

**COMPARATIVE STUDY OF NUTRITIONAL VALUE AND
ACCEPTABILITY OF ‘OGBONO’“*IRVINGIA GABONESIS*” AND
‘OKOHO’ “*CISSUS POPULNEA*” SOUPS AMONG FAMILIES IN
KADUNA STATE**

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**A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL OF AHMADU
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MASTER DEGREE IN EDUCATION (M.Ed. HOME ECONOMICS)**

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ZARIA**

MARCH 2019

DECLARATION

I hereby declare that this thesis titled “Comparative Study of the Nutritional Value and Acceptability of “Ogbono” “*irvingia gabonensis*”and “Okoho” “*cissuspulpunea*” Soups among Families in Kaduna State Nigeria” was written by me. The information derived from the literature has been cited in the text and duly acknowledged by means of references. There is no part of this work that has been previously presented for ward of any degree at any institution.

Christiana Oyigowo ADAJI
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Signature

Date

CERTIFICATION

This thesis titled “COMPARATIVE STUDY OF THE NUTRITIONAL VALUE AND ACCEPTABILITY OF “OGBOHO”“*IRVINGIA GABONESIS*”AND “OKOHO”“*CISSUS PULPUNEA*”SOUPS AMONG FAMILIES IN KADUNA STATE NIGERIA” by Christiana Oyigowo ADAJI met the regulations governing the award of the degree of masters of education in Home Economics of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to God Almighty for protection and provisions of finances for making this study a success.

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ABSTRACT

The research work was on comparative study of the nutritional value and acceptability of 'Ogbono' "*Irvingia gabonensis*" and 'Okoho' "*Cissus populnea*" soups among families in Kaduna State, Nigeria. The study was guided by four specific objectives, four research questions and four null hypotheses. The researcher adopted experimental design. The population of the study was all families in Kaduna state. Nineteen (19) panelists were used as sample for the study. Okoho sample were collected from the southern part of Kaduna state while the Ogbono sample was brought from Opanda village in Apa Local Government Area of Benue state. Proximate analysis was used to obtain the nutritional compositions of Okoho and Ogbono while structured scorecard was used to obtain data on physical properties and acceptability of the food product under study (.adopted from Linn Svenson). Frequency and percentages were used to describe the bio-data of the respondents. Mean scores and standard deviation were used to answer all research questions and ANOVA statistic was used to test all the four null hypotheses at significant level of 0.05. Based on the findings the results revealed that Ogbono, dried Okoho and fresh Okoho contained varying percentages of moisture, ash, protein, lipids, fibre, carbohydrates and minerals but the variation is not significant ($F=0.001$, $P=0.999$). Ogbono, dried Okoho and fresh Okoho soups varied in the proximate composition but the proximate variation of the soups is not significant ($F=12.00$, $P=0.967$). Ogbono, dried Okoho and fresh Okoho soups are different in physical properties and the difference that exists in the physical properties is significant ($F=121.625$, $P=0.000$). There exists difference in the general acceptability of Ogbono, dried Okoho and fresh Okoho soups. Dried Okoho soup is more acceptable than fresh Okoho and Ogbono soups among family members in Kaduna state ($F=23.820$, $P=0.000$). This study concluded that the nutritional compositions of Okoho and Ogbono are not significantly different and fresh Okoho soup is more acceptable among families in Kaduna. It was recommended that there should be awareness campaign on the nutritional contents and benefits of fresh Okoho and Ogbono as supplements that can cater for the nutritional deficiency of individuals.

