ANTIOXIDANT PROPERTIES OF SOME LESSER KNOWN FRUITS AND VEGETABLES CONSUMED BYFAMILIES IN SOUTH EAST ZONE OF NIGERIA.

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NOVEMBER, 2010

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A PROJECT REPORT PRESENTED TO THE DEPARTMENT OF VOCATIONAL TEACHER EDUCATION, UNIVERSITY OF NIGERIA, NSUKKA. IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE AWARD OF MASTERS DEGREE (M.Ed) IN HOME ECONOMICS EDUCATION, UNIVERSITY OF NIGERIA, NSUKKA.

NOVEMBER, 2010.

APPROVAL PAGE

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DEDICATION

The project is dedicated to my husband, Mr Aloy Okoli, my child, Chioma Okoli, and my brother, Pastor Christian and Mrs Chinyere Iheji for their love, supports and understanding throughout the programme.

ACKNOWLEDGEMENTS

My foremost gratitude goes to the Almighty God for His infinite mercy for the speedy completion of the project. I also register my profound appreciation and gratitude to my project supervisor, Dr (Mrs) N.M Eze for her ceaseless motherly advice, intellectual supervision and correction in spite of her tight academic schedule.

I am equally grateful to Dr Osinem for his constant contribution towards the successful completion of the work. The contributions and inputs of Ogochukwu Mbadugha, Nwokeji Nonye, Mrs Anne Onyele and Dr Umeh of crop science were highly appreciated.

My acknowledgement goes to my family members especially my little Chummy who felt my absence. It goes to my dear parents Ezinna and Mrs Obed Iheji, my sister Mrs Blessing Nnadi and her children, my cousin Sir, Dr Ernest Umeaka and wife, my uncles Mr and Mrs Sidney Awo and Mr and Mrs Clement Awo.I will not fail to appreciate Mrs Elizabeth Iheji, Chijioke and other sibilings, Mrs Stella Iheji and her family, Chief Sunday Iheji and the family.

Again, I express my profound gratitude to my unit members in the School Service for their understanding and filling of the gap created by my frequent absence from work throughout this programme.

Finally, I wish to express my unalloyed appreciation to my employer, the Imo State Basic Education Board Owerri (SBEB), the Ideato North Local Government Education Authority (LGEA), the Education Secretary, Chief Alaekwe and my Unit Head, Mrs Nwizu F.C. for their support throughout this programme.

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Abstract

This study was carried out to determine the antioxidant properties of some lesser known fruits and vegetables consumed by families in South East States of Nigeria. Twenty five (25) lesser known vegetables and seventeen (17) lesser known fruits were identified. Five research questions guided the study. The study adopted a survey design and experimental research design. An oral interview guide was used to answer research questions 1 and 2. The research questions 1 and 2 dealt with identification of lesser known vegetables and the lesser known fruits. Oral interview items were administered to South Eastern state women sampled from Imo and Enugu states. The atomic absorption spectrophotometer was used to determine the antioxidants present in the lesser known fruits and vegetables as required in research questions 3 and 4. Structured questionnaire was used to answer research question 5 that dealt with the strategies to enhance the consumption of fruits and vegetables by the families. These questionnaires were administered to the postgraduate students of Vocational Teacher Education of the University of Nigeria, Nsukka. The instruments for data collections were validated by experts. They were tested for reliability too. The reliability coefficient for the oral interview and the structured questionnaire were 0.68 and 0.65 respectively. The random sampling technique was adopted to select ten (10) lesser known fruits and ten (10) lesser known vegetables. Percentage was used to analyze research questions 1 and 2. The mean and standard deviation were used in analyzing the research questions 3, 4 and 5. The ten antioxidant properties were contained in the lesser known fruits and vegetables determined. Some strategies that will help to enhance the consumption of the lesser known fruits and vegetables were developed. One of the strategies indicated that the lesser known fruits and vegetables should be included in the school curriculum. It was therefore recommended that Home Economists and families should incorporate the lesser known fruits and vegetables in the diet to avoid micronutrient deficiency diseases and free radical damage to the body.

CHAPTER ONE
INTRODUCTION

Background of the Study

The wellbeing of any nation is the responsibility of the family. The family will continue to depends on the health of the family members.The family will enjoy good health through the consumption of foods that are abundant in nutrients.Fruits and vegetables contain nutrients that the family needs to produce healtny children and adults.

Vegetables are defined by Moris (1977) as plants cultivated for its edible part or parts as roots, stem, leaves or flowers. Wachap (2005) stated that vegetables are plants usually herbaceous that contain edible portion for soups, stews and served at daily meals. Hornby (2006) noted that it is a plant or part of a plant that is eaten as food, some of which parts include the root, stem, flower, and the leaf.

Tutare (2002) on the other hand defined fruits as the soft juicy part of a plant that contains seed.Some fruits and vegetables are popular because they are widely consumed, accepted, commonly found in the environment and are grown in the gardens and farms. They are plentiful during the rainy season especially the popular ones, at this time they are cheap. Sethi (2008) advised consumers to buy seasonal foods as they are cheapest in season and also contain maximum flavour, colour and nutrients.These popular vegetables include:*Telfairia occidentalis* (fluted pumpkin), *Vernonia amygdalina (*bitter leaf), *Amaranthus caidatus* (African spinach), *Gnetum africanum (*Okazi), *Talinium triangulase (*water leaf), *Curcurbita pepo (*pumpkin leaf), *Ipomea batatas* (Sweet potato leaves), *Ocimum gratissimum* (Scent leaf/tea bush), *Lypopersicon solanium* (Tomato), *Abelmuschus esculantum* (Okra), *Lectucal stiva* (Lettuce), *Piper cuineense* (Uziza), *Amaranthus spp*. (Amanth leaves) ,*Hibiscus sabdariffa* (Red sorrel), *Brassica oleracea* (Cabbage), *Daucus carota(*carrot), *Allium cepa (*onion), *Talinium triangulase* (water leaf). The fruits are the *Annona muricata* (sour sop), *prurous armeniaca* (apricots), *Rubus strigosu* (raspberries),*Rubus villosus* (black berries), *prunus persica* (peach), *Persea americana* (avocado pear), *Fragaria virginiana* (strawberries), *Pyrrus malus* (apples),*Carika papaya* (pawpaw), *Lichi sinensis (*Lyche*), Mangifera indica* (mango),

*Citrus limon (*lemon), *Psidum guajava linn (*guava), *Citrus sinensis* (oranges), *Ananas cosmosus* (Pineapple), *Icocos nucifera* (Coconut).

Beside these popular fruits and vegetables, there are others that are not popularly known or consumed. They are lesser known because they are not commonly seen and bought in the market and are not commonly found in the environment. Such fruits and vegetables are found mostly in the forest. The vegetables include *Adensonia digitalta* (Baobab), *Commelina nudiflora* (obogwu), *Myrianthus arboresu* (Ujuju), *Corchorus capsularis* (Jute), *Cassia occidentalis* (Stinking peg), *Ceiba pentandra* (Silk cotton tree*), Ficus elasticoides* (Ogbuike), *Fiscus vogeliana* (Ogbu aru), *Celosia argentica* (Shokoyokoto) ,*Moringa oleifera* (Okwe oyibo), *Ceiba pentandra* (Akpu).Also, the fruits include the *Icacina trichantha oliv* (ibiala, ututuogiri, urubia), *cola gigantea* (oji eyi) *Afromomium daniellia* (ose ohia), *Dialium guineense* (Icheku/ nnuagu/okponkporo).

These edible lesser known fruits and vegetables may contain some vital nutrients. Fruits and vegetables contain micronutrients which are rich sources of antioxidant that the family needs. It is likely that these fruits and vegetables have some indispensable micronutrients needed for good health. The antioxidant is among the indispensable micronutrient. According to World Health Organisation (WHO) (2009), antioxidants are ómagic wandsô that enables the body to produce enzymes, hormones and other substances essential for proper growth and development.The dependence on these popular fruits and vegetables alone for good health is risky since they are not available all the year round.The absence of these popular fruits and vegetables can affect the health and wellbeing of the family. Popular fruits and vegetables are known to reduce the actions of free radicals in the body because they contain antioxidant. Sizer & Whitney (2003) regard antioxidant as a system of defence against free radical.

The antioxidants are substances that inhibit oxidation and can guard the body from the damaging effects of free radicals. Duyff (2006) defined antioxidant as handful of vitamins, minerals, carotenoids and polyphenols present in a variety of foods that significantly slow or prevent the oxidative (damage from oxygen) process or stress and so prevent or repair damage to body cells. Antioxidants are the compounds found in plants especially in fruits and vegetables. According to Kim (2005), antioxidants are plentiful in plant foods particularly those that have bright colours. There may be one or more

antioxidant properties in a particular food. Equally, Duyff (2006) postulated that the deeper and richer the colour of fruits and vegetables, the more phytonutrients that are present.Phyto means plant. Duyff (2006) noted that phytonutrients are bioactive compounds in food that promote health by helping to slow the aging process and reduce risk of many diseases. Phytonutrients work as an antioxidant, enhance immunity and communication among body cells, causes cancer cells to die, detoxify carcinogen and repair damage to Deoxyribonucleic Acid (DNA).

According to Sizer & Whitney (2003) and Wright (2004) the body needs to produce several antioxidative enzymes that will help to defend it against free radicals. The concentrations of these enzymes are controlled both by inherited genes and by influences affecting these genes which include the diet. McEligot, Yang & Meyskens (2005) opined that when bodyôs defense is weakened and production of antioxidants is reduced, it is helpful to supplement antioxidants in the form of antioxidant-foods. Conscious efforts should be made on the quality of diets chosen in the family. The diet should contain antioxidant minerals, vitamins and phytonutrient. According to Papas (1999) and Venkarah, Anitha, Venu & Raphinath (2007) the vitamins such as vitamin A,C,E and minerals such as zinc,selenium,copper,manganese, iron,folate and pantothenic acid are some of the nutrient substances such as carotenoids, flavonoids, phenolics, polyphenols and uric important nutrients with antioxidant activity (AOA). There are a variety of non-acid that are potent antioxidant. The body uses other dietary antioxidant vitamins like the vitamin E, C, B, and B_{12} to keep the body healthy. The minor source of the antioxidant is the supplement which this study is not interested in.

Moreover, all studies carried out discouraged the usage of vitamin, mineral and antioxidant supplements and support the fruits and vegetables dietry sources. For instance, populations with high cancer rates have been found to consume few vegetables and fruits rich in beta-carotene and the cases of cancer reduced. For example, Whitney & Rolfes (2003) opined that researchers studying people in several countries report that deaths from heart diseases are low when flavonoid-containing foods are plentiful.This emphasizes the importance of antioxidant rich foods to the family in fighting the free radicals.

Free radicals are naturally occurring unstable compounds that are highly reactive. Whitney & Rolfes (2002) defined free radical as a molecule with one or more unpaired electrons. An electron without a partner is unstable and is highly reactive. To regain stability, the free radical finds a stable but vulnerable compound from which to steal an electron. With the loss of an electron, the formally stable molecule becomes a free radical itself and steals an electron from some other nearby molecule, setting off an electron-snatching chain. They are like sparks starting wildfire that leads to wildspread damage by oxidative stress. The majority of the free radicals are produced within the body but external sources include tobacco smoke, chemicals, exhaust emissions, radiation and alcohol, fried foods among others. The free radical causes oxidative stress.

The oxidative stress is damages inflicted on living system by free radicals. Akindahunsi (2008) defined oxidative stress as an imbalance between oxidants and antioxidant in favour of the oxidants potentially leading to damage. The oxidative stress begins when free radicals in the body exceed the antioxidant in the body. If the oxidant balances with the antioxidant in the body there will be no oxidative stress. Oxidative stress is caused by normal body process, environmental factors such as radiation, pollution, tobacco smoke, among others. These can act as oxidants and cause free radical formation. It is an antioxidant that can mop up these free radicals.

The study of antioxidant is necessary at this technological time of great affluence that people are suffering from many degenerative diseases. For instance washing machine is replacing the manual washing, microwave cooker is replacing the use of firewood, hand sewing is being replaced with motor sewing machine, and natural foods are replaced with refined foods.This agreed with the observation of Uguru (2008) that our ancestors whose diets consisted mainly of herbs, fruits, vegetables, nuts, whole cereals, wild animals, fish and starchy tubers (unlike many of the processed and refined foods we eat today), lived longer and were never victims of the many health problems afflicting man today. Also, Halliwell and Whiteman (2004) opined that the best nutrition results can be achieved from the consumption of plants with high antioxidant activities. Reddy & Shat in Tarwadi & Agte (2003) observed that the intake of antioxidant compounds present in food is now considered important. The nutrients and phytochemicals with antioxidant activity minimize damage by limiting free radicals or; repairing oxidative damage and

stimulating repair enzyme activity. The antioxidants are found much in plants particularly those that have bright colours such as citrus fruits, tomatoes, soybeans, whole grain foods as well as nuts containing vitamin E. These food sources help in keeping the body healthy and prevent the degenerative diseases in families.

Most of the ill-health suffered by man apart from the genetic diseases can be said to be caused by oxidative stress. Tarwadi & Vaishah (2003) observed that the prevalence of degenerative diseases such as cancer, cataracts, and heart disease is lower in Asian families due to their predominant vegetarian habits with ample use of fresh fruits and vegetables. It is now clear that there are certain fruits and vegetables that can provide good health because of their nutritive values, which might include the antioxidant properties.

Properties are defined by Yerkes (1994) as an essential or distinctive attribute or quality of a thing. Also, Hornby (2005) opined that it is the quality or characteristics that something has. Therefore the properties of an antioxidant include the antioxidant vitamins, such as Vitamin C, E; minerals like selenium, zinc, copper, manganese and phytonutrients like carotenoids and flavonoids.

However,Ujowundu, Igwe, Enemor, Nwaogu & Okafor (2008) noted that the early man survived primarily on diet of plant foods with little animal flesh because of the bioactive compounds of minerals, vitamins and certain hormone precursor contained in plants. Nutrition is probably the most important single component affecting the health status of the family. Tomas-Barberan & Gil (2008) posited that there is a substantial and growing body of evidences showing that increasing fruits and vegetables consumption reduce the risk of chronic diseases and increases lifespan and quality of life, while decreasing medical costs. However, there has been a growing reduction in the consumption of vegetables with each passing decade (Aranceta, 2004). This affluence in recent decades have made humans to focus on relatively fewer plant foods and placing humans at risk. The narrow focus has also resulted in a decline of original knowledge needed to identify and prepare wild plant specie.

Deficiencies of iron, iodine, vitamin A and other micronutrients are gaining increasing attention in developing countries, with the recognition of their adverse health effects and subsequent costs to human and economic development (Simitasiri &

Dhanamitta, 1999). This nutritional problem calls for the study of the lesser known fruits and vegetables.These will increase food security. Odika & Skipper (2004) noted that traditional leafy vegetables are important in ensuring food security since most of them are drought and pest resistant.

Adapting to the traditional or lesser known fruits and vegetables would however, not only improve the family nutrition but also prevent some of the chronic diseases and other degenerative diseases. However, the advantages not withstanding, traditional or lesser known plant foods are generally uncultivated and underutilized. According to Scrivastava, Kapoor, Thathola and Srivastava (2003), the solution to the problem of inadequacy of plant foods in the diet can be solved by exploitation of neglected lesser known plants. Mnzava (1995) indicated that acceptance and utilization of this specie is often constrained by lack of knowledge about their nutritive value. There is therefore the need for the exploitation of the antioxidant values of the lesser known fruits and vegetables.

Statement of the Problem

With the present economy where the cost of living is high, fruits and vegetables enriched diets will help the family to remain healthy. Fruits and vegetables supply vitamins and minerals required by the human body for proper functioning. Dary (2006) noted that green leafy vegetables are excellent sources of dietary fibre, vitamins A and C, folate and minerals. Carrier, Ruxton, Elaine, Gardner & Walker (2006) opined that fruits and vegetables contain a range of vitamins, minerals and trace elements which contain active components that can prevent chronic diseases that are likely to be soluble fibre and/or one or more antioxidant. Fruits and vegetables also contain roughages and antioxidants.

These popular fruits and vegetables are seasonal. Okudu (2008) emphasized that studies have shown that leafy vegetables are not available all year round due to seasonal variation. The few available ones during the dry season are very expensive and are usually above the reach of the poor. This may expose some families to some micronutrient deficiencies such as vitamin A, C and Iron; infections and other ailments like diabetes. This observation of Okudu calls for urgent need to analyse some lesser

known fruits and vegetables which are available all the year round. To achieve is to make use of the wild or lesser known fruits and vegetables which are available when popular fruits and vegetables are scarce.

Again, lesser known fruits and vegetables come from locally available natural resources which are part of or compatible with the local ecosystem. Lupien (1998) and Altieri, Merick, Anderson in Flyman and Afolaya (2007) emphasized that the tree and forest products can broaden the food base and diversify the diet, thus preventing nutrient deficiencies and ensuring dietary balance. Grivetti & Ogle (2000) and Adebooye & Opadope (2004) stated that wild vegetables contributed to diversification of the food base by augmenting agricultural wild plant collection. Forest foods are extremely important because they are frequently available to tide households over hungry seasons when other foods are in short supply.

The antioxidant properties of these forest or lesser known fruits and vegetables however are not known, there is therefore the need to analyse the antioxidant properties of these fruits and vegetables consumed by families in South East of Nigeria, hence this study.

Purpose of the Study

The major purpose of this study was to analyze the antioxidant properties of some lesser known fruits and vegetables consumed by families in South Eastern States of Nigeria.Specifically, the study soughts to:

1. Identify ten lesser known consumed vegetables by families in South Eastern states of Nigeria.
2. Identify ten lesser known consumed fruits by families in South Eastern States of Nigeria.
3. Analyse the antioxidant properties of the identified lesser known Vegetables.
4. Analyse the antioxidant properties of the the identified lesser known fruits.
5. Identify strategies for enhancing the consumption of the lesser known fruits and vegetables

Significance of the Study

It is hoped that the findings of this study will be useful to the Home economists, Nutrutionists, Dieticians, Restaurant chefs, farmers, foresters, Health workers, home makers and families.

It is expected that the result of these findings are to be used by the farmers through the guidance of the Ministry of Agriculture. This body will make efforts for the farmers at all levels to incorporate these wild fruits and vegetables into their traditional farming in order to produce enough fruits and vegetables to meet the population demand.

The findings will be beneficial to the foresters who are incharge of the forests. They conserve the trees in the forests and permit the cutting down of the matured ones through the directives of the Ministry of forestry, Lands and Natural Resources. The ministries will equally advice the foresters who will be guided through the findings to conserve these trees or plants that produce these fruits and vegetables at the local and state levels.

The findings will also be useful to the dieticians. This group of people plan meals and advice on what is to be eaten. They perform this task through the programmes and curriculum drawn by the ministry of education who incorporate these fruits and vegetables into the list of vegetables and fruits to be studied, their nutritional values in terms of their micronutrient and antioxidant composition.

The findings will be of immense benefit to the restaurant chef. The restaurant chefs prepare the menu in the restaurants through the knowledge obtained from programmes and curriculum mapped out by the ministry of education.The restaurant chefs that are supposed to possess the quality of expanding and updating healthful menus will now prepare meals using these lesser known fruits and vegetables.

The findings will be of immense benefit to the students of Home economics (foods and nutrition) at all levels of education. The young Home Economists who learn the content of the curriculum planned by the ministry of education will be taught various lesser known fruits and vegetables at school, nutritional values and healthiful benefits.This will expand the knowledge on fruits and also using various vegetables in food preparations.

The health workers and students will equally benefit through the curriculum plan mapped out by the ministry of health. Since they are the major people to handle patients with the deficiency diseases, they can now use the result to treat and advice patientsôwifh nutritional problems.

Also, the outcome of these findings will be useful to homemakers and families. The homemakers prepare family meals using the lesser known vegetables. They will also provide the fruits in the home. The awareness will be through seminars, workshops and conferences.

Research Questions

The following research questions were posed to guide the study;

1. What are the lesser known vegetables consumed by families in south eastern states of Nigeria?
2. What are the lesser known fruits consumed by families in south eastern states of Nigeria?
3. What are the antioxidant properties of the identified lesser known vegetables?
4. What are the antioxidant properties of the identified lesser known fruits?
5. What are the strategies for enhancing the consumption of the lesser Known fruits and vegetables?

Scope of Study

The study focused on identification of the lesser known fruits and vegetables, the antioxidant properties of some lesser known fruits and vegetables. The antioxidants properties analyzed include vitamin C and E, Mineral antioxidant such as selenium, manganese, Iron and zinc. Also determined were the phytonutrient which included the carotenoids and the flavonoid.The study also covered the strategies for enhancing the consumption of lesser known fruits and vegetables.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The related literature was reviewed under the following sub-headings:

- THEORETICAL FRAMEWORK

  Free radical theory

- CONCEPTUAL FRAMEWORK

  Antioxidant properties

  Lesser known fruits and vegetables

- REVIEW OF RELATED LITERATURE

  Vegetables

  Common vegetables

  Food value of vegetables

  Micronutrients of vegetables

  Fruits

  Nutritional compositions of fruits

  Micronutrient composition of fruits

  Composition of popular fruits

  Scarcity Implication of fruits and vegetables to the families

  Processes of determining antioxidant in fruits and vegetables

  Determining the antioxidant of vegetables

  Determining the antioxidant of fruits

- RELATED EMPIRICAL STUDIES

  Summary of the Literature Reviewed

Theoretical Framework

The theoretical bases for explaining the power of antioxidant is the free radical theory of aging. The free radical theory of aging according to Balaban, Nemoto & Funkel (2005) was first proposed in 1965 by Dr. Denham Harman who postulated that free radical (oxidative stress) damage to various cell components

underlies the aging process and cause degenerative diseases associated with aging. Today this theory is widely accepted. It is believed that free radical damage cause cancer, heart disease, Parkinsons Diseases, and skin aging (Packer and Colman, 2003).

The skin consists of three main layers, the epidermis, the dermis and the sub-cutaneous layer. The outermost layer known as the epidermis is comprised of mature cells that are constantly being shed and replaced. The dermis that is the second main layer provides most of the structure and strength of the skin. Collagen and elastic fibres both contribute to skin strength, shape and tone. As part of the aging process, skin cell production decreases, meaning that the epidermal cells are not replaced as quickly and skin appears older.The collagin production also declines weakening skin structure and resulting in wrinkles, furrows and saggings.

Again, the efficiency of nutrient delivery breaks down. Nakabeppu, Sakumi, Sakamoto, Tsuchimoto, Tsuzuki, Nakatsu, (2006) opined that free radicals, especially due to cigarette smoke and solar ultra violent (uv) rays accelerates the cellular processes of aging and leads to older, more wrinkled skin.

Fortunately antioxidants can scavenge or mop up free radicals, prevent them from harming the cell and slow aging process. However, we need to ensure our bodies receive enough through dietary intake.These antioxidants protect skin from free radical damage & aid in wrinkle reduction. To maintain health & vitality, your skin care routine must include regular consumption of antioxidant rich foods.

Our body needs various antioxidants in sufficient quantities to function well and protect the integrity of the cellular structures and DNA. Some antioxidants in the body are synthesized and many others the body must obtain from food. For our health, we need to consume a healthy adequate diet rich in antioxidant containing fruits and vegetables (Packer & Colman, 2003). Although each type of antioxidant has its own niche in the cell, they also work together, recycling each other, and providing an even stronger defense system. If enough

antioxidant is not available, the body cannot effectively protect itself from the free radicals and then damage is done to the cell structure.

The Conceptual framework

The following concepts - antioxidant properties, lesser-known fruits and vegetables are to be defined for a clearer understanding of the work.

Vegetable is a culinary term that generally refers to the edible part of a plant. All parts of herbaceous plants eaten as food by humans, whole or in part, are normally considered as vegetables Food and Agricultural Organisation(FAO) (1988) reported vegetables to be large class of plant food, rather difficult to define but well understood by those who prepare and consume them. However Olusanya, Eyisi, Arifani-Joe, Ogunyide & Egbuchulam, (1994) defined vegetable as a plant cultivated for an edible part or parts, roots, stems, leaves or flowers. Tutare (2002) sees vegetable as all edible plant part. Vegetables derive their name from the plant parts eaten. For instance the root vegetable, green leafy vegetable and so on.Uzo (1988) defined green leafy vegetables as the succulent herbaceous plants that are eaten in whole or in part, raw or cooked as a part of a main dish or in salad. Tutare (2002) defined it as the manufacturing organs of a plant where the life giving process of photosynthesis takes place. Oguntona & Oguntona (1986) opined that green leafy vegetable (GLV) is an indispensable constituent of human diet in Africa and West Africa in particular. Eka (1998) indicates that vegetables are also added to soups and stews that usually contain tomatoes, oil, salt and crushed seeds. Tutare (2002) opined that they are among the highly perishable foodstuff and are seasonal. Vegetables are thought of as being savoury, not sweet, although there are many exceptions. Foskett & Cessarani (2008) opined that some vegetables are botanically classified as fruits: tomatoes are berries and avocados are drupes, but both are commonly used as vegetable because they are not sweet. Foskett & Cessarani (2008) also stated that since vegetable is not a botanical term, there is no contradiction in referring to a plant part as a fruit while also being considered a vegetable thus vegetable can also include leaves (lettuce), stems (asparagus), roots (carrots), flowers (broccoli), bulbs (garlic), seeds (peas

and beans) and botanical fruits such as cucumbers, squash, pumpkins and capsicums.

Botanically, fruits are reproductive organs (ripened ovaries containing one or many seeds), while vegetables are vegetative organs that sustain the plant. Vegetables are eaten in a variety of ways as part of main meals or as snacks. Fruits are defined by Morris (1977) as the ripened ovary or ovaries of a seed bearing plant, together with accessory parts containing the seeds and occurring in a wide variety forms, an edible usually sweet and fleshy form of plant. Tutare on the other hand defined fruit as the soft juicy parts of a plant that contain seed. Hornby (2005) defined fruit as the part of a plant that can be eaten as food and usually tastes sweet. Iheanacho (2009) opined that fruits are the fully developed ovaries of flowering plants, containing one or more seeds that have developed from fertilized ovules and sometimes including associated structures such as the receptacle.

There are some fruits and vegetables that are not popularly known or consumed and are called the lesser known fruits and vegetables Flyman & Afolayan (2007) used lesser known to mean under-utilised. Arinathan, Mohan & De-Britto (2003) took lesser known to mean little known. Hornby (2000) defines less to mean small amount. Morris (1977) states it to mean smaller or less in size, amount, value or importance, especially in a comparison between two things. Known was defined by Morris (1977) to stand for proved satisfactorily, specified or completely understood. Hornby (2000) defines known to mean have information in your mind as a result of experience or because you have learned or been told it. Hence, the lesser known fruits and vegetables are the fruits and vegetables that are not well consumed, accepted and sold in the market. The lesser known fruits are the *Dialium guineense* (Icheku/nnuagu/okponkporo) among others.The lesser known vegetables are *Gongronema atifolium* (Utazi) among others. The Childrenôs Health Development Foundation (1998) opined that the minimum number of daily serves of vegetables, legumes and fruits needed to achieve at least 70% of the requirements of protein, vitamins and minerals for adults is five (5) servings per day of vegetables and two (2) servings per day of

fruits.This is to say that every fruit and vegetables contain some nutrient which will definitely include antioxidant.

