THE UNIVERSITY OF THE WEST INDIES
AT ST. AUGUSTINE, TRINIDAD AND TOBAGO

A Research Paper

Submitted in partial requirements

for HUEC 3012

of

The University of the West Indies

Title: An investigation of the Micronutrient content of selected foods consumed by Students of the University of the West Indies, St. Augustine Campus

Student Name: Natalia St. Louis

Project Supervisor: Dr. Patricia Dyett

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Department of Agricultural Economics & Extension
Faulty of Food and Agricultural

AN INVESTIGATION OF THE MICRONUTRIENT CONTENT OF SELECTED FOODS CONSUMED BY STUDENTS OF THE UNIVERSITY OF THE WEST INDIES, ST. AUGUSTINE CAMPUS.

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Natalia St. Louis

ID: 810003108

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SUPERVISOR: DR. PATRICIA DYETT

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Table of Contents

List of Tables

List of Figures

Abstract

Background- The micronutrient content of popularly consumed on-campus foods is unknown. Yet such an investigation is warranted because micronutrients play key roles in the body. Persons who study at the University of the West Indies campus St. Augustine are at increased risk for nutritional deficiencies because they might skip meals and or make poor food choices. One researcher argues that, portion sizes of burgers, fried potatoes, pizzas, soft drinks at fast food outlets have all increased 2.5 fold over the last 50 years. These meals are also typically energy dense. He continues reporting that energy density of the entire menu at fast food outlets is typically 1100 kj /100g (Stender et al 2007). Despite this increase in size and quality an increase in the quantity of micronutrients in meals have not followed suit.

Objective – The general objective of the present study was to chemically analyze selected micronutrient contents of the popularly consumed meals on the St. Augustine campus.

Methodology- Meal Sample selection was done based on the results of a preliminary interview done with 72 students. Calcium, Iron, Magnesium, Sodium, Phosphorus, and Vitamin C content from the meals was analyzed using special techniques and relevant equipment such as the AAS- ashing technique, the UV Vis at 880 nm, and colorimetry. Data was analyzed using SPSS [version 12.0] and the statistical tests performed were, Independent sample t-test, ANOVA, Tukey HSD post hoc and simple linear regression.

Results-Consumption of fast food and Soft drinks was high. Mineral content among all study samples was varied. The KFC meal sample had the highest sodium levels (445.26 mg). The items that contained cheese the pizza and the cheese pie sample had the highest amount of calcium of all the studied samples. The cheese pie sample had the highest mean magnesium (15.29mg), phosphorus (74.84mg) and calcium (265.88mg) content. Low Iron levels were observed in Yvette's Callalo lunch sample (0.46mg).

Conclusion –Fast foods are the popular menu items consumed by University of the West indies St. Augustine campus students. Regarding the micronutrient content of meals, both fast foods and traditional meals vary in mineral content from day to day. It was observed that differences in micronutrient content exist between all studied groups. Average sodium was found to be highest in the KFC meal sample (445.26mg) and lowest in the Mini garden pizza meal sample (112.63). Average calcium content was found to be highest in the Cheese pie meal sample and lowest in the Yvette's meal sample. On a micronutrient basis the Cheese pie sample is an ideal food because it provides adequate quantities of at least three micronutrients. This sample contained moderate sodium (302.05 mg) and average quantities of

Iron (1.5 mg). However this food item may not possess an ideal composition of Vitamins and Macronutrients that was not currently investigated.

Consumption of soft drinks should be limited. It was discovered that Trinidad fresh orange juice is a better source of Vitamin C than Sprite. Sprite was observed to be a poor source of Vitamin C (< 5 mg). Therefore Trinidad fresh Orange juice is an ideal beverage.

Definition of Terms:

Traditional foods; foods typically prepared and served at home and are typical of the culture of the country.

Fast foods; foods that are easy to procure and consume.

Callaloo; a soup made from dasheen bush leaves, coconut milk, vegetables.

Roti; flatbread type item, served with curried chick peas, curried potatoes, curried vegetables.

Background:

The consumption of home cooked meals is becoming less popular. Many factors can be attributed for this. Mahan and Stump-Escott (2008) states that, "In developed countries the tradition of eating three meals a day has been replaced by eating more frequent snacks, light, low calorie prepared meals and eating at fast foods outlets." He further explains, "These changes are due to affluence, eating out as a leisure activity, availability of convenience foods, more women working full time and a changed work, leisure pattern." Clegg and Mackean (2000) agree, "During human history our diet has changed with the move from hunting and gathering food to settled agriculture." As technology become more advance , it becomes ever more easier for individuals to depend on easier and more convenient means of attaining meals to provide them with the necessary nutrition. Clegg and Mackean (2000) also state that, "Changing food patterns result in an increase of foods higher in sodium, added fat, sweeteners and a decrease in basic foods such as fruits and vegetables."

One such avenue that has become highly popular is the consumption of Fast foods. Annual revenue generated by fast food according to Stats brain.com (2013) "is $110 billion." Despite the increasing popularity of fast foods health professionals continue to lobby against such action. Kolodinsky et al. (2007) concurs, "A higher risk of emotional depression was associated with consumption of Fast Food." Foods prepared away from home have been recognized to contain more energy and fat and less nutrients than foods prepared at home. "Fast food generally has a high-energy density, which, together with large portion sizes, induces over consumption of calories Stender et.al (2007)." Further he adds, "Serving sizes of burgers, fried potatoes, pizzas, and soft drinks at fast food outlets have all increased 2.5 fold over the last 50 years." These meals are typically energy dense. He continues reporting that energy density of the entire menu at fast food outlets is typically 1100 kj /100g (Stender et al 2007). Another researcher agrees,

"It is estimated that at a typical fast food restaurant the average energy density of an entire menu is approximately 1100 KJ/100 g which is more than twice the energy density of a healthy menu (Azadbakht and Esmailzadbeh 2008)."

The University of the West Indies, St. Augustine campus, currently has one main food court situated to the South of the Campus. At this location there are establishments such as KFC, Mario's ,Boomers, Subway, Veg out, Asha's East Indian Cuisine, Pank's doubles, Beirut grill, UWI Nectars, Savr d Flavr, Café UWI , Rituals, Small Café , Maureen's Cuisine and Club equinox. The KFC international franchise on the St. Augustine campus serves fried chicken, French fries, Cole slaw, biscuits, popcorn chicken, chicken and fish sandwiches and for the Lenten period shrimp and fish fillet served with French fries. Beverages include the choice of soft drink, mauby or bottled water. Mario's, a locally run company serves pizzas, hamburgers, French fries, nuggets, submarine type sandwiches and apple pie. Beverages served with these meals include orange juice, mauby, fruit punch and bottled water.

Boomers, a company run under the same management as Mario's serves salads, submarine sandwiches consisting of chicken, tuna, beef, pork, soya and shell fish with tomatoes, lettuce, cucumber, onion and cheese and wraps, muffins and cookies. The beverages served are similar to that of the Mario's restaurant. Veg out is a restaurant dedicated to serving only vegetarian dishes. These include cheese pies, cheese and spinach pies, sausage rolls, currants roll, egg less cakes and muffins, snacks and meals consisting of beans, soya, pasta, vegetable rice and salads. These meals are served with orange juice, punches, coconut water and soft drinks. Asha's Indian cuisine is the only restaurant solely dedicated to Indian cuisine. The restaurant serves roti, buss up shot, sadha roti with pumpkin, bhagi, bodi, curry potatoes, curry chicken, curry goat, curry beef, amchar mango, rice and dhal. These menu items are served with orange juice, mauby and soft drinks.

On the Northern side of the campus there is Yvette's and the Languages cafeteria. Yvette's is one of the few restaurants that are dedicated to selling traditional meals (creole foods). At this establishment meals

are rotated on a daily basis. Meals include red beans, callallo, macaroni pie, steamed provisions, stew chicken, bake chicken, steam fish, fry fish and bhagi rice. On Fridays curry dishes are served. These menu items are served with an array of juices, punches, soft drinks, coffee and teas. Few restaurants are located in this area because of its strategic locality near the busy Bus Route. Dispersed strategically throughout the campus are vendors that sell pies, a Doubles King establishment and a sublet of Yvette's.

