. *American Journal of Health Behavior, 24*(3), 201-208.

Allaire, G., Doyen, L., Jiguet, F., Leger, F., & Mouysset, L. (2011). Bio economic modeling for a sustainable management of biodiversity in agricultural lands. *Ecological Economics, 70*(4), 617-626.

Allen, N.E., Appleby, P. N., Key, T. J., Mann, J. I., Spencer, E. A., Thorogood, M., & Travis, R. (2009). Cancer indidence in British vegetarians. *British Journal of Cancer, 101*, 192-197.

Almeida, O., Nepstad, D., & Stickler, C. (2006). Globalization of the Amazon soy and beef industries: Opportunities for conservation. *Conservation Biology, 20*(6), 1595-1603.

Alva, A. K., Jayaraman, K., Jones, L. B., Kelson, L., Paramsivam, S., Wilson, T. C. (2009). Ammonia volitization loss from surface applied livestock manure. *Journal of Environmental Science & Health, 44*(3), 317-324.

Anand, S. S., Davis, B., Jacobs, R., Kelemen, L. E., de Koning, L., Lonn, E., Merchant, A. T., Teo, K. K., Vuskan, V. & Yusuf, S. (2008). Interrelation of saturated fat, trans fat, alcohol intake, and subclinical atherosclerosis. *The American Journal of Clinical Nutrition, 87*(1), 168-174.

Andersson, A., Nydahl, M., & Simunaniemi, A. M. (2009). Fruit and vegetable consumption close to recommendations. A partly web-based nationwide dietary questionnaire in Swedish adults. *Food & Nutrition Research, 53*, 1-9.

Anonymous. (2002). Super soy: Healthy eating. *Diabetes Focus, 30*, 26-29.

Anonymous (2010). Strong demand for meat abroad. *Farmers Weekly, 152*, 151-152.

Appel, L. J., Bray, G. A., Cutler, J. A., Evans, M. A., Harsha, D. W., Karanja, N., Lin, P., McCullough, M., Miller, E. R., Moore, T. J., Obarzanek, E., Sacks, F. M., Simons-Morton, D., Steele, P., Svetkey, L. P., Swain, J., Vogt, T. M., Vollmer, W. M., Windhauser, M. M. (1997). A clinical trial of the effects of dietary patterns on blood pressure. *New England Journal of Medicine, 336*, 1117-11124.

Archer, D. W., Barbour, N. W., Johnson, J. M. & Weyers, S. L. (2011). Do mitigation strategies reduce global warming potential in the northern U.S. corn belt? *Journal of Environmental Quality, 40*(5), 1551-1559.

Ashcroft, R. E., Marteau, T. M. & Oliver, A. (2009). Using financial incentives to achieve healthy behaviour. *British Medical Journal, 338*, 1415.

Ball, B. C., Degrootes, J., Lilly, A., & McTaggart, P. (2009). Spatial modeling of nitrous oxide emissions of the national scale using soil, climate and land use information. *Global Change Biology, 15*(9): 2321-2332.

Barker, M. E. & Kenyon, P. M. (1998). Attitudes toward meat-eating in vegetarian and nonvegetarian teenage girls in England—an ethnographic approach. *Appetite, 30*, 185-198.

Barnard, N. D., Cohen, J., Jenkins, D. J. A., Katcher, H., & Turner-McGrievy, G. (2009). Vegetarian and vegan diets in type 2 diabetes management. *Nutrition Reviews, 67*(5), 255-263.

Barnard, N. D., Ferdowsian, H. R., & Kottler, B. M. (2009). Effects of plant-based diets on plasma lipids. *American Journal of Cardiology, 104*(7), 947-956.

Barnes-Holmes, D., Barnes-Holmes, Y., Murtagh, L., & Stewart, I. (2010). Using the implicit association test and the implicit relational assessment procedure to measure attitudes towards meat and vegetables in vegetarians and meat-eaters. *The Psychological Record, 60*, 287-306.

Barr-Anderson, D., Larson, N. I., Nelson, M. C., Neumark-Sztainer, D., & Story, M. (2009). Disparities in dietary intake, meal patterning, and home food environments among young adult nonstudents and 2- and 4-year college students. *American Journal of Public Health, 99*(7), 1216-1219.

Batech, M., Fraser, G. E., Herring, R. P. Oda, K., Stewart, K. & Tonstad, S. (2011). Vegetarian diets and incidence of diabetes in the Adventist Health Study-2. *Nutrition, Metabolism and Cardiovascular Diseases*. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed.

Beauchemin, K. A., Janzen, H. H., Little, S. M., McAllister, T. A., & McGinn, S. M. (2010). Life cycle assessment of greenhouse gas emissions from beef production in western Canada: A case study. *Agricultural Systems, 103*(6), 371-379.

Beauchemin, K. A., Kreuzer, M., O'Mara, F., & McAllister, T. A. (2008). Nutritional management for enteric methane abatement: A review. *Australian Journal of Experimental Agriculture, 48*(2), 21-27.

Beline, F. & Guiziou, F. (2005). In situ measurement of ammonia and greenhouse gas emissions from broiler houses in France. *Bioresource Technology, 96*(2), 203-207.

Bender, S. & Wezel, A. (2004). Degradation of agro-pastoral village land in semi-arid southeastern Cuba. *Journal of Arid Environments, 59,* 299-311.