The antioxidant is something that limits the activity of the free radical. Wright (2004) defines antioxidant as substances that counteracts the activity of oxidative stress or free radical and prevent damage.. Also Wardlaw & Hampl (2007) defined antioxidant as any agent that can in some manner work against the damage of oxidative stress. *Whitney & Rolfes (2002) defined free radical as a molecule with one or more unpaired electrons*DELETE. An electron without a partner is unstable and highly reactive and causes oxidative stress. Whitney & Rolfes (2005) defined oxidative stress as a condition in which the production of oxidants and free radicals exceeds the body ability to defend itself. Scientist described oxidative stress as a causative factor and antioxidants as a protective factor in cognitive performance and the aging process and in development of disease such as cancer, arthritis, cataracts and heart disease.There are antioxidant properties.

Morris (1977) defined property to be the characteristic attribute possessed by all members of a class. It can be called quality. Hornby (2000) defines property as the quality or characteristics that something has.Uguru (2008) noted that antioxidant properties are the antioxidant nutrients that neutralize the free radicals. The chief antioxidant properties in food are vitamins A, C, E and beta-carotene. Hence antioxidant properties are those qualities that the antioxidants have to mop up free radicals that include the antioxidant minerals, antioxidant vitamins, and the phytonutrients. These are called the dietary antioxidants because the family gets them from the food they eat mainly from fruits and vegetables.

The family utilizes the antioxidant that the fruits and vegetables contain to remain healthy when they have consumed enough. Allergen (2010) opined that Fruits and vegetables form a large part of the average middle-class diet. Fixed numbers of portions per day are recommended by dieticians, and the recommendations are widely heeded, especially by parents and schools. Briz, Sijisema, Jasiulewicz, Kyriakidi, Guardia, Van den Berg & Van der Lans (2008) opined that a healthy product as fruit is strongly associated with ópureô and

ónaturalô and óhigh nutritional valueô. The authors continued to emphasize that fruit and vegetables are synonymous with health. They gives you a better look, better skin, helps to loose weight, prevents diseases and provides energy for sports. Freedman (2010) observed that a large prospective study of 500,000 men and women aged 50 and older have found that those who ate more fruits and vegetables had a reduced risk of head and neck cancer. Head and neck cancer is the sixth leading cause of cancer-related mortality worldwide, resulting in more than 350,000 deaths annually.The family is meant to consume the fruits and vegetable all the year round to achieve optimum health.

Therefore, the lesser known fruits and vegetables are the neglected fruits and vegetables by the families of South Eastern states that our fore-fathers ate and were healthy. They are the neglected fruits and vegetables that were abandoned in the bush. They are available all the year round and must have some nutrient in them since they are pigmented like the popular fruits and vegetables.

Vegetables

The gradual growth in population and rather steady supplies of plant nutrient result in a wide gap between demand and supply leading to malnutrition in developing countries (Siddhuraju, Vijaykumari & Janardhanan, 1995). In this context, a detailed investigation of all plant resources available worldwide, including little-known plant species, is the need for the hour to feed an ever-increasing population (Arinathan, Mohan & De-Britto 2003). Vegetables are not excluded in the plant specie that has the little known ones. There are some edible vegetables consumed locally when the popular vegetables are not in season. They are found mostly in the forest. They are not being used rather neglected. These under-utilized vegetables are the lesser known, it is this group that Tutare (2002) lamented on when she observed that sheer ignorance and carelessness in Nigeria is the major reason for less exploitation and utilization of fruits and vegetables. She observed that there are 200 varieties of vegetables to which majority of Nigerians are not accustomed to. Her statement proves that there are some lesser known vegetables in South Eastern Nigeria and the country at large and even

globally. Lupien (1998) in his own observation opined that ñsome 50,000 vegetable food species are known to exist world-wide, yet humanity used no more than 200 of them. In view of the food scarcity in many developing countries, this proportion is not sufficient. It is also ecological and nutritionally dangerous the researcher continued by stating that it is time to rediscover forgotten and neglected food plants and to broaden the food base using significantly more of the available resources. From the above statement, it is clear that there are vegetables that were neglected and need to be rediscovered because the narrowness in usage normally results to malnutrition. It will equally lead to the high cost of the acceptable ones when they are out of season. Hussian (1998) opined that according to F.A.O 123 million, people are at risk of vitamin A deficiency. For slum and rural communities in South Eastern states of Nigeria, consumption of protective foods such as green leafy vegetables has declined. Kumar & Mathur (1996) observed that the consumption of green leafy vegetable has declined over the years from 23 to 13g/day, which is far below their recommended dietary allowance (RDA). AVRDC (1996) stated that this fact is also seen in the National Nutrition Monitoring Bureau (1994-1995) data, wherein intakes of GLV in men and women are 40% and 13% of the RDA, particularly in rural and tribal areas. The production and consumption of GLV needs considerable boosting. Vegetable performs dual purposes as were pointed out by Tawardi & Agte (2003) thus: considering the value of GLV as a double fortificant of both iron and antioxidants, there is a good reason to emphasize importance in these populations as cheap and natural sources having protective functions. Serageldin (2000) noted that much of the increase in population will occur in developing counties, where the urban population will be more than triple. So the elimination of hunger and malnutrition today is not just a food problem, but is linked to population growth and poverty (Paroda, 2000). The solution to this problem in developing countries like Nigeria, which embodies the South Eastern states, does not call for excessive supplementation. Instead it can be solved by exploitation of neglected and lesser known plants with food potentials. According to Chaldha & Oluoch (2003) the integration of vegetables into human diets has been promoted as the most

practical and sustainable way to achieve optimal health, since they are efficient and cheap sources of several important nutrients. There are advantages of consuming the wild or lesser known vegetables

Firstly, the nutritional value of the traditional leafy vegetables is higher Shackleton Dzerfos Shackleton, Mathabela (1998). Secondly, they are important in ensuring food security since most are drought and pest resistant (Odiaka & Schippers 2004). Thirdly, most species have a potential for income generation since they grow throughout the year and can be harvested with minimal inputs (Jacks 1994). Fourthly, their consumption adds variety to diets Asfaw (1997). Furthermore, some species possess ecological, agronomic and cultural values, Abbiw (1997), Ogoye-Ndegwa, Abudho, Aagaard-Hansen (2002). Reversion to the traditional diets would, however, not only improve nutrition but also prevent some of the age-related degenerative diseases such as atherosclerosis, stroke and ischaemic heart disease, type II diabetes and osteoporosis (Lindeberg, Cordian Eaton, 2003. It shows that vegetables are indispensable and need to be consumed very well because of their nutritive value. Uguru in her statement opined that when we eat vegetable salad and soups we are actually consuming herbs.

Green leafy vegetables are important in the diet of many African countries. An International Plan Production and Protection Group Research Irrigation (IPGRI) project on traditional African leafy vegetables as cited by Audu, Igwe, & Ijomah (2000) is yielding important insights into diversity, use and farmer management of germplasm that is challenging conventional beliefs about their underutilized specie. Development specialists did not think that green leafy vegetables are cultivated very widely but gathered from the wild. The reverse was the case when socioeconomic research sponsored by IPGRI released its report. The report maintained that farmers actively cultivated green leafy vegetables and managed them according to the diversity they knew was within the species. Farmers would select the material they plant depending on who would be buying and consuming the leaves (ie bitter herb of several distinct genotypes with different degrees of bitterness that different culture groups prefer. There are some common vegetables utilized locally.

The common vegetables

Igbo Name	English	Scientic Name
Akwukwo jinnu	Sweet potato leaves	*Ipomea batatas*
	Water spinach	*Ipomoea aquatica*
.	Water crest	*Nasturtium offcinale*
	Celery water	*Oenanthe stolonifera.*
Ayabasi	Onion	*Allium cepa*
	Carrot	*Daucus carota*
Onugbu	Bitter leaf	*Vernonia amygdalina*
Ugu	Fluted pumpkin	*Telferia occidentalis*
Ugboguru	Pumpkin	*Cucurbita pepo*
Anara	Egg plant/garden egg	*Solanium melongena*
Gbolondi	Water leaf	*Talinium triangulase*
Inine	African spinach (popular green)	*Amaranthus caudatus*
Ahigbu, Nchonwu	Scent leaf/tea bush	*Ocimum gratissimum*
Tumatu	Tomato	*Lypopersicon solanium*
Okwuru	Okra	*Abelmuschus esculantum*
	Lettuce	*Lectuca stiva*
Uziza		*Piper cuineense*
Inie opotopo	Amanth leaves	*Amaranthus hibridus*
	Red sorrel	*Hibiscus sabdariffa*
	Cabbage	*Brassica oleracea*
Ukazi		*Gnetum africanum*
	Broccoli	*Broccoli oleracea*
	Curry leaf	
	Asparagus	*Asparagus offcialis*
	Peas	*Pisum sativus*
	Brassica oleracea	*Brussels sprouts*
	Beets	*Beta vugaris*
	Raddish	*Rhaphanus satvus*
	Turnips	*Brassical rapa*
	Spinach	*Spinacea oleracea*
	Kenaf	*Hibiscus cannabinus*
Ora (oha) ocha		*Pterocarpus mildbreadii*
Ora (oha) ojii		*Pterocarpus mildbreadii*

Source Uguru, (1996) Onyeonagu, (2008) Obute (2009)

On the other hand, there are the unpopular vegetables that this study is interested in, they are the lesser known. Wild plants can be eaten in their early stages as greens or after the rainy season when they are more developed. Berly in Okonkwo (2003) emphasized that vegetables are better if taken in its raw state, since cooking affects the food value and the taste. Also Wolf (1981) stated that vegetables have sustained human life as long as there have been humans. Yet many people seem to be rediscovering vegetable for better health resulting from high calorie foods.

Food value of Vegetables

Vegetables play important roles in human diet; it supplies some of the things which other food materials are deficient. They are important in neutralizing the acid substances produced in the process of digestion of meats, cheese and other foods. They are of value as roughage which promote digestion and helps to prevent constipation. They are important source of mineral elements needed by the body, being especially rich in calcium and iron. They are valuable sources of vitamins.

Vegetable as a source of minerals

At least ten mineral elements are needed for the proper growth and development of the body. Extensive investigation have shown that calcium, phosphorous and iron, except in rare instances, are the only mineral elements that are not present in food in quantities sufficient for the needs of the body. The green vegetables are good sources of the important mineral elements. Potatoes, sweet potatoes and mature onions contain appreciable quantities of phosphorous. According to Mpkughe (2002) the vegetable especially leafy ones are rich in mineral salt like potash, salts, phosphorous, iron and calcium.

Vegetable as a source of vitamins

The name vitamin has been given to a group of food substances other than fats, proteins, carbohydrates and salt that occurs in small quantities in natural food materials. They are essential for growth, for reproduction and for maintenance of health. It was observed by Thompson & Kelly (1957) that green and yellow vegetables contribute about

33 percent of the vitamins A supplied by the major food groups. They supply also about 25percent of ascorbic acid, appreciable quantities of thiamin, niacin and folic acid. Potatoes and sweet potatoes supply about 16 percent of ascorbic acid, while citrus fruits and tomatoes furnish about 34percent. In the opinion of OðReliy-Wright (1980) vitamins A, B, and C are present, but vary in quantity with the particular type of vegetables Vitamin C is present in tomatoes, some green leaves, green pepper and germinated pulses. All green and yellow vegetables contain vitamin C and B vitamins are mostly in pulse foods.

Energy content of leafy vegetables

Green leafy vegetables are not good sources of dietary energy (Oguntona in Osagie 1998). This is a reflection of the low dry matter (DM) content of many of these leaves. Foskett & Ceserani (2007) stated that little or no energy is stored in the leaves, it is only produced. Therefore energy value is low.

Protein content of Vegetables

In the opinion of Wachap (2005) green leafy vegetables have crude protein content ranging from 1.50 to 1.70% Aletor & Adeogun (1995) postulated a mean of 4.2% for seventeen of such vegetables when dried samples were used, crude protein ranged from 15.00 to 36.00, however, the mean is usually around 20.00%. In the report of Aletor & Adeogun (1995) and Schmidt (1971) 75% of total nitrogen in most vegetables is protein nitrogen.OðReilly Wright (1980) confirms that pulses are rich in second class protein. Also Anaezionwu-Bello (1987) agreed to the protein content of the leafy vegetable by citing that the leafy vegetable also contains small amount of protein, up to 5 percent in dark green leaves. Cassava leaves supply more protein than the cassava root.

Moisture

All vegetables contain a large percentage of water. Moloney (1979) states that vegetables are bulky food having a high moisture content estimated to be 90 to 95 percent. In a study carried out by Ukam (2007) on leafy vegetables the mean moisture content of the ones studied was 75.38-78.67.

Fat:

Leafy vegetables contain little fat, therefore, a poor source of fat. Eka and Osagie (1998) stated that it is unusual to find levels of ether extract exceeding 1.9% in fresh leafy vegetables, however, values in dry samples can range from 1.0-30%.

Antinutrient component:

It is stated by Eka and Osagie (1998) that the major anti-nutrient commonly found in green leafy vegetables are phytic and oxalic acids. The report of Taylor (1975) was that these are important because of their significant adverse effect on the nutritional value of these vegetables. High levels of either phytale or oxalates inhibit the absorption and utilization of foods in animals and man. Despite the high level of anti-nutrients in spine green leafy vegetables (e.g. cassava leaves contains 5 to 20 times high cyanogenic glycoside than the roots). Green leafy vegetables when processed and cooked are free of food toxicants (Bokanga, 1994).

Guidelines on the preparation and cooking of vegetables:

The suggested guidelines of Fayemi (1999) and Mkpughe (2002) on the preparation and cooking of vegetables are thus:

1. Prepare vegetables just before cooking to prevent the destruction of vitamins by enzymes. They can be placed in a plastic bag, in a cool place to prevent the oxidation of vitamins like C and thiamin.
2. Cook the vegetable in a minimum amount of boiling water, placing them in boiling water destroys the enzymes and therefore helps to preserve the vitamins.
3. The amount of water used in cooking vegetable is of major importance in preventing loss of water soluble nutrients, such as vitamins C, B and some of the minerals. The smaller the amount of water used in cooking, the more food value is retained in the cooked vegetables.

4. Vegetables should be cooked for the minimum time with a tight fitting lid on the pan. Covering the pan helps prevent the escape of steam and vapour so that vegetables can be cooked quickly in a small amount of water.

5. When the vegetables are just tender, they should be drained and served or used immediately, if kept hot there will be further losses of vitamins, steaming, boiling and baking is used.

6. The addition of bicarbonate of soda to green vegetables destroys Vitamin C.

Purpose of cooking Vegetables

To soften the cellulose structure Bamalli (2005) stated that the cooking of vegetable is not necessary because it softens the cellulose structure which becomes coarse as the vegetables becomes older. Also the cellulose is more digestable when cooked.Cooking makes the vegetable more palatable and appetizing.

Factors to consider when choosing leafy vegetables

According to OôReily-Wright (1980) Olusanya, Eyisi, Anfani-Joe, Ogunyide, Egbuchulam, (1994) prescribed the quality of leafy vegetable thus:

1. The colour should be attractive, and they should look crisp and fresh.

2. The mid-rib of large leaves e.g cocoyam leaves should snap sharply when broken across.

3. They should be free from insect attack.

4. The leaves should not drop when the bunch is shaken. If many leaves drop when shaken, it shows that the vegetable is not fresh.

Micronutrient of vegetables

Vegetables are the most economically efficient source of micronutrients (Solomon & Bulux 1997 and Ali & Tsou 2000).Most people lack between 40 and 80% of the minimum required quantity of vegetables. Welch, (1997) opined that traditional micronutrient rich plant foods have become less abundant and more expensive to obtain because their production has fallen and/or not kept abreast with demand because of increased population pressure. In fact, in many nations in Asia, consumption of vegetables has not met the recommended per capita vegetable supply of 73kg/year per

person, the minimum amount to prevent malnutrition. The statement of Maberly, Trowbridge, Yip, Sullivan & West (1994) was that the consumption of calorie by people in developing nations has increased since the 1960s, the focus on staple crops such as rice, and wheat, has resulted in the decreased availability of micronutrient-rich food crops to millions of disadvantaged people and contributes to increase in micronutrient malnutrition namely óhidden hungerô globally. Combs, Welch, Duxburg, Uphoff & Nesheim (1996) and Solomons, Bulux (1997) observed that the problem encountered in most food-based approaches to improving micronutrient status are multifaceted. They include concerns about nutrient concentrations and interactions in the selected food; bioavailability and bioconversion of the nutrient of interest; and issues related to cultural sensitivity. According to Vuong (2008) despite those problems, solutions to micronutrient malnutrition that make use of local food sources offer many benefits in the following ways: the most apparent advantage is the self-sustainability of the program. Another benefit is that the foods provide not only the deficient nutrient but also calories and other nutrients. Another attributes to long-term success of food-based strategies are the ready acceptability target groups due to familiarity. Improved production of the foods will motivate the advancement of methods of processing, storing and preserving the foods, which in turn not only will improve availability of the foods but also will increase household income, which quite often is positively correlated with low nutritional status.

In an attempt to prevent micronutrient deficiency in developing countries by food-based strategies, most efforts have been spent on fortifying foods with synthetic ingredients or supplying foods that provide the needed nutrients to populations, rather than finding local sources of foods that contain the needed nutrients and promoting local production of these foods. The observation of Miura, Kunii & Wakai (2003) on the comment of pregnant women was thus ñWe eat vegetables as an alternative to tablets because we cannot afford tablets. If we were not poor, we would not eat vegetables. We can balance our diet without vegetables. The ideal meal is white rice mixed with óstarô margarine with canned sardine as topping served with instant noodle as soup. All these fortified foods are certified by the government but we cannot afford themò. Also Vuong (2008) noted that fortification requires centralized, well-monitored food processing and effective distribution channels, this type of infrastructure is often rudimentary in third

world countries. Fortification of certain nutrients also changes the appearance and taste and renders it less desirable to the target population. The observation of Vuong (2008) continued to indicate that none of the fortification methods provides a sustainable solution to prevent micronutrient deficiency in developing countries. It was stated by Ruel & Levin (2000) that a review of food based strategies recognized three main types: Increased production of micronutrient rich foods, from either commercial or home gardening, small livestock or agriculture; Increase intake of micronutrient rich foods, through nutrition education, mass media and other programs intended to change food selection and improve nutrient bioavailability, by food processing or the simultaneous consumption of enhancing foods. It is worthy to note that vegetables are one of the things that can be obtained from the home gardening. Leafy vegetables was not considered by Tarwadi, Mengal & Chiplonkar, (2000) to be good source of vitamin E but they are rich in trace minerals and other vitamins.

The trace metals are the one this study is concerned with the trace element is required in the body in small quantity but its deficient is dangerous. Fosket & Ceserani (2007) states that the body at a certain times make a greater demand for certain minerals elements and there is danger then of a deficiency in the diet. The effect of deficiency may be quite complex in some cases and as with vitamins, the condition may arise either as a direct result of dietary insufficiency or be because of some mal-absorption or other dysfunction within the body. There are two groups of mineral element namely; the major and minor elements. They can be found in fruits and vegetables which Onigbinde (2005) called base food.

The minor or trace element is required in the body in an amount that is less than 100mg per day. According to Wright (2004) minerals that are needed in minute amount are called trace elements. Green leafy vegetable is observed by Cho, Saddom, Ronse, Willet & Hankison (2004) to contain many bioactive compounds and thus serves as an important source of minerals, vitamins and certain hormone precursors in addition to protein and energy sources This is why Penny, Karr, Andrea, Stacie, Amy, Kristen, Army & Terry (2002) opined that leafy vegetables have continued to provide population with limited access to meat or fish, a rich source of proteins and micronutrients essential for pregnant and lactating mothers, as well as young and growing children Also,

Akindahunsi & Salawu (2005) opined that studies have shown that vegetarians are less susceptible to diseases, live longer, healthier and more productive lives with stronger immunity. It was observed by Agte, Tarwardi, Mengal & Chiplonkar, (2000) that vegetables are not good source of vitamin E but they are rich in trace metals and other vitamins.

Trace metals or element

Some dietary minerals perform some crucial roles in the metabolic functions of the body in only one peculiar way, while others may serve in several capacities. These are grouped into major elements and micro or trace element (Onugbinde, 2005). Generally, a major element is one whose daily requirement is 100mg or more; while the body requires much less of the trace elements per day (Onigbinde, 2005). The basic idea to remember for healthôs sake is that we are made of the minerals and trace elements present in the soil, and unless the foods we eat are grown on rich, fully mineralized soil, our bodies will become deficient in one or more essential chemical elements, and we will become vulnerable to a disease (Jensen, 2000).

The essential trace elements are many and Jensen (2000) gave them to be iron, fluorine, zinc, copper, iodine, selenium, manganese, molybdenuium, chromium, cobalt. Onigbinde (2005) opined that foods, which on combustion, leave a residue comprising mainly the basic elements such as sodium, iron, calcium, potassium and magnesium are called base forming foods because they contain fruits and vegetables. Green leafy vegetable is observed to contain many bioactive compounds and thus serves as an important source of minerals, vitamins and certain hormone precursors in addition to protein and energy sources.

There are various types of the popular or known leafy vegetables eaten in South-Eastern parts of Nigeria that have been studied. The following are to be reviewed;

a. *Gnetum africanium* (Okazi)
b. *Amaranthus caudatus* (spinach)
c. *Abelmosthus esculenta* (okro)

***Gnetum africanum* (Okazi)**

It is a vegetable commonly known as óUkaziô or óOkaziô in Igbo. The Efik calls it Afang. The plant is a tough, slender twining shrub. It is propagated by seeds in some parts of Eastern Nigeria where it is used as leaf vegetable. An observation of Ukam (2008) indicated that its vitamin A content is 545.43 IU, ascorbic value of 278.10mg and phytate content of 18.60mg. Again, Bamalli 2005 and Ekumankama (2008) observed that Gnetum africanum has the following nutrients protein; 19.74%, lipid 11.8%, crude fibre 24.6%, ash 2.7%, carbohydrate 41.08%, energy 1,467kg, potassium 1.4%, magnesium 0.21%, phosphorus 0.14%, calcium 0.30% and iron 450ppm. When one observed the results of the analysis especially the one of Bamali and Ekumankama one would find out that diets containing several servings of Gnetum africanum will help to combat micronutrient deficiency.

Amaranthus species **(spinach)**

It is called ónineô in Igbo. It is produced on the seed-bed of humus soil. Seeds are sprinkled evenly on the surface and covered with a layer of small dry grass or lentil-sized gravel or pebbles. The leaves are used in preparing yam porridge and a relish to main meals. According to Eka & Osagie (1998) the leaf contains iron, zinc and oxalate. The FAO, (1998) stated that the leave contain Vitamin A. Audu, Igwe & Ijomah (2000) noted that the iron content was 38.4mg/100g dry weight.

Vernonia amygdalina **(bitter leaf)**

It is called ónugbuô in Igbo. It is known for its bitter taste. The bitterness necessitates much squeezing and thorough washing prior to use for cooking. It is a complement to a dish. When fresh, the moisture content as Eka and Osagie noted is 21.6%, energy 408.0kcal, protein 22.2%, fat 27%, carbohydrate, 64.4%, crude fibre 10.9% and ash 10.0%.

Fruits

Forests and trees provide foods that supplement and complement traditional agricultural sources. Adepoju & Adeniji (2008) opined that foods obtained from trees and

forests make an important direct contribution to peopleôs food security needs, although the quantities involved may be small. Fruits are among the foods that can be obtained from the forest and trees in a small quantity. This group of fruits is the lesser known type that is under-utilized. It was observed by Duyff (2006) that there are some fruits that are lesser known by stating that rather than going for fruits that you know already, try something new. The researcher continued to emphasize that many fruits arenôt well known. Also Vuong (2009) gave reasons for under-utilization of a gac fruit to be that the local people have a poor perception of the health and commercial benefits of the plant. There have been no efforts to promote the production and educate the target population about its nutritional benefit. These reasons given to gac fruit under utilization equally affects the under utilization of the wild fruits in general. There are few studies on forest food as Olapade & Kio (1991) and Ball, Baatz & Chandrasekeran (1995) observed that the causes of little forestry focus on nutrition may probably be due to the fact that nutritionist concentrate on what are considered agricultural food rather than the bush berries and tiny reptiles, mammals or insects derived from the wild. Kehnlein (1989); The opinion of Hernandex-Perez, Frias, Rabanal & Vidal-Valverde (1994) and melgarejo, Salaza & Amoros (1995) indicated that however, there seems to be more awareness of the importance of the wild fruits consumed by the local people where the trees are indigenous as source of meeting their nutritional needs. On the other hand, Tindall (1965) observed that the lesser known fruits remain either in the bush for hunters and thirsty farmers to pick and nibble or else find their way to the villages for children to eat or play with the surplus. The observations from all indication prove that they remain to be unaccepted by all. If some of the rural dwellers accept, it is not enough because the urban dwellers need them too to be healthy. The World Health Organization (WHO) (1995) and FNRI (2000) observed that the problem with the urban was not of energy but overweight. Hodgeson, Hso-Hage & Wahlqvist (1994) observed that they consumed carbohydrate-rich food, which was mainly purchased refined foods. Ifeanacho (2009) posited that in no other class of food is the beauty of nature made manifest than in fruits. By their charm of attractive colours and pleasant flavours they attract the eye and stimulate the palate (appetite). Again Briz, Jasiulewiez, Guardia, Van der lans, Sijitsema, Kyriakidi, Ven den Berg (2008) observed that the local fruit tastes better and that people equally want fruits

that are easy to eat. Also, Tuorila (2001) gave product characteristic which lesser known fruits met to be (a) functional foods that have a beneficial health effect (b) genetically modified products (c) nutritionally modificed foods (having higher fibre content or reduced fat/sugar), (d) organic foods and (e) ethnic foods (having higher unfamiliar cultures).

It was observed byTutare (2002) that there are over 70 varieties of fruits to which Nigerians are not accustomed. Nigeria can boast of different fruits, ranging from the very sweet, with a rich flavor, to a mild and with little or no flavor. The more popular ones are frequently sold in the markets of the larger towns and cities when they are in season. They include the following:

Igbo Name	**Common Name**	**Scientific Name**
Gova	Guava	*Psidium guajava linn*
Mangoro	Mango	*Mangifera indica*
Nkpuru Nkwu	Palm tree fruit	*Elaeis guineensis jacq*
Ube	African pear	*Dacryodes edulis*
Lemonu	Lemon	*Citrus limon*
Oroma nkirisi	Lime	*Citrus aurantifolia*
Okwuruoru, Mgbimgbi, Okwuruezi	Pawpaw	*. Carica papaya*
Kanshuu/kashu	Cashew	*Anarcadium occidentale*
Ose	Green pepper	*Capsicum annum*
Aki oyibo	Coconut	*Icocos nucifera*
Oroma	Sweet orange	*Citrus sinensis*

	Grape fruit	*Citrus paradise*
	Madarine orange, tangerine	*Citrus reticulate*
Chokwu chokwu	Sour sop	*Annona muricata*
Oji Igbo	Kola (3-5 cotyledon)	*Cola acuminate*
Oji Gworo/Oji Hausa	Kola (2 cotyledons)	*Cola nitida*
Ube Bekee	English pear /avocado pear	*Persea Americana*
Unere	Banana	*Musa sapientum*
Ukwuoba	Pineapple	*Ananas comosus*
Ogede	Plantain	*Musa pardisiaca*
	Cocoa	*Theobroma cocao*
Ose Ocha	Red pepper	*Capsicum frutescens*
	Water melon	*Citruaillus vulgaris*
	Cucumber	*Cucumis sativus*
	Star fruit	*Averrhoa carambola*
	Lyche	*Litchi sinensis*
	Pomegrante	*Punica granatum*
	Olives	*Olea europaea*
	Apricots	*Prurous armeniaca*
	Apples	*Pyrus malus*
	Cherries	*Prunus cerasus*
	Raspberries	*Rubus strigosu*
	Plums	*Prunus domestica*
	Peach	*Prunus persica*
	Straw berries	*Fragaria virginiana*
	Black berries	*Rubus villosus*
	Almond fruit.	*Termi ppa*

Sources: (Dyuff 2006)

Others are apples, blue berry, cranberry, black currant, kiwi fruit, purple figs, raisins, dates, brown pear, plum, honey-dew.