Students that study at the University of the West Indies (UWI) St. Augustine campus are usually residents on halls or are commuting students. According to the Guardian newspaper (Doughty, 2012), "40 per cent of the students attending the university come from central and southern communities." A greater percentage of students commute than those who stay on the resident halls. There are three halls located on the main campus. They are Milner, Trinity and Canada Hall. These halls of residence are all within walking distance from classes, faculty buildings, and campus food court, as well near major North East Trinidad traffic routes - the Eastern Main Road, the Priority Bus Route and the Churchill Roosevelt Highway. The Joyce Gibson-Inniss Hall is located near the Mount Hope Medical School & Complex. This Hall is for students from the Faculty of Medical Sciences only. The newest hall, the Sir Arthur Lewis Hall of Residence is located a short distance off-campus. Shuttles are assigned to service this hall to ensure its residents easy access to campus.

The hectic schedule that university students have to try to manage can possibly prevent them from attaining adequate micronutrients in food. While many health officials and researcher focus on macronutrients, appropriate and proportional intake of micronutrients is just as important; this is because micronutrients play vital roles in the body. Micronutrients are necessary for normal functioning of the body but needed in small quantities. They include the Water soluble Vitamins, Fat soluble Vitamins and Minerals. According to Mahan et al. (2008) "Minerals represent about 4% to 5% of body weight." Additionally, "Of this percentage 25% is Phosphorus, 50% Calcium, with 99% of the Calcium and 70% of the Phosphate are found in the bones and teeth." On the other hand the Fat soluble vitamins are transported along with dietary fat and are stored in the regions of lipid membranes and lipid droplets in

the body. Water soluble vitamins are transported by carriers and is stored in large quantities but excreted in urine.

Further in a healthy adult female total body iron is 2.4g and in males 3.6g of total body iron. Clegg and Mackean (2000) describes that, "iron is a component in Hemoglobin, Myoglobin, enzymes and cytochromes." The World Health Organization (WHO, 2013) states that, "Iron deficiency is the most common and widespread nutritional disorder in the world." Bio Sorghum.org agrees, "Iron deficiency alone is a contributing factor in over 20 percent of post-birth maternal deaths in Africa." Despite this statistic other micronutrients also seem to be absent from the diets of many. WHO (2013) states that, "Two hundred and twenty four million people live with Iodine deficiency." Haghollahi (2008) explains that, "Zinc deficiency occurred in 1.4% and 5.7% of female students in his study population."

On the other hand Vitamin C (Ascorbic acid) also plays an important role in adult nutrition. According to Clegg and Mackean (2000) Vitamin C is critical in the maintenance of connective tissue." Leathem (2006) agrees with this statement and explains, "Vitamin C is necessary for the maintenance of the intracellular matrix of cartilage, bone and dentine, collagen synthesis and activity as an antioxidant." Yet its most important role in women of reproductive age is its ability to increase absorption of non heme iron.

Another micronutrient that plays a variety of roles in the body is magnesium. "Magnesium plays a role in stabilizing the structure of ATP in ATP dependent enzyme reactions, as a cofactor for more than 300 enzymes, and in neuromuscular transmission." (Mahan et. al 2008) Due to the significance of these nutrients ions cross membranes of cell organelles and aid in smooth muscle contraction. Likewise (Leathem 2006) agrees, "Magnesium aids in energy metabolism." Due to the significance of these nutrients in one's diet it is almost crucial to ensure that a diet contains these nutrients in adequate quantities.

Adequate Calcium consumption is necessary in the body to promote bone mass development during the adolescent period. Yet however after these formative years it plays a critical role in transmission of ions across membranes of cell organelles and in smooth muscle contraction. Shahar et. al (2010) adds that , " calcium also plays a crucial role in weight maintenance and in preventing obesity and overweight."

On the other hand Sodium is one of the most abundant nutrients in food. Yet most of the sodium found in foods is added during processing and manufacturing. The FDA (2013) states that, "over 75% of dietary sodium comes from eating packaged and restaurant foods." Yet this high consumption of sodium can never be good for the human system because high sodium consumption has been linked to many disease states. It was stated that, "Hypertension affects approximately one in three US adults, or 75 million people." PAHO (2007) explains that, "cardio-vascular diseases resulting from hypertension and diabetes account for about 40% of Caribbean mortality." Despite these troubling statistics sodium plays a crucial role in the body. Sodium acts as an electrolyte in the body and regulates fluid substances in the body.

This Research paper will chemically analyse typical meals consumed by University of the West Indies students to determine the micronutrient content and compare the Fast food meals with the Traditional type meals. The Micronutrients that would be studied are Calcium, Iron, Sodium, Magnesium, Phosphorus (Ca, Fe, Na, Mg, and P) and Vitamin C.

Purpose of the study:

The purpose of this study is to determine whether meals offered on the UWI campus are healthy in terms of the micronutrient content of the foods by chemically analyzing selected meals to determine their micronutrient content.

Rationale: Due to the changing lifestyles people live, more persons are now busier and have less time to prepare traditional meals. Thus they depend on fast foods (convenience) for adequate nutrition. Despite being busier and having less time, persons are becoming health conscious due to the growing availability

of information about nutrition and increased media promotion of health. This paper is concerned with the foods consumed by University students because at this stage persons are transitioning from adolescence to adulthood and health and wellness can take on greater importance in their lives. Additionally adults are in the ideal lifecycle phase for health promotion and disease prevention. The purpose of this study is twofold. First, this study will add to the body of knowledge about the micronutrient composition of typical meal items and secondly make recommendations about healthy meal options. Thus this work can be used in the decision making process by persons desiring to make healthier food choices. This study is one of the first to be undertaken surrounding this topic and can therefore lay the foundation for future research endeavors.

Problem statement: Little or no information is available about the analysis of locally consumed (traditional food). On the other hand more and more fast food restaurants release information about the content of their meals whether via the internet or through labeling. Despite this there is no information about the nutritional content of traditional food for any comparison to occur. Thus persons might hold distorted views about the healthfulness of consuming fast foods against choosing the traditional meals peculiar to the culture. Daily the media transmit messages that attack the consumption of fast foods. Thus the health conscious and persons desirous of losing weight might subscribe to these messages. As a result they try to avoid consuming fast foods in preference for traditional meals. Preparation of traditional meals is time consuming, and university students may not have such valuable time to spare. Currently little information is available about the micro-nutritional content of fast foods and traditional meals provided at the UWI campus. This research paper will highlight the micronutrient content of foods typically consumed by university students in an effort to increase knowledge that could stimulate wise decision making.

Objectives

General Objectives:

- To determine the micronutrient content of meals consumed by the University of the West Indies St. Augustine student population.
- To determine the Vitamin C content of beverages.
- To investigate whether traditional meals are healthier than popularly consumed fast foods.
- To provide recommendations based on micronutrient content.

Specific Objectives:

- To determine the faculty enrollment of students.
- To determine the meal preferences of students at the University of the West Indies, St. Augustine campus.
- To determine the mineral content of the popular meals consumed by students.
- To compare mineral content of meals between groups.
- To determine the percentage of students that typically consumes beverages.
- To determine the mean Vitamin C content of popular beverages.
- To compare Vitamin C content between groups.

Hypotheses

- Fast foods are associated with lower levels of Iron than traditional meals.

- Traditional meals are associated with higher levels of micronutrient content than Fast foods.
- Fast foods are associated with high levels of sodium.
- Soft drink is associated with lower levels of Vitamin C content than Trinidad fresh Orange juice.

Literature review

Chemical analysis of food encompasses a wide range of techniques, methodologies and principles that can be undertaken. Each technique possesses its own unique array of equipment, methodologies and sample preparation. Yet each methodology will allow the researcher to be put at some advantage and on the other hand a disadvantage. Thus in an effort to maximize reliability, and validity of tests, the researcher must choose the most precise and viable tests and methodology to follow. As a result the research undertaken would be a true reflection of the sample population. Beside the fact that the most accurate technique might be chosen, there are still some factors that may influence the amount of nutrient reported after analysis. Thus this literature review focuses on methodologies employed by researchers that have performed similar work; and consideration of certain factors that contribute to the levels of mineral content reported after analysis.

Sample Preparation

The design of different equipment and techniques require the use of varying sample preparation techniques. Sher et al. (2011) conducted a study that analyzed the micronutrient contents of eight forage shrubs. In the preparation of the sample, the samples were dried, ground then stored in plastic bags for chemical analysis. Conversely, Azor and Joseph (2008) in their research performed proximate analysis on castor seeds and cake. To prepare the samples for analysis the castor seeds were ground into fine meals using a blending machine. In addition, another researcher freeze dried the sample then weighed before testing for micronutrients (Santos et al. 2010). Nurmadia et al. (2012) states that, "after bagging

and freezing his samples, they were dried." Contrary to this, the samples used in a study by Mahadhar et. al (2012) were oven dried at 60◦C until constant weight was obtained, and then transferred to a grinding machine to make a powder and the dried powder then was randomly mixed and powdered.