Bere, E., Klepp, K. I. & Veierod, M. B. (2005). The Norwegian school fruit programme: evaluating paid vs. no-cost subscriptions. *Preventative Medicine, 41*(2), 463-470.

Berman, E. R., Dowling, H., Heshka, S., Heymsfield, S. B., Lichtman, S. W., Matthews, D. E., Offenbacher, E., Pestone, M., Pisarka, K. (1992). Discrepancy between self-reported and actual caloric intake and exercise in obese subjects. *The New England Journal of Medicine, 327*(27), 1893- 1897.

Bernstein, D., Ottenfield, M., & Witte, C. L. (2008). An exploration of U.S. consumer perceptions and affect: Two forms of a soy-based food product. *Journal of Food Products Marketing, 14*(3), 49-76.

Bloem, J., Brussard, L., Faber, J. H., Goede, R. G. M., Postma-Blaauw, M. B. (2010). Soil biota community structure and abundance under agricultural intensification and extensification. *Ecology, 91*(2), 460-473.

Badhan, J., Bosman M. J. C., Bouwer, S.C., Ellis S.M., Erasmus A.C., Harmse N., Jerling J. C. (2009). South African consumers' opinions and consumption of soy and soy products. *International Journal of Consumer Studies, 33*, 425-435.

Boeken, B. & Golodets C. (2006). Moderate sheep grazing in semiarid shrubland alters small-scale soil surface structure and patch properties. *CATENA, 65*(3), 285-291.

Boland, T. M., Foley, P. A., Hart, K. J., Kenny, D. A., McGeough, E. J., & O'Kiely, P. (2010). Methane emissions, feed intake, and performance of finishing beef cattle offered maize silages harvested at 4 different stages of maturity. *Journal of Animal Science, 88*, 1479-1491.

Boland, T. M., Hart, K. J., Kenny, D. A., McGeough, E. J., Moloney, A. P., & O'Kiely, P. (2010). Methane emissions, feed intake, performance, digestibility, and rumen fermentation of finishing beef cattle offered whole-crop wheat silages differing in grain content. *Journal of Animal Science, 88*, 2703-2716.

Bosland, M. C., Lin, Y., & Spitznagel, L. E. (2010). Soy consumption and colorectal cancer risk in humans: A meta-analysis. *Cancer Epidemiology, Biomarkers & Prevention, 19*(1), 148-158.

Brinegar, C. H., Haddad, E. H., Lee, J. W., Singh, P. N. & Vang, A. (2007). Meats, processed meats, eats, obesity, weight gain and occurrence of diabetes among adults: Findings from Adventist health studies. *Annals of Nutrition & Metabolism, 52*, 96-104.

Buckova, K., Klimes, I., Krajcovicova-Kudlackova, M., & Sebokova, E. (2003). Iodine deficiency in vegetarians and vegans. *Annals of Nutrition and Metabolism, 47*, 183-185.

Burtraw, D., Palmer, K., Shih, J., & Siikamäki, J. (2008). Air emissions of ammonia and methane from livestock operations: Valuation and policy options. *Journal of the Air & Waste Management Association*. 2008; 58:1117-1129.

Butmer, C. E., Chapman, B. K., Krzic, M., Newman, R. F., & Trethewey, C. (2006). Cattle grazing effects on plant species composition and soil compaction on rehabilitated forest landings in central interior British Columbia. *Journal of Soil and Water Conservation, 61*(3), 137-144.

Buttler, A., Gillet, F., Gobat, J. M., Hamelin, J., & Kohler, F. (2005). Soil microbial community changes in wooded mountain pastures due to simulated effects of cattle grazing. *Plant & Soil, 278*(1-2), 327-340.

Byles, J. E., Dai, Y., Holmboe-Ottesen, G., Hu, G., Hu, X., Pan, X., Shi, Z., & Yuan, B. (2008). Vegetable-rich food pattern is related to obesity in China. *International Journal of Obesity, 32*, 975-984.

Callan, J., Conolly, J., Finlay, M., Lovell, S., Lovett, D., O'Mara, F. P., & Stack, L. (2003). Effect of forage/concentrate ratio and dietary coconut oil level on methane output and performance of finishing beef heifers. *Livestock Science, 84*(2), 66-73.

Camire, M. E., Dougherty, M. P. & Teh, T. (2007). How do consumer attitudes influence acceptance of a novel wild blueberry-soy product? *Journal of Food Science, 72*(7), 516-521.

Campbell, M. K., Fraser, W. D., Macdonald, H. M., New, S. A., & Reid, D. M. (2005). Low dietary potassium intakes and high dietary estimates of net endogenous acid production are associated with low bone mineral density in premenopausal women and increased markers of bone resorption in postmenopausal women. *American Journal of Clinical Nutrition, 81*(4), 923-933.

Carroll, M. D., Curtin, L. R., Flegal, K. M. & Ogden, C. L. (2010). Prevalence and trends in obesity among US adults, 1999-2008. *The Journal of the American Medical Association, 303*(3), 235-241.

Casey KD, Gates, RS, Pescatore AJ, Wheeler EF, & Xin H. (2008). U.S. broiler housing ammonia emissions inventory. *Atmospheric Environment, 42*(14), 3342-3350.