Classification of fruits

Olusanya, Eyisi, Anfani-Joe, Ogunyide, Egbuchulam (1990) and Mkpughe (2002) classified fruits into two broad groups viz.

Fresh fruits**:** These include:

a. Soft fruits e.g the different types of berries, bananas, guavas, pineapples

b. Hard fruits e.g apples, pears, plums, melons, mangoes,

c. citrus e.g. oranges, lemons, grapefruits.

Dried fruits: They include figs, apricots, dates, prunes and peach.

Fruits can also be classified according to colour as Duyff (2006) noted them thus:

a. Green fruits**:** They include avocado, green apples, green grapes, honeydew, kiwifruit, lime, green pears.
b. Orange and Deep yellow fruits**:** apricot, cantaloupe, grapefruit, mango, papaya, peach, pineapple, yellow apple, yellow fig.
c. Purple and blue fruits**:** blackberries, blueberries, plums, purple figs raisins.
d. Red fruits: cherries, cranberries, pomegranate, red/pink grapefruits, red grapes, strawberries, water melon.
e. White, tan, brown fruits**:** banana, brown pear, dates, white peaches.

Nutritional Composition of Fruits

Vitamins: Fruits contain a lot of ascorbic acid that is vitamin C since most fruits are consumed raw. Most fruits contain small quantities of carotene and the B group of vitamins.

Carbohydrate: Fruits contain carbohydrate in the form of sugar, cellulose and starch. The cellulose is however indigestible and so add bulk to the stool.

Protein: Fruits contain protein

Fat: They contain fat for instance avocado and olive have high fat content.

Anti-nutrient: Fruits contain some anti-nutrients like oxalic, tannin, phytate.

Moisture: The water content of fruits is high, it ranges from 85%-90%.

Important health benefit of fruit

Duyff (2006) states them to include:

a. reduce risk for heart disease, type2 diabetes, and some cancers.

b. helps to maintain healthy blood pressure and perhaps reduce the risk of developing kidney stones or possibly help reduce bone loss with age due to the potassium content.

c.the dietary fibre may help reduce heart disease risk, blood cholesterol levels, constipation and diversification in overall healthful eating pattern.

d.fruits vitamin C promote growth and repair of all body tissues, helps to heal cuts and wounds and keep teeth and gums healthy.

e. Its fibre aids the digestive process.

f. Its folate helps form red blood cells

g. for many women helps reduce the risk of birth defects.

h. It may help to lower calories in meals and snacks since they are low in calories.

Eat varieties of the fruits because of the differences in their composition.

How much fruits to take

The amount of fruits to take depends on age, gender, height, weight and level of physical activity.Duyff (2006) opined that a person that requires 2,000 calories a day needs about two cups of fruit a day. As a rule of thumb, a cup of fruit is 1 cup of fruit or 100 percent fruit juice or 1 ½ juice or 1 ½ cup of dried fruit. Counting one cup with whole fruit takes more estimating.

a. cup cut-up fresh frozen or canned fruit, or apple sauce.

b. 1 cup fruit juice

c. 1 large (8-to 9-inch) banana

d. 1 medium pear (2 ½ pears per pound)

e. 3 medium or 2 large plums

f. 1 medium (4-inch-diameter) grape fruit

g. 32 seedless grapes

h. 1 small 2 ½ -inch-diameter) apple

i. 1 small wedge (1-inch-thick) water melon

j. 8 large strawberries.

Factors to consider when selecting fruits

Fruits like vegetables, is perishable therefore, the following points should be considered when selecting fruits as identified by Olusanya, Eyisi, Anfani-Joe, Ogunyide, & Egbuchulam (1994) and Mkpugbe (2002).

d. They must be fresh.

e. They must be free from insect infestation.

f. They must not be over ripe.

g. They must be firm to touch.

h. Fruits in season e.g bananas. Pawpaw, citrus and carrots are common during the dry season, while guava and mangoes are common during the rainy season. Fruits in season is likely to be cheaper and of good quality.

i. Where grade fruit is available, choose the highest grade for eating whole or raw, and lower grades for fruit salads and for cooking.

j. For jellies and jams buy fruit with a high pectin content because it will set better.

Methods of serving fruits

Fruits can be served whole, fresh, ripe, and raw. Almost all the fruits of the South Eastern states of Nigeria are eaten ripe without cooking. This makes available all the vitamin C they contain. The unripe fruits, sour fruits and fruits with hard seeds may be cooked as advised by Olusanya, Eyisi, Anfani-Joe, Ogunyide & Egbuchulam (1994).

Micronutrient composition of fruits

Micronutrient malnutrition as it was noted by Allen (1993) occurs in the face of adequate energy and protein intake due to poor dietary quality as well as where there is an inadequate quantity of food, poor availability (influence of inhibitors, interactions) and presence of infection. It is much more widespread than protein energy malnutrition (PEM). Also, Ngongi (2003) observed same by stating that nutrition and hunger were not separate but identical. However there are countries that are hunger free but have serious malnutrition especially micronutrient. Again, Ngongi (2003) continued that it was not the absence of hunger that corrected all nutritional problems. Reduction in micronutrient malnutrition should have a separate target because of the magnitude of women and children suffering from micronutrient deficiencies. The emphasis should be on how shadows of hungers as awareness have improved. From all the above statements, it is worthy to note that malnutrition is not caused by lack of food but can be caused by poor dietary habits. It also can be caused by certain nutrient inhibitors that do not allow the nutrients to be absorbed in the body.

This was why kehnlein, (2003) advised that a shift away from national traditional food resources generally means a decrease in the consumption of fish, domestic animals,

locally grain agricultural crops and uncultivated with a simultaneous increased consumption of industrial intake is likely consequence in addition to obesity and other conditions associated with increasing dietary energy, carbohydrate and fat. Understanding the micronutrient contents of species in traditional food system would be an essential step towards the goal of building health promoting activities that could incorporate these foods. Kehnliens (2003) continued to state that indigenous people risk micronutrient problems, local traditional food resources should be investigated for items with which to build food strategies to alleviate these peopleôs malnutrition. The answer to Kehliens observation of using traditional food to solve the problem of micronutrient deficiency is to use the lesser known vegetables that should contain these micronutrients.

On the other hand, Ene-Obong and Madukwe (2001) reported that trace element deficiency were not exclusively as a result of inadequate dietary intakes but by a host of other interacting factors. These factors include levels of intake of the nutrient, its form and enhancers such as ascorbate. Other factors might be the chelators, inhibitor and interaction between minerals, age, physiological and pathological states and biological differences of the subjects. It is to be noted here that micronutrient deficiency is necessary caused by poor diet, it can be caused by certain inhibitors like lack of ascorbate can prevent the absorption and host of other factors like age among others.

Also, Burgess (2003) opined that in addition to the consumption of trace minerals, vitamins consumption is important in small amounts. Vitamins and minerals (micronutrients) are needed in minute amounts; their lack in the diet affects the health and development of children and adults. This might potentially be life-threatening deficiency (iron, iodine and vitamin A). Since the deficiencies of the micronutrients are life threatening, it is worthy to note that their local sources should be beneficial for them to be consumed.

Still UNICEF (1993) reported that the proportion of the population suffering from micronutrient deficiency and the resultant disease is at a critical level. Almost 20 million Nigerians are estimated to suffer from the deficiency disorders (IDDs) with goiter prevalent at 20%. Participatory information collection (PIC) (1993) discovered that about 9.2% and 7.2% of children and women, respectively are deficient of vitamin A.

The National Policy on Food and Nutrition (NPF & N) (2001) opined that high maternal mortality is associated with the high incidence of anemia.

Iron Deficiency (Anemia)

It was observed by the FAO (1998) and Usha, (2002) that iron deficiency is the most widespread nutrient deficiency. The Administrative committee on coordination-sub-committee on Nutrition (ACC &SCN) (1992) opined that iron deficiency is the commonest nutritional disorder in the world and affects over one billion people, particularly reproductive-aged women and preschool children in tropical and sub-tropical zones. It also has serious impact on school children and working males. It is generally held that at least half of the anaemia worldwide is directly due to dietary iron deficiency.

Roles of Iron

It was noted by Jensen (2000) that rosy, delicate cheeks and beauty of complexion depends upon a high-iron diet, but it has to be ferrous iron to be readily used. The body absorbs this kind of iron which is found in meat, poultry and fish, three times more readily than iron from eggs, legumes, and whole grain. Lack of copper or manganese in the diet reduces iron assimilation, as does vitamin C. Oxalic acid foods, such as chard and rhubarb can block iron intake. Soft drinks that is high in phosphates cause iron to be excreted in the urine. Drinking tea with a meal will inhibit iron absorption more than if tea follows the meal, ACC/SCN 1992).

Zinc Deficiency

The physiological role of zinc in normal taste sensation has been established. Hypogensia (loss of taste acuity) and dysgensia (disordered taste) commonly occur in adults, (Onigbinde, 2005). The symptoms deficiency include retarded growth, reduced appetite and impaired reproductive development and function and Wright (2004) states that it is vital in Vitamin A absorption.

Role of Zinc

It is metallic component of the enzyme carbonic anhydrase, which is found chiefly in the red blood cell and also in the parietal cells of the stomach. Zinc serves as a co-factor for arginase, enolase, several peptidases and oxaloacetic decarboxylase. It is involved in the synthesis and metabolism of protein.

Iodine Deficiency

It was cited by Wright (2004) that a deficiency of iodine causes goiter in which the thyroid gland enlarges in order to increase its output of hormones. Iodine deficiency, combined with hypothyroidism (reduced thyroid activity) may be associated with fibrocystic diseases of the breast or even breast cancer in some cases.

Role

It is vital for the correct functioning of the thyroid gland and is present in the hormones thyroxine and triodollyronine that is essential for the regulation of metabolism and growth.

Selenium Deficiency

Wright (2004) also stated that its deficiency can cause effects on the heart and circulation and may be implicated in some cases of anaemia. The RDA is 0.05 to 0.2mg.

Role

Selenium in conjunction with vitamin E is a powerful antioxidant being the c factor necessary for the activity of the enzyme glutathione peroxidase which mops up free radicals. Selenium ensures correct functioning of the liver and blood system but it is believed that many people are deficient in this mineral.

The deficiency diseases caused by lack of the micronutrient can equally be solved through the consumption of fruits. Gale (2001) states that the vitamins in fruit are dominated by vitamin C, but the content of folate, vitamin and the pro-vitamin A carotenes may also have nutritional significance. Also Tutare (2002) noted that the most important nutrients found in fruits and vegetables are vitamins and minerals.

From the statement it means that fruits contain the micronutrient. The micronutrients of the popular fruits are to be analyzed.

Composition of the popular fruits

The fruits that are to be analyzed include mango (*Mangifera indica), Dacryodes edulis* (African pear). Orange (citrus sinensis), pawpaw (carica papaya), guava (psidium guajava) Banana (Musa esculentum)

***Mangifera indica* (mango)**

Mango tree is a nutritive of Indopakistan region but now cultivated in many tropical countries including Nigeria. It was opined by Bowea (1979) that in tropical Africa mangoes are grown for local consumption, although some fruits are for making chutney, which is usually eaten with curries. The mango tree composition was reported by Amoo & Lajide (1999) to contain about 85% fluid, low protein and carbohydrate but with high percentage composition of vitamin C, digestible sugar. Also, Vickery & Vickery (1979) noted that mango trees are rich in sugar, vitamins A and C accordingly.

The composition of Vitamin A and C of mango fruits are within 0.20,g/100g and 300mg/100g respectively. In the work of Amoo & Owoeye (2006) the elements in mango fruit was determined. Three grammes of mangoes were analysed using 200A Bulk scientific (3) and the result obtained was sodium(Na) 232.7ppm, potassium(k) 199.7ppm, calcium (ca) 194.1ppm, magnesium (mg) 18.5ppm, iron (fe) 48ppm, manganese (mn) 20ppm, Aluminium (Al) 11.4ppm, zinc (zn) 19.7ppm, Lead (pb) 1.28ppm, Nickel (Ni) 7.16ppm, copper (cu) 1.13ppm, chromium (cr) 0.2ppm, Tin (sn) 0.1ppm.

Composition of *Dacryoides edulis* (Native pear)

It is one of such useful fruit tree. It originated in America and is called ọ́ubeô in the South Eastern part of Nigeria where it is commonly found. The tree is tall with a large trunk that produces wax when cut, while the fruits which grow in cluster on a single tendril, start off with a pinkish black or blue to blue black on maturity. Adepoju & Adeniji(2008) gave the composition of the raw fruit, and roasted fruit and steamed to be:

Potassium 1.14mg, 1.14mg, 2.12mg; Sodium 1.41mg, 1.41mg, 1.14mg; Calcium 2.12mg, 1.14mg, 0,71mg; Magnesium 2.83mg, 2.12mg, 1.41mg; Iron 1.41mg; 1.41mg; 2.12mg Phosphorus 1.41mg, 1.41mg 1.12mg; Manganese 0.02mg, 0.01mg; 0.01mg Copper 0.02mg, 0.01mg, 0.01mg; B-carotene 0.02µg, 0.04µg, 0.02µg; Riboflavin 0.01µg, 0.01µg, 0.01µg; Niacin 0.03µg 0.03µg, 0.01µg; Ascorbic acid 0.3m, 0.01µg, 0.03µg; Tocopherol 0.01µ, 0.02µ**,** 0.01µ, .

Scarcity Implications of Fruits and Vegetables to the Family

Food systems worldwide have changed as a result of the increasing industrialization in agriculture, consolidation in the food chain (production, processing and distribution), and shifting diets and food cultures. This development has increased access to foods (especially imported ones) in many parts of the world. The resulting ecological, socio-economic and cultural changes, however, are not always conducive to human health or sustainable to families or communities. Allergen related documents (2010) opined that fruit is experiencing a renewed importance in the human diet, as an indirect result of this very ñsweet toothò. With a very abundant food supply and wide choice among foods in the present-day developed world, the preference for sweetness has run amok, one result being widespread overindulgence in candy, pastries and other processed sweet foods. This has contributed to the obesity epidemic and unprecedented rates of diabetes and other obesity-related illnesses. But with health awareness growing, there is, at least in industrialised countries, a partial return to human dietary roots, with more and more ñnaturalò, less-processed foods being eaten, and this trend includes the replacement of fattening sweets with non-fattening fruits.

The implication of scarcity of fruit and vegetables to the family are so numerous. The scarcity of fruits and vegetables will lead to the deficiency of the nutrients that fruits and vegetable supply thereby leading to the development of chronic diseases. The chronic disease is a life long process. Risk factors may begin early in the life cycle without symptoms and then cause illness and disability in later years. Australian Institute of Health and Walfare (2006) stated that there is need to manage not only the diseases but also the risk factors that preced them. Risk factors are an important determinant of disease outcomes and generally as the number of risk factors a person has for a

particular condition increases so does their risk of developing that condition. The opinion of Irigaray ,Newby ,Clapp , Hardell ,Howard , Montagnier , Epstein & Belpomme (2007) was that many chronic diseases are considered to be preventable because many of the risk factor can be avoided or modified. They stated that results from National Health Survey (NHS) conducted in 2004-2005 indicated that nearly 97% of adults had at least one of the reported chronic disease risk factors, and that 6.6 million Australian Adults had at least three of the eight modifiable risk factors outlined below by Australian Bereau of Statistics (2006) to include high blood Low density Lipoprotein (LDL) (bad) cholesterol, low blood High Density Lipoprotein (HDL) (good) cholesterol, high blood pressure, diabetes, obesity, physical inactivity, cigarette smoking and a diet high in saturated, low in vegetables, fruits and wholegrains. Australian Institute of Health and Welfare (2006) enumerated the unmodifiable risk factors to include family history, gender and age. These various risk factors and determinants of disease all have different roles in the prevention of chronic diseases. Childrenôs Health Development Foundation (1998) indicated that the individual requirements for protein, vitamin minerals differ depending on the age, gender, pregnancy or breastfeeding. The minimum number of daily serves of vegetables and legumes and fruit needed to achieve at least 70% of the requirement of protein, vitamins and minerals for adults is five (5) serves per a day of vegetables and two (2) serves per a day of fruits.

Vegetable and Cancer:

World Health Organisation (2000) observed that cancer is an abnormal growth of cells, which proliferate in an uncontrollable manner as a result of the failure of normal cellular regulatory controls. Other terms are malignant tumours and neoplasms. In many cases, these abnormal cellular growths can metastasize which involves the cancer spreading from its original location. Cancer can arise from all organ systems and tissues and therefore cannot be considered a single disease, although the basic aetology is similar. According to Hanahan & Weinberg .(2000) a number of mutation must occur to a cell in order for it to become self sufficient in growth signals, insensitive to anti-growth signals, able to evade apoptosis(cell death), acquire the ability to replicate continuously and must be able to sustain angiogenisis (stimulate blood vessel

production). Also; Hanahan & Weinberg (2000) further stated that an ability to invade surrounding tissue must be acquired in order for metastasis to occur.This process takes many years therefore there are many opportunities for outside intervention to interrupt this process. The comment of Lichteinstein, Holm, Verkasalo, Iliadou, Kaprio, Koskenvuo, Pukkala, Skytthe & Hemmininki (2000) was that although there are some cancers that have a strong genetic basis, studies that have examined the coï occurrence of cancer in identical twins have shown that environmental factors are more important than genetic factors in the aethology of most common cancers. Irigaray, It was added by Newby, Clapp, Hardell, Howard, Montagnier, Epstein, Belpomme (2007) that environmental factors of particular importance are thought to be cigarette smoking, diet, and exposure to radiation and environmental pollutants. Still, Belliveau & Gingras (2007) opined that poor diet is thought to account for approximately 30% of all cancers and as much as gastrointestinal tract. Yet, Renehan, Tyson, Egger, Heller & Zwahlen (2008) agreed that increasing body weight is also an important risk factor for many common and less common cancers

The School of Exercise (2008) enumerated the various types of cancer to include mouth, pharynx and larynx, nasopharynx, oesophagus, lung, pancrease, gullbladder, liver, colon and rectum, pre-menopausal breast cancer, post-menopausal breast cancer, ovary, endometrium, cervix, prostrate, renal, bladder, skin The Australian Bereau of Statistics (2006) reported that in 2004-05, 2% of the population (about 390,000 people) had a medically diagnosed neoplasm. Of these 87% reported that they had a malignant neoplasm and 14% reported that they had a bengn neoplasm or neoplasm of an uncertain nature. The indication of Irigaray,.Newby, Clapp, Hardell, Howard, Montagnier, Epstein, Belpomme (2007) showed that the incidence of the most common cancers of breast and prostrate has increased markedly in the last twenty(20) years and this is thought to be due to the increasing burden of mutagenic chemicals present in the environment in addition to increases in obesity and worsening dietary habit as well as better detection method.

When the familyôs diet is free from fruits and vegetable a poor diet results and results in many chronic diseases. When a family does not eat with vegetables and fruits due to its scarcity there will be increase in body weight resulting to poor health. It was

opined by Prentice, Thompson, Caan, Hubbell, Anderson, Beresford, Pettinger, Lane, Lessin, Yasmeen, Singh, Khandekar, Shikany, Satterfield & Chlebowski (2007) that the effect of a low diet on the incidence of breast, cholesterol, ovarian and edomettrial cancer risk was examined in 48,835 post-menopausal women of whom 19.541 were randomly assigned to a low fat diet and 29.294 remained on their usual diet and were followed for an average of 8.1 years.Although the primary aim of the intervention was to reduce the total fat intake to 20% of energy, this was done primarily by increasing consumption of fruits and vegetables and grains. The author found out that the intervention diet resulted in a reduced risk of ovarian cancer after year four of study. The evidence for the other types was only suggestive.

Cardiovascular Disease and Vegetables and Fruits

Cardiovascular disease (CVD) is another chronic disease that can develop in the life of any member of the family due to scarcity of fruits and vegetable in the diet. Cardiovaascular disease is seen by Australian Institute of Health and Welfare (2005) as a group of common, serious diseases which relate to plaque build up in the artries of the heart, brain and other organs and affects the vascular system of the body. These associated diseases include coronary heart disease (CHD), stroke and other conditions of blood flow insufficiency. Draper, Unwin, Serafino, Somerford, The position of Price (2005) was that CHD is also known as ischaemic heart disease, consists of acute myocardial infection (MI) (a heart attack) and angina (chest pain). A heart attack is caused by a vessel, which supplies blood to the heart muscle, becoming blocked. Angina is a chest pain which results from reduced blood flow to the heart. CHD occurs due to a blockage in the coronary arteries, the arteries which supply blood to the heart. The author continued to emphasize that over time these blood vessels can harden due to a build up of fatty deposites (known as atherosclerosis.) Accumulation of these fatty deposite is known as plaque, and this can lead to bleeding at a blockage site, or the formation of a blood clot. The Australian Institute of Health and Welfare (2005) opined that either of these can result in a heart attack or in the case of blockage of cerebral blood vessels, cerebral infarction in the brain results. The addition of Draper, Unwin, Serafino, Somerford, Price (2005) was that stroke includes a number of cerebrovascular

diseases including Ischemic stroke (IS). IS occurs when an artery supplying blood to the brain becomes blocked and lack of blood supply can cause damage to parts of the brain possibly leading to impaired body function.

The Australian Institute of Health and Welfare (2005) stated that CVD is caused by many factors, some modifiable and some not.The unmodifiable ones age, gender and family history. The unmodifiable risk factors include high blood Low Density Lipoprotein(LDL) cholestrol, low blood High Density Lipoprotein (HDL)cholesterol, high blood pressure, diabetes, obesity,physical inactivity, cigarette smoking and a diet high in saturated fat, low in vegetable, fruits and whole grains. The author emphasized that the association between CVD and total blood cholesterol has been shown to be very strong, and the higher the LDL cholesterol, the higher the risk of CVD. A diet high in saturated fat and low in vegetables increases LDL cholesterol, increasing CVD risk. However, Bogers, Bemelmans , Hoogenveen , Boshuizen , Woodward , Knekt , van Dam , Hu , Visscher , Menotti , Thorpe ,Jr, Jamrozik , Calling , Strand , Shipley (2007) posited that hypertension also frequently coincides with CVD among other diseases, and the higher a personôs blood pressure , the greater the risk of CVD. Having diabetes greatly increases the risk of CVD, due to blood vessels becoming blocked and poor circulation. This increases the development and progression of atherosclerosis. Obesity and physical inactivity greatly increases the risk of CVD due to risen LDL cholesterol and increasing the risk of diabetes. Obesity may also contribute to an increased risk of CVD independently of its association with other risk factors. Australian Institute of Health and Welfare (2006) noted that as a result of CVD 1.4 million Australians (6.4% of the population) suffered from disability which resulted in CVD accounting for 17% of the overall disease burden in 2003. Much of this disease burden was caused by years of Life Lost (YLL) to premature mortality, equating to 29% of total YLL in Australia. The years of healthy life lost as a result of poor health or disability (YLD) caused by CVD were 7% of Australiaôstotal YLD.

It has being noted by Papandreou, Rousso, Makedou, Arvanitidou, Mavromichalis, (2007) that lower intakes of certain nutrients have been associated with higher risk for CHD, diabetes, hypertention and cancers in later life.Due to vegetables being high in folate, lower intakes have been linked to increased total homocysteine

levels in children. The indication of Dauchet , Amouyel , Hercberg , Dallongeville (2006) was that there is some clinical and laboratory data which support the belief that the micro and macro constituents of vegetables and fruits improve important risk factors of CHD including hypertension, diabetes and abnormal lipid level. For instance Rissanen , Voutilainen , Virtanen , Venho , Vanharanta , Mursu , Salonen (2003) conducted a prospective cohort study in middle aged men from Eastern Finland assessed the association between vegetable, fruits, berries and all causes CVD and non CVD related mortality, The 3,235 35-60 years old men were followed for 12.8 years, with results showing that the lowest rates of CVD and non CVD and all cause mortality were among those who consumed the highest qauntities of vegetables, fruits and berry intake had greater intake of vitamin c,e, folate, dietary fibre, beta-carotene and total energy than the other subjects, Those who died of CVD within the first five years of follow up were shown to have had a 41% lower intake of vegetables, fruits and berries. Thus an association between regularly consuming vegetables and fruits and a reduced risk of developing CVD exist. The authors further studied the protective effect of dietary vitamin C, E, beta ï carotene, lycopene, folate and fibre intake and it was found that the nutrients which are negatively associated all cause of mortality were vitamin C (which explained the 10.4% protection of vegetables, fruits and berries), folate(6.5%) lycopene (5.6%) and vitamin E (5.3%). The nutrient that protected against CVD mortality was vitamin C (19.4%), folate (14.6%), and vitamin E (1.9%). Protection from non CVD mortality occurred with increased vitaminC (57.9%), lycopene (22.6%) and vitamin E (14.6%) intake. Therefore, when families do not eat fruits and vegetables either because of industrialization or scarcity due to seasonal variation, lives of members of the family will be at stake.

Diabetes and vegetables/fruits

Diabetes is another chronic disease that a family can encounter if there is scarcity of fruits and vegetables due to seasonal variation.Diabetes was defined by Brown (2008) as a metabolic disease characterized by abnormal utilization of carbohydrates used by the body and elevated blood glucose levels.There are three types of diabetes, type 1, type 2, and gestational diabetes. The Australian Institute of Health and Welfare (2006)

and Brown (2008) opined that people with type 1 diabetes have high blood glucose levels which result from destruction of insulin producing cells of pancreas. People with type 1 diabetes usually require insulin injection for survival. The Australian Institute of Health and Welfare (2006) posited that type 2 diabetes is characterized by high blood glucose levels which are due to the bodyôs inability to either produce enough insulin or use insulin normally. This type of diabetes is common among people aged 45 or above. Progression of type 2 diabetes is likely to be associated with obesity and can be managed by dietary changes, and may need to be managed with glucose lowering drugs and insulin therapy. The Australian Institute of Health and Welfare (2006) and Brown (2008) indicated that gestational diabetes is the type of diabetes which develops during pregnancy, involving high blood sugar levels and affecting women who have not previously been diagnosed with other forms of diabetes. This type of diabetes usually disappears after the birth of the child; however it is a marker of increased risk of type 2 diabetes later in life.

The Australian Institute of Health and Welfare (2006) opined that the causes of diabetes is multifactoral with type 1 believed to be caused by biological interactions, as well asexposure to environmental agents. Life style risk factors including dbesity, physical inactivity and poor nutrition as well as genetic predisposition and ageing play arole in the development of gestational diabetes are similar to those which contribute to the development of type2 diabetes with women in later life or obese when pregnant being of a higher risk.