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OPERATIONAL DEFINITION OF TERMS

Okoho “*cissus populnea*”: A woody climber whose mucilage is used as soup thickener

Ogbono “*irivinga gabonesis*”: The seed of the African wild mango used to prepare soup

Dika Nut/Bush Mango: other names for Ogbono

Okpehe: The traditional spice used by the Idomas in soup making

Uziza Seed: A spice, which is used in making soups.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Nutrition is nourishment or energy that is obtained from food consumed or the process of consuming the proper amount of nourishment and energy. In a broader sense, nutrition is defined as the combination of process by which the living organism receives and utilizes the materials necessary for the maintenance, functions for growth and renewal of its components (Begum 2007). Good nutrition is a basic human right in order to have a healthy population that can promote development (Kuhnlein 2002).

In developing countries, one of the ways of achieving this is through the exploitation of available local foods ingredient in the formation of nutritional adequate diet, which incorporate within essential food groups. Food and Nutrition is a major area of Home Economics, which comprises of the principles of nutrition-meal management. There have been many calls for nutrition education for acquisition of knowledge, skills and competencies, which family members require to prevent obesity and overweight and satisfactorily improve family living. (Adebisi, Babayeju & Gbadebo 2016).

Soups are the main sources of proteins and minerals in our diet. One of the ways to improve the diet is to enrich the nutrient content of soups. The traditional soup meals of most societies are good and only minor modifications are needed for them to meet the nutrient requirements of all members of family. Ogbono and Okoho are a rich vegetable draw soups that are native to the people of North-central Nigeria.

Cissus populnea is a woody climber whose mucilage is currently used in the home as thickening agent in soup especially among the Idomas of North Central Nigeria where it goes by the name Okoho. It is also used as a form of stabilizer in 'Akara' balls. The plant belongs to the family of *Vitaceal/Amplidacea* and the genus *Cissus* that comprises of about

350 species (Brotherton, 1969). The plant occurs in Northern and Southern Nigeria. It grows in diverse Eco zones of Nigeria, Uganda, Niger Republic, Cameroon and Ivory Coast. Studies from herbarium collections indicate that it is confined to the savanna zones of the country (Nigeria) and thus is more abundant in the northern region where it is used by the Fulani to feed their cattle ostensibly to increase milk production as reported by Brotherton, (1969) in the West Africa, it is mostly used in medical preparation

Cissus populnea is among the tropical plants used to correct male infertility factor in south-western part of Nigeria. Extracts from the roots of the plant have been used for the treatment of skin diseases, boils, infected wounds and treatment of urinary tracts infection. The vernacular names include; ‘Okoho’ by the Idomas and Igala, ‘Obolo Ajala’ by the Yoruba’s and ‘Dafaaraa by the Hausas Burkill, (2000).

Irvingia gabonensis (sweet bush mango also known as Dika nut) is common in the southwestern part of Nigeria. It is a drupe with a thin epicarp, a soft and fleshy mesocarp and hard endocarp encasing a soft dicotyledonous kernel. Sweet bush mango in all its parts serves as food for humans with the exception of its endocarp. The mesocarp and epicarp can be eaten fresh, while the cotyledon encased in the endocarp serves as an ingredient for soup. In recent times, there have been claims verified by clinical trials that the seed extract of *Irvingia gabonensis* commonly known as “African Bush Mango” is an effective weight reducing herbal medication with no side effects (Ngondi *et al.*, 2005). Both *Cissus populnea* and *Irvingia gabonensis* are used as soup thickeners and medicine by many tribes in Kaduna state.

Kaduna state is one of the six North-west states in Nigeria. Kaduna was created on May 27th, 1967 but the prominence of the state dates back to the colonial periods when the state was made the Northern capital states. Being a central state, all the other Northern states are accessible from Kaduna. There are over about 60 tribes in Kaduna.

Popular soups taken in Kaduna include Maiyan Kuku, Yakuwa, Okra Taushe, Zogile, groundnut soup amongst others. Apart from the indigenous settlers in the state, many people from different tribes in other parts of Nigeria such as Yoruba, Igbo, Tiv, Idoma, and others also settle in Kaduna.