Cattle, S. R., Greene, R. S. B., & McPherson, A.A. (2009). Role of eolian dust deposits in landscape development and soil degradation in southeastern Australia. *Austral Journal of Earth Sciences, 56*(1), 55-65.

Centers for Disease Control and Prevention (2009). *Prevelance and trends data.* Retrieved from http://www.cdc.gov/BRFSS/.

Centers for Disease Control and Prevention (2010). State-specific tr*ends in fruit and vegetable consumption among adults—United States, 2000-2009.* Retrieved from http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5935a1.htm.

Chakravorty, U., Fisher, D. K. & Umetsu, C. (2007). Environmental effects of intensification of agriculture: livestock production and regulation. *Environmental Economics and Policy Studies, 8*, 315-336.

Chan, N. & Wansink, B. (2001). Relation of soy consumption to nutritional knowledge. *Journal of Medicinal Food, 4*(3), 145-150.

Chen, X. & Wang, Y. (2012). Between-group differences in nutrition- and health-related psychosocial factors among US adults and their associations with diet, exercise and weight status. *Journal of the Academy of Nutrition and Dietetics*, 112(4), 486-498.

Cheney, M. M., Wansink, B. & Westgren, R. E. (2005). Hierarchy of nutritional knowledge that relates to the consumption of a functional food. *Nutiriton, 21*(2), 264-268.

Chiaffarino, F., Cipriani, S., Malvezzi, M., Parazzini, F., & Ricci, E. (2010). Soy isoflavones and bone mineral density in perimenopausal and postmenopausal western women: A systematic review and meta-analysis of randomized controlled trials. *Journal of Women's Health, 19*(9), 1609-1617.

Chung, S. & Vickers, Z. (2007). Influence of sweetness on the sensory-specific satiety and long-term acceptability of tea. *Food Quality and Preference, 18*, 256-264.

Clarke, T., Eckard, R. J., Grainger, C., Williams, R., & Wright, A. D. G. (2010). Supplementation with whole cottonseed causes long-term deduction of methane emissions from lactating dairy cows offered a forage and cereal grain diet. *Journal of Dairy Science, 93*, 2616-2619.

Collins, P., Hayward, C. S., Ilsley, C. D., Mason, M. J., & Webb, C. M. (2008). Coronary vasomotor and blood flow responses to isoflavone-intact soya protein in subjects with coronary heart disease or risk factors for coronary heart disease. *Clinical Science, 115*(12), 353-359.

Conner, M., Povey, R. & Wellens, B. (2001). Attitudes towards following meat, vegetables, and vegan diets: an examination of the role of ambivalence. *Appetite, 37*, 15-26.

Cross, A. J., Daniel, C. R., Koebnick, C. & Sinha, R. (2011). Trends in meat consumption in the United States. *Public Health Nutrition, 14*(4), 575-583.

Crouch, J. E., Johnson, J. L., Meiselman, H. L. & Reeve, W. (2000). Demonstrations of the influence of the eating environment on food acceptance. *Appetite, 35* (3), 231-237.

Cui, Z. H., He, Y. N., Hu, Y. S., Li, Y., Li, Y. P., Ma, G. S., Wang, Z. H., Yang, X. G., Zhai, F. Y., & Zhao, L. Y. (2005). Study on the current status and trend of food consumption among Chinese population. *Zhonghua Liu Xing Bing Xue Za Zhi, 26*(7), 485-488.

Cummings, S. R., Sebastian, A., Sellmeyer, D. E., & Stone, K. L. (2001). A high ratio of animal to vegetable protein increases the rate of bone loss and the risk of fracture in postmenopausal women. *American Journal of Clinical Nutrition, 73*(1), 118-122.

Davis, A. J., Dozier, W. A., Freeman, M. E., Ward, T. L. (2003). Early growth and environmental implications of dietary zinc and copper concentrations and sources of broiler chicks. *British Poultry Science, 44*(5), 726-731.

De Bree, A., Floter, E., Laitinen, K., van Duijn, Zeelenberg, M., & Zevenbergen, H. (2009). Foods with a high fat quality are essential for healthy diets. *Annals of Nutrition & Metabolism, 54*(1), 15-24.

De Bruycker, E. & de Houwer, J. (2007). Implicit attitudes towards meat and vegetables in vegetarians and nonvegetarians. *International Journal of Psychology, 42* (3), 158-165.

De Graaf, C., Hoek, A. C., Luning, P. A., & Stafleu, A. (2004). Food-related lifestyle and health attitudes of Dutch vegetarians, non-vegetarian consumers of meat substitutes, and meat consumers. *Appetite, 42*, 265-272.

Deeks, A., Lombard, C., Michelmore, J. & Teede, H. (2009). The effects of gender and age on health related behaviors. *BMC Public Health, 9*, 213.

Delange, F. (1994). The disorders induced by iodine deficiency. *Thyroid, 4*(1), 107-128.

Denny, C., Farris, R., Gillespie, C., Kettel-Khan, L., Serdula, M. K., & Seymour, J. (2004). Trends in fruit and vegetable consumption among adults in United States: Behavioral risk factor surveillance system, 1994-2000. *American Journal of Public Health, 94*(6), 1014-1018.

Derby, B. M., Levy, A. S. & Roe, B. (1999). The impact of health claims on consumer search and product evaluation outcomes: results from FDA experimental data. *Journal of Public Policy and Marketing, 18*, 89-105.