The position of Montonen, Jarvinen, Heliovaara, Reunanen, Aromaa & Knekt, (2005) was that diabetes is the sixth leading cause of death in Australia, and in the year 2000, there were an estimated 160 million people with diabetes in the world. This figure is predicted to rise to over 280 million by the year 2025.It has become obvious that type 2 diabetes is increasing in prevalence in Western societes and in societies with an increasing level of affluence. Also, Roseribloom, Joe, Young & Winter (1999) stated that there is clear evidence that this disease is now occurring in children, where this was not previously the case and this is likely to be the result of poor dietary habit associated with increased refined sugar intake and decreased activity levels in the young and the increase in prevalence of obesity, Diabetes can shorten life expectancy by up to 15years.

Liu, Serdula, Janket, Cook, Sesso, Willett, Manson, Burning (2004) analysed prospective data from the Womenôs Health Study which comprised of 39,876 females aged above 45 years. Detailed dietary information was received via semi quantitative food frequency questionnaire. At baseline, median intake of totalvegetables and total fruit ranged from two and a half serving per day to a greater than ten servings per day. After nearly 9 years follow up, 1,614 cases of diabetes were diagnosed. The author adjusted the age, total energy intake and smoking, it was observed that a significant inverse relationship existed between diabetes risk and total vegetable and fruit intake, citrus fruit, green leafy vegetables, legumes, and potato intake Montonen, Jarvinen, Heliovaara, Reunanen, Aromaa & Knekt, (2005) studied the relationship between food consumption and the incidence of type 2 diabetes in 4,304 men and women 40 ï 69 years of age over a 23 year follow ï up period, Consunption of vegetables (especially green vegetables), fruit and berries was associated with a reduced risk of diabetes after adjusting for age, sex, energy intake and BMI. The author identified vegetables and fruits as ideal sources of numerous antioxidants such as vitamins E and C, carotenoids, flavonoids and fibre. Vitamins C and E have been shown to have a promising protective effect against type 2 diabetes development due to relieving oxidative stress which interferes with the uptake of glucose by cells.

Since the consumption of fruits and vegetable have positive impact on diabetes especially type 2 diabetes, it becomes obvious that when a family eats without fruits and vegetable because of scarcity is risking their lives.

Musculoskeletal Conditions

The Australian Institute of Health and Welfare (2006) describes musculoskeletal conditions (MSC) as large contributors to illness, pain and disability among older people in Australia and around the world. MSC include Osteoarthrities (OA) and Rheumatoid Arthrities (RA) as well as other bone disorders.

Osteoporosis

Osteoporosis is a serious condition that results from porous bones and is the major cause of disability in Australia. Osteoporosis results from low bone mass caused by

gradual but progressive deterioration of the bone tissue. This deterioration leads to weakness and fragility of the skeleton, which in turn increases the risk of fracture, particularly at the spine, wrist, hip, pelvis and upper arm. Access Economics Pty Limited (2001) posited that bone loss is usually gradual and warning signs are not often present until the disease is at the advanced stage. In the case of spinal osteoporosis, the collapsed vertebrae at ihe spine are generallyresponsible for severe back pain deformities such as kyphosis and loss of height. Osteoporosis is a major problem globerly, which is an increasing in significance, as the population ages, and affects both men and women. The author indicated tha the causes of osteoporosis are numerous and which in production include age, hormones, diet and lifestyle. Esmmaillzadeh, Kimiagar, Mehrabi Azadbakht, Hu, Willett (2006) opined that in women, the 5- 10 years after menopause involves a sharp decline in ovarian oestrogen an important hormone for maintaing bone mass. During this time, womenôs bone mineral density (BMD) can decrease rapidly. By age 65, some women have lost half of their skeletal mass. Males are also at risk, due totestosterone, the maleôs equivalent hormone, having a similar effect on bone health asostrogen.

Access Economics Pty Limited (2001) opined that diet is an important contributor to the risk of OP due to various nutrients being of importance in the attainment of peak bone mass(PEM) and in the maintenance. Access Economics Pty Limited (2001) observed that inadequate calcium intake or calcium absorption are major risk factor for osteoporosis. Calcium is found in dairy foods such as milk, cheese and yoghurt, as well as in green leafy vegetables, almonds and dried fruits. Excessive dieting increases risk of osteoporosis, as do excessive intake of caffeine, salts, protein and alcohol.Families should be mindful of their diets since it affect the bone fobmation of their children too. Faulkner & Bailey (2007) opined that osteoporosis have pediatric antecedent. It is clear through research that intervention strategies aimed at reducing osteoporosis incidence are important and must begin early in-utero and during early childhood, in order to have maximal effect. The author further emphasized that in order for the skeleton to develop, adequate levels of nutrients such ascalcium, phosphorus, magnesium and zinc,copper , manganese, carbonate and citrate, and vitamin C, D and K are required from certain food groups such as dairy products, vegetables and fruits, and

foods contributing to acid-base balance. When the family diet is poor by lacking this essential food group (fruits and vegetable) due to their scarcity, their chances of developing ostoporosis and athrities with their disability burden will be high.

Arthritis

Draper, Unwin, Serafino, Somerford & Price (2005) indicated that arthritis includes a diverse group of diseases, such as osteoathrities (OA) and rheumatoid athrities (RA). These conditions cause inflammation of joints and associated stiffness, pain and associated stiffness, pain and deformity.OA the most common form of arthritis mainly affect the spine, hands and weight bearing joints such as the hips, knees and ankles. Australian Institute of Health and Welfare (2006) noted that the condition often worsens with time limiting the movements and daily functioning of the sufferer. Few reseach studies have been conducted to determine the aetiology of RA and how vegetables, fruit and antioxidants can aid in prevention of the condition.Linos, kaklamani, kaklamani, Koumantaki, Giziaki , Papazoglou & Mantzoros (1999) examined the relation between dietary factors and risk of RA in people residing in Southern Greece. Results showed that risk of developing RA was reduced when consumption of raw and cooked vegetables increased, however only consumption of cooked vegetables was significant. Those in the highest quartile (two to three servings per day)of cooked vegetable consumption had a reduced risk of developing RA of 60% compared to those in the lowest quartile of consumption (less than one serving per day). On the other hand, Wang et al (2007) found that fruit intake was not significantly associated with tibial cartilage defects. Moreover, vegetable intake was not significantly associated with knee cartilage or bone measures in the population of healthy middle aged people with no clinical knee OA. However, vitamin C intake was inversely associated with tibial plateau bone area and presence of bone marrow lesions, both of which are important in the pathogenesis of knee OA. This suggests a protective effect of vitamin C on risk of knee OA.These data suggests that a beneficial effect exists between vitamin C and fruit on bone structure. It is clear from all indications that fruits and vegetables have positive impact on arthritis therefore any family that eats without them because of their scarcity will eventually suffer arthritis.

Alzheimer's disease and fruit/ vegetable

The Australian Institute of Health and Welfare (2006) defined Alzheimer as a type of dementia, which is a general term for memory loss and other intellectual abilities, and it is serious enough to interfere with daily life. Many diseases can cause dementia with the most common form being Alzheimer, which is responsible for about 70% of cases. Alzheimer is a progressive and fatal brain disorder whereby the brain cells are destroyed causing problem with memory, behaviour and thinking. There are numerous factors for developing Alzheimer like family history, gender, education and employment, and other health risk factor like high blood pressure, irregular heart beat, diabetes, adiet high in saturated fat, smoking, It was asserted by Lau, Shukkitt-Hale, Joseph (2005) that neurons are largely post-mitotic, damaged neurons cannot be readily replaced by formation of new ones, so damaging oxidative stress is particularly deleterious to the brain. In addition, the brain is particularly susceptible to oxidative stress because it utilizes a much larger proportion of the bodyôs total oxygen consumption in comparisom to other organs, and the brain is rich in peroxidizable polyunsaturated fatty acids. Oxidative stress can only be fought with diets rich in antioxidants that can only be found in colourful fruits and vegetables. When the family diet is poor in fruits and vegetables because of the scarcity of fruits and vegetable, they will likely be exposed to this illhealth.

Cataract and fruits /vegetables

Cataracts are common in Western populations are largely preventable. Proteins in the eye are very susceptible to photo-oxidation, which produces cataracts. Taylor (1993) showed that elevated levels of antioxidant vitamin C and E and carotenoids are associated with delayed development of particular forms of cataract. Wheen the family, out of scarcity of fruits and vegetable did not eat fruits and vegetables, they will be suffering from cataract diseases.It is only fuits and vegetables that can assure one of reasonable antioxidant.

Processes of determining antioxidant in Fruits and vegetables:

Antioxidants are found mostly in fruits and vegetables with bright colours. Duyff (2006) opined that the array of colours in fruits and vegetables such as red, yellow, orange comes from their carotenoids. Its no surprise that apricots, cantaloupes, mangoes, carrots, red and yellow peppers, and sweet potatoes, for example all contain carotenoids. Duyff (2006) indicated that green fruits like lime, green pears supply lutein and indoles (antioxidants) that help to promote healthy vision and reduce cancer. The orange and deep yellow fruits contain carotenoids, biflavonoids and antionxidant vitamin C. The purple and blue fruit contains anthocyanins and phenolics. The red fruits provide lycopene and anthocyaninsô, the white, tan, brown fruits provides allicin and selenium that have antioxidant properties.

Colour gives you a clue, not an assurance that frults and vegetables are good sources of antioxidant

Since colour alone cannot be used to determine the presence of antioxidants in plant foods, researchers have used some processes to determine antioxidants in fruits and vegetables. Tarwadi & Agte (2003) carried out a research on the potentials of commonly consumed green leafy vegetable for their antioxidant capacity and its linkage with the micronutrient profile. The process that was used was that the vegetables were procured from the market, cleaned and edible portion collected. Since cooking involves addition of oil and other food ingredients that may also have antioxidant activities. Green leafy vegetables (GLV) alone were pressure cooked for 5 minutes at 15 Ib pressure and homogenized to estimate the antioxidant activities of the cooked form.

Objectives:

(1)To asses the antioxidant potential of GLV by screening 30 commonly consumed type using TIBARS, suproxide scavenging activity and ferrous ion chelating activity as the model systems (2) to assess the loses due to cooking in the antioxidant capacity of GLV.

Measurement of Tibars Activity

This was measured as per Williamson et al (1997). Briefly a sunflower oil and water emulsion (10%) was made using TWEEN 20. The oxidative stress was created using ferrous ions and TBARS were estimated after adding 0.67% TBA and heating the

tubes on a boiling water bath for 40 minutes with either increasing levels of alpha-tocopherol acetate or the sample extracts prepared in methanol. The colour developed was read at 52 nm after cooling the tubes in a refrigerator for 30 min. The values of antioxidant are expressed as micromoles of tocopherol equivalents per 100g of food material. The estimation was made for raw and cooked form in duplicate sets.

Micronutrient Profile:

Methods used to determine beta-carotene, ascorbic acid, riboflavin, thiamin, zinc, copper, iron, manganese and selenium as well as total polyphones were the spectrophotometer method of using the spectronic 21 (Bausch and lomb. UK).

Visible spectra for raw and cooked GLV

Visible spectra was a useful tool for the study of polyphenolic components like anthocyanindins and proanthocyanidins that show absorbance between 520, 540 545, and 560nm. These components showing antioxidant properties are likely to be destroyed during cooking. The absorbance bands for chlorophylls are at 400-500 and 600-700nm. Among the various GLV, eight top-ranking ones were studied as methanolic extracts for the pattern of visible spectra (400-800nm) in raw and cooked states using a spectrophotometer.

Statistical methods:

The mean and standard deviation of all the study parameter were calculated. Individual GLV were given scores for the values of antioxidant capacity in terms of TBARS activity. SOSA and ferrous iron chelating was computed as the sum of individual scores and was used for comparing the performance of different GLVs. A paired test was used to compare differences between raw and cooked GLV for the antioxidant indices.

Comparison of observed values of TBARS with expected valuest values computed (as weighed average from individual foods) was also done using a paired t- test. Correlations between various parameters were computed as Pearsonôs (r)

Antioxidant solution

Tocopherol was dissolved in ethanol and Trolox was dissolved in diluted water at different concentrations (0.05-10.0mM) stock solutions were stored in the dark at -18 0C

Determinant of antioxidant activity by spontaneous antioxidation of brain homogenate.

Adult male wistar rats fed on a standard diet were maintained on a 12h light/dark cycle and allowed free access to diet and water. They were perfused with 240.ml cold 0.9% physiological saline solution via aortic artery, under (xylogen, ceramin and Aceplomazine) anesthesia. The brain of each animal was immediately removed, weighed, chopped into pieces and homogenized with four volumes of phosphate-buffered saline solution, (8.18g NaCl, 2.75g NaH_2 PO_4 per litre, PH 7.4) for 2min in a homogenizer. Tubes were centrifuged at 1000xg for 15 min at 4^0C and the supernatani was stored at -80^0C and used as substrate for lipoperoxidation. A sample (50 µ l) of a-tocopherol and Trolox solution (0.05 to 5.0 mM) was added to Im brain homogenate thawed at room temperature and to 2.95 shakers. An aliquot of 1.0ml thiobarbituric acid/trichlorocetic acid/burylated hydroxyl toluene solution (3.75g thiobarbituric acid, 93.75 mg trichloroacetic acid and 5.00 mg burylated hydroxyl toluene dissolved slowly in 25 ml of 0.25 N HCl) was added and the tubes were incubated at 100^0C and for 15min. After cooling, the tubes were centrifuged at 1000xg for 15min. at 25^0C and oxidation products represented by thiobarbiruric acid reactive substances were determined by spectrophotometry at 532 nm according to Stocks et al (1974).

The tocopherol and Trolox concentrations were plotted against the concentration of malondialdehyde (µg MDA)/mg protein. MDA formed during the brain homogenate oxidation was estimated by 1, 1, 3, 3- tetrathoxypropane standard curve. According to Wheatley (2000), MDA reacts in a 1:2 molar ratio on heating with thiobarbituric acid to give a red adduct (^{A} max=532-532 nm). Brain homogenate protein was determined by the loury method using bovine serum albumin (sigma A7906) as standard (Lowry et al, 1951) percentage inhibition of spontaneous autoxidation at steady state was calculated by the first derivative from non-linear regression fitted for each compound. The

concentration of sample presenting 50% inhibition (IC_{50} value) was obtained by substitution of this value in the respective regression.

Determination of antioxidant activity by linoclic acid emulsion:

Linolic acid emulsion was prepared with 1.56 µl linoleic acid and 180µl Tween 20 in 40ml 0_2- free water. The solution was homogenized avoiding air bubbles. NaOH (2 N) was added to yield a clear solution, bringing the volume to 50ml. The substrate solution was divided into 10.0ml portons in small screw cap vials, flushed with N_2 before closing, and kept frozen at -18^0C until needed. A sample of 100 µl a-tocopherol and Trolox solution (0.05 to 5.0mM) and 500 µl emulsion, and was incubated at 37^0 C/1h in a water shaker. The same procedure applied to the brain homogenate method was followed from this part until the end. The a-tocopherol and Trolox concentrations were plotted against the concentration of MDA. The percentage inhibition of linoleic acid oxidation at steady state was calculated by the first derivative from the non-linear regression fitted for each compound. The concentration of sample presenting 50% inhibition (IC_{50} value) was obtained by substitution of this value in the respective regression.

Statistical analyses

All results were obtained in triplicate and expressed as the mean ± standard deviation. Trolox and a-tocopherol data were analyzed statistically by students, t-test for independent samples with the level of significant. The non-linear regression and graphs wree made using the STATISTICA 6.0 software

Another process of determining antioxidant was the one used by Jastrzebski, Medina, Moreno & Gorinstein (2007) in carrying out a research work on In vitro studies of polyphenol compounds, total antioxidant capacity and other dietary indices in a mixture of plants (prolipid). The materials include Trolox (6-hydroxy-2,5,7,8-tetramethyl-Chroman-2- Carboxylic acid) butylated hydroxyanisole, 2,2-azinobis (3-ethylbenzothiazoline-6-sulfonic acid) ABTS), feCL, $x6H_20$, Folin (10Calteu reagent, DPPH radical and B-carotene, 2,4,6, tripyridyl-s- triazine (TPTZ). All reagents were of analytical grade, Deiorized and distilled water were used throughout.

The raw material used in prolipid was a mixture of the following plants*: Sondws arvensis* L. from the compositae (Asteraceae) family, Guacuma ulmifolia L from the sterculeaceae family and murraya paniculata L from the Rutaceae family. Prolipids contain extracts of the G. ulmifolia (220%w/w), M. pumiculata (10%w/w) and S. avensis (10%w/w). The rest are supporting substances. One prolipid capsule contains extracts of the following herbs and supporting substances. Guazuma, 86mg. Murray, 43mg, Souchi, 43mg, Colloidal silicon dioxide, 20mg, amyium maydis, 237.14mg: and mithylparaben flophlparaben, O.86mg.

Extraction of polyphenois

Prolipid Samples were taken from capsules, defatted with acctone and then extracted from 1g with 20ml of 80% methanol for 3/h three times at room temperature, and the solvent was then removed by vaccum distillation for polyphenok (methanol soluble extract). Decoction was prepared from 1g dried plant material from the capsule of prolipid in 20ml distilled water for 20min by boiling for soluble water polyphenols (water fraction). The samples were centrifuged for 5min at 4,000 xg with a benchtop centrifuge to remove solids. Aliquots of 1 ml water extracts were frozen and used when necessary for the antioxidant test.

Ultraviolet- visible spectophotometric analysis

The spectra of water and methanol extracts in concentrations of 1mg/ml were measured on a Unvi/con 930 spectrometer (Bio-Teck-Kontron, Kontron Instruments Watford, U.K) and were recorded from 180 to 300nm. The solution standard catechin was prepared in methanol at a concentration of 50µm (Sar Munchade et al (2000).

Polyphenols:

The folin ciocalteu method was used and the messurement was performed at 765nm with garlic acid as the standard (singleton et al, 1999). The results were expressed as milligrams of garlic acid equivalent (GAE) per gram of dry weight (DW)

Flavonoids:

Flavonoids (extracted with 5% NaNO3, 10% A1Cl3x $6H_2o$ and M NaOH) were measured at 510nm with a known (1)- catechin concentration as a standard. The results were expressed as milligrams of catechin equivalents (CE) per gram DW (Sinqleton et al, 1999)

Antioxidant capacities:

The B-carotene-linoleic acid assay was performed according to Ferreira et al, (2006) A stock solution of B- Carotene and linoleic acid was prepared by dissolving 0.5mg B-Carotene in /ml Chloroform and adding 25,µl linoleic acid together with 200mg Tween 40. The chloroform was evaporated. One hundred milliliter of aerated water was added to the residue. To 2.5 ml of this mixture were added 300µl of each extract.The samples were incubated in boiling water for 120min together with two blanks, one containing the antioxidant butylated hydroxyanisole (BHT) and the other one without antioxidant. The absorbance was measured at 470nm.

For the TEAC assay, the $ABTS^+$ radical cation was generated by the interaction of ABTS (250µm) and $K_2 S_2 O_8$ (40µM). after the addition of 990µl $ABTS^+$ solution to 10µl Prolipid extracts or Trolox standards (final concentration 0- 20 µM) in methanol or 20mM acetate buffer (PH 4.5), the absorbance at 734nm was calculated and plotted as a function of the concentration of the extracts and of Trolox for the standard reference data (Ozegen et al 2006).

The FRAP assay measures the ability of the antioxidants contained in the samples to reduce ferric- tripiridyltriaizine ($Fe3^+$ -TPTZ) to a ferrous form (Fe^{2+}) that absorbs light at 593nm.. The FRAPlevel was calculated by plotting a standard curve of absorbance against concentration of Trolox (Ozgen et al 2006)>

In the DPPH assay, the volume of prolipid extracts in different test tubes was adjusted to 100µl by adding Me OH. A. O.1 mM methanolic solution of DPPH was added 5µl to these tubes. The control was prepared as above without any extract, and MeOH was used for the baseline correction. Changes in the sampleôs absorbance were

measures at 517nm. Butylated hydroxyanisole was used for comparison (Ozegen et al. 2006).The three antioxidant assays (DPPH, ABTS and FRAP) were compared at the same periods of time duration (10, 30, 60 and 120min) and the same concentration of the investigated Prolipid water and methanolic extracts of 10mg/ml. For each individual assay, a trolox aliquot was used to develop a standard curve (Ozgen et al, 2006) All data were then expressed as trolox equivalents (TE).

Statistical analysis:

The values are the mean .+ standard deviation of three measurements. Where appropriate, data were tested by two-way analysis of ovariance using Graph pad prism, version 20, following the Duncan new multiple range test to assess differences between-group means. Differences of $p< 0.05$ were considered significant.

There is also another process of determining the antioxidant as used by Saxena, Venkaiah, Anitha & Raghunath (2007) in work titled Antioxidant Activity of Commonly Consumed plant foods of India: Contribution of their phenolic Content. The chemicals and reagents materials are the B-carotene, linoleic acid, Tween 20 and gallic acid and the solvents and other chemicals were of analytical grade. Food samples include twenty-one commonly consumed plant foods belonging to nine different food groups were analyzed

Collection and processing of foods;

Considering the varietal differences usual observed in the content of different nutrients and antioxidants in plant foods. These foods were analyzed to account for these differences to the extent possible. For this purpose, three samples of each of the commonly consumed were used.

After cleaning the food samples of the extraneous contaminants, equal quantities of the edible portions of each food three samples pooled and the pooled sample was analyzed for the AOA and PC. Thus, each food was analyzed three samples, each of which in a pooled sample of three samples.

One hundred grams of the edible portion of the pooled food sample (of dry foods such as cereals, whole legumes, dehusked and spoilt legumes, oil seeds and spices) were

finely powdered in a domestic grinder and 1g of this powder was used for the extraction of the AOA and PC.

About 100g finely chopped, pooled fresh vegetables were homogenized in a domestic grinded using appropriate amount of municipal drinking water. The volume of the extraction of the AOA and PC as described below.

Extraction of food for AOA and PC.

The AOA and PC of all the foods studied (except oil) were extracted according to Emmons et al (1999). Briefly, methanol and water were added to the homogenized food sample to make it to a final concentration of 70% methanol, and the volume of 70% methanol was at least 10times that of the food powder homogenate used.

Considering that oils are poorly miscible with methanol, 1g pooled oil sample was extracted with a mixture of chloroform: methanol (70:30v/v) as reported earlier (Fayaz et al, 2005). Thus, in these studies, all the food samples except oils were extracted with 70% methanol.

In general, food samples were shaken with solvent mixture in a flask shaker for 2h at room temperature and were centrifuged for 1h at 6000 x g at 4^0C. The supernatant was collected, the volume measured and was then stored as the extract at ï 20^0C. The samples were analyzed within 10days of extraction for the AOA and PC as described below.

Determination of the AOA

Considering that oxidation of upids in the earliest and most sacrificing component of the oxidative damage in view, the ability of the food extracts to inhibit the coupled auto-oxidation of B-carotene and linoleic acid in a mixture was measured according to Emmons et al (1999). Briefly 2mg B-carotenes solution was dessolved in 4ml chloroform, and 600µl of this solution was added to 44µl linoleic acid and 400µl Tween 20 in an amber-coloured bottle and mixed well. Chloroform, was evaporated from this mixture under a stream of nitrogen gas, and to this was added 100ml double-distilled water into which gaseous oxygen was passed for 10 min just before use.

Sample extracts were taken in 10, 25, 50µl aliquots and the volume were made up to 50µl with 70% methanol. Three milliliters of the B-carotene-linoleic acid mixture was added rapidly to each sample, vortexed and the optical density (OD) read immediately (O time) at 470nm in a Spectronic AquaMate spectrohpotometer incubated for 60min. The mixture was then incubated for 60min in a water bath at 50^0C and the OD read after incubation. The B-carotene linoleic acid mixture incubated with 50µl of 70% methanol at 50^0C for 60min was used as the negative control (ie 100% coupled auto-oxidation). The B-carotene and linoleic acid in the mixture calculated since the decrease in OD over time in nonlinear. The antioxidant activity of the food extract was calculated from the ODs measured at O and 60min. of incubation using the following equation.

Where is the optical absorbance at Omin and b that at the end of 60 min of incubation at 50^0C.

As large variations were observed in the percentage AOA of different foods, an attempt was made to keep the AOA values expressed in a narrow range. For this purpose, it was considered prudent to express the AOA of foods as the amount of raw food (in milligrams) required for 50% inhibitions of the assay. It therefore follows that, B-carotene and linoleic acid under the conditions of the assay. It therefore follows that, in these studies, the higher the value for the AOA, the lower is its antioxidant activity.

Determination of total pc

The total of the food was determined in the extract using Folin-Ciocalteu phenol reagent according to Emmons et al (1999). Briefly, appropriate aliquors of the extracts were taken and the volume made up to 125µl with 70% methanol. To this were added an additional 40µl methanol and then mixed with 75µl of 2N Folin-Ciocalteu reagent, followed by 400µl of 20% sodium carbonate solution. The reaction was alloyed to proceed for 15min at room temperature. The samples were diluted with 1.25min double-distilled water, were vortexed and were centrifuged at 1500xg for 15min at room temperature. The OD of the supernatant was measured at 725nm in a spectronic AquaMate spectrophotometer. The total PC of the food is expressed as Milligrams of gallic acid (GA) equivalents in 100g of the edible portion of that foodstuff.

Evaluation of Antioxidant Activity:

The antioxidant activities of test samples were assessed using a BPCL model Utra Neak Chemiluminescence Analyzer at 30^0C, high voltage 800v, injection at I kv.

Calculation of antioxidant activity:

The scavenging rate (%) was calculated by the following equation:

Scavenging rate % = (CL control ï CL_O) ï (CL sample- CL_O

In both group, different concentrations were tested to find the concentrations at which 50% of chemiluminence intensity is inhibited (EC 50 values) of Mogroside V and 11- oxo- mogroside V. All analyses were run in triplicate. The data were expressed as the mean + standard deviation.

Another process of determining antioxidant was shown in the work of Revindra & Narayan (2003) entitled antioxidant activity of the anthocyanin from carrot (Daucus Carota) callus culture.In the material and methods, isolation and purification of anthocyanin: the pigmented callus cultures of Nantes scarlet ï 104, a local variety carrot, were raised on a Murashige & Skoog (1962) medium. The anothocyanin from the pigmented callus (500g) was extracted with 11 acidified water (97. 3 Water: HCL) at room temperature. Repeated extraction was performed and all the extract were pooled and concentrated to dryness by rotavapour. The dried anthocyanin was dissolved with minimum amount of water and then it was washed with chloroform and diethyl ether in order to remove the chlorophyll. The concentrate was then loaded on a Dowex 50- 4x H^+ resin column (50g resin in a 4x 20 cm^2 column). The anthocyanin was anionic bound to the resin so the column was thoroughly washed with water and menthanol in order to remove other impurities. The bound anthocyanin was eluted with acidified water (21).The elute was concentrated to dryness and then it was loaded on a Saphadex LH- 20 column (25g Sephadex in a 2x 45cm^2 column). The column was washed with water and methanol to remove the carbohydrates and protein fractions. The eanthocyanins were further separated by eluting with methanol: acetic acid water (10: 1: 9) mixture (11) with

a flow rate of 1ml/ min. and two distinct bands were found and collected.The anthocyanin contents was estimated using the extinction coefficient E $1cm^{1\%}$ = 98.2nm at 535nm) of cyanidin ï 3- glucoside anthocyanin from cranberry as standard (Francis, 1982). The amounts of anthocyanin present-in the callus were calculated on the basis of dry weight of the callu. The callus were dried in an oven at 60^0C for 24h until a constant weight was obtained. The first being minor (10%) and the second being major (90). The major peak was found to be cyanidin -3- lathyroside, and the minor one cyanidin - 3-glucoside. The delphin, peonin and malvin were obtained from egg- plant, Chinese mustard and grapes, respectively, in a similar manner as already described.