Despite having a variety of soups to choose from for consumption, some healthy and beneficial plants that can be used for soup are either not popular or not accessible. The focus of this work is to compare the nutritional value of *Cissus populnea* (Okoho) and *Iruingia gabonesis* (Ogbono) and its acceptability among families in Kaduna State.

1.2 Statement of the Problem

Home Economics is the study that tries to improve goods and services which families use, especially in terms of food it also concerns itself with the economy of the home. With the present state of the country's recession, people tend to look for alternative to almost everything especially in terms of food. In the same vain people tend to value food they have idea on its nutritional value and the desire for such increase when they know the health benefits. People can also shift value when they are given proper information and counsel on the nutritional values of food they eat. Ogbono and Okoho are soups eaten by people in different parts of the nation. Presently, a cup of ogbono goes for five hundred naira (₦500) which will serve as soup for just once or twice in some homes while a short stem of okoho cost one hundred naira (₦100) which will serve as soup for once or twice in some homes. Both plants are used as soups in different parts of the country and are also associated with medicinal uses ,the researcher feels that when the nutritional value is known, it will help to make it more acceptable and can also be used as a substitute for ogbono because it is cheaper and will be more economical with the present recession.

Every day we read and hear of the importance of different kinds of foods either for their medicinal or nutritional content. The researcher observed that though both plants are used in soup, *Irvingia gabonensis* (Ogbono) has high popularity even though its price keeps rising every day; while *Cissus populinea* (Okoho) even though cheap has not gained much popularity.

The gross increase in health problem of nutrition such as obesity or malnourishment will help prompt families in the types and quality of consumption of these soups and it might aid the combination of the soups.

The researcher intends to compare the nutritional composition of both plants [okoho and ogbono] and their acceptability as soups

1.3 Objectives of Study

The General objective of the study is to compare the nutritional value and acceptability of Ogbono and Okoho Soup among families in Kaduna state.

Specific objectives are:

- i. To evaluate the proximate composition of *Cissus populnea* (Okoho) and *Irvingia gabonensis* (Ogbono).
- ii. To compare the proximate composition of Okoho and Ogbono soups
- iii. To compare the physical properties of Okoho and Ogbono soups
- iv. To compare the acceptability of Okoho and Ogbono soups among families in Kaduna State.

1.4 Research Questions

The following research questions were answered:

- i. What is the proximate composition of *Cissus populnea* (Okoho) and *Irvingia gabonensis* (Ogbono)?
- ii. What is the difference in proximate composition of Okoho and Ogbono soups?

- iii. What is the difference in the physical properties of Okoho and Ogbono soups?
- iv. What is the difference in the general acceptability of Okoho and Ogbono soups among families in Kaduna State?

1.5 Hypotheses

Consequent upon the above research questions the following hypotheses were formulated for the study.

H₀1: There is no significant difference in the proximate composition of *Cissus populnea* (Okoho) and *Irvingia gabonensis* (Ogbono).

H₀2: There is no significant difference in the proximate composition of Okoho and Ogbono soups.

H₀3: There is no significant difference in the physical properties of Okoho and Ogbono soups.

H₀4: There is no significant difference in the general acceptability of Okoho and Ogbono soups among families in Kaduna State.

1.6 Significance of the Study

Every day we read and hear of the importance of different kinds of foods either for their medicinal or nutritional content. The researcher observed that though both plants are used in soup, *Irvingia gabonensis* (Ogbono) has high popularity even though its price keeps rising every day; while *Cissus populnea* (Okoho) even though cheap has not gained much popularity.

The study therefore, will be a point of reference to

Individuals/Families: With respect to individuals this study will be an eye-opener to individuals on one's choice of food or soup based on the insight from the result of the study. This choice can be fashion by the various desire of the individual. The result from the findings in comparative nutrient content analysis of both *Cissus*

populnea and *Irvingia gabonensis* will help families to determine the right type of nutrients they need and should take.