Dinkins, J. (2001). Beliefs and attitudes of Americans toward their diet. *Family Economics & Nutrition Review, 13*(1), 98-100.

Dobson, D. & Ness, M. (2009). Undergraduate students' attitudes towards food shopping and attitudes to time. *International Journal of Consumer Studies, 33*, 659-668.

Dorrough, J. & Scroggie, M. P. (2008). Plant responses to agricultural intensification. *Journal of Applied Ecology, 45*(4), 1274-1283.

Dougill, A. J., Heathwaite, A. L., & Thomas, D. S. G. (1999). Environmental change in the Kalahari: Integrated land degradation studies for nonequilibrium dryland environments. *Annals of the Association of American Geographers, 89*(3), 420-442.

Dougill, A. J., Sporton, D., Thomas, D. S. G., & Twyman, C. (2008). Soil degradation assessment in mixed farming systems of southern Africa: Use of nutrient balance studies for participatory degradation monitoring. *Geographical Journal, 168*(3), 195-210.

Drake, V. J., Duncan, A. M., & Higdon, J. (2009). Soy isoflavones. *Linus Pauling Institute*, Retrieved from http://lpi.oregonstate.edu/infocenter/phytochemicals/soyiso/.

Dwyer, J. T., Fogli-Cawley, J. J., Jacques, P. F., McCullough, M. L., Saltzman, E., & Troy, L. M. (2006). The 2005 Dietary Guidelines for Americans adherence index: development and application. *The Journal of Nutrition, 136*, 2908-2915.

Edwards, J. S. A. & Meiselman, H. L. (2003). Changes in dietary habits during the first year at university. *Nutrition Bulletin, 28*, 21-34.

Eik, L. O., Moe, S. R., & Yayneshet, T. (2009). The effects of exclosures in restoring degraded semi-arid vegetation in communal grazing lands in northern Ethiopia. *Journal of Arid Environments, 73*(4-5) 542-549.

Eisenberg, M., French, S. A., Jeffery, R. W., Murray, D., Sidebottom, A., Snyder, P. & Story, M. (1997). Pricing strategy to promote fruit and vegetable purchase in high school cafeterias. *Journal of the American Dietetic Association, 97* (9), 1008-1010.

van Elsas, J. D., Salles, J. F. & van Veen, J. A. (2004). Multivariate analyses of burkholderia species in soil: effect of crop and land use history. *Applied and Environmental Microbiology, 70*(7), 4012-4020.

Environmental Protection Agency. (2007). *Inventory of U.S. greenhouse gas emissions and sinks: 1990-2005*. Retrieved from http://www.epa.gov/climatechange/emissions/usgginv_archive.html.

Environmental Protection Agency. (2005) *Emission Facts: Average Carbon Dioxide Emission Resulting from Gasoline and Diesel Fuel.* (Publication No. EPA420-F-05-001). Retrieved from http://www.y12sweis.com/draftrefpdfs/RM%20273%20-%20EPA%202009.pdf.

Evans, E. M. & Thorpe, M. P. (2011). Dietary protein and bone health: harmonizing conflicting theories. *Nutrition Reviews, 69*(4), 215-230.

Fiala, N. (2008). Meeting the demand: An estimation of potential future greenhouse gas emissions from meat production. *Ecological Economics, 67*, 412-419.

Fitter, A. H., Mace, G. M. & Norris, K. (2011). Biodiversity and ecosystem services: a multilayered relationship. *Trends in Ecology and Evolution.* Retrieved from http://www.ncbi.nlm.nih.gov/pubmed.

Flesch, T. K., Harper, L. A., Wilson, J. D. (2010). Environment, well-being, and behavior: Ammonia emissions from broiler production in the San Joaquin Valley. *Poultry Science, 89,* 1802-1814.

Food and Agriculture Organization (2006). *Livestock's long shadow: Environmental issues and options.* (Publication No. 978-92-5-105571-7). Retrieved from http://www.fao.org/docrep/010/a0701e/a0701e00.HTM.

Food and Agriculture Organization. (2009). *The State of Food & Agriculture.* (Publication No. 0081-4539). Retrieved from http://www.fao.org/docrep/012/i0680e/i0680e00.

Franluebbers, A. J., Johnson, J. M., Reicosky, D. C. & Weyers, S. L. (2007). Agricultural opportunities to mitigate greenhouse gas emissions. *Environmental Pollution, 150*(1), 107-124.

Fu, H., Pei, S., & Wan, C. (2008). Changes in soil properties and vegetation following exclosure and grazing in degraded Alxa desert steppe of inner Mongolia, China. *Agriculture, Ecosystems, & Environment, 124*(12), 33-39.

Ge, K. Y., Mi, J., Shan, X. Y., Wang, Q. J., & Wang, Y. (2007). Is China facing an obesity epidemic and the consequences? The trends in obesity and chronic disease in China. *International Journal of Obesity, 31*, 177-188.

Geisel, J. & Herrmann, W. (2002). Vegetarian lifestyle and monitoring of vitamin B-12 status. *Clinica Chimica Acta, 326*(1-2), 47-59.

Groom, N. (2008). California cows start passing gas to the grid. *Reuters*, Retrieved from http://www.reuters.com/article/2008/03/04/environment-energy-cows-dc-idUSN0440606220080304.