Preparation of aglycone

The identification of aglycone (anthocyanindin) in the callus extract was performed by acid hydrolysis (Francis, 1982). To 1 ml anthocyanin extract, 4ml of 2N HCL was added. The mixture was boiled in a water bath for 35 min. for complete hydrolysis. After cooling, the mixture was extracted with solvent either to remove carboxylic acid if it is present. To the aqueous solution, 2ml amyl alcohol was added and mixed thoroughly to extract the pigment. The upper layer that contained anthocyanidin was adopted for the egg-plant, Chinese mustard and grape anthocyanin extract in order to get the anthocyanidins, delphinidin, peonidin and malvidian respectively. These aglycones were indentified by high- performance lquid chromatography, as per the method of Willkinson et al (1977), with slight modification, a µ- Bondapack C_{18} (waters) column (3.9 x $300mm^2$) with a pore size of 10µm was used. Methanol: acetatic acid: water (70: 10: 20) was used as the eluting solvent with a flow rate of 1.5ml/min. and detection was performed at 530nm.

Antioxidant activity

The pure major anthocyanin cyanidin-3-lathyroside was used for the antioxidant activity. One milliliter of Linolenic acid was diluted with an equal amount of ethanol was used as the substrate. A mixture of 0.9 µmol anthocyanin in 2.6 ml of 99. 5% ethanol, 0.5ml linolenic acid, 1 ml of 1/15 m citrate buffer (Ph2and 4) and 0.4 ml water

in a screw- capped test tube was taken. In the case of Ph 7, phosphate buffer was used instead of citrate buffer. In another tube, 0.9 µmol a- tocopherol was taken using linolenic acid only. All the tubes were kept at 70^{o}C for incubation. An aliquot of O.ml was taken at different intervals of time 0, 1, 4, 6. 8 10, 12,21 and 24h, and the hydroperxide forms was estimated using the thiocyanate method (Mitsuda et al 1966) the amount of Fe^{3+} produced from Fe^{2+} was measured spectromatically at 500nm. The percent activity of anthocyanin with respect to a tocopherol was calculated by the data 100x (D_0 ï D_1) / (D_0 ï D_R). Where in Do is the optical density value for blanks D_1 that for the anthocyanin and Dv that for a-tocopherol. In other experiments the effect of different concentrations of anthocyanin (0.9,0.4,0.23 µmol) or the autoxidation of linolenic acid and comparision of the activity of anthocyanin and its aglycone (cyanidin) at different PH values were carried out.

Ocksook, Jovel, Neil Towers, Wahbe & Cho (2007) used the process below to determine the antioxidant in a research work entitled the antioxidant and antimicrobial activities of native Rosa SP-from British Columbia, Canada. The chemicals used were galic acid, Folin-Ciocalteu phenol reagent (2.0.N), (+) ï a ï tocopherol (95%) lindeic acid (approximately 60%), ferrous chloride, ammonium thiocyanate, ascorbic acid and 1- a ï phosphatidylcholine (leathin from soybean, approximately 40%) were purchased Methanol and ethanol were obtained and sodium carbonate from BDH Chemicals.

Plant Materials:

From September to December (2003) rose hips was collected. Rose hips without calyxes were washed several times with distilled water and lyophilized in a freeze dryer at 5µmHg pressure and ï 50^{0}C. Seeds and pericarps were manually separated from whole rose hips. Whole rose hips, seeds and pericarp were ground separately in a coffee grinder and used for antioxidant and antimicrobial activity assays.

Preparation of Extracts:

One gram of ground samples was mixed with 40ml of 80% methanol and the mixture was shaken for 24h at room temperature. Extracts were filtered through whatman No.1

paper and methanol and water were removed using a rotary evaporator under vacuum at 45^0C and reconstituted with 5ml methanol.

Total phenolic concentration.

The concentration of total phenolic compounds in rose hip extracts was determined colorimetrically by a modified procedure of singleton & Rissi (1965). The extract sample (0.1 ml) was added into a test tube and mixed thoroughly with 1.0 ml of 0.2 N Folin-Ciocalteu reagents. After 5 min, 0.8 ml of 7.5% sodium carbonate solution was added and the reaction mixture was allowed to stand for 30 min before the absorbance at 765 nm was measured. The total concentration of phenolic compound was expressed as gallic acid equivalents (GAE) in milligrams per liter.

Total antioxidant activity assay:

The total antioxidant activity of the extracts was determined according to the thiocyanate method (Osawa & Namiki, 1981). Twenty Microlitres of extracts were added to the screw-cap vials containing 0.13 ml Linoleic acid (approximately 60% mixed with 5.0ml of 0.02m phosphate buffer Ph. 7. 0. and 5.0 ml of 99.5% (m/v) ethanol. These were mixed thoroughly and kept in the dark at 45^0C. The mixture prepared as above but without the extract served as the control. Aliquots (0.1ml) were drawn from the incubation mixture and mixed with 3.0 ml of 75% (V/V) ethanol and 0.1 ml of 30% (w/v) ammonium thiocyanate. Precisely 3 min. after the addition of 0.1 ml of 20m/M ferrous chloride in 3.5% (V.V) hydrochloric acid to the reaction mixture, the absorbance of the resulting red colours was measured at 500nm using a spectrophotometer. A-tocopherol 100 (µg/ml) was included as a natural antioxidant control for comparison. All data are the average of triplicate analysis. The inhibition of lipid per oxidation as a percentage was calculated using the following equation:

$$\% \text{ Inhibition} = 100 - (A_1 = / A_O) \times 100$$

Where A_O is the absorbance of the control reaction and A_1 is the absorbance in the presence of he extract sample (Dhu et al 1999).

Lecithin liposome oxidation assay:

Liposome oxidation was monitored according to (Yi et al 1979). Lecithin was suspended in deionized water at a concentration of 8mg/ml by sonication and stirring with a glass rod in a bath-type sonicator (Fisher scientific Sonicator FS 140). For the antioxidant assay, 10g liposome samples were weighed into a 30 ml screw capped vial and 20µl extracts were added to the liposome system and sonicated again for 1min, then stored at 45^{o}C. The above reaction mixture (0.1 ml) was dissolved in 5.0 ml methanol, and conjugated dienes were measured at 234 nm.

Antimicrobial activity assay:

The disc diffusion method was employed for the determination of antimicrobial activities of extracts (National Committee for Clinical Laboratory standards 1997). A suspension of the test microorganism (0.1ml of 10^8 cells/ml) was spread on the solid media plates. Filter paper discs (6mm in diameter) were soaked with 20µL extracts and placed on the inoculated plates. After 2h at room temperature, the plates were incubated for 24h at 37^0c for bacteria and at 33^0c for fungi. the diameters of the inhibition zone were measured in millimeters. Bacterial strains were grown on mueller Hinton ager plates and maltose-yeast-peptone agar plates were used for candida albicans. Streptomycin was used as reference antimicrobial agents. The following seven bacterials strains were used in the study: Bacillus Subtilis (environment isolate), Entrococcus Faecallis (ATCC 29212), Escherichia Coli (UB 1005) Pseudomonas aeruginosa (PA 101), Salmonella typhimurium, S. aureus (ATCC 25923), MRSA (clinical isolate), and the yeast C albicans.

Statistical analysis:

All Measurement were carried out in triplicate (n=3), and mean values were analyzed using analysis of variance. Where differences among multiple means were statistically significant, fischerôs least significant test (SYSTAT Institute 1992) to evaluate which means differed. All reported P. values were obtained using statistics tested against a present significance level of a = 0.05. Correlation coefficients between

antioxidant and antimicrobial activity were performed using the Microsoft Excel Data Analysis Tool Kit.

Also, Ndukwe, Achimugu & Amako (2005) used another process of determining antioxidant in a research work entitled phytochemical and antimicrobial screening of the crude extracts from the stem bark of Irvingia gabonensis (Oô Rorke) Baill. The plant material was collected and the sample air-dried, pulverized using wooden pestle and mortar and stored in polythene bags for use.

Extraction procedure:

Air dried and pulverized plant material (325.60g) was defatted using redistilled

Petroleum spirit (60-80%) using the soxhlet extractor to afford 6.50g (1.85%) of fatly acids and their derivatives. The defatted pulverized plant material was then successively and exhaustively extracted with redistilled chloroform Methanol respectively. The various extracts were concentrated in vacuo at 40^{o}C using rota vapour. This gave 0.80g (0.24%) of crude chloroform extract and 22.28g (6.00%) of methanol respectively. The various crude extracts were stored in a refrigerator and later subjected to bioassay studies.

Phytochemical analysis of the plant sample:

The pulverized plant material was phytochemically screened for usual plant metabolites using standard Techniques of Brain and Turner (1975). The metabolites include carbohydrates, free reducing sugars, ketoses, pentoses, soluble starch, glycosides, alkaloids, anthraquinone derivatives, steroidal, glycone, flavones, saponins, tannins and anthracene derivatives.

Equally Nuhu, Adejoh & Mshelia (2005) determined the antioxidant in a work entitled phytochemical and antimicrobial screening of the root extract of dichrostachys cinerea. The process used were as follows: The bark of the plant was collected and cut

into smaller pieces and allowed to dry under room temperature for four weeks. The dried material was ground into course powder (Wall et al, 1965).

Extraction:

About 100g of the powdered bark of dichostachys cinerea plant was extracted using a soxhlet apparatus. The solvent used was ethanol and the extraction lasted for five (5) hours. The ethanolic extract was concentrated until a hard cake weighing about 6g was obtained. The crude drug (residue) was later partitioned between chloroform and water (400m; 1:1) which gave separate soluble fractions and each was concentrated. The part of the chloroform residue was further partitioned between methanol and pet ether (60-80) (400ml 1:1) which gave separate soluble fraction and each was also concentrated. The residues were stored and later tested for antimincrobial activity against some isolated microorganisms (Bourgard, Putaraud & Guckert 1994).

Phytochemical screening:

The ethanolic extract of the bark of D. Cinerea was screened for the presence of the following phytocompounds.

Alkaloids:

3 mls of the plant extracted was stirred with 5mls of 1% aq HCL on a hot water bath and then filtered, the filterate was divided into 3 portions of 1ml each. Each of portions was separately treated with dragendorff, Meyers and Waqnerôs reagents (Trease & Evans, 2002).

Saponing:

1ml of the extract was shaken with distilled water in a test tube. If frothing formed persist upon warming it indicates the presence of the compound (Sofowoara, 1993)

Tannins:

Small quantity of the extract was mixed with distilled water and heated on a water bath. The mixture was filtered and few mls of cone H_2S0_4 and 5% FeCl, were added to

the filterate A blue-black, green or blue green precipitate is confirming the presence of tannins (Trease and Evans 92002).

Steroids:

Salkowskii test was adopted in which small amount of the extract was dissolved in 2ml chloroform and was followed by the addition of cone $H_2804$to form a lower layer. A reddish brown colour at the interphase conforms the presence of steroidal nucleus (Sofowora, 1993).

Flavonoids:

1 cm^3 of 10% NaOH was added to 2cm^3 of the extract. Few drops of dilute HCL were added to the solution. A change in Colour from yellow to colourless indicates the presence of flavonoids (Trease & Evans, 2002).

Determining the antioxidant properties of Green Leafy Vegetable (GLV)

Food especially fruits and vegetables offer not only antioxidants but an array of other valuable vitamins and minerals as well (Whitney & Rolfes, 2005). Plants are viable source of natural antioxidants. Anwar, Manzoo & bajwa (2004) stated that some plants have been found as promising sources of natural antioxidants. Siddiq, Answar, Manzoor & Fatima (2005) asserts that many medicinal plants contain large amount of antioxidants other than Vitamin C, vitamin E and carotenoids. Bandoniene, Pukalskas, Venskutomia & Gruzzdiene (2000) and Lious, Chen & Yen (1999) observed that the growing consumer preference to the natural products forces the fats and oil industry to seek natural sources for antioxidant rather than inventing in synthetic ones. A significant number of plants have been evaluated for their antioxidant activities continued to be stated by them. Ahmedu & Holdsworth (2003) investigated 50 plants specie used by Kadazan Dusun communites in Sabah, Malaysia as traditional herbal medicine. Agbor, Oberi, Ngogang, Cai, Vinson (2005) stated that the antioxidant capacity of 14 herbs/spices from Cameroon has been evaluated and it was found that the herbs contain

high amount of antioxidants Xiufen, Tomlinson, Benzie (2003) indicated that the bioactivity of traditional Japanese herbs was also reported.

The production and consumption of GLV needs considerable boosting (AVRDC, 1996) considering the value of GLV as a double fortificant of both iron and antioxidant, there is a good reason to emphasize their importance in these populations as cheap and natural sources having protective factors. GLV offer a cheap but rich source of a number of other micronutrients and phytochemicals having antioxidant properties Tarwadi & Agte (2003).Ifenacho (2009) Posited that like fruits, vegetables are rich in phytochemicals like flavonoids, carotenoids and chlorophyll that are responsible for their pigments. However the levels of antioxidants may vary depending on the type of GLV. Secondly, the antioxidant properties and micronutrient profile in terms of contents as well as bioavailable amounts of only limited traditionally prepared GLVs is available (National Institute of Nutrition, 1997-98, Akindahunsi & Salawu, (2005) stated that the bioavailability of these essential nutrients that include the bioactive compounds, minerals and vitamins could be reduced by the presence in these plants of some anti-nutritional factors such as oxalates, cyanogenic, glycosides. Peterson, Gordan, Nwat, George, Parr, Waroonphan, Love (2006) opined that antioxidant compounds commonly found in vegetables and fruits include vitamin A, C and E, carotenoids such as beta-carotene, lycopene, lutein, beta-cryptoxanthin and zeaxanthin, and the phenolic compounds, particularly flavonoids for instance have been reported to have many antioxidant characteristics such as scavenging of free radicals and consequently can improve endothelial function in both healthy individuals and those suffering from cardiovascular diseases.

Some vegetables have been studied for antioxidant properties and includes

Carrot (*Daucus carota)*

Carrot is a vegetable as indicated by Google cache (2009). They store a goldmine of nutrients. This is a vegetable that contains about 87% water, rich in mineral salts and vitamins B,C,D,E. Raw carrot are an excellent source of potassium and contains vitamin

B_6, copper, folic acid and magnesium. The high level of beta-carotene is very important and gives carrot their distinctive orange colour.

Carrot also contains in a smaller amounts essential oils, carbohydrates and nitrogenous composites. They are well known for their sweetening antianaemic, healing, diuretic remineralising and sedative properties. They are rich in antioxidant alpha carotene, calcium, manganese, phosphorous, and sulphur. This is a versatile vegetable that one need not to miss in eating.

Pseudocedrella KotsChyii harms (Melcaceae).

Musa, Haruna, Hyas, Yaro, Ahmadu & Usman (2005) conducted a research on phytochemical and Analgesic effects of the Ethyl acetate extracts of the leaves of pseudocedrella kotschyii harms (melcaceae).

The result revealed that pseudocedrella Kotschyii contains tannins, glycosides, and flavonoids major chemical constituents. Alkalodis, saponions, cardiac glycosides, steniods were not detected in the extracts.

Determining the Antioxidant Properties of the fruits

The antioxidant is found in fruits. Hertog, Feskens, Hollman, Kataqn & Kromhout, (1993) opined that antioxidants derived from fruits and vegetables are believed to maintain health and afford protection from coronary heart disease. In addition to vitamins c, a great number of other phenolics especially the flavonoids have strong antioxidant, (Wang Coa & Prior 1996). Also Ravindra & Narayan (2003) observed that these phenolic compounds are found in the plants for their normal growth, development and defense against injury and infection. Francis, (1982) opined that anthocyanins that are natural flavonoids pigments having a wide range of colours from red to blue hue and are widely distributed in flowers, fruits and vegetables. Dragsted, Ijonneland, Ravn-Haren, Kristensen, Poulsen, plocharsky & Bugel (2008) opined that fruit composed mainly water, carbohydrate and fibre, small amount of protein, lipids and even smaller amount of other plant metabolites which serve a wealth of necessary functions in the fruit acting as vitamins or enzyme cofactors, antioxidant, natural pesticides aromas etc. Single antioxidants including vitamins C (Gale, Ashurst, Powers,

Martyn (2001) and (Vita Keaney, Raby, Morrow, Freedman, Lynch Koulouris, Hankin & Fei, 1998) Vitamin E (Lannuzzi, Celentano, Panico, Galasso, Covetti, Sacchetti, Zarrilli, De, Rubba (2002) and Vitamin E plus beta carotene (Gale, Ashurst, Powers, Marytyn 2001) and other antioxidative carotenoids (McQyillan, Hung, Beilby, Nidorf & Thompson (2001) and Russanen, Voutilainen, Virtanen, Venho, Venharanta, Mursu & Salonen; 2003). This is to state that fruits contain vitamin C, E and betacarotene Dragsted, Tjonneland, Ravn-Haren, Kristensen, Poulsen, Piocharsky and Bugel (2008) states that the antioxidant contents in fruit are to a large part identical to the vitamin content but there are also non-nutrient antioxidants mainly belonging to the large and chemically diverse group of polyphenols. The polyphenols are potent antioxidant and their antioxidant action in humans seems uncertain despite numerous studies. Polyphenols may be subdivided into several groups including the different flavonoid subclasses, the phenolic acids and the proanthocyanidins. Flavonoids and proanthocyanidins in general have low bioavailability in humans whether as aglycons or as glycosides (Nielsen in Dragsted, Tjohneland, Ravn-Haren, Kristensen, Poulsen, Plocharsky & Bugel (2008) others such as specific flavonol glucosides may enter the gut cell lining at relatively high concentrations but most of it is then excreted again into the gut flow (Day, Gee, Duppont, Johnson, Williamson, 2003). Young et al in Dragsted, Tjonneland, Ravn-Haren, Kristensen, Poulsen, Plocharsky & Buge (2008) opined that catechin is common in most fruits and flavonone from citrus, for both of which 3-10% may be absorbed. Fruits contains phenolic acids as observed by Gross et al and Hollman all in Dragsted, Tjonneland, Ravn-Haren, Kristensen, Poulsen, Plocharsky & Bugel (2008) that bacterial degradation product of most flavonoids are formed and comprise numerous phenolic acids most of which have high bioavailability just like the phenolic present in the fruits.

It has been found that fruit sugars, calcium, iron, vitamin A, B-complex and C control the graduation of heart-energy. Hence, eating fruits like apple, lemon, orange and pomegranate can aid the proper functioning of the heart and keep it healthy even in old age (All-Bran, 2009). There are some of these common fruits that have been analyzed for their antioxidant properties that this study is to review;

Berries

All-Bran (2009) indicated that all berries, being extremely rich in iron, phosphorous and sodium are highly beneficial for blood building and nerve strengthening.

Apples, Date and mango

All-Bran (2009) again stated that fruits like date, apple, and mango have direct action with the central nervous system. The phosphorous, glutamic acid and vitamin A and B-complex of these fruits exert a protective and tonic effect on the nerves. Hence regular use of these fruits in the diet will sharpen memory and prevent nervous exhaustion, mental tension, hysteria and insomnia.

Acai berry

A work from Google search (2008) revealed that Brazilian natives esteemed it high for its nutritional benefit and capacity to promote energy and strength. This fruit is available worldwide.

The Acai Berry has a high content of vitamin B_1, B_2, B_3 C, and E along with iron, phosphorous, calcium and potassium. But the benefits donâ stop there; Acai fruit contains so many other natural health enhancing ingredients.

Coconut Oil

The coconut as was cited in google cache (2009) states the benefit of coconut oil include hair care, skin care, stress relief, heart disease, cholesterol levels, weight loss, kidney problems, digestion, metabolism, high blood pressure, immunity, dental care, diabetes, bone strength HIV and energy.

These benefits are attributed to the presence of lauric acid, capric acid and caprylic acid and its properties such as antimicrobial, antioxidant, antifungal, antibacterial soothing etc. The human body converts the lauric acid into monolauric which is claimed to help in dealing with viruses and bacteria causing diseases such as

herpes, influenza, cytomegalovirus and even HIV. It helps in fighting harmful ba such as listeria monocytogenes and leliobacter pylori, and harmful protozoa such as giardia lamblia. It is worth eating coconut because of these health benefits.

Review of Related Empirical Studies

There is paucity of research on antioxidant composition of lesser known fruits and vegetables but some studies have been carried out in relation to fruits and vegetables generally. However, these studies reviewed have some relationship to the present study, but not in the determination of the antioxidant properties of the lesser known fruits and vegetables.

The nutritional, antinutritional factors and contribution of native pear (*Dacryoides edulis*) pulp to nutrient intake of consumers was investigated by Adepoju & Adeniyi (2008) in the following ways. Ripe *Dacryodes edulis* fruit was purchased at Bodija market in Ibadan Oyo state of Nigeria.The objective of the study was to provide information about nutrient composition, antinutritional factors and contribution of Dacroyodes edulis to nutrient intake of its consumers. The fruits were randomly divided into three portions to prepare three composite samples and contribution of *Dacryodes eduis* to nutrient intake. One portion was peeled raw with knife and used as fresh sample. Another portion was boiled at 100^0C for five minutes (Steamed sample), while third portion was roasted in hot ashes (Roasted sample). The steamed and roasted sample pulps were scraped with knife and the composite samples were analysed for moisture, crude protein, lipid, and fibre, ash, minerals, vitamins and anti-nutritional factors using standard methods of AOAC (1995).

The moisture content of the samples was determined by air oven method (Gallenkamp). The crude protein of the pulp was determined using micro Kjeldhal method, crude lipid determined by soxhiet extraction method and the ash determined by heating the sample in a muffle furnace at 550^0C for 4hours. Crude fibre was determined using Saura calixto, Canalias & Soler (1983). The carbohydrate content was obtained by difference, while gross-energy of the fruit pulp was determined using Gallenkamp ballistic bomb calorimeter. In the mineral analysis, potassium and sodium were determined by digesting the ash of the pulp with perchloric acid and nitric acid and then

taken the readings on Jenway digital flame photometer/spectronic 20 Bonire, jalil & Lori (1990). Phosphorous was determined by Vanadomolybdate colorimetric method. Calcium, magnesium, iron, , manganese, and copper were determined with spectrophotometer (Buck scientific Norwalk (Essien, Ebana, & Udo (1992).

The result showed that the fruit is high in moisture, carbohydrates, and low in crude protein, lipid and fibre, ash and soluble sugars. The macro mineral such as potassium, sodium, calcium, and magnesium and phosphorous was low but high in iron.

The pulp was high in B-carotene, ascorbic acid and a-tocopherol that were antioxidant. The pulp was low in riboflavin and niacin. Indeed, the study investigated a popular fruit not the lesser known one.Also, the antioxidant properties under the present study were not studied by the researchers.

Ukam (2007) carried out a research on the potential of *Gnetum africanum* (Okazi). The material and method was the *Gnetum africanum* bought from (Ruwatt) market in Calabar. The proximate analysis was carried out using AOAC methods. The moisture, ash, fat, protein and crude fibre contents were determined on duplicate sample. The minerals sodium, calcium, potassium, magnesium, iron, coppsser, zinc, manganese were determined using AOAC method. Vitamin A (carotene) and vitamin C was determined using spectophotometric method of Bassey et al (1946). The result showed that *Gnetum africanum* has moisture content of 75.38, ash 5.15, protein 18.25, fat 7.60, fibre 10.80, carbohydrate 16.57, sodium (Na) 92.00, (K) Potassium 3.45, calcium (ca) 52.00, Manganese (Mn) 6.80, phosphorous (P) 83.30, Vitamin A 545.43, Vitamin C 278.10.

This study has relationship with the present one in that it is a popular vegetable.The result revealed some of the nutrient content but it failed to investigate on the antioxidant properties that the present study focused on.

Yet, another literature reviewed the nutrient content of a mango fruit. Owoeye & Amoo (2006) carried out a research on the determination of some elements in mango. The purpose was to find out the trace element level in most food including fruits which varies depending on soil composition. This is true especially for cobalt, mercury and copper which may be deficient in the soil. The material used was the mango fruit bought from Oliha market in Benin City in Edo state. The fruit was peeled dried and pulverized

with ken-wood blender and stored in plastic container in refrigerator prior to the analysis. About 3g of the sample was weighed and ashed in electric murfle furnace. The ashed sample was dissolved in 0.1m HNO, filtered and made up to 100ml mark in a volumetric standard soluble salt graded chemical (BDH). The result of the findings was that mango has these elements; sodium 232.7ppm potassium 199.7 ppm, calcium 194.1ppm, magnesium 18.5, iron 48, manganese 20, Aluminium 11.4, zinc 19.7, lead 1.28, Nickel 7.16, copper 1.13, chromium 0.2, tin 0.1. This study is related to the present study in that all are fruits. It differs in that mango is a popular fruit and the antioxidant properties were not determined.

Still, Bamalli (2005) conducted a research on obtaining the Nutritive value of leafy vegetables for family survival. The research was conducted using Spinach (*Amaranthus caudatus*). The purpose was to identify the best method of cooking which preserve nutrient. The method of research design was experimental study. They are further tested for fat and fibre content in the laboratory using 100g spinach, 50mls of water, pinch of salt. The 100g of spinach was washed, shredded and packed in a polythene bag and stored in a refrigerator before the laboratory testing. Another 100g of spinach was also prepared and steamed in an air tight pot with 50mls of water for 4-5mins. It was allowed to cool down and then packed in polythene and taken to laboratory testing. Fat/lipid was determined by using two round bottom flasks and were added few anti-bump granule to prevent bumping, 300ml of petroleum ether (40-60^{0}C) boiling point were poured into the flask. These are fitted into the soxhlet extraction unit. Extraction thimbles were weighted and twenty milliliter of the sample was placed into it, the thimble was fixed into the soxhlet extraction unit with forcep and cooled water circulation put on. The heating mantle was switched on and solvent refluxing was adjusted in a steady rate. Extraction was carried out for eight hours. The thimble was removed and (dried to constant. Weight in an oven at 70^{0}C and was weighed (W_2). The extractable lipid/fat was calculated as %. The result was 0.26 for fresh and 0.12 for steamed. The fibre was determined using hot water added H_2SO4 in the round bottom flask and boiled under reflux for 30mins. The insoluble matter was washed several times until it was acid free. It was transferred to another flask containing 100ml of hot NaOH solution and it was boiled under reflux for 30mins and washed again until base free. It

was dried and weighed in an oven at 100^0C. The result was that the fibre content of the fresh was 0.88 and the steamed 1.56. The conclusion was that most vegetables have high nutrient when fresh and the nutrient content decreases when steamed. Recommendation was that vegetables should be steamed lightly. This study dealt with *Amaranthus caudatus* but the antioxidant properties of this vegetable was not determined as the present study will do.