On the other hand, Adeyeye et al. (2012), "allowed their samples to be dry ashed at 55°C then dissolved in 10% (25ml) HCL." According to the AOAC (2002) freeze drying is the most applicable technique to any type of food. It was further explained that, " use of microwave drying usually results in charring of the sample and that oven drying allows losses of volatiles, degradation of fats and caramelisation of sugars." Some researchers who wrote extensively on food analysis comments that, "sample preparation is recognized to be the largest source of error and one of the most critical points of analysis." Welna et al (2011) further stated that, "there is no unique sample preparation technique that can maintain all requirements of analysts." Thus researchers mostly consider using any of the following sample preparation techniques: drying, dilution, acid digestion, extraction and slurry sampling or direct solid analysis. After the right sample preparation technique is performed then the choice of equipment becomes the next important subject.

Equipment

As technology advances more and more sophisticated equipment for the analysis of food reach the markets. But to ensure that results are accurate care must be taken in determining which of the available equipment to use. Adeyeye et al (2012) in his study employed the use of a Flame Photometer [Model 405] for the analysis of Sodium and Potassium, Phosphorus were determined colorimetrically using a [Spectronic 20] instrument and Calcium, Iron and Magnesium were determined by use of an Atomic Absorption Spectrophotometer [AAS Model 403]." Conversely another researcher used Absorption Spectrophotometer equipment but version [AVG 210] in the analysis of Calcium, Iron, Potassium, Magnesium, Sodium and Zinc (Omale and Ugwu 2011).

According to the FAO (2012), "Flame Photometry and Atomic Absorption Spectrophotometry are the preferred techniques for micro-mineral analysis." Spada and colleagues (2010) analyzed the micro-mineral content of frozen fruits used a completely different methodology. In order to quantify mineral compounds in frozen fruits, they employed the use of Particle Induced X-ray Emission (PIXE) analysis. It was stated that, "this technique has a multi-elemental capability, so that all elements with atomic number higher than 11 can be simultaneously detected in a single measurement (Spada et al. 2010)."

Contrary to this in the analysis of rice to determine the mineral content use of the AAS equipment was employed by Sharma and colleagues (2012). Yet it was reported that, "perchloric acid and nitric acid was mixed in a 1:1 ratio and 1 gram of the sample was allowed to digest in this mixture before AAS analysis." Other researchers compared three popular techniques employed to analyze the Calcium content of food. They observed that the AAS-ashing method detected more calcium than the titration method and the AAS- non-ashing method. Additionally their study also concluded that, AAS non-ashing was the least accurate technique, whilst AAS ashing requires less supervision but may require greater financial investment (Bissessur et al. 1999).

Both Rathod et al (2012) and Ordonez- Santos et al. (2011) employed the use of AAS in the analysis of their specific study samples for the determination of iron, calcium and zinc. However Rathod et al. (2012) used flame photometer to determine sodium and potassium.

Another researcher also believes in the validity of the AAS technique. In the proximate analysis of edible mushrooms the minerals iron, copper, manganese was read on AAS (Adejumo and Awosanya 2004). Another technique was employed by a researcher in the determination of Co Cu, Fe, Mn, Zn, Na, K, Ca, and Mg. It was reported that, Ten ml of sample was transferred into a 15 ml polypropylene test tube for injection into inductively-coupled plasma-optical emission spectrometer [ICP-OES)] (Nurnadia et al. 2013).

Conversely another researcher allowed his samples to be digested by a microwave digestion technique and after this step; the mineral elements were measured using the (Pye-Unicam) Flame Atomic Absorption Spectroscopy (Musaiger and D'Souza 2008). It was also reported that in an effort to attain a single large representative bulk sample; mixing was done by a high-powered Buchi Mixer B-400 (Musaiger and D'Souza 2008) Spada et al. (2010) argues that, analysis by PIXE is relatively fast when compared to other methods and is a nondestructive technique therefore additional measurement can be done if necessary.

Additionally it was revealed that, "contamination is greatly reduced because there is no need to prep the sample for analysis and most importantly it can be used to analyze a wide range of sample types." Spada et al. (2010) Despite the method employed in the determination of mineral other factors might play a role in how much of the original content is reported on.

Cooking Method and Mineral Retention

Cooking methods vary from each other on a wide array of factors. Yet for the purpose of this study it is of upmost importance to discover whether mineral retention is equal for all cooking methods. Ghidrus et al. (2010) explains that, "changes are almost negligible during frying, with the loss of water, mineral content is expected to rise." Other researchers who studied the effect of cooking technique on mineral retention discovered a surprising relationship. It was discovered that micro-minerals were lost in variable quantities when the foods were prepared with techniques available at home (Severi et al. 1998).

Further it was reported by Ghidrus et al. (2010) that, "mineral losses in deep fried foods vary from 1% each in potatoes to 26% in beef and are significantly lower than in boiled foods of the same type."

Shah et al (2011) performed research on four different types of pulses; chick peas, lentil, mung bean and mash bean. The samples were analyzed both in the raw and cooked state. Proximate composition of the elements (Na, K, Ca, Mg, Fe, Cu, Zn and Mn) was undertaken in order to study the retention of each nutrient. It was discovered that, "Cooking had a significant effect on the mineral contents of chickpea ($P<0.01$)." Additionally after cooking all the eight minerals was significantly reduced in all pulses, this

loss in minerals on cooking may be attributed to leaching out of these minerals into the cooking water (Shah et al 2011).

Another study (Musaiger and D' Souza 2008) analysed eight cooked varieties of fish and one variety of shrimp (grilled, curried, fried and cooked in rice) that is commonly consumed for their mineral content. It was reported that there was no variation in the iron content in all the varieties of fried fish, but the highest iron content was in the curried item (1.0 mg/100g (Musaiger and D'Souza 2008). Additionally the highest sodium content was found in the fried samples (600 mg/100g). The researchers also explained that, "potassium content was higher in all the fried fish (500-560 mg/100g)." On the other hand calcium level was highest in the samples that were curried (92 mg/100g) and in the curried samples (100 mg/100g) cooked in rice (Musaiger and D' Souza 2008). Likewise, "phosphorous content was highest in the fried fish sample and the other 3 methods did not show much of a variation." Additionally cooking in rice was shown to improve the phosphorous content (Musaiger and D' Souza 2008).

Another study performed proximate analysis of fish that was prepared using a variety of cooking methods. Revi and Sarojnalini (2012) discovered that magnesium and chromium content was highest in the curried fish sample and the authors concluded that the mineral composition of fish was affected by all the cooking methods.

Standards at Food Establishments

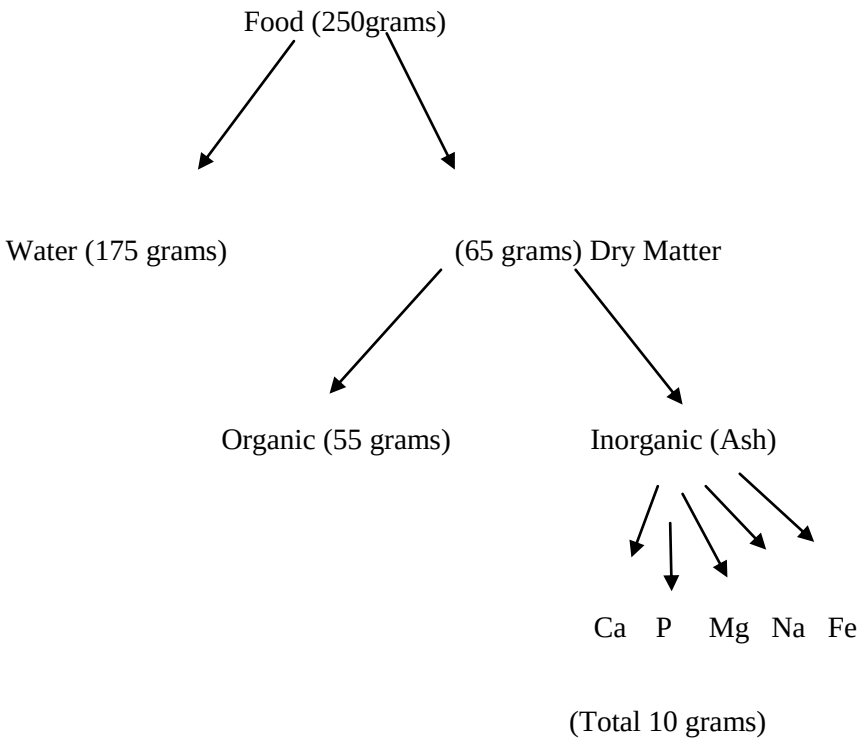
Restaurants in an attempt to control cost employ a variety of standardization techniques. Some establishments accurately weigh and measure ingredients. The benefits of implementing a system are numerous. Benefits of using standardized recipes are consistent food quality, predictable yield, customer satisfaction, consistent nutrient and food cost control (USDA 2002).