Gurr, G. M., Wade, M. R., & Wratten, S. D. (2008). Ecological restoration of farmland: Progress and prospects. *Philosophical Transactions of the Royal Society B Biological Sciences, 363*(1492), 831-847.

Hahn, A., Koschizke, J. W., Leitzmann, C., & Waldmann, A. (2004). *Annals of Nutrition and Metabolism, 48*, 103-108.

Hamilton-Reeves, J. M., Kurzer, M. S., Rebello, S. A., Slaton, J. W., & Thomas, W. (2008). Effects of soy protein isolate consumption on prostate cancer biomarkers in men with HGPIN, ASAP, and low-grade prostate cancer. *Nutrition & Cancer, 60*(1), 7-13.

Harding, J. S., Hayes, J. W., Shearer, K. A., Stark, J. D., & Young, R. G.. (1999). Changes in agricultural intensity and river health along a river continuum. *Freshwater Biology, 42*, 345-357.

Hart, J. (2009). The health benefits of a vegetarian diet. *Alternative and Complementary Therapies, 15*(2), 64-68.

Hasler, C. M., Sonka, S. T. & Wansink, B. (2004). Front-label health claims: when less is more. *Food Policy, 29*, 659-667.

Havenstein, G. B., Liu, Z., Oviedo-Rondon, E. O., Sheldon, B. W., Small, J., Wang, L., & Williams, C. M. (2010). Farm-scale evaluation of ozonation for mitigating ammonia concentrations in broiler houses. *Journal of the Air & Waste Management Association, 60*(7), 789-796.

Herman, C. P., Vartanian, L. R. & Wansink, B. (2008). Are we aware of the external factors that influence our food intake? *Health Psychology, 27*(5), 533-538.

Hermansen, J. E., Mogensen, L., & Nguyen, T. L. (2010)-a. Environmental consequences of different beef production systems in the EU. *Journal of Cleaner Production, 18*(8), 756-766.

Hermansen, J. E., Mogensen, L. & Nguyen, L. T. (2010)-b. Fossil energy and ghg saving potentials of pig farming in the EU. *Energy Policy, 38*(5), 2561-2571.

Hetherington, M. M., Pirie, L. M. & Nabb, S. (2002). Stimulus satiation: effects of repeated exposure to foods on pleasantness and intake. *Appetite, 38*, 19 – 28.

Hinze, A., Karg, C., Mohamed, N., Steyn, N. P. & van Zyl, M. (2004). The acceptability of different types of soymilks available in Cape Town in consumers from high and low socioeconomic areas. *International Journal of Consumer Studies, 28* (1), 40-48.

Hobbs, R. J. (2001). Synergisms among habitat fragmentation, livestock grazing, and biotic invasions in southwestern Australia. *Conservation Biology, 15*(6), 1522-1528.

Hobbs, R. J., Norton, D. A., & Yates, C. J. (2000). Grazing effects on plant cover, soil and microclimate in fragmented woodlands in south-western Australia: Implications for restoration. *Austral Ecology, 25*(1), 36-47.

Horn, R., Pietola, L., & Yli-Halla, M. (2005). Effects of trampling by cattle on the hydraulic and mechanical properties of soil. *Soil & Tillage, 82*, 99-108.

Huang, J., Huo, J., Li, W., Liu, C., Liu, Z., Sun, J., Yu, B., & Zeng, Q. (2004). Intake of soy foods and soy isoflavones by rural adult women in China. *Asia Pacific Journal of Clinical Nutrition, 13*: 204-209.

Iao, M., Kim, J. C., Kim, N., Kim, R. B., Kim, S. S., Lee, J., Lew, P., Lin, W. J., Poon, G., Syu, K., Tam, C. F., & Tzou, O. S. (2010). A comparison of dietary patterns and nutrient intakes between Korean American college students and their respective parents living in the same household. *College Student Journal, 44*(4), 979-993.

Johnston, C. S. & Kniskern, M. A. (2011). Protein dietary reference intakes may be low for vegetarians if low amounts of animal protein are consumed. *Nutrition, 27*(6), 727-730.

Jouany, J. P., Moss, A. R., & Newbold, J. (2008). Methane production by ruminants: Its contribution to global warming. *Annales de Zootechnie, 49*, 231-253.

Keady, T., Kilpatrick, D., Mayne, C., & Gordon, F. (2008). Effects of replacing grass silage with maize silages, differing in maturity, on performance and potential concentrate sparing effect of dairy cows offered two feed value grass silages. *Livestock Science, 119*, 1-11.

Kear, M., Klein, C. A. M., Ledgard, S. F., Lindsey, S. B., & Luo, J. (2008). Effects of dairy farming intensification on nitrous oxide emissions. *Plant Soil, 309*(1-2), 227-237.

Kim, J. H., Kim, M. K., Kong, G., Nam, S. J., & Ryu, S. (2008). Dietary intake of soy protein and tofu in association with breast cancer risk based on a case-control study. *Nutrition & Cancer, 60*(5), 568-576.

King, W. M., Snow, V.O., & White, T. A. (2010). Intensification of New Zealand beef farming systems. *Agricultural Systems, 103*, 21-35.

Kirk, S. F. L. & Packman, I. (2000). The relationship between nutritional knowledge, attitudes and dietary fat consumption in male students. *Journal of Human Nutrition and Dietetics, 13*(6), 389-395.