Another study was conducted by Nartinez, Curros, Bermudex, Carballo & Franco (2007) on the composition of Arnoia pepper (*Capsicum annum*) at different stages of maturity. The purpose was to investigate the difference in quality of Arnoia peppers at different stages of ripeness (mature, green and red fruits). Since they studied the changes that take place in the gross composition then main physico-chemical parameters and the mineral composition were evaluated.

Arnoia peppers were harvested from three different plantations in three areas of production in the region of Arnoia (Qurense, Northwest, and Spain) samples containing 20 fruits at the same ripening stage red and green were collected directly from the plant at two different stages. In August and September 2003, this corresponds to the period of highest production. In addition mature green Arnoia peppers (green B) were purchased from three local supermarkets (20fruits x 3) Arnoia peppers are normally commercially harvested at the mature green stage. Peppers were washed with deionized water, cut into pieces and peduncles, and the seeds were removed. The analytical method of Estrada et al (2000) was used to determine moisture, ash and soluble solids contents. The Ph and acidity were analyzed using the method outlined by the AOAC (1980) and the total protein content according to AOAC (1995) total carbohydrates were quantified by the anthrone method following the procedure of Molla et al (1994). The fat content was quantified by the procedure of Perez-Galvez et al (1999) and pectin content was determined by the gravimetric method described by Kirt and Sawyer (1991).

Dietary fibre was determined by use of a fibertec system (1023 filtration Module, Tecator, Hogands, Sweden) as described Prosky et al. 1988). Mineral elements, macroelements (Potassium, magnesium, calcium and sodium and copper were extracted by wet digestion (0.2g samples were extracted with 10ml concentrate nitric acid over night) Cavero et al, 1993). The samples were treated at 90^0C for 5h, and were

centrifuged after cooling. An aliquot of 5ml resulting supernatant was mixed with 5ml distilled water. The minerals were determined by atomic absorption spectroscopy (Varrian Model 220 Fast Sequential, Mulgrave, Victoria, Australia).

The vitamin C content was determined by the use of modified version of the method of Tsumura et al (1993). The statistical method used was analysis of variance and the result for Red, Green A and Green B were as follows: weight 75.5,70.7, 62.1; thickness 3.4,3.1, 3.4; moisture g/100g, 89.9, 92.793.7; Ph 4.6,5.5, 5.5; protein 1.13, 0.80, 0.71; carbohydrate 6.23,3.84,3.51; fibre 1.62,1.63, 1.31; pectin 0.15, 0.14, 0.12; lipid 0.54,0.22,0.16; Ash 0.62,0.40, 0.33; vitamin C 150,109,58; potassium 2.51,2.91,2.80; magnesium 0.10,0.14,0.15; calcium 0.07, 0.08, 0.15; sodium 0.018, 0.015, 0.023; iron 7.56, 9.31,10.2; zinc 1.56,1.29,1.80; manganese 0.95,1.03, 1.02 and copper is 0.69, 0.74, 1.09.

The relationship of this study with the present is that they are fruit but the antioxidant content of them was not determined.

Chen, Wang, Q_1 & Xie (2007) carried out a research work on the antioxidant activities of natural sweetens, mogrosides, from fruits of Siratia grosvenori. The purpose of the study was to search for possible antioxidative agents from natural sources, the inhibitory effect of sweet glycosides, mogroside v and 11-oxo ï mogroside v, obtained from S. grosvenori, on superoxide anion (O_2) hydroxyl radical (OH) and hydrogen peroxide (H_2 O_2) and DNA damage. The materials and method used were Luminol, Calf thymus DNA, Pyrogallol and 1, 10- phenanthroline (phen) were purchased Mogroside v (purity 95%) and 11-oxoï mogroside V (purity 95%) were isolated from the fruits of sigrosvenori according to the reported method and were identified with authentic samples (Ukiya et al, 2002_a). The plant material used was Chinese Q in- pi fruits of S. grosvenori harvested in November and obtained. The result was obtained using model Ultra Weak Chemilumiuminescence Analyzer. It was found out that Qin ï pi fruits of S. grosvenori has two natural sweetners, mogroside v and 11-oxo ï mogroside v. The 11 ï oxo- mogroside v showed a higher scavenging effect on O_2 . Mogroside v was more effective in scavenging + OH. Further more, 11-oxo ï mogroside v exhibited a stronger scavenging activity towards the superoxide anion, hydrogen peroxide and inhibiting effect on DNA damage than those of mogroside v, while it elicited less to the

scavenging hydroxyl radical. Therefore, these two compounds could be effective as free radical scavenging agents and D. grosvenori might be valuable as a source of antioxidant agents. It was also suggested that the natural sweetners would be valuable as a substitute in food ingredients or as a food additives.This study is related to the present study because it was on antioxidant activity of natural sweeteners of fruits but differs in that the antioxidant of the entire fruit was not determined.

Summary of Literature Reviewed

Antioxidants serve to imitigate the harmful effect of free radicals by giving up an electron and stabilizing them in the process. Although, many of the antioxidants are produced in the body, food provides an essential source for these key players of defense system. A free radical theory has been propounded to explain how this antioxidant neutralizes the activities of the oxidative stress caused by the free radicals. Antioxidant has many properties namely vitamin C, E, Minerals like selenium, copper, zinc, iron, carotenoids and flavonoids.The intake of antioxidant compounds present in food is now considered as important as vitamins for health promotion and protection against damage due to oxidative stress.These lesser known fruits and vegetables are likely to have similar nutritional values since they possess similar colour as the commonvegetables and fruits quality being consumed and grow within our environment but are neglected.

The literature reviewed further revealed the micronutrient composition of the popular fruits and vegetables. They are rich sources of vitamins and minerals. The micro elements of the popular fruits and vegetables were found to include magnesium, copper and others, unavailability of the micronutrients result in deficiency diseases. The consumption of the lesser known fruits and vegetables will help to increase the availablability of fruits and vegetables. It will also help to combat the micronutrient deficiency suffered, due to seasonality of the fruits and vegetables with high cost of the

available ones during the dry eason. There are factors that can hinder the nutrients from being used by the body.

It was also revealed in the reviewed literature that some fruits and vegetables have some antioxidant qualities. The processes of determining the antioxidant was ascertained. Finally, reviewed literature on empirical studies indicated that many works have been done on fruits and vegetables. However, the review of empirical studies related has specifically shown that no work has been done on antioxidant properties of the lesser known fruits and vegetables. The empirical studies failed to provide the antioxidant properties of the lesser known fruits and vegetables. It is this gap that the present study seeks to fill.

CHAPTER THREE

RESEARCH METHOD

This chapter described the procedure that was used in carrying out the study. It was organized under the following sub-headings: design of the study, area of the study, population of the study, sample and sampling technique, instrument for data collection, validation and reliability of instrument, method of data collection and method of data analysis.

Design of the Study

The study adopted two designs namely the survey design and the experimental design. The survey design made use of the oral interview in collecting the necessary information. This method was used to get responses from the rural women who are not able to indicate their responses in a questionnaire.

Also the survey design adopted the questionnaire method which was filled by post graduate students to get responses to the strategies for enhancing the consumption of lesser known fruits and vegetables by families. The design was considered suitable as critical analyses of opinion are required.

The experimental study of Campbell and Stanley (1963) was used in determination of nutrient composition of fruits and vegetables. The design was considered suitable since the study sort information on the antioxidant composition of the fruits and vegetables. The experiment was carried out in steps for better presentation of information, thus:

Determination of Antioxidant Properties**:** This involved the following steps:

a) Processing of the selected vegetables.
b) Processing of the selected fruits.
c) Coding of the fruits.
d) Coding of the vegetables.
e) Analysis of the antioxidant properties of fruits and vegetables.

Area of the Study

The study was carried out in the South Eastern states of Nigeria. The South Eastern states of Nigeria are made up of five states namely Abia, Anambra, Ebonyi, Enugu and Imo. The lesser known fruits and vegetables are mostly found and consumed in theSouth-Eastern states of Nigeria. This is as a result of the geographical area which encourages the growth of these fruits and vegetables in wild forests and farmlands with lesser or no attention, hence the choice of the area for the study.

Population for the Study

The population for the study was made up of four groups, the lesser known fruits, the lesser known vegetables, post graduate students and women aged 45 years and above.

(a) Lesser Known Fruits: In the South East states seventeen (17) lesser known fruits were identified .The Igbo and scientific names of the identified fruits are as follows: *Carcinia*

cola (bitter cola pulp) ñaki iluò *Canarium schweinfurthii* ñUbe Okpokoò, *Dennettia tripetala* ñmmimiò, *Afromomium daniella*, ñOse ohiaò Hippocretae myrint ñnkpuruamunwebuleò, *Terminala Catappa* ñfurutuò, *Olasivirdis* ñaziza ohia, okpaaò, *Dialium guineese* ñnnuagu, icheku, okponkporoò, *Napoleana imperialist* ñodure, nkpoduò, *cola gigantea* ñOji-eyiò, *Parkia clapptoniana* ñnkpuru ugbaò, *Landolphia oweriansis* ñutuò *Nauclea diderrch*ii ñUvuruò, Ficus elasticoides ñutu nkilisiò, *Icacina trichatha oliv* ñibiala, urubiaò, *Blinghia unijugata sapindocea* ñUsoò, *Piper cuineense* ñUzizaò, *Spondias mombin* ñnkpuru ijikara*", Irvingia gabonensis* ñugiriò, *Irvingia smithii* (ogbono),The English name can be found at the appendix pages in a tabular form.

(b)Lesser Known Vegetables: Also, twenty five (25) lesser known vegetables were identified. The Igbo and scientific names were given as well thus: *Triplochiton scleroxylon sterculiaceae(*Okpo*), Daniella olivera(*Agba), *Ficus thonningin moraceae*(Ogbu*), pterocarpus santaliniodes*(Uturukpa*), vitex doniana(Uchakiri)*, *Myrianthus arboreus(*Ojijo, ujuju), *Berlinia grandflora(*Ububa*)*, *moringa oleifera(Okwe oyibo)*, *Bambosah spp*.(Achara), *Blinghia unijugata sapindocea(Uso), ceiba* pentandra(Akpu), *Gongronema atifolium(*Utazi*), ficus sur(*Aku-okoro*), solanium spp.(*Anara), *Amarantus spinosus*(Inine ogwu), *corchorus olitorus(*Ahihara, eleghile*), Boerhavia diffuse(Erimmiri) colocasia esculenta.L., Adansonia digitata(*Baobab), *commelina nudiflora(*Obogwu*), corchorus capsularis(jute], ficus vogeliana(*Ogbu aru), *celosia argentica(*Eri emi onu*), piper cuineense(*Uziza) .

(c Post Graduate Students of Home economics: The Post Graduate Home Economics students were chosen. This group was made up of 25 persons. They were chosen because they understand the nutrient and importance of fruits and vegetables.They understood the questions and critcally responded to them.

(d) Women aged forty-five years and above: All the women aged forty-five years and above in the states of study were sampled. The age group was chosen because they are the group that are familiar and have continued to use the vegetables whenever available. Majority of this group utilized these fruits and vegetable but ceased from their utilization due to urbanization which tends to erode the forests and farmlands where these fruits and vegetables thrive. The population of the group was 4553 (National Population Commission, 2006).

Sample and Sampling Technique:

The sample size of ten (10) lesser known leafy vegetables and ten (10) lesser known fruits were sampled using random sampling technique. In this sampling process, seventeen (17) identified fruits were given numbers starting from one to seventeen and were placed into a basket in a folded form. The researcher deeped hand inside the basket and picked ten papers at random and the names of the fruits indicated in the papers were written down to form the sample of fruits for the study,Also the names of 25 identified vegetables were written on pieces of paper and put into another container. Ten pieces of papers were randomly picked from the container. The vegetables that were randomly sampled formed the sample size used for the study.

Multi-stage sampling technique was used to select the twenty (20) respondents aged 45 years and above.Out of the five states, two states namely Enugu and Imo states was sampled from the population zone. From the two states, ten women each were used for the study to get twenty respondents.

All the 25 post graduate students were chosen. The questionnaire was administered to them to fill by the researcher. The instruments were given out with close monitoring inorder to make sure that all the responded questionnaire were collected back since the sampling group were not much.

Instrument for Data Collection

Three instruments were used in data collection. They are the oral interview, questionnaire and the atomic absorption spectrophotometer. The oral interview guide contained 20 questions for identifying the edible lesser known leafy vegetables and fruits. The questions were divided into two sections.Section 1 contains ten questions to collect informations on the lesser known vegetables. The section II was to collect information on the lesser known fruits. The interview schedule was administered on the sampled 20 women that were aged 45years and above. This was done with the help of a research assistant who was earlier guided on how to administer the interview schedule. The edible lesser known leafy vegetables and fruits consumed were identified and recorded.

The questionnaire contained two sections named secion A and section B. The secton A is the personal data while the section B solicited information on strategies for enhancing the consumption of lesser known fruits and vegetables by families. These were administered on the 25 post graduate students and collected immediately by the researcher to ensure complete return of the instrument. Through this way the strategies for enhancing the consumption of the lesser known fruits and vegetables were derived.

The atomic absorption spectrophotometer was used to collect the antioxidant content of these fruits and vegetables. The antioxidant analysed were the vitamin C and E, mineral antioxidant such as selenium, manganese, iron and zinc, the carotenoids as beta-carotene and lycopene and the flavonoid, the flavones.

Validation of Instrument

The oral interview guide instrument was subjected to face validition by three experts; two of the experts were from the Department of Vocational Teacher Education and one was from Home Science and Nutrition of the University of Nigeria, Nsukka. Uzoagulu (1998) indicated that face validation was to ascertain the appropriateness of the instrument for data collection. The validators were given the copies of the oral interview guide for the purpose of proffering correction for the improvement of the instrument for achieving the objective of the study. The comments and corrections by the validators were used in correcting the final interview items used in collecting data from the respondents.

The questionnaire was also subjected to face validation by three experts; two experts from Vocational Teacher Education (VTE) and one from Curriculum Development and Instructional Material Centre (CUDIMAC). The validators were given the copies of the questionnaire to proffer correction to achieve the objective of the study. The corrections were effected to produce the final questionnaire that was used to collect the responses from the respondents.

The atomic absorption spectrophotometer is a standard instrument that requires no validation. It has a high validity and has been used in determining the antioxidant contents of fruits and vegetables.

Reliability of Instrument

The atomic absorption spectrophotometer for analysis of antioxidant of fruits and vegetables was reliable as they are standard instrument and gave accurate data since the method for each of the antioxidant test was duely followed. A test re- test method and Cronbach alpha were used to determine the reliability of the interview guide and the questionnaire that were administered to the respondents. The reliability coefficient of the interview guide and the questionnaire were 0.68 and 0.65 respectively.

Method of Data Collection

To ensure high percentage of response to the oral interview, it was administered personally by the researcher with the help of a research assistant that was trained for the purpose. Using the interview guide the edible lesser known leafy vegetables and fruits were identifified. The questionnaire was administered to the respondents to achieve the highest response.This was used to obtain the strategies for enhancing the consumption of the lesser known fruits and vegetables. The determination of the antioxidant content of the identified edible lesser known leafy vegetables and fruits were done on the laboratory following the procedures as indicated by the flow charts.

Determination of Antioxidant Properties

This was done following various steps as shown below.

Processing of Vegetables

Step 1: The sampled vegetable and fruits were processed individually using these processes.

Leafy Vegetables

↓

Plucked

↓

Sorted

↓

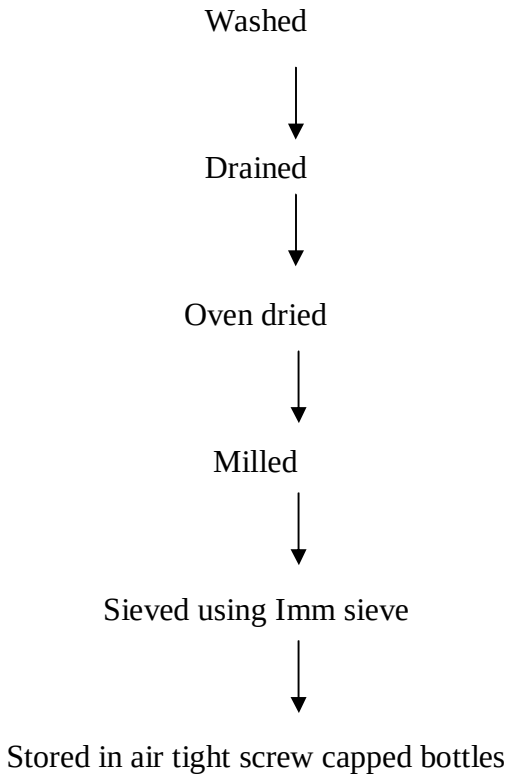
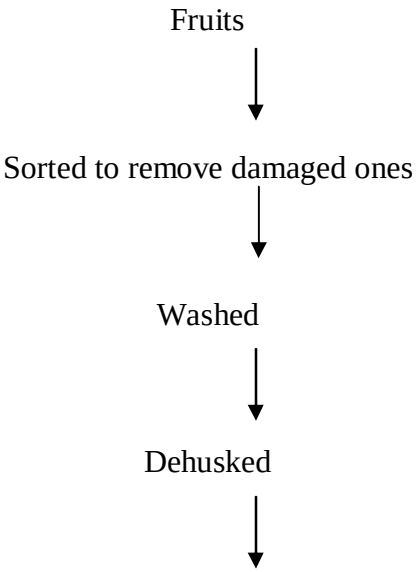


Fig 1: Flow chart diagram of the processing of the Individual leafy vegetables.

Processing of the fruits.

The sampled fruits were processed using the following procedures.



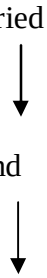


Fig 2: Flow chart diagram of the processing of fruit.

Step 2: Coding of the sampled lesser Known Vegetables and Fruits

Vegetables**:**

Vegetable BUS - *Blinghia unijugata sapapindoceae* (uso)
Vegetable CEP - *Ceiba pentandra* (akpu)
Vegetable MYA - Myrinathus arboreus (ujuju)
Vegetable FIV– Fiscus vogeliana.(ogbuike)
Vegetable VID – Vitex doniana(uchakiri)
Vegetable FIS *– Ficus sur* (Akuokoro)
Vegetable TSS– *Triplochiton scleroxylon sterculiaceae* (Okpo)
Vegetable PTS – *Pterocarpus santalinoides* (Uturukpa).
Vegetable FTNï *Ficus thonningin* (Ogbu)
Vegetable DOL - Denialla olivera (agba)

Fruits ;

The sampled lesser known fruits in screw capped bottles were coded for analyses as follows:

Fruit ITO – *Icacina trichantha oliv (ibiala)*
Fruit FIE ï *Ficus elasticoides (utu nkilisi)*
Fruit COGï *Cola gigantean (oji eyi)*
Fruit NAD ï *Nauclea diderrichii (uvuru)*
Fruit LAO ï *Landolphia oweriansis (utu)*
Fruit PIC - *Parkia clappatoniana (nkpuru ugba)*
Fruit NAI ï *Napoleana imperialist (odure, nkpodu)*

Fruit OLA ï *Olasivirdis (*aziza ohia, okpaa)

Fruit HIM ï *Hippocretae myrint (nkpuruamunwebula)*

Fruit ADAï *Afromomium daniella (ose ohia)*

In all 10 samples of lesser known vegetables and 10 lesser known fruits were coded and categorized accordingly.

Step 3: Determination of antioxidant content of the sample vegetables and fruits.

The atomic absorption spectrophotometric method was used in the determination of the antioxidant contents of the vegetables and fruits as follows:

Lycopene Content:

The lycopene contents in the fruits and vegetables samples were determined thus:

- One gram of each sample was weighed into a conical flask.
- 10ml of acetone was added into the sample inside the conical flask,
- Sample agitated for about one minute to extract the colour substance in the samples.
-After agitation, it was allowed to settle and then, decant was obtained.
-5ml of benzene was added to the decant in the test-tube and was agitated again.
-Two distinct layers observed after agitation.
-This was separated using separating funnel.
- The upper layer obtained and was used for lycopene analysis.
- About 2ml of the supernatant was pipetted into the test tube and read off in the spectrophotometer at wavelength of 487nm.

thus, lycopene content $= \frac{(Abs \times 10 \times 1/5) \times 10^4}{3370}$

where Abs = absorbance

Beta-carotene Content

-One gram of the sample was weighed into a conical flask.

-10ml of acetone was added into the sample in the conical flask and was agitated for about one minute to extract the colour substances present in the sample.

-This was allowed to settle and then, decant was obtained.

-5ml of hexane was added to the decant and was agitated.

-Two distinct layers were observed after agitation.

-This was separated using separating funnel.

-The upper layer obtained and was used for B-Carotene analysis.

-About 2ml of the supernatant was pipetted into a test-tube and read off in spectrophotometer at wavelength of 453nm.

Thus, B-carotene content $\frac{[Absx10x1/5]x10^4}{3370}$

Where Abs = absorbance

Ascorbic acid (vitamin C)

-5ml of each sample is pipetted into a beaker.

-10ml of sodium chloride (NaOH) was added and a colour change was

observed.

-This happens when the normality of the two mixing substances are

equal.

-The mixture was allowed to settle and decant obtained.

-The decant is used for ascorbic acid determination.

-About 2ml of the supernatant was pipetted into a test-tube and read off

in the spectrophotometer at wavelength of 226nm.

Calculation of ascorbic acid(vit. c) $\frac{Abszx10/5}{26}$

Where 10/5 = Dilution factor

abs = absorbance

Iron Content

To determine the iron content of the fruits and vegetable samples

Reagents**:** Dissolve 0.702g ferrous amonioum sulphate, Fe $(NH_4)_2$ (so_4), $6H_2O$, in water, add 2 drops of hydrochloric acid and dilute to 1000m; (1ml=0.005mg fe).

Preparation of Standard Graph

-Pipette 5mls of each working solution into a 25ml volumetric flask, add 1ml of quinol solution and mix.

-Add 3ml of phenanthroline solution, mix and add 5ml of sodium citrate solution.

-Dilute to 25ml and allow to stand for 4hours.

-Measure the absorbance in 40ml. optical cell at 510nm.

-Construct a graph relating absorbance to μg of iron present.

-The absorbance corresponding to O and 20 μg of iron are approx .05 and .20 respectively.

Examination of sample solution- Transfer an aliquot containing 0-20 μg of iron of the sample solution into a 25ml graduated flask, dilute to 5ml with approx. 4m HCL and continue as in add 1ml of quinol solution and end at in 40mn optical cell at 510nm.

Calculation: Read from the standard graph the number of μg of iron equivalent to the absorbance of the sample and the blank determinations at 510nm.

Determination of Flavone**.**

- Extract the milled sample with 70% elhanol
- Pattition with 50ml Petroleum Ether and allowed to stand for 20min.
- Separate the layers with separating funnel and use the aqueous layer.
- Pipette 5ml of the extract into test-tube.

- Add 3mls 10% NaOH
- A yellow colouration developed will be measured at 460nm

Determination of zinc

- Pipette 5ml of the solution into a 30ml test-tube
- Add 5ml buffer solution (70g ammonium chlorides in 570ml conc Ammonia, delule to 1 litre)
- Add 2ml Eriochrome Blank ï T indicator
- Nead Asorbance at 520nm

Determination of manganese (mn).

- Pipette 5ml of ñAsh solutionò into 30ml test-tube
- Add 10ml phosphoric acid and 0.2g potassium iondiate
- Heat on steam set for 30mins
- Dilute to 100ml with water
- Measure absorbance at 540nm.

Determination of Vitamin E.

- 5g. Fresh plant tissue is extracted in a blender with (50ml) acetone.
- The acetone extract is transferred into a separating funnel and added 3oml of water to form two layers.
- The upper layer is transferred into a test-tube.
- Add 20ml of petroleum spirit
- Decant the upper layer into cuivent and measure absorbance at 440nm.

Method of data analysis:

The research questions one and two were analysed using percentages while research questions three, four and five were analysed using the mean and standard deviation. The research question five made use of decision rule which states that: Any weighted mean ranging from

1 - 2.49 = Unagreeable

2.5 ï 3.49 = Neutral

3.50 ï 5.00 = Agreeable

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

This chapter deals with the presentation of data and analysis of results. The data presentation and analysis were carried out according to the research questions formulated in the study.

Research question 1

What are the lesser known vegetables consumed by families of South Eastern States of Nigeria?

The data for answering the research question was derived from the oral interview guide instrument. These were presented in percentages to show the responses and the popularity of the vegetables.

Table 3: Rate of popularity of lesser known vegetables consumed.

S/N	Lesser Known Vegetable	Frequency	Percentage
1	PTS	4	20%
2	FTN	3.6	18%
3	CEP	2.8	14%
4	TSS	1.8	9%
5	MYA	1.6	8%
6	VID	1.4	7%
7	FIV	1.4	7%
8	DOL	1.4	7%
9	BUS	1.2	6%
10	FIS	0.8	4%
	Total	20	100%

Keywords:

BUS - *Blinghia unijugata sapapindoceae* (akpu), (Akee, Uso)

CEP - *Ceiba pentandra*

MYA - Myrinathus arboreus (ujuju)

FIV– Fiscus vogeliana (ogbuike)

VID – Vitex doniana (uchakiri**)**

FIS – *Ficus sur* (Akuokoro)

TSS–*Triplochiton scleroxylon sterculiaceae*

PTS– *Pterocarpus santalinoides*

(Uturukpa)

FTNï *Ficus thonningin* (Fig tree, Ogbu)

DOL - Denialla olivera (agba)

The Table 3 above showed the responses given by the interviewee on the lesser known vegetables. The responses were expressed in percentages. The response for PTS is 20% showing its rate of popularity.The *FTN* had 18% popularity from the respondents. The CEP ranked third in popularity from the respondents. The TSS rate had 9%; the MYA had 8% from the respondents. The VID and the DOL were all 7% each showing equal popularity. The BUS had 6% and the FIS had 4% popularity.

Research question 2

What are the lesser known fruits consumed by families of South Eastern States of Nigeria?

This research question was answered using percentages to show the responses which also showed the popularity of the vegetables.

Table 4: Rate of popularity of lesser known consumed fruits

S/N	Lesser-Known Vegetables	Frequency	Percentage (%)
1	CAS	4	20
2	LAO	3.8	19
3	ITO	2.2	11
4	NAI	1.8	9
5	PIC	1.8	9
6	HIM	1.6	8
7	OLA	1.6	8
8	ADA	1.4	7
9	COG	1.2	6
10	ANS	0.6	3
Total	10	20	100%

Keywords

ITO – *Icacina trichantha oliv (ibiala),*
COGï *Cola gigantean (oji eyi),*
NAD ï *Nauclea diderrichii (uvuru),*
LAO ï *Landolphia oweriansis* (Monkey fruit, utu)
PIC - *Parkia clappatoniana* (West African Locust bean, Nkpuru ugba)
NAI ï *Napoleana imperialist (odure,)*
OLA ï *Olasivirdis (aziza ohia, okpaa),*
HIM ï *Hippocretae myrint*
ADAï *Afromomium daniella (ose ohia)*
CAS - *Canarium schweinfurthii* (Incense tree. Ube okpoko)

The table above showed the responses given by the interviewee on the lesser known vegetables. The responses were expressed in percentages thus: The responses for CAS were 20% showing its highest rate of popularity among the women. The LAO had 19% popularity from the respondents. The (ITO) ranked third in popularity from the respondents and had 11%. The NADôs rate of popularity was 9%; the PIC had 9% from the respondent also; the HIM had 8%, OLA had also 8%; the ADA had 7%; the COG had 6% popularity and the ANS had 3% rate of popularity.