KFC (2012) took the position that, "variations that may occur can be expected due to seasonal influences and minor differences in product."

There is available a great number of techniques and preparation methodologies for the determination of mineral content of food. Yet each method will possess its own advantage and disadvantage, this may prove to be a challenge for a new researcher during the selection process. However an overall assessment of the techniques has resulted with the conclusion that the AAS ashing method is superior and UV Vis determination of phosphorus is a popular method. Sample preparation techniques must be done as accurately as possible in order to eliminate contamination. Additionally quality control measures must be included in the procedure for the analysis of minerals. Yet it must be noted that the preparation of food using different cooking methods may result in differing levels of mineral retention.

Figure 1:

Schematic Framework



Theoretical Framework

Atomic Absorption Spectroscopy

Atomic absorption spectroscopy (AAS) is a popularly used technique for the determination of a number of elements. This technique can be used to analyze over 62 minerals in a solution. It requires a liquid sample containing the mineral sample. The liquid sample is aspirated by an air-acetylene flame which causes evaporation of the solvent and evaporation of the solvent and vaporization of the minerals. The compounds that make up the sample are heated and become excited. This process is referred to as atomization. The hollow cathode lamp operates in the UV-visible spectral region and causes electronic excitation of the metal atoms. The absorbance is measured with a conventional UV-visible dispersive spectrometer with photomultiplier detector. Then the light beam passes through the cloud of atomic vapor formed in the flame. The Atomic absorption method measures the amount of energy that is absorbed by the sample. The equipment uses Beer's Law to quantify mineral content in samples.

Molecular UV-Visible Spectroscopy

Molecular UV-visible spectroscopy is performed by undertaking a transmittance measurement analysis with a liquid sample. It works at wavelength ranges from 190 nm to 800 nm. The Beer's law is used by this technique. This technique describes a straight line relationship between absorbance by the sample's atoms and mineral concentration. The UV-Vis equipment measures the percentage of radiation that may be absorbed at a prescribed wavelength. It can be used for qualitative and quantitative analyses. This method can also be used for the analysis of solids and gas materials. This equipment lies on the principle that molecules absorb ultraviolet or visible light. As light hits the molecule absorbance of the sample increases. Absorption of light is proportionately linked to excitation of electrons.

Methodology:

Description of Materials:

The study population includes all the food served by the food establishments that operate on the St. Augustine University of the West Indies Campus. These include fast food restaurants, home cooked / traditional food establishments, minimarts and small scale vendors.

The study sample included food from KFC, Subway, Mario's Pizzeria, Asha's roti and Yvette's. Table 1 provides the meal content for each sample.

Table 1: *Description of Materials*

Sample	Constituents
KFC	2 piece leg and thigh (fried, spicy) , regular fries without dressings and a sprite soft drink
Subway	six inch Teriyaki sandwich served with cheese, tomato, cucumber, lettuce, green peppers, with garlic sauce, chadon beni and ketchup and a sprite soft drink
Asha's	chicken roti,(dhal puri served with curry channa , potatoe and chicken) without pepper and a Trinidad fresh orange juice
Mario's	mini pepperoni pizza with ketchup with sprite soft drink
Mario's	mini garden pizza with ketchup sprite soft drink
Yvette's	Parboiled rice, callaloo, stew chicken, cabbage salad and Trinidad fresh orange juice
Yvette's	cheese pie and Trinidad fresh orange juice

Design:

This research project was a repeated measure, food analysis study. The Dependent variables were the foods and the independent variables were Ca, Fe, Na, Mg, P. Each dependent variable was analyzed in triplicate and the mean calculated and recorded. Control procedures were undertaken to ensure that the results recorded were a true representation of what was observed.

Sampling Procedure:

Interviews: A seven question sheet was prepared. 72 persons were interviewed within a three week period. It included two sections. The first section included demographic questions and the other section questions about meal choice. Statistical analysis was performed to determine the most popularly consumed meals. The ten most popular meals were chosen. However due to the time restraints and availability seven meals were chosen and two beverages. Analysis was performed on seven meals and two beverages that were purchased on three separate days during the hours of 11am-1 pm daily.

Sample Preparation

Meat sample were deboned and all other inedible portions were removed. The sample was broken into 1" pieces and mixed to form a homogenous mixture. Rice samples were mixed with other components. The samples was placed into Styrofoam boxes, weighed and labeled. Weights were recorded for later use. Samples were placed in the freezer at -20 ° C for a 24 hour period. After the 24 hour period the samples were freeze dried in increments of 24 hours. See Table 2. for the freeze drying times for the different samples. Freeze drying was done in a SB4 Armfield industrial freeze dryer. The samples were dried until constant weight was achieved. Samples were removed from the freeze drier and weighed. Weights were taken as the first stable weight and were then recorded. Samples were bagged in a plastic bag and placed into the dessicator to prevent the absorption of moisture.

Table 2: Freeze drying times of individual samples

Sample	Freeze Drying Times/ hrs.
Mini Pepperoni Pizza	24
Mini Garden Pizza	48
Cheese pie	24
Subway teriyaki sandwich	48
KFC	24
Roti	48
Yvette's callalo lunch	48

Each sample was removed individually and grinded to a fine powder with a mortar and pestle. The ground sample was placed in a specimen bag and labeled. All ground, bagged samples were placed in a dry cupboard for storage until analysis.

Determination of Dry Matter

38 clean crucibles were dried overnight at 105 ◦ C. the 38 crucibles were labeled. Then the crucibles were placed into dessicators to cool. The cooled crucibles were weighed and the weights recorded. A weight between 1.5 g to 2.0 g of sample was accurately weighed after the crucible weight was tared for the 38 samples. The weight was recorded. The 38 crucibles containing the samples were placed in the oven at 105 ◦ C overnight. The crucibles were removed with thongs and cooled in dessicators to room temperatures. The cooled crucible and dried sample was weighed. The weights were recorded.

Determination of Ash

After dry matter was determined the 38 crucibles containing the samples was placed in a muffle furnace and ashed at 600◦ C for 6 hours. The furnace was allowed to cool to 150 ◦ C and the crucibles and contents were transferred to dessicators to be cooled. The crucibles were weighed and recorded. Ash content was calculated.

Preparation of Ash Solution for the Determination of Ca, Mg, Fe, Na and P.

10 ml of concentrated (50%) HCL acid was added to the ashed crucible samples whilst inside the muffle furnace on the sand bath. It was allowed to evaporate to about 3-4 ml volume. Then 20 ml of distilled water was added and the samples were heated at 100◦ C. The samples were allowed to evaporate to evaporate to about 10ml. Then 10 ml of water was added and heated to around 90 ◦ C. The 38 samples were allowed to cool and the samples were individually filtered through Whatman (#54, low ash filter paper) in long stem funnels into 100ml volumetric flasks. The crucible and the filter paper were rinsed with distilled water. Distilled water was added to make up the solution. The ashed solution was bottled and labeled and saved for mineral analysis.

AAS (Atomic Absorptionometry) Mineral Determination.

This technique was used to determine FE, NA, Ca, Mg mineral content of the 38 samples. The computer was turned on. Then the Perkin Elmer machine was turned on. The AA win lab was clicked and the specific lamps were turned on. The aspiration tube was placed in distilled water. The analyze button was pressed and the machine was auto-zeroed. The aspiration tube was placed into the standards one at a time and analyzed. Each sample was analyzed one at a time for the different elements. Sodium, Iron, Magnesium, and Calcium were analyzed. Two minerals were analyzed in any one day. The results was printed on sheets of paper and kept safely for calculation of total mineral content per sample. A quality control check was performed by calculating the percent recovery for the different minerals.

Table 3: The minerals analyzed using AAS and the content percent recovery associated with the element.