Agriculturalist: In the field of agriculture, the findings from this study can help to increase concentration in the cultivation of the both plants. *Cissus populnea* and *Irvingia gabonensis* are not mostly planted rather they usually grow in the wild before claimed, this study can encourage the personal intentional planting and cultivation of these plants. The result from the study will also help in encouraging the propagation of *Cissus populnea* as cash crop.

Marketers: Though the business activity of *Irvingia gabonensis* is already highly propagated, the result from this study can also lead to market focus on *Cissus populnea* where it could be marketed nationally or even globally as a cash crop for soups and industrial use.

Medical World: From the chemical analysis result that will be gotten from the research on the plants, concentration of medical world on research and utilization of the both plants to tackle medical issues will increase. Phytochemistry revealed the presence of tannins, flavonoids, saponins, and steroids (Anthony *et al.*, 2006), which are important pharmaceutical target for drug development.

Home Economist: The research will be of benefit to the Home Economist and future researchers to develop more recipes for the preparation of okoho and ogbono soups. This category of people will have access to the findings of this study through departmental library and seminars.

Curriculum Planners: The research will be of benefit to the curriculum planners, to include cultivation of okoho and ogbono plants as part of economy tree production in the curriculum.

1.7 Basic Assumption

It is assumed that *Cissus populnea* (Okoho) has little or no nutritional value

It is assumed that *Irvingia gabonensis* (Ogbono) have more nutritional value

It is also assumed that *Irvingia gabonensis* Ogbono is more acceptable and given preference over *Cissus populnea* (Okoho).

1.8 Delimitation of the Study

This study is delimited to Ogbono as well as dried and fresh Okoho product and soups. This is because both Ogbono and Okoho are good soup materials but many people do not know their proximate compositions and physical properties. The study is confined to two high institutions of higher learning in Zaria, Kaduna state (Ahmadu Bello University and Federal College of Education Zaria). This is because families from different local government areas of the state are well represented and they will be in better position to give accurate information on the acceptability of *Cissus populnea* and *Irvingia gabonensis*.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

In this chapter, the researcher reviewed related literature relevant to the topic. This was discussed under the following sub headings.

2.1 Conceptual Framework

2.1.1 Concept of Nutritional Value

2.2 Historical Background and Varieties of Okoho

2.3 Health Benefits of Okoho

2.4 Historical Background and Varieties of Ogbono

2.5 Health Benefits of Ogbono

2.6 Sensory Evaluation

2.7 Review of Related Empirical Studies

2.8 Summary Reviewed Related Literatures

2.1 Conceptual Framework

2.1.1 Concept of Nutritional Value

The nutritional value of food defines what a food is made of and its' impact on the body. Because of disease and weight control, it is particularly important to understand the nutritional value of food due to the impact on the body as it relates to cholesterol, fat, salt, and sugar intake. The food label is the primary tool enabling consumers to understand nutritional values in order to make informed decisions about consumption.

The construction of a nutritious meal requires leaning about which food are healthy and which food are not, how foods and nutrition function in your body. This research intends to provide you with information necessary to make sound nutritional choices that will uptime health and help prevent diseases

i. Nutrients

The foods we eat contain nutrients. Nutrients are substances required by the body to perform its basic functions. Nutrients must be obtained from diet since the human body does not synthesize them. Nutrients are used to provide energy, defend and respond to the environmental surroundings, move, excrete wastes, respire (breathe), grow and reproduce. There are six classes of nutrients required by the body to function and maintain overall health. These are Carbohydrate, Fat, Protein, Water, Vitamins and Minerals.