Research question 3

What are the antioxidant properties of the lesser known vegetables consumed by families of South Eastern States of Nigeria?

Table 5 showed the mean and standard deviation of the antioxidant properties of the lesser known vegetables.

Table 5: Mean and Standard deviation of antioxidant properties of lesser known Vegetables

S/N	A.O.Code. Name	Lyco	Vit.A	vit.C	Vit. E	Fe	Cu	Zn	Mn	Se	Flav
1	BUS	31.2±0.19	41.2±0.2	14.2±0.35	1.12±1.24	1.4±0.90	0.2±0.12	1.4±0.33	2.6±0.33	2.6±0.33	4.6±0.59
2	VID	10.4±0.18	11.6±0.01	12.1±0.0	0.96±0.13	0.9±0.28	0.4±0.0	2.6±0.71	1.7±0.66	2.1±0.31	6.8±0.29

3	DOL	10.1±1.13	30.8±0.03	11.6±0.08	1.14±1.00	1.14±0.38	0.6±0.66	1.8±0.71	0.4±.77	0.0	2.0±0.35
4	TSS	9.6±0.02	12.0±0.18	14.3±0.06	0.08±0.11	0.0±1.08	0.9±0.31	1.7±0.94	3.6±1.05	0.0	2.6±0.74
5	CEP	26.1±0.03	11.2±1.21	12.2±0.35	3.11±0.76	3.11±0.77	0.1±1.24	2.3±0.42	0.6±0.31	1.9±0.11	1.6±0.14
6	FIS	12.7±1.24	21.4±0.35	11.4±0.29	3.36±0.73	3.3±0.14	0.3±0.01	1.6±0.66	0.2±0.42	1.6±0.38	1.4±0.35
7	FTN	Trace	Trace	32.9±0.01	Trace	Trace	1.3±0.4	1.3±0.64	3.8±0.14	0.0	2.3±0.24
8	FIV	8.8±0.05	9.8±0.06	16.5 o.o3	1.24±0.35	1.2±0.74	1.2±0.11	2.9±0.62	4.8±0.07	0.0	15.7±0.17
9	PTS	8.4±0.23	7.4±0.04	11.6±0.24	0.67±0.94	0.6±0.01	0.4±0.03	0.04±1.24	1.3±0.09	3.9±1.05	4.3±0.02
10	MYA	4.6±0.13	2.7±0.07	2.4±1.21	Trace	Trace	0.0±0.11	0.00	0.6±0.52	12.6±0.2	3.9±0.01

Keywords:

Antioxidant AO BUS - *Blinghia unijugata* *sapapindoceae* (Akee, uso)

CEP - *Ceiba pentandra* (akpu), *MYA* - *Myrinathus arboreus* (ujuju)
FIV– Fiscus vogeliana (ogbuike) *VID – Vitex doniana (uchakiri)*
FIS – *Ficus sur* (Akuokoro) TSS– *Triplochiton scleroxylon* *sterculiaceae*

(Okpo)
PTS– *Pterocarpus santalinoides* FTNï *Ficus thonningin* (Fig tree, Ogbu)
(uturukpa)
DOL - Denialla olivera (agba) Lyco. = lycopene
Vit. A = vitamin A. Vit. C. = vitamin C.
Vit E =vitamin E. Fe = iron.

Cu = copper
Zn = zinc
Mn = manganese
Se = selenium
Flavo. = flavone

The table 5 above showed the mean/standard deviation of the Antioxidant properties of the various lesser known vegetables analysed. The results of the individual vegetables were analysed thus:

The result of the antioxidant properties of BUS is presented in table 5. The vitamin A had the highest mean/standard deviation of 41.2±0.2 in the analysed antioxidant present; the lycopene was also high with 31.2±0.19. The vitamin C had 14.2±0.35. The flavone had 4.6± 0.59; the vitamin E had 1.12±1.2; the iron had 1.4± 0.90; the copper had 0.2±0.12; the zinc had 1.4± 9.33, the manganese had 2.6± 0.33; and the selenium had 2.6± 0.33.

The antioxidant levels of VID varied. The highest antioxidant property found is Vitamin C which was 12.1 ±0.1; the vitamin A had 11.6±0.01; lycopene had 10.4± 0.18; the flavone had 6.8±0.29. The vitamin E, iron, zinc, manganese and selenium were low with the mean/standard deviation of 0.96±0.13; 0.96± 0.28; 0.4±0.03; 2.6±0.71; 1.7± 0.66 and 2.1± 0.31

The antioxidant levels of DOL varied. The most occurring is vitamin A that had 30.8±0.03 and the least being selenium that had 0.0, which means the absence of it. The vitamin C had 11.62 ±0.08; the lycopene had 10.4±1.13; the vitamin E had 1.14±1.00; the iron had 1.14±0.38; the zinc had 1.8 ±0.11; the copper had 0.6±0.65 and the manganese is 0.4±0.77 while the selenium (0.0).

The result of the antioxidant properties determined in the leaf of Triplochiton scleroxylon sterculiaceae (TSS) revealed that the antioxidant levels varied. The vitamin A is predominant with mean/standard deviation of 14.3±0.06; the vitamin A had 12.0±0.18; the lycopene had 9.6±0.02; the manganese had 3.6 ±1.05; the flavone had 2.6± 0.74; the zinc had 1.7 ±0.94; the vitamin E had 0.08±0.11; the iron had 0.08±1.08; the copper had 0.9±0.31 while the selenium is 0.0 showing the absence of it.

The ten antioxidant properties determined in CEP proved to be present in the following quantities: the lycopene is more predominant with mean/standard deviation of 26.1±0.03; the vitamin C had 12.2±0.35; the vitamin A had 11.2±0, 77; the vitamin E had

3.11±0.76; the iron had 3.11±0.77; the zinc is 2.3 0.42; the selenium is 1.9±0.11; the flavone is 1.6±0.14; the manganese had 0.6± 0.31 and the copper had 0.1±1.24.

The levels of the antioxidant properties varied in FIS too. The vitamin A had the highest mean/standard deviation of 21.4±0.35; the lycopene had 12.7±2.4; vitamin C had 11,4±0.29; vitamin E had 3.36±0.73; the iron had 3.36±0.14; zinc had 1.6±0.66; selenium had1.6±0.38; flavone had 1.4±0.35; manganese had 0.9±0.42 and the copper 0.3±0.01

There is variation in the occurence of the degree of the antioxidant properties determined in FTN. The highest antioxidant had vitamin C which had 32.9±0.01; zinc had 1.37±10.64; copper had 1.3±0.4; manganese had 38±0.14; flavone had 2.3±0.24. There is no occurence of selenium. The lycopene, vitamin A, E and iron occurred in trace level.

The highest occurring antioxidant in FIV is vitamin C which had 16.5±0.03; the flavone is high and had 15.7±0.17; vitamin A had 9.8±0.06; lycopene had 8.8±0.05; manganese had 4.8±0.07; the zinc had 2.9 ±0.62; the vitamin E had 1.24±0.35; the iron had 1.24 ±0.74; the copper had 1.2±0.11 and the selenium had 0.0.

In PTS, the highest occuring antioxidant is vitamin C which had 11.6±0.24 mean/standard deviation; the lycopene had 8.4±0.23; the vitamin A had 7.4±0.041; flavone had 4.3±0.02; selenium had 3.9±1.05; manganese had 13 ±0.09; iron had 0.67±0.04; vitamin E had 0.67±0.94 and copper is 0.4±0.03.

The highest occurring antioxidant in MYA is selenium which had mean/standard deviation of 13.6±0.2; lycopene had 4.6± 0.13; flavone had 4.6 ±0.01; vitamin A had 2.7±0.07; vitamin C had 2.4±1.21. There are traces of vitamin E and iron and the zinc had 0.00 which means its absence in MYA

Research Question 4

What are the antioxidant properties of lesser known fruits consumed by families of South Eastern states of Nigeria?

Table 6 showed the mean/standard of the antioxidant properties present in the lesser known fruits.

Table 6: Mean/standard deviation of antioxidant properties of lesser known fruits

S/N	A.O. Code Name	Lyco Pene	Vit.A	Vit.C	Vit.E	Fe	Cu	Zn	Mn	Se	Flavo.
1	NAD	1.2±0.22	7.4±0.11	13.4±0.04	1.02±0.06	4.8±0.10	0.02±0..02	0.7±0.00	2.8±0.07	12.9±0.17	0.5± 0.21
2	HIM	Trace	Trace	22.7±0.02	Trace	9.6±0.02	0.03±0.02	0.03±0.16	1.6±1.15	10.7±0.29	0.5±0.08
3	ITO	0.1±0.12	0.1±0.01	4.9±0.06	Trace	2.1±0.02	0.04±0.01	0.8±0.29	0.4±0.10	6.8±0.04	0.4±0.55
4	NAI	Trace	Trace	3.8±0.01	Trace	9.4±0.12	0.02±0.00	0.6±0.11	0.3±0.08	7.4±010	0.6±0.8
5	OLA	2.1±0.11	0.1±0.02	2.4±0.09	Trace	3.6±0.09	0.00	0.01±0.43	0.03±0.11	9.8±0.03	0.6±0.00
6	COG	Trace	Trace	1.2±0.09	Trace	1.7±0.03	0.04±0.01	0.00	0.04±0.03	11.7±0.01	0.44±0.13
7	ADA	8.3±0.01	3.4±0.00	14.8±0.03	6.71±0.01	8.4±0.04	0.01±0.02	0.4±0.18	0.1±0.18	1.6±0.16	4.3±0.04
8	PIC	Trace	Trace	1.2±0.09	0.31±0.07	2.9±0.12	0.06±0.05	0.8±0.11	0.4±0.17	6.7±0.12	5.4±0.19
9	LA0	1.8±0.02	Trace	38.9±0.01	0.64±0.02	16.8±0.06	0.04±0.04	0.6±0.20	6.6±0õ17	0.5±0.14	4.5±0.13
10	CAS	30.6±0.07	Trace	2.1±0.00	6.93±0.01	7.3±0.05	0.26±0.05	0.2±0.15	0.9±0.55	6.4±0.29	4.3±0.43

Keywords

ITO – *Icacina trichantha oliv (ibiala)*, COGï *Cola gigantean(oji eyi)*,

NAD ï *Nauclea diderrichii (uvuru)*, LAO ï *Landolphia oweriansis* (Monkey fruit,

utu)

PIC - *Parkia clappatoniana* (West African NAI ï *Napoleana imperialist*

(odure,nkpodu),

Locust bean, Nkpuru ugba)

OLA ï *Olasivirdis(aziza ohia, okpaa),* HIM ï *Hippocretae myrint(nkpuruamunwebula),* ADAï *Afromomium daniella(ose ohia)* CAS - *Canarium schweinfurthii* (Incense tree,

	Ubeokpoko)
A.O. Code Name ï Antioxidant Code Name	Lyco. = lycopene
Vit. A = vitamin A.	Vit.C. = vitamin C.
Vit E =vitamin E.	Fe = iron.
Cu = copper	Zn = zinc
Mn = manganese	Se = selenium
Flavo. = flavone	Mean ± = standard deviation

The table above showed the mean/standard deviation of the antioxidant properties of the various lesser Known fruits analysed. The results of the individual fruits were analysed thus:

The highest antioxidant found in NAD had vitamin C which had 13.4±0.04; selenium had also high with mean/standard deviation of 12.9 ±0.17; the vitamin A had 7.4±0.11; iron had 4.8±0.10; manganese had 2.8±0.07; lycopene had 1.2±0.22; vitamin E had 1.02±0.06; zinc had 0.7±0.00; flavone had 0.5±0.21 and the copper had 0.02±0.02.

In HIM, the vitamin C had the highest occurring antioxidant which is 22.7±0.02; the iron had 9.6±0.02; the selenium had 10.7±0.29; manganese had 1.6±1.15; the copper had 0.03±0.02; zinc had 0.03±16 and the flavone had 0.5±0.08. There were traces of lycopene, vitamin A and E.

All the antioxidant properties tested for in ITO were all present. Selenium appeared highest in ITO with the mean/standard deviation of 6.8±0.04; vitamin C had 4.9±0.06; iron had 2.1±0.02; zinc had 0.08±0.29; manganese had 0.4±0.10; flavones had 0.4±0.55; copper had .04±0.01; lycopene had 0.1±0.12; vitamin A had 0.1 ± 0.01. The vitamin E appeared in trace form.

The iron is the dominating antioxidant in NAI with the mean/standard deviation of 9.4±0.12; selenium had 7.4±0.10; vitamin C had 3.8±0.01; zinc had 0.6±0.11; flavone had 0.6±0.08; manganese had 0.3±0.08; copper had 0.02±0.00. The vitamin A, E and lycopene occurred in trace forms.

The selenium occurred in higher form in OLA with the mean/standard deviation of 9.8±0.03; the iron had 3.6 ±0.09; vitamin C had 2.4±0.09; lycopene had 2.1±0.11; flavone had 0.6±0.00; manganese had 0.03±0.11; zinc had 0.01± 0.43; vitamin A is

0.1±0.02. There is a trace of vitamin E and the copper had 0.00 meaning there is absence of it.

The highest antioxidant property found in COG indicated selenium with a mean standard deviation of 11.11 ±0.01; iron had 1.7±0.03; vitamin C had 1.2±0.09; flavone had 0.44±0.13; manganese had 0.04±0.13; copper had 0.04±0.01. There were traces of lycopene, vitamin A, and E. The zinc had 0.00 meaning there is the absence of zinc in COG.

The vitamin C is highest antioxidant found in ADA. It had a mean/standard deviation of 14.8±0.03; iron had 8.4±0.04; lycopene had 8.3±0.01 vitamin E 6.71± 0.01; flavone had 4.3±0.03; vitamin A had 3.4±0.00; selenium had 1.6±0.16; zinc had 0.4±0.18; manganese had 0.1±0.18 and copper had 0.01±0.02.

The dominating antioxidant found in PIC is vitamin C. It had a mean/standard deviation of 38.9±0.01; selenium had 6.7±0.12; flavone had 5.4±0.19; iron had 2.9 ±0.12; zinc had 0.8±0.11; manganese had 0.4±0.17; vitamin E had 0.31±0.07; copper had 0.06±0.05. The lycopene and vitamin A occur in traces.

In LAO, vitamin C is the highest antioxidant property found. It had 38.9±0.01; iron had 16.8±0.06; manganese had 6.6±0.17; flavone had 4.5±0.14; zinc had 0.06±0.20; copper had 0.04±0.04. The vitamin E had 0.64±0.01; the lycopene had 1.8±0.02 and the selenium had 0.5±0.14.There is a trace of vitamin A.

The lycopene is the highest antioxidant found in CAS. It had 30.6 ± 0.07; iron had 7.3± 0.05; vitamin E had 6.93±0.01; selenium had 6.4±0.29; flavone had 4.3±0.43; vitamin C had 2.1±0.00; manganese had 0.9±0.55; copper had 0.26 ± 0.05; zinc lndicated 0.2± 0.15. There is a trace of vitamin A.

Research Question 5

What are the strategies for enhancing the consumption of lesser known fruits and vegetables by families**?**

Table 7: Mean and standard deviation of strategies for enhancing the consumption of lesser known fruits and vegetables by families.

S/N	The following strategies for enhancing Fruits and vegetables.	5	4	3	2	1	N	$\bar{X}$	SD	Remark
1	Availability of lesser known fruits and vegetables	8	14	2	1	-	25	4.16	2.08	Accept
2	Increase in the growth of attractive lesser known fruits and vegetables.	3	13	5	3	1	25	3.56	1.89	Accept
3	Market infrastructure development to showcase the lesser known fruits and vegetables.	3	13	5	4		25	3.6	1.90	Accept
4	Associate eating of fruits and vegetables to meals usually as dessert.	13	4	4	2	2	25	3.96	1.98	Accept
5	Growing forest fruits and vegetables should be encouraged and increased	5	15	1	3	1	25	3.76	1.94	Accept
6	Increases the real incomes of households.	5	5	12	3		25	3.48	1.87	Reject
7	Decrease in prices of lesser known fruits and vegetables increase consumption.	12	10	2	1		25	4.32	2.08	Accept
8	Lesser known fruits and vegetables to be part of the learning content in schools.	12	8	1	3	1	25	4.08	2.02	Accept
9	Good health and well-being is a driving force for fruits and vegetable consumption.	12	11	2			25	4.4	2.07	Accept
10	Childhood habit of eating fruits and vegetables should be encouraged.	13	12				25	4.52	2.13	Accept
11	Convenience appears to be important in consuming more fruits and vegetables.	10	14	1				4.36	2.09	Accept
12	Media campaign of lesser known fruits and vegetables.	17	8	-	-	-	25	4.68	2.16	Accept
13	Promotional campaign should be	3	13	7	2	-	25	4.68	2.16	Accept

	funded by the government									
14	Promotional campaign funded by producers.	6	7	5	3	4	25	3.32	1.82	Reject

Keywords:

$\bar{X}$ = Mean

SD= Standard deviation

Decision Rule:

Any weighted mean ranging from:

1 ï 2.49 = unagreeable

2.5 ï 3.49 = neutral

3.50 ï 5.00 = agreeable

Table 7 showed that most of the respondents agreed with the strategies for enhancing the consumption of lesser known fruits and vegetables. This is because the respondents responded positively to the following questionnaire items: media campaign regarding to positive effect of lesser known fruits and vegetables with a mean/standard deviation of 4.69±2.16; promotional campaign should be funded by the government with a mean/standard deviation of 3.68±1.92; market infrastrure development to showcase lesser known fruits and vegetables with a mean/standard deviation of 3.6±1.90; Associate eating of fruits and vegetables usually as dessert with a mean/standard deviation of 3.96±1.98; Growing forest fruits and vegetables should be encouraged and increased with a mean/standard deviation of 3.76±1.94; Decrease in prices of lesser known fruits and vegetables increase consumption with a mean/standard deviation of 4.32±2.08; Availability of fruits all year round with a mean/standard deviation of 4.6±2.04; Lesser known fruits and vegetables to be part of the learning content in schools with a mean/standard deviation of 4.08±2.02; Good health and well-being is a driving force for fruits and vegetablesô consumption with a mean/standard deviation of 4.4±2.07; Childhood habit of eating fruits and vegetables should be encouraged with a mean/standard deviation of 4.52±2.13; increase in the growth of attractive lesser known fruits and vegetables with a mean/standard deviation of3.56±1.89; Convenience appears to be important in consuming more fruits and vegetables with a mean/standard deviation of 4.36±2.23. They disagreed that fast development of real income of households;

Promotional campaigns funded by producers that have mean/standard deviation of 3.48 ±1.87 and 3.32±1.82 respectively are not going to enhance the consumption of fruits and vegetables by families. The majority of the questionnaire items were accepted to be strategies to enhance the consumption of fruits and vegetables.

Findings

The results were presented based on the identification, the antioxidant determination and strategies.

1. Identification of the Lesser Known Vegetables**.**

(a There were twenty five lesser known vegetables identified in the area of study (Appendix I)

(b) Ten of the lesser known vegetables were studied (Table 3)

2. Identification of the Lesser Known Fruits

(a)There were seventeen lesser known fruits identified in the area of study (Appendix II).

(b) Ten of the lesser known fruits were studied (Table 4)

3. Antioxidant Determination of Lesser Known Vegetables

(a) There were varied quantities of antioxidant properties in the lesser known vegetables (Table 5).

(b) All the ten antioxidant properties determined were present in BUS (Table 5).

(c) The VID contains all the antioxidant properties determined in it in varied quantities (Table 5).

(d) The DOL has the ten antioxidant properties determined in it in varied quantities. It is only the selenium that was absent (Table 5).

(e) The TSS contained almost all the antioxidant that was determined in it except the selenium that proved absent (Table 5).

(f) There is the presence of the antioxidant properties determined in the CEP (Table 5).

(g) All the antioxidant properties determined in FIS were present in it (Table 5).

(h) The FIV has all the antioxidant properties determined in the study except the selenium that was absent (table 5).

(I) There is the presence of all the antioxidant properties determined in the FTN except the selenium that was absent (Table 5).

(J) The PTS has all the ten antioxidant properties determined in the study (Table 5).

(k) All the antioxidant properties determined in MYA proved present except the zinc that was absent (Table 5).

Antioxidant Determination of Lesser Known Fruits.

(a) There are varied quantities of antioxidant properties available in the determined lesser known fruits (Table 6).

(b) The NAD has all the antioxidant properties determined in it (Table 6)

(c) All the antioxidant properties determined in the HIM were all present (Table 6)

(d) The ten antioxidant properties determined in ITO proved present (Table 6).

(e) The NAI has all the ten antioxidant properties determined in it (Table 6).

(f) It was only the copper that was absent in OLA out of the ten antioxidant properties determined (Table 6).

(g) The COG has the ten antioxidant properties determined except the zinc that was absent (Table 6).

(h) The ADA has all the ten antioxidant properties determined (Table 6).

(i) The PIC has the ten antioxidant properties determined (Table 6).

(j) The ten antioxidant properties determined in the LAO were all present (Table 6).

(k) All the antioxidant properties determined were present in the CAS (Table 6).

Strategies for Enhancing the Consumption of the Lesser known Fruits and Vegetables**.**

a. Convenience is important in consuming more fruits and vegetables.

b. Good health and well being were driving force for consumption of more fruits and vegetables.

c. Media campaign was accepted as one of the strategies that would improve the consumption of fruits and vegetables.

d. Market infrastructure development will showcase lesser known fruits and vegetables which will enhance their consumptions.

e. The growing of the out-of-home fruits and vegetables will enhance the consumption of these lesser knowns.

f. Promotional campaigns will be funded by government.

g. Lesser known fruits and vegetables should be part of the learning content in schools.

h. Childhood habit of eating fruits and vegetables should be encouraged.

i. Associate eating of fruits and vegetables to meals usually as dessert.

j. Availability of fruits and vegetables all the year round.

k .Decrease in prices of lesser known fruits and vegetables increase consumption the consumption of fruits and vegetables.

l. Increase in the growth of attractive lesser known fruits and vegetables.

Discussion of Findings

The findings of the study were discussed according to the major issues as follows:

1. The antioxidant vitamins in vegetables.
2. The antioxidant minerals in lesser known vegetables.
3. The carotenoid in lesser known vegetables.
4. The flavonoid in lesser known vegetables.
5. The antioxidant vitamins in lesser known fruits.
6. The antioxidant minerals in lesser known fruits.
7. The carotenoid in lesser known fruits.
8. The flavonoid in lesser known in lesser known fruits.

Antioxidant Vitamins in Vegetables (Tables 5)

The antioxidant vitamins are the vitamin C and E and are expressed in percentages per 100g.In all the fruits and vegetables studied there are the presence of these vitamins. The vitamin C has occured highest in FTN with a mean /standard deviation of 32.9±0.01; CEP is the next with the mean/standard deviation of 14.3±0.06; BUNS has 14.2. The MYA is the least in vitamin C composition with 2.7± 0.07 as the mean/standard deviation. The vitamin E occurred highest in FIS with a mean standard deviation of 3.36; the next with high value of vitamin E which is 3.11 mean/standard deviation; the FEL is 1.24 while the least is the FTN which occurred in trace form.This high value of vitamin is in accordance with the observation of Balzer , Heiss ,, Schroeter , Brouzos , Matern , Lauser , Rassaf , Kelm (2006) who identified the antioxidant compounds commonly found in vegetables and fruits to include vitamins A, C and E, carotenoids such as beta-

carotene, lycopene, lutein, beta-cryptoxanthin, zeaxanthin and the phenolic compounds particularly flavonoids. This observation agreed with the result of the finding of *Vitex doniana.*

Antioxidant Minerals in Vegetables (Table 5)

The antioxidant minerals to be discussed include the iron, copper, zinc, selenium and manganese and are expressed in percentage per 100g.The zinc (Fe) occurred highest in FIS with a mean/standard deviation of 3.36±0.73; the CEP has 3.11± 0.77; the FEL has 1.24 and the FTN and the MYA occurred in trace level.

The copper is high in FTN with the mean/standard deviation of 1.3 ± 0.4. It was followed by FEL that has mean/standard deviation of 1.24±0.11 and followed by TSS that has 0.9 ± 0.31.The copper occurred least in CEP with the mean/standard deviation of 0.1 ±1.24.

The zinc is another mineral discussed, it occurred highest in FEL with the mean/standard deviation of 2.9 ± 0.62; it was followed by VID that has 2.6 ± 0.71 and the CEP that has 2.3± 0.43 mean/standard deviations. The PTS occurred in the least form with the mean/standard deviation of 0.04 ±1.24.

The selenium was highest in MYA with the mean/standard deviation of 12.6 ± 0.2. It was high in PTS with a mean/standard deviation of 3.9 ± 1.05 and 2.6 ± 0.33 in VID. Its least occurence was in DOL, TSS, FTN, and FEL that were in traces.

The manganese occurred highest in FEL with the mean/standard deviation of 4.8 ±0.07. It was followed by FTN that had the mean/standard deviation of 3.8 ±0.14 and the TSS had the next high concentration of 3.6±1.05 mean/standard deviations. The FIS occurred in the least state with the mean/standard deviation of 0.2 ±0.42. The level of occurence of mineral is generally very poor and this agreed with the observation of Wardlaw & Hampl (2008) which indicated that trace minerals are found in plants and animals.

The Carotenoid in Lesser Known Vegetables:

The flavonoid includes the beta-carotene and the lycopene. The beta-carotene is vitamin A precursor; therefore it is treated as vitamin A and it is treated under vitamins. The vitamin A occurred highest in BUS with a mean/standard deviation of 41.2±0.2;

DOL is the next one with the mean/standard deviation of 30.8±0.03 and TSS is the next with the mean/standard deviation of 12.0±0.18. The CEP is the least with the vitamin A in trace level.

The lycopene is most prominent in BUS with 31.2 ± 0.19 mean/standard deviation. It was followed by the CEP which is 26.1±0.03 and the next is FIS that had 12.7±1.24 mean/standard deviation. The vegetable with the least occurence is the FTN that had traces of lycopene.

The presence of flavonoids in these vegetables agreed with the observation of the study carried out by Rissanen , Voutilainen , Virtanen, Venho , Vanharanta , Mursu , Salonenn (1999) stated that the protective effect of dietary vitamin C,E, bete-carotene, lycopene,folate and fibre, were studied and it was found that the nutrients which were negatively associated with all cause of mortality were vitamin C (which explained the10.4% protection of vegetables, fruits and berries), folate (6.5%) lycopene (5.6%) and vitamin E (5.3%).This report proved that lesser known fruits and vegetables contain beta-carotene and lycopene.

Flavonoids in Lesser Known Vegetables

The flavonoid that was discussed was flavones. The flavones occurred in all the vegetables studied. It occurred highest in FEL with the mean/standard deviation of 15.7 ± 0.17; VID was 6.8 ±0.29 and the BUS was the next that ranked high with the mean/standard deviation of 4.6±0.59. The least occurrence of flavone was in the FIS which was 1.4±0.35.The carotenoid found in the lesser known vegetables agreed also with the observation of Momtonen, Jarvinen, Heliovaara, Reunanen , Aromaa , Knekt (2005) that vegetables and fruit are ideal sources of numerous antioxidant compounds such as vitamin C and E, carotenoids, flavonoids and fibre.