Mineral	Percent recovery (%)
Sodium	97
Calcium	92
Iron	98.5
Magnesium	94.4

Phosphorus determination using UV Vis

A mixed reagent was mixed in the following order: 50 ml of 0.25 M H_2SO_4, 5 ml of PAT solution, 15 ml of AM solution and 30 ml ascorbic acid solution. Then phosphate standards (0.1, 0.2, 0.3, 0.4, 0.5, 0.6 ppm) were prepared using 25 ml volumetric flasks and a blank. 4.0 ml of mixed reagent was added to the solution. The solution was diluted to volume with distilled water and mixed well. It was allowed to stand for 10 minutes for a color change to be observed. 5 ml (or further of the sample was diluted if necessary) in a 25 ml volumetric flask. 5 drops of p-nitrophenol indicator was added and the solution made up with distilled water. The absorbance was measured at 880 nm on the UV VIS mini.

Determination of Vitamin C content of beverages

10 mls of the sample was titrated with the indophenol solution. The rose pink color was observed for at least 10 seconds to indicate an end point. The titrated volume was recorded and used to calculate Vitamin C content.

Statistical Analysis:

Inferential statistics was undertaken to make conclusions. Tests used included an Independent Sample t-test or one way ANOVA, and regression analysis. Statistical procedures included comparing mean contents using analysis of variance, summary statistic and mean variance. The Regression Analysis was used to determine the strength and direction of the relationship between two or more variables. SPSS software [version 12.0] was also used to generate descriptive statistics which included statistical tables, bar graphs and pie charts. All tests were conducted at the 5% level of significance ($p \leq 0.05$).

RESULTS

Demographics

The students who were surveyed on most popular meals purchased included 40.5 % of subjects who belonged to the Faculty of Food and Agriculture, 21.5% who belonged to the Faculty of Science and Technology, 27.8% who belonged to Social Sciences and 8.1 %who belonged to the other faculties. Table 4 summarizes the faculties that the students belonged to.

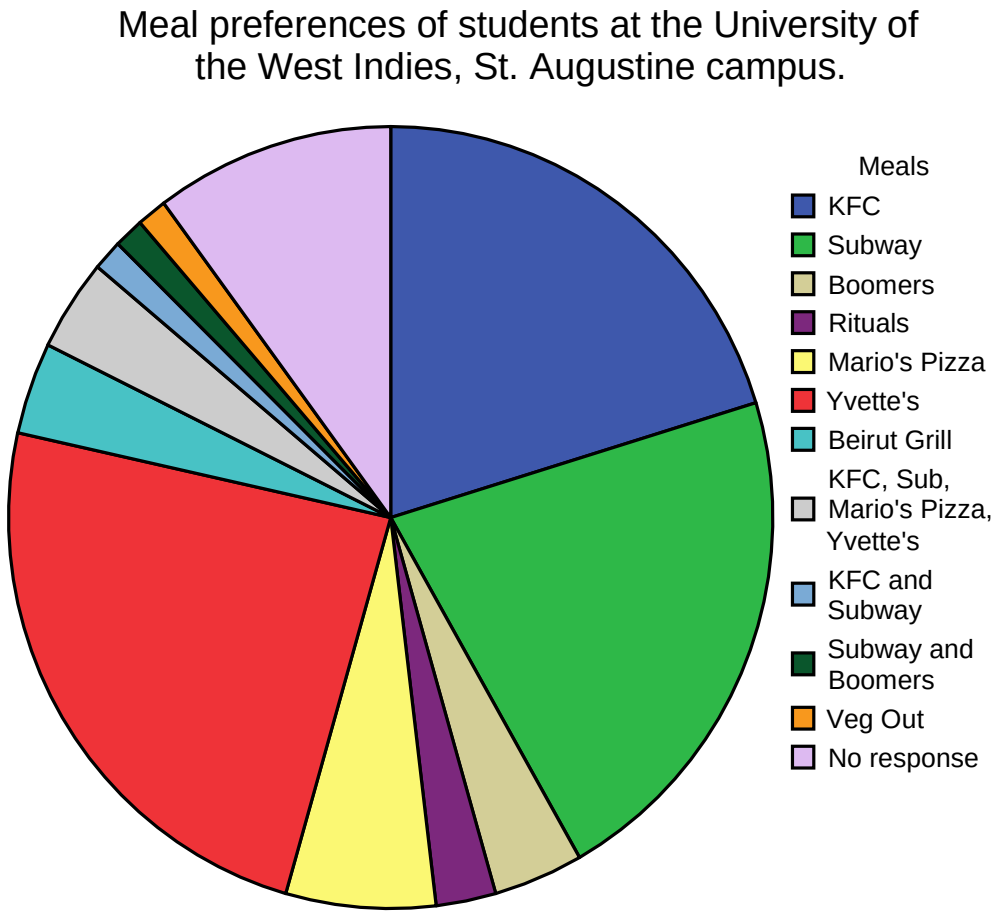
Table4: Faculty enrollment of students surveyed about meal popularity.

Faculty	Percentages of students
Food and Agriculture	40.5
Science and Technology	21.5
Social sciences	27.8
Other	8.1

Meal preferences

Students consume Subway sandwiches more than any other food type. Consumption of Yvette's, KFC and Mario's are also very high among students. Figure 1 shows the meal preferences of students.

Figure 2:



Mineral content

Mineral content varied across the three sampling days and across samples. Sodium content was the greatest in KFC (747.67mg) when sampled at day one. In the Cheese pie sample calcium (345.80 mg) content was greatest among all the samples, magnesium (17.43 mg) and phosphorus (91.63 mg) when sampled at day two. Iron content was greatest in the Mini pepperoni pizza (1.94 mg) sampled on day one. Conversely the Sodium content was least in the Mini garden pizza (112-63mg) when sampled on day two. Also Calcium content was lowest in the Roti (25.81 mg) when sampled on day one. Iron content was

lowest in the Mini pepperoni pizza (0.30 mg) when sampled at day two. Magnesium content was lowest in the Yvette's Callaloo (7.82mg) lunch when sampled on day one. Phosphorus content was lowest in Roti (26.63mg) when sampled on day two. Table 5 summarizes the mineral content of the different samples and the day of purchase.

Table 5: Mineral composition of Popular Meals.

Food	Day of purchase	Sodium content/ mg	Calcium content/mg	Iron content/mg	Magnesium content/mg	Phosphorus content/mg
Mini pepperoni	1	382.39	120.74	1.94	11.93	63.21
	2	207.81	144.70	.95	10.43	50.07
	3	313.49	185.40	.54	12.27	58.19
Mean Content		301.23	150.28	1.14	11.54	57.15
Mini garden	1	198.55	109.14	1.02	10.85	34.59
	2	112.63	68.56	.30	9.62	27.57
	3	170.71	169.34	.62	8.55	30.23
Mean Content		160.63	115.68	0.64	9.67	30.79
Cheese pie	1	329.77	165.44	1.20	17.43	91.63
	2	333.36	345.80	1.78	14.77	67.12
	3	243.04	286.40	1.81	13.69	65.78
Mean Content		302.05	265.88	1.59	15.29	74.84
Subway Teriyaki	1	317.00	129.93	1.22	15.35	62.18
	2	340.80	227.41	1.08	15.22	57.98
	3	307.75	191.74	.35	12.16	47.06
Mean Content		321.85	183.02	0.88	14.24	55.74
KFC	1	747.67	41.80	.77	12.93	52.54
	2	330.06	89.59	.47	11.33	51.80
	3	258.06	55.30	.54	9.54	35.79
Mean Content		445.26	62.23	0.59	11.26	46.71
Roti	1	181.36	25.81	.61	6.83	26.88
	2	234.31	56.98	.99	8.85	26.63
	3	183.35	98.00	.57	8.82	65.24
Mean content		199.67	60.22	0.72	8.1	39.58
Yvette's Callaloo lunch	1	259.13	35.99	.46	7.82	28.33
	2	.00*	.00*	.00*	.00*	.00*
	3	.00*	.00*	.00*	.00*	.00*
Mean		259.13	35.99	0.46	7.82	28.33

*missing data

When a regression analysis was done, it was found that Weight is not a useful predictor of Iron content of foods. (p> 0.05, 0.880) and Weight is not a useful predictor of Sodium content of foods (p>.0.05, 0.700)

Comparisons of Mineral Content

Based on the ANOVA statistical test the mean Sodium, Iron, Phosphorous and Magnesium content varied between groups. Sodium among groups were not equal and there was a significant difference (p=.051). There was also a significance difference (p=0.018) between the means of food groups for the variables Iron content (p=0.018), Phosphorous (p=0.001) and Magnesium (p=0.000) where in all instances the means were greater. Table 6 summarizes the ANOVA findings.

Table 6: ANOVA Analysis of the Dependent variable Food Names with Selected Independent Variables and their Corresponding p Values.