Koh, W. P., Lee, H. P., Wang, R., Wu, A. H., & Yu, M. C. (2008). Soy intake and breast cancer risk in Singapore Chinese health study. *British Journal of Cancer, 99*(1), 196-200.

Kolonel, L. N., Maskarinec, G., Morimoto, Y., & Steinbrecher, A. (2011). Soy consumption is not protective against diabetes in Hawaii: The multiethnic cohort. *European Journal of Clinical Nutrition, 65*(2), 279-282.

Koster, E. P. (2009). Diversity in the determinants of food choice: a psychological perspective. *Food Quality & Preference, 20*(2), 70-82.

Ledgard, S., McLay, C., Meneer, J. C., & Silvester, W. (2004). The impact of grazing animals on nitrogen fixation in legume-based pastures and management for impvoement. *Soil Biology & Biochemistry, 37,* 1625-1629.

Ledgard, S., McLay, C., Meneer, J. C., & Silvester, W. (2005). Animal treading stimulates denitrification in soil under pasture. *Soil Biology & Biochemistry, 37*(9), 1625-1629.

Liu, C. M., Liu, Y. L., & Yang, S. S. (2003). Estimation of methane and nitrous oxide emissions from animal production sector in Taiwan during 1990-2000. *Chemosphere, 52*, 1381-1388.

Mackay, A.D. (2008). Impacts of intensification of pastoral agriculture on soils current and emerging challenges and implications for future land uses. *New Zealand Veterinary Journal, 56*, 281-288.

Mackay, A. D., Parfitt, R. L., Ross, D. J., Schon, N. L., Wardle, D. A., & Yeates, G. W. (2010). Effect of fertilizer, herbicide and grazing management of pastures on plant and soil communities. *Applied Soil Ecology, 45*, 175-186.

Moore, L. L. (2011). Functional foods and cardiovascular disease risk: building the evidence base. *Current Opinion in Endocrinology, Diabetes and Obesity, 18*(5), 332-335.

Morganosky, M., Park, S. B., Sonka, S & Wansink, B. (2000). How soy labeling influences preferences and taste. *International Food and Agribusiness Management Review, 3*, 85-94.

Mosier, A. R. (1994). Nitrous oxide emissions from agricultural soils. *Fertilizer Research, 37*, 191-200.

Oh, M. S. & Uribarri, J. (1996). Bone buffering of acid: fact or fancy? *Journal of Nephrology, 9*, 261-262.

New, S. A. (2004). Do vegetarians have a normal bone mass? *Osteoporosis International, 15*, 679-688.

Norman, A. G. (2004). The impact of grazing animals on nitrogen fixation in legume-based pastures and management options for improvement. *Advanced Agronomy, 83,* 181-241.

Ohki, K. (1984). Zinc nutrition related to critical deficiency and toxicity levels for sorghum. *Agronomy Journal, 76*, 253-256.

Pelletier, N., Pirog, R., & Rasmussen, R. (2010). Comparative life cycle environmental impacts of three beef production strategies in the upper Midwestern United States. *Agr Syst*. 103: 380-389.

Pidgeon, A. (2009). Food at work: a qualitative study to investigate the drivers and barriers to healthy eating in two public sector workplaces in Barnsley. *Journal of Human Nutrition, 22* (3), 272.

Pirouznia, M. (2001). The association between nutrition knowledge and eating behavior in male and female adolescents in the US. *International Journal of Food Sciences and Nutrition, 52*, 127-132.

du Preez, C. C. & Snyman, H. A. (1993). Organic matter content of a soil in a semi-arid climate with three long-standing veld conditions. *African Journal of Range & Forest Science, 10*(2), 108-110.

Qingyuan, Z., Shi, J., Shuhuai, W., Xinmei, K., & Xu, H. (2010). Effect of soy isoflavones on breast cancer recurrence and death for patients receiving adjuvant endocrine therapy. *Canadian Medical Association Journal, 182*(17), 1857-1862.

Reijnders, L. & Soret, S. (2003). Quantification of the environmental impact of different dietary protein choices. *American Journal of Clinical Nutrition, 78*(3), 664-668.

Savadogo, P., Sawadogo, L., & Tiveau, D. (2007). Effects of grazing intensity and prescribed fire on soil physical and hydrological properties and pasture yield in the savanna woodlands of Burkina Faso. *Agricultural, Ecosystems, & Environment, 118*(1-4), 80-92.

Schectman, J. (2009). High consumption of red meat and processed meat was associated with increased risk for mortality. *Annals of Internal Medicine, 151*(2), 1-15.

Scudlark, J. R. & Siefart, R. L. (2008). Determination of ammonia emission rates from a tunnel ventilated chicken house using passive samplers and a Gaussian dispersion model. *Journal of Atmospheric Chem, 59*(2), 99-115.

Shork, D. (2000). A matter of taste: How Soyaworld captured 60% of the dairy alternative market. *MacLean Hunter, 105*, 14.

Skepasts, A. V., Solomon, K. R., Stephenson, G. R., & Thompson, D. G. (1984). Persistance of (2,4-dicholorophenoxy) acetic acid and 2-(2,4-dichlorophenoxy) propionic acid in agricultural and forest soils of northern and southern Ontario. *Journal of Agricultural and Food Chemistry, 32*(3), 578-581.

Strunk H. (2003). Soil degradation and overland flow as causes of gully erosion on mountain pastures and in forests. *CATENA, 50*(2-4), 185-198.