The antioxidant vitamins in Lesser Known Fruits (Table 6)

The antioxidant vitamins discussed include the vitamin C and E. In the lesser known fruits studied, the vitamin C content was highest in LAO with the mean/standard deviation of 38.9±0.01. It was followed by HIM that had 22.7± 0.02 and the next in high composition was the PIC that had a mean/standard deviation of 18.9 ±

0.01. The least in the composition of the vitamin C is the COG that had 1.2 ± 0.09 as the mean/standard deviation.

The vitamin E was another antioxidant vitamin studied in the lesser known fruits. The vitamin E was found highest CAS with a mean/standard deviation of 6.93±0.01. It was followed by the ADA that had the mean/standard deviation of 6.71±0.01 and the next with high mean/standard deviation was the ANS which had 1.02 ±0.06. The least of the vitamin E composition were the fruits that possess it in trace levels that include the HIM, ITO, NAI, OLA and COG. The result of the findings of the lesser known fruits agreed with the findings of Gale; Ashurst , Powers & Marlyn (2001) that the vitamins in fruits are dominated by vitamin C, but the content of folate, vitamin E and the pro-vitamin A carotene may also have nutritional significance.

The antioxidant Minerals of Lesser Known Fruits

The antioxidant minerals studied under this study include the iron, copper, zinc, manganese and the selenium. The iron occurred highest in LAO with a mean/standard deviation of 16.8 ±0.06. It is high in HIM with a mean/standard deviation of 9.6 ± 0.02 and in NAI with a mean/standard deviation of 9.4 ±0.12.It was minute in COG with a mesn/standard deviation 1.7 ±0.03.

The copper occurred more in CAS with a mean/standard deviation of 0.26 ± 0.05; high in PIC with a mean/standard deviation of 0.06±0.05 as well as 0.4 ±0.04 and no occurence at all in COG that had 0.00 as its mean/standard deviation.The zinc occurred in greater quantity in PIC with a mean/standard deviation of 0.8 ±0.11; 0.8 ±0.29 in ITO; 0.7 ±0.00 and occurred the least in OLA with a mean/standard deviation of 0.01 ± 0.43.The selenium occurred highest in ANS with a mean/standard deviation of 12.9±0.17; it is 11.7 ± 0.01 COG and 10.7 ±0.29 ln HIM. It occurred least in ADA that has 1.6 ± 0.16.

The manganese occurred in the highest form in LAO with the mean/standard deviation of 6.6 ± 0.17. It is high in ANS with a mean/standard deviation of 2.8 ±0.07 and 1.6 ±1.15 in HIM. The least occurence was in OLA that had a mean/standard deviation of 0.3 ±0.08.These observations on antioxidant minerals are in accordance with the observations of Kliebenstein (2004) who emphasized that fruits and vegetables

are excellent sources of minerals and fibre; but are also unique sources of vitamins (C,E,B and folic acid).

The Flavonoids in Lesser Known Fruits

The flavonoid under discussion in this study is the flavones. The flavone is high in PIC with the mean/standard deviation of 5.4 ±0.19. It had 4.5±0.13 in LAO and 4.3±0.04 in ADA. It is low in ITO with a mean/standard devlation of 0.4 ±0.55.

The Carotenoids in Lesser Known Fruits

The carotenoids under study are the beta-carotene and the lycopene. The beta-carotene had the highest occurence in ANS with the mean/standard deviation of 7.4±0.11.It was 3.4±0.00 ADA and 0.1±0.02 in OLA. The HIM, NAI, PIC, LAO and CAS had the traces of beta-carotene. The lycopene occurred highly in CAS with a mean/standard deviation of 30.6±0.07. It is followed by ADA with a mean/standard deviation of 8.3±0.01. OLA is the next with the mean/standard deviation of 2.1±0.11. The HIM, NAI and COG occurred in traces The carotenoids and the flavonoids are all phytochemicals,in other words called the phytonutrients are all present in the lesser known fruits. It agreed with the findings of Osbourn, Qi, Townsend, and Qin (2003) that fruits and vegetables accumulate several thousands phytochemicals in response to a variety of stresses like insects and pathogens attack.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS.

The chapter summarized the following: Re-statement of problem, procedures used for the study, Findings, Implication of the study, and suggestion for further study.

Re-Statement of the Problem

Fruits and vegetables supply important parts of the vitamins and minerals required by the human body for proper functioning. According to Carrier,Ruxton, Elaine &Walker (2006) fruits and vegetables contain a range of vitamins minerals and trace elements which contain active components that can prevent chronic diseases which are likely to be soluble fibre and\or one or more antioxidant too.These fruits and vegetables are seasonal. Okudu (2008) emphasized that studies have shown that leafy vegetables are not available all year round due to seasonal variation. The few available ones are very expensive when they are out of season and are usually above the reach of the poor. This may expose some individuals to deficiency diseases. The observations of Okudu calls for urgent need to identify ways of making these important fruits and vegetables available all year round.This way is to make use of the wild or lesser known fruits and vegetables which are available when popular fruits and vegetables are scarce.

The observation of Altieri, Merick, Anderson in Flyman and Afolaya (2007) and Lupien (1998) emphasized that the tree and forest products can broaden the food base and diversy the diet,thus preventing nutrient deficiencies and ensuring dietary balance.

The antioxidant properties of the forest or lesser known fruits and vegetables are not known. to determine the antioxidant properties of these fruits and vegetables. There is therefore the need to determine the antioxidant properties and analyze the antioxidant properties of the locally consumed lesser known fruits and vegetables in South East of Nigeria.

Summary of the Procedure

The method of data collection used in this study was oral interview to collect information on research questions one and two. The atomic absorption spectrophotometer was used to analyse reseach questions three and four for antioxidant properties.A research assistant and the researcher administered the instrument to twenty women aged forty-five (45) years and above.The instrument contained twenty questions that were administered to the respondents. Ten (10) questions were administered on lesser known fruits and the other ten questions on lesser known vegetables.The questionnaire was used to collect information on research question 5. The questionnaire was administered to 25 postgraduate students of the Department of Vocational Teacher Education of the University of Nigeria, Nsukka. This group was chosen because of their level of education.

The data for research question one and two were analysed using percentages and the data for research question three, four and five were analysed using the Statistical Package for Social Sciences (SPSS).The mean standard deviation was sort for. The research question 5 made use of decision rule. The rule was that any weighted mean ranging from:

1 -2.49 =unagreeable

2.5 ï 3.49 = nutral

3.50 ï 5.00 = agreeable

Principal Findings

Apart from the popular fruits and vegetables, there are the lesser known vegetables.The lesser known fruits and vegetables includes the following

The Lesser Known Fruits

There were seventeen (17) lesser known fruits identified in the South Eastern states. They include the *Carcinia cola* (bitter cola pulp) ñaki iluò *Canarium schweinfurthii* ñUbe Okpokoò, *Dennettia tripetala* (mmimi), *Afromomium daniella*, (Ose ohia) *HIppocretae myrint* (nkpuruamunwebule), Terminala Catappa (furutu), *Olasivirdis* (aziza ohia, okpaa), *Dialium guineese* (nnuagu, icheku, okponkporo), *Napoleana imperialist* (Odure, nkpodu), *cola gigantea* **(**Oji-eyi), *Parkia clapptoniana* (nkpuru

ugba), *Landolphia oweriansis* (utu) *Nauclea diderrch*ii (Uvuru), Ficus elasticoides (utu nkilisi), Icacina trichatha oliv (ibiala, urubia), Piper cuineense (Uziza), *Spondias mombin* (nkpuru ijikara*),*

The Lesser known vegetables:

There were also twenty five (25) lesser known vegetables identified. They include the*Triplochiton scleroxylon sterculiaceae* (Okpo*), Daniella olivera (*Agba), *Ficus thonningin moraceae(*Ogbu*)*, *pterocarpus santaliniodes(*Uturukpa), *vitex doniana(*Uchakiri), *Myrianthus arboreus(*Ojijo, ujuju), *Berlinia grandflora(*Ububa), *moringa oleifera(*Okwe oyibo*)*, *Bambosah spp*.(Achara), *Blinghia unijugata sapindocea(Uso), ceiba* pentandra(Akpu), *Gongronema atifolium(Utazi), ficus sur(Aku-okoro), solanium spp.(*Anara*),* *Amarantus spinosus*(Inine ogwu*), corchorus olitorus(*Ahihara, eleghile*),Boerhavia diffuse(*Erimmiri) *colocasia esculenta.L., Adansonia digitata*(Baobab*), commelina nudiflora(*Obogwu*), corchorus capsularis(jute], ficus vogeliana(*Ogb*u aru), celosia argentica(*Eri emi onu*), piper cuineense(*Uziza*),*.

Determining the Antioxidant Properties of Lesser Known Vegetables

It was observed from the finding that all the ten antioxidant properties determined in the lesser known vegetables studied were all present.

1. Vitamin C
2. Vitamin A
3. vitamin E
4. Lycopene
5. Iron
6. Copper
7. Zinc
8. manganese
9. Selenium

10. Flavones

Determining Antioxidant Properties of Lesser Known Fruits

It was discovered from the findings that the underlisted antioxidant properties were available in the lesser known fruits studied.

1. Vitamin C
2. Vitamin A
3. vitamin E
4. Lycopene
5. Iron
6. Copper
7. Zinc
8. manganese
9. Selenium
10. Flavones

Strategies for enhancing the consumption of the lesser known fruits and vegetables

The study revealed various ways of enhancing the consumption of lesser known fruits and vegetables to include the following:

1. Convenience is important in consuming more fruits and vegetables.
2. Good health and well being were driving force for consumption of more fruits and vegetables.
3. Media campaign regarding the positive effect of fruits and vegetables.
4. Market infrastructure development like supermarket where lesser known fruits and vegetables will be bought will enhance their consumptions.
5. The growing of the out-of-home fruits and vegetables will enhance their consumption.
6. Promotional campaigns funded by government will enhance the consumption.
7. Lesser known fruits and vegetables should be part of the learning content in all levels of the schools system.

8. Childhood habit of eating fruits and vegetables should be encouraged.

9. Associate eating of fruits and vegetables to meals usually as dessert.

10. Availability of fruits and vegetables all the year round

11. Increase in the quantity and decrease in prices of lesser known fruits and vegetables will increase the consumption.

12. Increase in the growth of attractive lesser known fruits and vegetables will also increase consumption

Conclusion:

The objective of this study was to analyse the antioxidant properties available in some locally consumed fruits and vegetables in South Eastern states of Nigeria. Based on the results of the study the following conclutions were made:

That there are some lesser known vegetables such as *Triplochiton scleroxylon sterculiaceae*(Okpo*), Daniella olivera(*Agba), *Ficus thonningin moraceae(Ogbu)*, *pterocarpus santaliniodes(*Uturukpa), *vitex doniana(*Uchakiri*)*, *Myrianthus arboreus(*Ojijo, ujuju*)*, *Berlinia grandflora(*Ububa*)*, *moringa oleifera(*Okwe oyibo*)*, *Bambosah spp*.(Achara), *Blinghia unijugata sapindocea(Uso), ceiba* pentandra(Akpu), *Gongronema atifolium(Utazi), ficus sur(*Aku-okoro*), solanium spp*.(Anara), *Amarantus spinosus(*Inine ogwu*), corchorus olitorus(*Ahihara, eleghile*),Boerhavia diffuse(Erimmiri) colocasia esculenta.L., Adansonia digitata*(Baobab*), commelina nudiflora*(Obogwu), *corchorus capsularis*(jute], *ficus vogeliana*(Ogbu ike), *celosia argentica(*Eri emi onu), *piper cuineense(*Uziza)

There *are some lesser known fruits that include Carcinia cola* (bitter cola pulp) ñaki iluò *Canarium schweinfurthii* ñUbe Okpokoò, *Dennettia tripetala* (mmimi), *Afromomium daniella*, (Ose ohia) myrint (nkpuruamunwebule), Terminala Catappa (furutu), *Olasivirdis* (aziza ohia, okpaa), *Dialium guineese* (nnuagu, icheku, okponkporo), *Napoleana imperialist* (Odure, nkpodu), *cola gigantea* (Oji-eyi), *Parkia clapptoniana* (nkpuru ugba), *Landolphia oweriansis* (utu) *Nauclea diderrch*ii (Uvuru), Ficus elasticoides (utu nkilisi), Icacina trichatha oliv (ibiala, urubia), *Blinghia unijugata*

sapindocea (Uso), Piper cuineense (Uziza), *Spondias mombin* (nkpuru ijikara*), Irvingia gabonensis* (ugiri), *Irvingia smithii* (ogbono).

That there are antioxidant properties available in vegetables that include the lycopen, Vitamin C, Vitamin A, vitamin E, Lycopene, Iron,Copper, Zinc, Selenium Flavones.

That there are antioxidant properties available in vegetables that include the lycopen, Vitamin C, Vitamin A, vitamin E, Lycopene, Iron,Copper, Zinc, Selenium Flavones.

There are some strategies for enhancing the consumption of lesser known fruits and vegetables by families.

Implication of the Study

The findings of the study have implications for Home Econmics educators, Curriculum and programmes planners, Ministry of Agriculture, Ministry of Women Affairs, Families and the society at large.

The Home Economics educators will plan Home Economics programs to include lesser known fruits and vegetables in all levels of education.This will go a long way in educating Home economists on the usefulness of these fruits and vegetables.

The study has implications for the curriculum and programme planners in the states also perceived as the policy making body for the school and in deseigning the school curriculum should find a way of incorporating the lesser known fruits and vegetables into school curriculum that will help in sensitizing the youths on how to utilize the lesser known fruits and vegetables in their environment.

The Ministry of Agriculture should evolve programmes such as seminars, workshops, radio broadcasts and so on that will help to create awarness on the importance of lesser known fruits and vegetables.They should also evolve policy and strategies that would act as deterrent to the farmers and foresters that would fail to preserve and grow these fruits and vegetables.

The families as the bedrock that benefits most from the findings.The benefits accrue to the families because family meals are prepared in the home where the fruits and vegetables are consumed. They also suffer from the chronic dieases when they fail to

include the lesser known fruits and vegetables into the diet when the popular ones are not in season to enable them consume the right servings of fruits and vegetables per day.

Recommendations

Based on the result of these findings, the researcher made the following recommendations in other to utilize the lesser known fruits and vegrtables in the South Easth States of Nigeria.

1. In view of the importance of adequate nutrition in promoting good health, it is necessary to emphasize the use of the lesser known fruits and vegetables in Nutrition Education and in Home Economics as a whole.

2. Every individual and household should be encouraged to use the lesser known fruits and vegetables that are rich in antioxidant properties to reduce the degenerative diseases caused by free radicals.

3. Engagement and mobilization of health workers, nutritionists and Home Economists to enlighten the public on the use of these lesser known fruits and vegetables.Also,to sensitize school children in primary and secondary levels on the importance of these fruits and vegetables to health.

4. Agricultural Organisations should be encouraged by government and non-governmental (NGO) to propagate these lesser known fruits and vegetables on a large scale in order to facilitate the improvement of the present nutritional status of the country.

5. Every individual and household should be encouraged to cultivate and utilize these lesser known fruits and vegetables in their daily menu or diet in order to facilitate good health as well as forestall occurrence of deficiency diseases.

6. The baseline information will be used to encourage the usage in both season and off ï season to achieve food security and diversification of diets.

Suggestions for Further Research.

1**.** Based on the results, more lesser known leafy vegetables in the state and outside the states of study need to be investigated to diversify their food use to increase food security.

2. The comparative study of the nutritive value of the popular fruits and vegetables should be studied to help in the acceptance of the lesser known fruits and vegetables.

3. The antinutrient values of the popular fruits and vegetables and the lesser known fruits and vegetables should be studied to increase awareness.

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APPENDIX I

An oral interview Guide

The researcher is carrying out a study on the analysis of the antioxidant Properties available in some less known fruits and vegetables locally consumed in Eastern States of Nigeria. Please do respond to the questions truthfully as the answers will help to increase the number of fruits and vegetables consumed in these states. This also will also help to solve the nutritional problems of these states. This oral interview will be administered to the aged women (45 years and above) in these states.

SEX: Male **Female**

For Section I

(1) Do you know of any vegetable that your parents used to feed you when you were a child?
(2) When you started your own family do you still eat them?
(3) If No, Why?
(4) If yes, do all your family members accept them?
(5) What are these vegetables?
(6) Where are they gotten from?
(7) Are they still growing in the forest?
(8) What type of dish do you use them in preparing?
(9) How do they taste?
(10) Can you get them for me?

For Section II

(11) Do you still remember some fruits that you used to take when you were a child?
(12) What are those fruits called?
(13) Where are they gotten from?
(14) Are they still available in the forest?
(15) Do you still remember their taste?
(16) Are you still taking them?
(17) If No, Why?
(18) If yes, do all your children still take them?
(19) Are they sold in the market?
(20) If No, can you get them?

APPENDIX 11

SECTION A

Personal Data

INSTRUCTION: Please tick (ã) in the appropriate bracket.

State: Enugu ☐

Imo ☐

Sex: Male ☐

Female ☐

Occupation: Farming ☐

Forestry ☐

Teaching ☐

Others ☐

SECTION B

Please tick (ã) the following that can be used to enhance the consumption of the lesser known fruits and vegetables by families.

Note: SA = Strongly agreed 5points

A = Agreed 4 points

U = Undecided 3 points

D = Disagreed 2 points

SD = Strongly disagreed 1 point

Research Question 5.What are the strategies that can enhance the consumption of the lesser known fruits and vegetables by families?

Strategies for enhancing the consumption of lesser known fruits and vegetables.

S/N		SA	A	U	D	SD

1	Media campaign regarding to positive effect of lesser known fruits and Vegetables.					
2	Promotional campaigns should be funded by the government. .					
3	Market infrastructure development to showcase lesser known fruits and vegetables.					
4	Associate eating of fruits and vegetable to meals usually as dessert.					
5	Growing out-of-the home lesser known fruits and vegetables should be encouraged and increased.					
6	Fast development of real incomes of households.					
7	Decrease in prices of lesser known fruits and vegetables increase consumption.					
8	Availability of fruits and vegetables all year round.					
9	Lesser known fruits and vegetables to be part of the learning content in schools.					
10	Good health and well-being is a driving force for fruits and vegetables consumption.					
11	Childhood habit of eating fruits and vegetables should be encouraged.					
12	Increase in the growth of attractive lesser known fruits and vegetables.					
13	Convenience appears to be important in consuming more fruits and vegetables.					
14	Promotional campaigns funded by producers.					

APPENDIX III

Department of
Vocational
Teacher Education
(V.T.E.),
University of Nigeria,
Nsukka.
20th February, 2010.

Dear Respondent,

QUESTIONAIRE ON ANTIOXIDANT PROPERTIES OF SOME LESSER KNOWN LOCALLY CONSUMED FRUITS ANDVEGETABLES BY FAMILIES IN SOUTH EASTERN STATES OF NIGERIA

I am a post graduate student of the University of Nigeria, Nsukka, and currently conducting research on the topic shown above. The attached questionnaire is designed to collect information necessary for accomplishing the research.

Your cooperation in this regard is very much solicited in order to make this research work successful. Please respond to the items honestly and independently as possible, all information will be regarded and treated as confidential. You do not need to put down your name any where in the document.

Thank you for your anticipated cooperation.

Yours Faithfully

Iheji Charity Uzoamaka

APPENDIX IV

Lesser known Vegetables

Igbo Name	English Name	Scientific name
Aku-okoro		Ficus sur
Okpo		*Triplochiton scleroxylon sterculiaceae*
Agba		*Daniella olivera*
Ogbu	Fig tree	*Ficus thonningin moraceae*
Uturukpa		*Pterocarpus santalinoides*
Uchakiri		*Vitex doniana*
Ojijo, ujuju		*Myrianthus arboreus*
Ububa		*Berlinia grandflora*
Okwe oyibo		*Moringa oleifera*
Achara		*Bambosah spp.*
Uso	Akee, Ackee	*Blinghia unijugata sapindaceae*
Akpu ogwu		*Ceiba pentandra*
Utazi		*Gongronema atifolium*
Anara	Egg plant leaves	*Solanium spp*
Inine ogwu		*Amarnatus spinosus Amarantus*
Ahihara, eleghile	Jute	*Corchorus olitorus*
Ero	Mushroom	
Erimmiri		*Boerhavia diffuse*
	Baobab	*Adensonia digitata*
Obogwu		*Commelina nudiflora*
Krem krem	Jute	*Corchorus capsularis*
Azuma mmuo, Nsigbu mmuo	Stinking peg	*Cassia occidentalis*

Ogbu ike		*Ficus vogeliana*
Eri emi onu	Shokoyokoto	*Celosia argentica*
Akwukwo ede	Cocoa yam leaf and flower	*Colocasia esculenta.L.*

APPENDIX V

The Lesser Known Fruits

Igbo Name	**Common/English**	**Scientific Name**
Ose ohia		*Afromomium daniella*
Nkpuruamunwebule		*Hippocretae myrint*
Aziza ohia,okpaa		*Olasivirdis*
Oji eyi		*Cola gigantea*
Nkpuru ugba	West African locust bean	*Parkia clappatoniana*
Utu	Monkey fruit	*Landolphia oweriansis*
Uvuru		*Nauclea diderrichii*
Utu nkilisi		*Ficus elasticoides*
Ibiala, Urubia, Ututuogiri		*Icacina trichatha oliv*
Uso	Akee or fruit	*Blinghia unijugata sappindocea*
Uziza		*Piper cuineense*
Nkpuru ijikara	Hog plum	*Spondias mombin*
Ugir*i*	Bush mango	*Irvingia gabonensis*
Ogbono		*Irvingia wombolu*
Ugoro, aki ilu, igogoro	Bitter cola pulp	*Garcinia cola*
Ube okpoko	Incense tree	*Canarium schweinfurthii*
Mmimi	Pepper fruit	*Dennetia tripetala.*

APPENDIX VI

Fruits

Plate I

Nauclea diderrichii (Uvuru)

Cola gigantea (Oji-Eyi)

Icacina trichatha Oliv (Urubia)

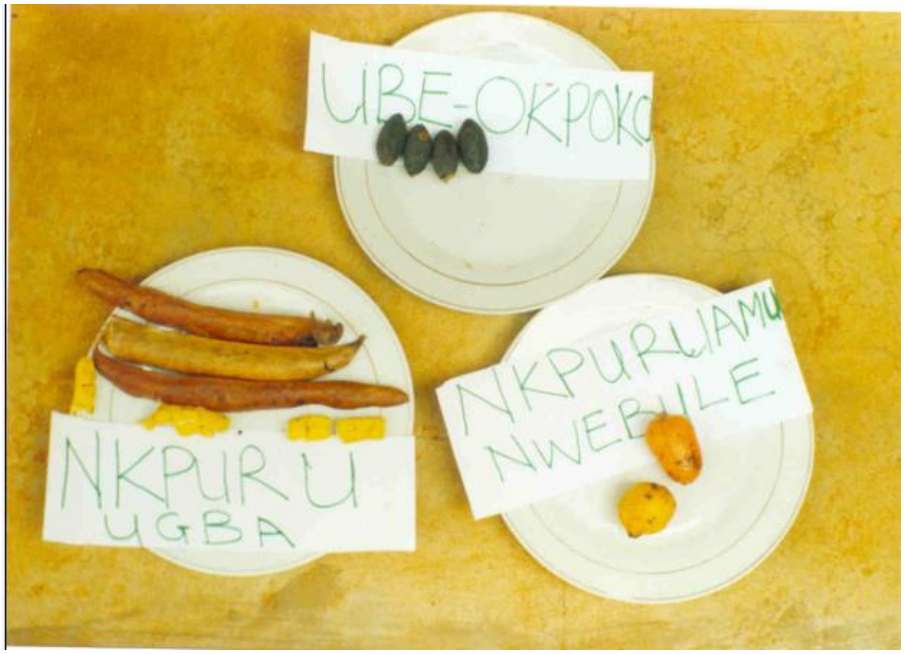

Plate II

Parkia clappatoniana (Nkpuru ugba)

Hippocretae myrint (Nkpuruamunwebule)

Canarium schweinfurthii (Ube Okpoko)

Plate III

Olasivirdis (Aziza Ohia, Okpa)

Afromomium daniella (Ose Ohia)

Napoleana imepralist (Odure, Nkpodu)

Plate IV

Ficus elasticoides (utu nkilisi)

Landolphia oweriansis (utu)

(Utu kperekpete)

Plate V

Dialium guineense (okponkporo, Icheku, Nnuagu)

Averrhoea carambola (Udara)

(Ikpakpa mbe)

APPENDIX VII

VEGETABLES

Plate I

Blinghia unijugata (Uso)

Vitex doniana (Uchakiri)

Myrianthus arboreus (Ujuju, Ojijo)

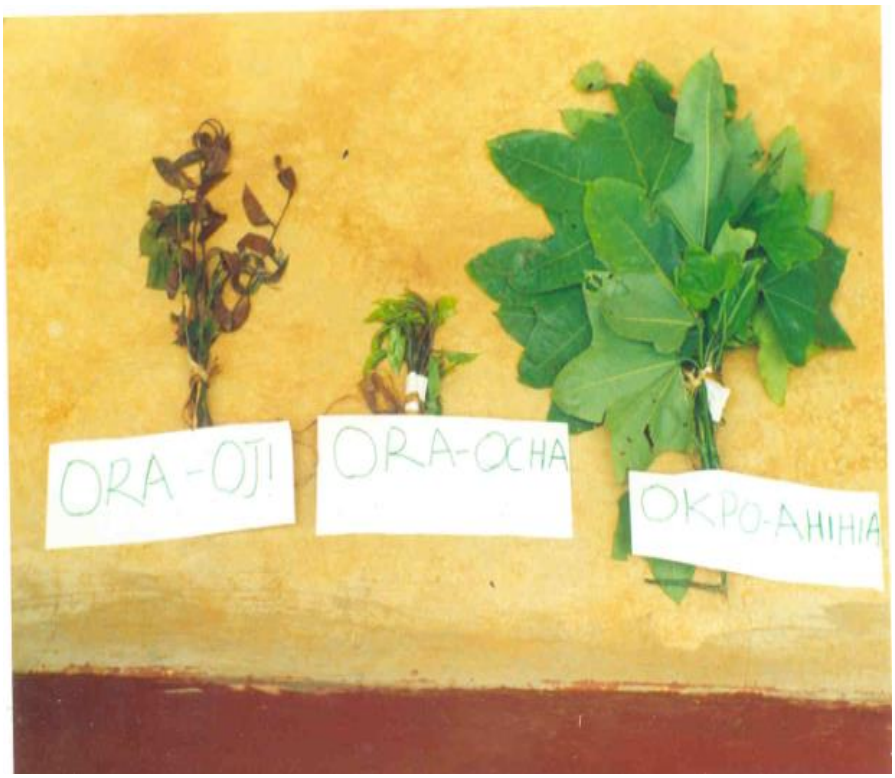

Plate II

Triplochiton scleroxylon sterculiaceae (Okpo)

Pterocarpus mildbreadii (Ora Ocha)

Pterocarpus mildbreadii (Ora Oji)

Plate III

Pterocarpus santalinoides (Uturukpa)

Ficus sur (Aku-Okoro)

Ficus thonningin moraceae (Ogbu)

Plate IV

Daniella olivera (Agba)

Ficus vogeliana (Ogbu Ike)

(Ede**)**

Plate V

Ceiba pentandra (Akpu)

Ogbashi

Gongronema atifolium (Utazi)