Independent variables	Significance (p value)
Sodium	0.051
Iron	0.018
Phosphorus	0.001
Magnesium	0.000

Sodium

Sodium content of KFC was greater than that of the Yvette's callaloo lunch. (p = 0.037) All other food means when compared to KFC show no difference in means. Table 7 summarizes the significant findings.

Table 7: Tukey Post Hoc Test Analysis.

Dependent variable: Sodium

Independent variable	Significance (p value)
KFC, Callalo lunch	0.037

Calcium

Mini pepperoni pizza had greater calcium content than the Yvette's callaloo lunch ($p < 0.5$). The Tukey HSD Post Hoc test showed a mean difference of 138.28. Cheese pie calcium content was greater than the mini garden pizza ($p < 0.027$). Table 8 summarizes the significant findings.

Table 8: Tukey HSD post Hoc Test Analysis.

Dependent variable	Independent variables	Significance (p value)
Calcium	Mini pepperoni, Yvette's callaloo lunch	0.047
	Mini garden, Cheese pie	0.027
	Cheese pie, Mini garden	0.002
	Cheese pie, Roti	0.002
	Cheese pie, Yvette's callalo lunch	0.000
	Subway meat, Yvette's callalo lunch	0.11
	Yvette's callalo lunch, mini pepperoni	0.47
	Yvette's callalo lunch, Subway meat	0.011

Iron and Phosphorus

Iron content was greater in the Cheese pie than in the Yvette's callalo lunch (P = 0.008). Table7 summarizes the significant findings. Mini pepperoni Phosphorous content was greater than Yvette's callaloo lunch content (p= 0.007), Mini garden pizza content was greater than Cheese pie (p= 0.013), Cheese pie content was greater than Yvette's callaloo lunch (p = 0.000) and Subway meat was greater than Yvette's callaloo lunch (0.009). Table 9 summarizes the findings.

Table 9: Tukey HSD Post Hoc test Analysis findings.

Dependent variable	Independent variable	Significance (p value)
Iron	Cheese pie, Yvette's callalo lunch	0.008
Phosphorus	Mini pepperoni, Yvette's callaloo lunch	0.007
	Mini garden, Cheese pie	0.013
	Cheese pie, Yvette's callaloo lunch	0.000
	Subway meat, Yvette's callaloo lunch	0.009
	KFC, Yvette's callaloo lunch	0.042
	Yvette's callaloo lunch, Mini pepperoni pizza	0.007
	Yvette's callaloo lunch, Cheese pie	0.000
	Yvette's callaloo lunch, Subway meat	0.009
	Yvette's callaloo lunch, KFC	0.042

Magnesium

Magnesium content was not equal among the different groups ($p<0.05$). Yvette's callaloo lunch magnesium content was lower than Mini pepperoni pizza ($p= 0.003$). Mini garden pizza was greater in magnesium content than Yvette's callaloo lunch ($p=0.20$). Cheese pie magnesium content was greater than roti content ($p= 0.018$) and Yvette's callaloo lunch ($p= 0.000$). Roti magnesium content was lower than Subway meat ($p=0.053$) .Yvette's callaloo lunch magnesium content was greater than Mini pepperoni ($p=0.003$), Mini garden ($p=0.020$), Subway meat ($p=0.000$), and KFC ($p=0.004$). Table 10 summarizes significant findings.

Table 10: Showing Tukey HSD Post Hoc Analysis findings.

Dependent variable	Independent Variable	Significance (p value)
Magnesium	Mini pepperoni, Yvette's callaloo lunch	0.003
	Mini garden, Yvette's callaloo lunch	0.020
	Cheese pie, Roti	0.018
	Cheese pie, Yvette's callaloo lunch	0.000
	Subway meat, Roti	0.053
	Yvette's callalo lunch, Mini pepperoni	0.003
	Yvette's callalo lunch, Mini garden	0.020
	Yvette's callalo lunch, Subway meat	0.004
	Yvette's callalo lunch, KFC	0.087

Beverage choice

The most popular beverage consumed was Coca Cola (39%). Trinidad orange juice was also a popular beverage choice (32 %).Table 11 summarizes the percentages of students and beverage choice that is purchased and consumed with their meals.

Table 11: Percentage of Students that Typically Consume and Purchase Beverages.

Beverage	% of persons
Sprite	7.5
Sorrel soft drink	9
Trinidad orange juice	32
Coca cola	39
Trinidad fruit punch	12.5

Vitamin C

Vitamin C content was high among the three sample days for Trinidad Orange Juice, but low among the three sample days for Sprite. Variations were seen among each day for each sample. Table 12 summarizes the findings.

Table 12: Mean Vitamin C Content of Two Beverages from Three Different Samples**.**

Beverage	Sample Days	Vitamin C / mg
Trinidad Orange Juice	1	162.00
Trinidad Orange Juice	2	180.80
Trinidad Orange Juice	3	187.50
Mean		176.76
Sprite	1	3.94
Sprite	2	4.79
Sprite	3	2.82
Mean		3.85

The Mean Vitamin C content of Sprite and Trinidad fresh Orange Juice was not equal. The test revealed that variances were not equal. See Table 13 for a summary of the findings.

Table 13: Mean Vitamin C analyzed by Independent Sample T -test.

Beverage	Mean	Std. Deviation	Significance (2-tailed)
Trinidad fresh orange juice	176.76	13.21	0.002
Sprite	3.85	0.98	

Discussion

Analysis of micronutrient content of popular meals consumed by University of the West Indies, St. Augustine students is very critical. This may be so because meal patterns of young adults and adults are ever changing and access to key micronutrients may be impossible for this group. Studies have consistently linked poor micronutrient intake with a variety of health complications and conditions. Commonly included among these complications are overweight and obesity, hypertension, bone abnormalities and anemia. These and many other deficiency states may be undiagnosed for many years. It may not be discovered until the university students leave the university and enter the world of work. Thus it is essential for students to make wise food choices throughout their course at the university, so as to prevent bad outcomes after this period.

This study discovered a high consumption pattern of Fast foods by students. It was revealed that consumption of soft drinks were also higher than consumption of juices. The results of this study show that currently consumption of home cooked meals is lower than other types. Additionally whereas a sizable percentage of persons consume juices with their meals, a much greater percentage consumes soft drinks. This high consumption of fast foods and soft drinks can be attributed for the low cost of these items, ease of access, mass advertising and appealing taste of these products. On the other hand students may have consistently patronized such establishments because they are unaware of the nutrient constituents of these items. Or they are not interested in what they consume, believing that they are invincible or that their food choice will not affect their health now or in the future. Yet studies show that high consumption of soft drinks and fast foods are linked to obesity, diabetes and other lifestyle diseases (Gillis and Bar 2003).

This study revealed that mineral content varied across the three sampling days and across samples. ANOVA analysis revealed Sodium ($p=0.051$), Calcium ($p<0.001$), Iron ($p=0.018$), Phosphorus ($p=0.001$) and Magnesium ($p<0.001$).Variation of mineral content may be due to many factors. These include failure

to use standardized recipes, measuring equipment, use of different cooks and variability in raw material. Some food establishments account for these variations in their advertising releases. KFC (2012) states that, "variation can be expected and may be due to a variety of reasons." This is also true of other food establishments whether large scale or of smaller origin. Sodium content was the greatest in KFC (747.67mg) when sampled at day one. This figure is high when compared to the lowest sodium content of KFC (258 mg) on day three. Yet another researcher agrees with the findings of our study. He related that the highest sodium samples in his study were observed in the fried samples (Musaiger and D'Souza 2008). Thus sodium content for the study samples at this establishment may fluctuate; at times it may be more than three times higher than the day before. It must be noted that these figures are for the spicy chicken recipe and not for the original chicken recipe. Therefore sodium content of The Original Recipe may be higher or lower when compared to the results of this study. KFC on its website reports that, "a 2 pc thigh and leg with potato wedges has 2000 mg of sodium." This figure is greater than all our studied sodium content of KFC values. This present study also highlighted other key relationships.

Calcium content between groups were significant ($p<0.001$). At least three of the samples contained cheese as a main ingredient. Therefore calcium content of these items was expected to be high. It was observed by this study that the Calcium content of the Mini pepperoni pizza, Mini garden pizza and cheese pie was high. These food items had higher calcium content when compared among the samples. The mini pepperoni pizza had more calcium than the Yvette's callaloo lunch ($p=0.047$) and a mean difference in content of 138.28 was observed. This result was expected because cheese products are good sources of calcium.