United States Department of Agriculture. (2010). *Childhood obesity: Researchers attack a nationwide epidemic*. Washington DC: Klurfeld, D. Retrieved from http://www.bcm.edu/cnrc/index.cfm?pmid=17154.

United States Department of Agriculture. (2011). C*hoose MyPlate.* Retrieved from www.choosemyplate.gov.

Verbruggen, M. A., Xing-Yi, T., Yan-Bin, Y., & Yi-Xiang, S. (2006). Soy isoflavones attenuate bone loss in early postmenopausal Chinese women. *European Journal of Nutrition, 45*(6), 327-334.

Wansink, B. (2003). Overcoming the taste stigma of soy. *Journal of Food Science, 68*(8), 2604-2606.

Appendix A

Questionnaire & Sensory Ballot

1. What is your gender?

a. Male b. Female

b. What is your age? (Please print) _____

c. What is your major? (Please print) _____

d. What year in school are you?

a. Freshman b. Sophomore c. Junior d. Senior e. Graduate Student

How often do you consume beef burgers?

a. Never b. Once every month c. Once every week d. More than 1/week

How often do you consume vegetarian or garden burgers?

a. Never b. Once every month c. Once every week d. More than 1/week

Sensory Ballot

Garden burger (Please circle the number that best reflects your evaluation of the garden burger)

Characteristic	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance—should look appetizing with a strong structure	4	3	2	1
Texture—should be firm and dense, but very chewable.	4	3	2	1
Overall Acceptability- How satisfied are you with this sample given appearance and texture?	4	3	2	1

Beef Burger (Please circle the number that best reflects your evaluation of the beef burger)

Characteristic	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance—should look appetizing with a strong structure	4	3	2	1
Texture—should be firm and dense, but very chewable.	4	3	2	1
Overall Acceptability- How satisfied are you with this sample given appearance and texture?	4	3	2	1

Appendix B

Demographic Data

Table 1

Gender of Participants

Gender (n=39)	Males	Females
Results	5 (12.8%)	34 (87.2%)

Table 2

Age of Participants

Age (n=39)	20	21	22	23	27	31	32	36
Results	11 (28.2%)	17 (43.6%)	5 (12.8%)	2 (5.1%)	1 (2.6%)	1 (2.6%)	1 (2.6%)	1 (2.6%)

Table 3

School Year of Participants

School Year (n=39)	# of the participants
Freshman	0
Sophomore	3 (7.7%)
Junior	18 (46.2%)
Senior	17 (43.6%)
Graduate Student	1 (2.6%)

Table 4

Major of Participants

Major (n=39)	# of the participants
Family Services	11 (28.2%)
General FCS	11 (28.2%)
Psychology	1 (2.6%)
Career & Technology Education	3 (7.7%)
Apparel, Textile & Design	3 (7.7%)
General Studies	1 (2.6%)
Education	1 (2.6%)
Merchandising	4 (10.3%)
Consumer Studies	1 (2.6%)
Fashion Merchandising	3 (7.7%)

Exposure to and Consumption of Beef and Vegetarian Burgers

Table 5

Responses to the frequency of consumption questions for beef and vegetarian burgers

Frequency of Consumption	Never	Once/month	Once/week	More than once/week
Beef Burger (n=36)	3 (7.7%)	17 (43.6%)	14 (35.9%)	5 (12.8%)
Vegetarian Burger (n=39)	32 (82.1%)	6 (15.4%)	0	1 (2.6%)

* 3 of the participants did not sample the beef burger.

Sensory Ratings of the Beef & Vegetarian Burgers

Table 6

Responses to the Sensory Properties of the Beef Burgers

Characteristic (n=36)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	11 (30.6%)	19 (52.8%)	5 (13.9%)	1 (2.8%)
Taste	8 (22.2%)	16 (44.4%)	10 (27.8%)	2 (5.6%)
Overall Acceptability	10 (27.8%)	15 (41.7%)	9 (25.0%)	2 (5.6%)

Table 7

Responses to the Sensory Properties of the Garden Burgers

Characteristic (n=39)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	10 (25.6%)	23 (59.0%)	3 (7.7%)	3 (7.7%)
Taste	19 (48.7%)	17 (43.6%)	2 (5.1%)	1 (2.6%)
Overall Acceptability	17 (43.6%)	20 (51.3%)	1 (2.6%)	1 (2.6%)

Sensory Ratings Based on the Consumption of Vegetarian Burgers

Table 8

Responses to the Sensory Participants of the Beef Burger by Participants that Never Consumed Vegetarian Burgers

Characteristic (n=32)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	10 (31.3%)	16 (50.0%)	5 (15.6%)	1 (3.1%)
Taste	6 (18.8%)	15 (46.9%)	9 (28.1%)	2 (6.3%)
Overall Acceptability	8 (25.0%)	13 (40.6%)	9 (28.1%)	2 (6.3%)

Table 9

Responses to the Sensory Properties of the Garden Burger by Participants that Never Consumed Vegetarian Burgers

Characteristic (n=32)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	9 (28.1%)	19 (59.4%)	2 (6.3%)	2 (6.3%)
Taste	17 (53.1%)	12 (37.5%)	2 (6.3%)	1 (3.1%)
Overall Acceptability	14 (43.8%)	16 (50.0%)	1 (3.1%)	1 (3.1%)