Additionally the lunch that was compared to the pizza contained rice, stew chicken, salad and callaloo, items that are not necessarily rich sources of calcium. Shah and colleagues (2011) observed that eight minerals were significantly reduced in pulses upon cooking, including Calcium. It was explained that this reduction of mineral content can be attributed to leaching of the minerals into the cooking water. This process occurs due to the softening of tissues by heat and the exposure of molecules to enzymatic activity.

Therefore if a food product is not consumed with its sauce, the likelihood of consuming an adequate amount of the nutrient is greatly reduced. Another researcher accounts for this phenomena. Musaiger and D'souza (2008) explained that cooking in rice reduced calcium content of fish in combination meals and their study also revealed that calcium content was highest in the curry fish meal. Contrary to this our study revealed low calcium in our curry dish, Roti. The Cheese pie and Roti had a mean difference of (205.6) and a ($p = 0.002$) value. These results was expected because an item that contains cheese and flour as its main ingredients were compared to one with flour, curried chick peas and curried chicken. Remarkably our study revealed that Mini garden pizza had lower calcium content than the Cheese pie. This was significant at the 5% level ($p=0.027$) This result was remarkable because the cheese pie is significantly smaller in size and differs in price from the Mini garden pizza. The pizza item is both larger in size and more expensive than the cheese pie. It was also observed that the Subway meat sample contained more calcium than the Yvette's lunch. This is to be expected because Subway sandwiches are served with cheese and the bread may contain milk as an ingredient. Another mineral that is critical to health that revealed significant patterns was Iron.

Our study revealed that Cheese pie had a greater Iron content than the Yvette's callaloo lunch ($p=0.008$). This result was far from what was expected. Callaloo is a green, leafy, vegetable food item, therefore it was expected that the iron content of this food to be superior to or near equal to the other samples. Additionally when an examination is made of the ingredients in cheese pie, these results seem very puzzling. The Cheese pie contains flour, cheese, seasoning and spices, at times there are small pieces of vegetables added. Yet one researcher accounts for this. Shah and colleagues (2011) explains that there were increased amounts of Iron in cooking water seen in their samples upon heating. It was further suggested that this process can be attributed to the iron becoming solubilized in hot water during cooking.

Therefore the iron in our studied sample (Yvette's callaloo lunch) may appear to be low due to the leaching of iron into the cooking water. It may be argued that this process is not occurring in the present circumstance because the vegetable is served in its cooking water like a soup. Yet methods of preparation

utilized to prepare this dish can account for the mineral lost. Many cooks remove the thin, external peel of callaloo bush and proceed to soak it in water before cooking. This water is thrown away and new water is added for cooking of the dish. Therefore Iron losses may occur at this stage when the water used for washing the exposed vegetable is thrown away. Another strong argument in favor of this point is that the Iron leached into the water during the cooking process may be unevenly distributed throughout the meal. Therefore meals that are served show variations in Iron content and homogeneity is not possible. Equally important is phosphorus.

The Phosphorus content of the Mini pepperoni was higher than that of the Yvette's callaloo lunch (47.71, p=0.007). This was expected because high phosphorus foods include cheese, processed meats; sausages and rice and rice products. Whereas the both samples contain food products that are high phosphorus foods there is ample justification for the phosphorus content of the pizza surpassing that of the lunch. The pizza sample contains at least two high phosphorus foods; cheese and processed meat, while the callalo lunch contains only one; rice. The findings of an earlier study appear to be in general agreement with rice products increasing phosphorus content of meals. Musaiger and D' Souza (2008) discovered in their study that phosphorus content of fish was improved by cooking in rice.

Conversely phosphorus content was higher in Cheese pie than the Mini garden pizza. There was observed a mean difference of (44.04, p=0.013). This can probably be explained by quantifying and comparing cheese content of the both foods. However one explanation for the high phosphorous content in the cheese pie is that a large amount of cheese may be added during preparation, since cheese is the main ingredient in this item. On the other hand less cheese may be added in the Mini garden pizza because more emphasis may be placed on the vegetable toppings.

Further, phosphorus content was observed to be higher in the KFC sample than in the Yvette's callaloo lunch (37.26, p=0.42). This finding is consistent with another researcher, (Musaiger and D' Souza 2008), who discovered that phosphorus content was highest among fried fish sample. The high phosphorus

content of KFC can be attributed to the addition of phosphate additives to enhance the taste of meat and sausage products.

Magnesium content showed differences among the groups. Mini pepperoni magnesium content was higher than Yvette's callaloo lunch (8.9, p=0.003) . This observation was expected to occur because wheat and wheat products contain greater amounts of magnesium than vegetables.

It was believed that a sample weight may have a positive relationship with both Sodium and Iron content. However no statistically significant relationships were observed between weight and either Sodium content or Iron content. Therefore it can be inferred that both Sodium and Iron content do not increase with the increase in sample weight. Despite the fact that our study revealed variation among the study days of Sodium and Iron content and weight, there appears to be no relationships.

Another obvious observation of the present study was that the Vitamin C content of Trinidad fresh Orange juice and Sprite show significant differences (p=0.002). It was reported on the packaging of The Trinidad fresh Orange juice that the beverage provides 100 % of The DV. On the other hand vitamin C content is not reported or mentioned on the packaging of the Sprite. Despite this fact, consumers of this product may not be interested in consuming a food that provides adequate Vitamin C, but are attracted to the taste and high sugar content. Conversely persons who drink Trinidad fresh orange juice can hope to have greater absorption of Iron and other benefits that are crucial to having a balanced diet.

Limitations

- The study used a small sample size of meals, thus there might be bias in the selection of the samples.
- Data collection for the Yvette's Callaloo lunch was incomplete. This was of no fault of the researcher. Workers at the food establishment stated that the stated menu items were sold throughout the week. But upon attempting to purchase the sample variations of menu items occurred. Therefore it was difficult to attain similar menu items as the sample in an effort to possess all similar samples purchased on three separate days.
- Only five minerals were studied in the present study. More minerals could not be studied because the equipment; element lamps, was not available for use throughout the study period.
- Only minerals were studied. Only vitamin C analysis on the beverage samples was performed. This was due to the researcher not getting access to convenient laboratories that performed such analysis throughout the study period.
- An inconsistent pipe borne water supply prolonged laboratory work.
- The time period for the analysis of the mineral content of the samples was extended because the equipment required servicing.
- The equipment malfunctioned at times, therefore time was spent in trouble shooting the problem and recalibrating the equipment.
- Little information was available surrounding the topic, thus few comparisons could be made to existing bodies of literature.

Recommendations

- Further research needs to be undertaken in this area to validate the results of this study.
- I also recommend that a lifestyle intervention program be initiated among the student population. This program should attempt to address the poor eating habits of students and to inform them about the nutrient composition of the meals they regularly consume. One initiative of this program should be to encourage labeling of menu items and the provision of nutrition facts tables.
- Food establishments should also be encouraged to use standardized recipes and measurements when preparing foods.
- Additionally it is recommended that steps be taken to alter the eating environment around campus to encourage healthier food choices among students.
- I recommend to my fellow colleagues that they adjust their diet patterns to include more fruits and vegetables and to limit their consumption of Fast foods.
- I also recommend that consumption of soft drinks be reduced because they contribute minutely to overall Vitamin C intake, but greatly to sugar and total calorie intakes.
- Finally I recommend that the results of this study be used to influence the decision making process of persons allowing change to occur.

Conclusion

In the Literature there is little information available about the analysis of Traditional foods and Fast foods provided at the UWI campus. This study discovered that Fast foods are the popular menu items consumed by University of the West Indies, St. Augustine campus students. Regarding the micronutrient content of meals, both fast foods and traditional meals vary in mineral content from day to day. It was observed that differences in micronutrient content exist between all studied groups. Fast foods are not associated with lower iron levels than traditional meals. Traditional meals are not associated with higher levels of the micronutrient content; Fe, Mg, P and Ca. Some fast foods are associated with higher levels of Sodium. Average sodium was found to be highest in the KFC meal sample (445.26mg) and lowest in the Mini garden pizza meal sample (112.63). Average calcium content was found to be highest in the Cheese pie meal sample and lowest in the Yvette's meal sample. On a micronutrient basis the Cheese pie sample is an ideal food because it provides adequate quantities of at least three micronutrients. This sample contained moderate sodium (302.05 mg) and average quantities of Iron (1.5 mg). However this food item may not possess an ideal composition of Vitamins and Macronutrients, which was not currently investigated.

Trinidad fresh orange juice is a better source of Vitamin C than Sprite. The juice sample provided more than the recommended daily allowance of Vitamin C (75-100mg). Sprite was observed to be a poor source of Vitamin C (< 5 mg). Therefore Trinidad fresh Orange juice is superior to the other study sample, and maybe considered an ideal beverage when the Vitamin C content is the factor under investigation.

Bibliography

Adejumo T. O. and Awosanya O. B. (2005). "Proximate and mineral composition of four edible mushroom species from South Western Nigeria." *African Journal of Biotechnology*, Vol. 4 (10), pp. 1084-1088, http://www.academicjournals.org (Accessed: 13th February, 2013).

Adeyeye E.I, Orisakeye O.T. and Oyarekua M.A. (2012) "Composition, Mineral Safety Index, Calcium, Zinc And Phytate Interrelationships in Four Fast-Foods Consumed In Nigeria." *Bull. Chem. Soc. Ethiop.* 2012, 26(1), 43-54. ISSN 1011-3924. (Accessed: 14th February, 2013)

Azadbakht Leila and Esmaillzadeh Ahmad (2008)"Fast foods and risk of chronic diseases." *Journal of Research in Medical Sciences;* January & February 2008; Vol 13, No 1. (Accessed: 13th February, 2013).

Bissessur V., Goburdhuni D. and Ruggoo A. "Evaluation of Atomic Absorption Specrtrophotmetry (ASHING, NON-ASHING) And Titrimetry For Calcium Determination in selected foods." *FOODS SCIENCE AND TECHNOLOGY*- Volume 3 – 1999. (Accessed: 15th February 2013)

Ghidrus Michaela, Mira Turto, George Boskou, Petru Niculita and Vasilica Stan.(2010) "Nutritional and health aspects related to frying." *European Journal of Cancer Prevention* 1998, 7, 331-335

Haghollahi Fedyeh, Ramezanzadeh Fatemeh, Norouzi Mansoureh, Shariat Mamak, Mahdavi Atossa, Foroshani Abbas, Sarafnejad Abdolfattah,Sadeghi Ahmad, Shahsavari Fatemeh and Charami Maryam "Zinc Deficiency in First Year Female Students of TehranUniversity of Medical Sciences."(2008) *Journal of Family and Reproductive Health,* Vol. 2, No. 2, June 2008. (Accessed12th February 2013)

Horwitz William and Latimer George (2005) "*Official Methods of Analysis of AOAC International*." 18th edition. ISBN: 0-9355 84- 773

Kolodinsky Jane, Harvey-Berino Jean, Berlin Linda and Johnson Rachel, (2007). *"Knowledge of current dietary Guidelines and food choice by college students: Better Eaters have higher knowledge of dietary guidelines."* Journal the American Dietetic Association; of 107 (8): 1409-13 (Accessed: 12th February 2013).

Mahan Kathleen, Stump- Escott Sylvia, Raymond Janice. *Krause's Food & Nutrition Therapy , International Edition.* United States: Elsevier Saunders, 2012.

Mahadkar Shivprasad, Rathod Varsha. (2012) "Nutritional assessment of some selected wild edible plants as a good source of mineral." Asian Journal of Plant Science and Research, 2012, 2 (4):468-472 ISSN: 2249-7412, www.pelagiaresearchlibrary.com.

Doughty, Melissa 2012*, "UWI Principal: Penal/Debe ideal for new campus."* Accessed: 24th February 2013.http://guardian.co.tt/news/2012-08-03/uwi-principal-penaldebe-ideal-new-campus

Musaiger Abdulrahman and D'Souza Reshma (2008*) "The effects of different methods of cooking on proximate, mineral and heavy metal composition of fish and shrimps consumed in the Arabian Gulf." Archivos Latino Americanos de Nutricion Organo Oficial de la Sociedad Latinoamericana Nutrición* Vol. 58 .

Nurnadia A.A., Azrina, A., Amin I.,Mohd A.S. and Mohd Effendi. "Mineral contents of selected marine fish and shellfish from the west coast of Peninsular Malaysia." *Romanian Biotechnological Letters Vol. 15, No. 6, 2010 http://www.ifrj.upm.edu.my.*

Omale James and UgwuChidiebere Emmanuel, "Comparative studies on the protein and mineralcomposition of some selected Nigerian vegetables." *African Journal of Food Science, Vol 5.* (1) *pp. 22 – 25, January 2011, http://www.academicjournals.org/ajfs, ISSN 1996-0794 ©2011 DOI: http://dx.doi.org/10.4314/bcse.v26i1.5*

Pizza Hut (2013) http://www.pizzahut.com/nutritionpizza.html

Santos, Ode´riz M. and Rodrı´guez M. (2011) *"Micronutrient contents in organic and conventional tomatoes (Solanum lycopersicum L.)."* International Journal of Food Science and Technology Vol 46, pp. 1561-1568, August 2011, DOI: 10.1111/j 1365-2621.2011.02648.x.

Shah H.U., Khan U. L, Alam S., Shad A. A., Z. Iqbal and Parveen S. *(2011) "Effect of home cooking on the retention of various nutrients in commonly consumed pulses in Pakistan." Sarhad J. Agric. 27(2): 279-284*

Sharma J.K., Sharma T.R. and Sharma Kumar Sapan. "Comparative Study on Macro and Micro Minerals Composition of Selective Red Rice Landraces from Chamba District of Himachal Pradesh-India." World *Journal of Agricultural Sciences* 8 (4): 378-380, 2012 ISSN 1817-3047 © IDOSI Publications, 2012, DOI: 10.5829/idosi.wjas.2012.8.4.1672

Spada Patricia, Bortolini V. Giovani, Pra Daniel , Santos Carla , Dias F. Johnny , Henriques A.P. Joao and Salvador Mirian ." Macro and microminerals: are frozen fruits a good source?" *Anais da Academia Brasileira de Ciências* (2010) 82(4): 861-867 (Annals of the Brazilian Academy of Sciences) ISSN 0001-3765,www.scielo.br/aabc.

Steneder S, Dyerberg J and Astrup A, (2007). "Fast food: unfriendly and unhealthy." International Journal *of Obesity*; 31, 887–890; doi:10.1038/sj.ijo.0803616; published online 24 April 2007 Accessed: 12/03/2013,http://www.nature.com/ijo/journal/v31/n6/abs/0803616a.html.

University of the West Indies (2013), http://sta.uwi.edu/sas/accommodation/oncampus.asp

http://sta.uwi.edu/admissions/uwi/default.asp.

U.S. Department of Agriculture, Food and Nutrition CService, with the National Food Service Management Institute. (2002) "*Measuring success with standardized* recipes*."* University, MS; National Service Management Institute, *NFSM order # EX60-02m L.I.J.A.B.R., VOL.2 (4)2012:641-645 ISSN 2250-3579, 641*

Wahengbam Sarjubala Devi and Ch. Sarojnalini "Impact of Different Cooking Methods On Proximate And Mineral Composition Of Amblypharyngodom Mola Of Manipur." Department of Life Sciences Manipur University,Canchipur, Manipur India Pin code- 795003

World Health Organization (2013) "Micronutrient deficiencies." *http://www.who.int/nutrition/topics/ida/en/index.html, Accessed 12/03/2013.*

Appendices

Interview Questions

1. Do you commute to and from U.W.I daily?
   Yes O No O

2. Do you live on campus or the surrounding areas?
   Yes O No O

3. Do you purchase meals daily on campus?
   Yes No

4. Which faculty do you belong to?
   Food and Agriculture Social sciences Engineering Science and Technology

   Humanities Languages and linguistics

Complete the following sentences by ticking which answer most represents you:

5. I regularly purchase …… for a midday meal.
   O KFC O Subway O Boomers O Rituals

   O Mario's Pizzeria O Yvette's O Asha's Roti O Pank's Doubles

   O Beirut Grille O Maureen's cuisine

6. My meal consists of …… .
   O 1 pc and fries (spicy) 0 breast 0 thigh O I pc and fries (original) 0 breast 0 thigh

   O 2 pc and fries (spicy) 0 breast and wing 0 leg and thigh

   O 2 pc and fries (original) 0 breast and wing 0 leg and thigh

   O Pepperoni pizza 0 mini 0 small O Garden pizza 0 mini 0 small

   O Hawaiian pizza 0 mini 0 small O Students lunch (beans)

   O Students lunch (callaloo) O panini 0 chicken 0 vegetable

   O wrap 0 chicken 0 vegetable O cheese pie O beef pie

   O teriyaki sandwhich O Vegetarian sandwhich

7. I usually drink this beverage ……. with my meal.

O Sprite soft drink O Sorrel soft drink O Trinidad orange juice

O Trinidad fruit punch O Coca cola O Water