Table 10

Responses to the Sensory Properties of the Beef Burger by Participants with Some Consumption of Vegetarian Burgers (Once a month or more than once per week)

Characteristic (n=4)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	1 (25%)	3 (75%)	0	0
Taste	2 (50%)	1 (25%)	1 (25%)	0
Overall Acceptability	2 (50%)	2 (50%)	0	0

Table 11

Responses to the Sensory Properties of the Garden Burger by Participants with Some Consumption of Vegetarian Burgers (Once a month or more than once/week)

Characteristic (n=7)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	1 (14.3%)	4 (57.1%)	1 (14.3%)	1 (14.3%)
Taste	2 (28.6%)	5 (71.4%)	0	0
Overall Acceptability	3 (42.9%)	4 (57.1%)	0	0

* The group of participants that reported some consumption of vegetarian burgers included 6 participants that consumed vegetarian burgers once per month and 1 participant that consumed vegetarian burgers more than once per month. No participants reported consuming vegetarian burgers once per week.

Sensory Ratings Based on the Consumption of Beef Burgers

Table 12

Responses to the Sensory Properties of the Garden Burger by Participants that Never Consumed Beef Burgers

Characteristic (n=3)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	1 (33.3%)	2 (66.7%)	0	0
Taste	1 (33.3%)	2 (66.7%)	0	0
Overall Acceptability	2 (66.7%)	1 (33.3%)	0	0

* None of the participants in this group sampled the beef burger.

Table 13

Responses to the Sensory Properties of the Beef Burger by Participants that Consumed Beef Burgers Once per Month

Characteristic (n=17)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	4 (23.5%)	9 (52.9%)	3 (17.6%)	1 (5.9%)
Taste	3 (17.6%)	9 (52.9%)	5 (29.4%)	0
Overall Acceptability	4 (23.5%)	8 (47.1%)	4 (23.5%)	1 (5.9%)

Table 14

Responses to the Sensory Properties of the Garden Burger by Participants that Consumed Beef Burgers Once per Month

Characteristic (n=17)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	6 (35.3%)	9 (52.9%)	0	2 (11.8%)
Taste	8 (47.1%)	7 (41.2%)	1 (5.9%)	1 (5.9%)
Overall Acceptability	5 (29.4%)	11 (64.7%)	0	1 (5.9%)

Table 15

Responses to the Sensory Properties of the Beef Burger by Participants that Consumed Beef Burgers Once per Week

Characteristic (n=14)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	4 (28.6%)	8 (57.1%)	2 (14.3%)	0
Taste	3 (21.4%)	6 (42.9%)	4 (28.6%)	1 (7.1%)
Overall Acceptability	3 (21.4%)	7 (50.0%)	4 (28.6%)	0

Table 16

Responses to the Sensory Properties of the Garden Burger by Participants that Consumed Beef Burgers Once per Week

Characteristic (n=14)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	0	10 (71.4%)	3 (21.4%)	1 (7.1%)
Taste	6 (42.9%)	7 (50.0%)	1 (7.1%)	0
Overall Acceptability	5 (35.7%)	8 (57.1%)	1 (7.1%)	0

Table 17

Responses to the Sensory Properties of the Beef Burger by Participants that Consumed Beef Burgers More than Once per Week

Characteristic (n=5)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	3 (60.0%)	2 (40.0%)	0	0
Taste	2 (40.0%)	1 (20.0%)	1 (20.0%)	1 (20.0%)
Overall Acceptability	3 (60.0%)	0	1 (20.0%)	1 (20.0%)

Table 18

Responses to the Sensory Properties of the Garden Burger by Participants that Consumed Beef Burgers More than Once per Week

Characteristic (n=5)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	3 (60.0%)	2 (40.0%)	0	0
Taste	4 (80.0%)	1 (20.0%)	0	0
Overall Acceptability	5 (100%)	0	0	0

Sensory Ratings Based on Gender

Table 19

Responses to the Sensory Properties of the Beef Burger by Male Participants

Characteristic (n=4)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	1 (25%)	2 (50%)	1 (25%)	0
Taste	1 (25%)	0	1 (25%)	2 (50%)
Overall Acceptability	1 (25%)	0	2 (50%)	1 (25%)

Table 20

Responses to the Sensory Properties of the Beef Burger by Female Participants

Characteristic (n=32)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	10 (31.3%)	17 (53.1%)	4 (12.5%)	1 (3.1%)
Taste	7 (21.9%)	16 (50%)	9 (28.1%)	0
Overall Acceptability	9 (28.1%)	15 (46.9%)	7 (21.9%)	1 (3.1%)

Table 21

Responses to the Sensory Properties of the Garden Burger by Male Participants

Characteristic (n=5)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	1 (20%)	3 (60%)	1 (20%)	0
Taste	3 (60%)	2 (40%)	0	0
Overall Acceptability	3 (60%)	2 (40%)	0	0

Table 22

Responses to the Sensory Properties of the Garden Burger by Female Participants

Characteristic (n=34)	Very Satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Appearance	9 (26.5%)	20 (58.8%)	2 (5.9%)	3 (8.8%)
Taste	16 (47.1%)	15 (44.1%)	2 (5.9%)	1 (2.9%)
Overall Acceptability	14 (41.2%)	18 (52.9%)	1 (2.9%)	1 (2.9%)