The list of nutrients that people are known to require is, in the words of Marion Nestle, "almost certainly incomplete" (Nestle, 2013). As of 2014, nutrients are thought to be of two types: macro-nutrients that are needed in relatively large amounts, and micronutrients, which are needed in smaller quantities (Fuhrman, 2014). A type of carbohydrate, dietary fiber, i.e. non-digestible material such as cellulose, is required, for both mechanical and biochemical reasons, although the exact reasons remain unclear. Other micronutrients include antioxidants and phytochemicals, which are said to influence (or protect) some body systems. Their necessity is not as well established as in the case of, for instance, vitamins.

ii. Macronutrients

The macronutrients are carbohydrates, fiber, fats, protein, and water (Fuhrman, 2014). The macronutrients (excluding fiber and water) provide structural material (amino acids from which proteins are built, and lipids from which cell membranes and some signaling molecules are built) and energy. Some of the structural material can be used to generate energy internally, and in either case, it is measured in Joules or kilocalories (often called "Calories" and written with a capital C to distinguish them from little 'c' calories). Carbohydrates and proteins provide 17

kJ approximately (4 kcal) of energy per gram, while fats provide 37 kJ (nine kcal) per gram (Berg *et al.*, 2002), though the net energy from either depends on such factors as absorption and digestive effort, which vary substantially from instance to instance. Vitamins, minerals, fiber, and water do not provide energy, but are required for other reasons.

Molecules of carbohydrates and fats consist of carbon, hydrogen, and oxygen atoms. Carbohydrates range from simple monosaccharides (glucose, fructose, and galactose) to complex polysaccharides (starch). Fats are triglycerides, made of assorted fatty acid monomers bound to a glycerol backbone. Some fatty acids, but not all, are essential in the diet: they cannot be synthesized in the body. Protein molecules contain nitrogen atoms in addition to carbon, oxygen, and hydrogen. The fundamental components of protein are nitrogen-containing amino acids, some of which are essential in the sense that humans cannot make them internally. Some of the amino acids are convertible (with the expenditure of energy) to glucose and can be used for energy production, just as ordinary glucose, in a process known as gluconeogenesis. By breaking down existing protein, the carbon skeleton of the various amino acids can be metabolized to intermediates in cellular respiration; the remaining ammonia is discarded primarily as urea in urine. This occurs normally only during prolonged starvation.

a, Carbohydrates

Carbohydrates may be classified as monosaccharides, disaccharides, or polysaccharides depending on the number of monomer (sugar) units they contain. They constitute a large part of foods such as rice, noodles, bread, and other grain-based products. Monosaccharides, disaccharides, and polysaccharides contain one, two, and three or more sugar units,

respectively. Polysaccharides are often referred to as complex carbohydrates because they are typically long, multiple branched chains of sugar units.

Traditionally, simple carbohydrates are believed to be absorbed quickly and therefore to raise blood-glucose levels more rapidly than complex carbohydrates. This, however, is not accurate (Otto, (1973), Crapo *et al.*, (1977) and Crapo *et al.*, (1980). Some simple carbohydrates (e.g., fructose) follow different metabolic pathways (e.g., fructolysis) that result in only a partial catabolism to glucose, while, in essence, many complex carbohydrates may be digested at the same rate as simple carbohydrates (Jenkins *et al.*, 1986). Glucose stimulates the production of insulin through food entering the bloodstream, which is grasped by the beta cells in the pancreas.

b, Fiber

Dietary fiber is a carbohydrate that is incompletely absorbed in humans and in some animals. Like all carbohydrates, when it is metabolized it can produce four Calories (kilocalories) of energy per gram. However, in most circumstances it accounts for less than that because of its limited absorption and digestibility. Dietary fiber consists mainly of cellulose, a large carbohydrate polymer that is indigestible, as humans do not have the required enzymes to disassemble it. There are two subcategories: soluble and insoluble fiber. Whole grains, fruits (especially plums, prunes, and figs), and vegetables are good sources of dietary fiber. There are many health benefits of a high-fiber diet.

Dietary fiber helps reduce the chance of gastrointestinal problems such as constipation and diarrhea by increasing the weight and size of stool

and softening it. Insoluble fiber, found in whole-wheat flour, nuts and vegetables, especially stimulates peristalsis – the rhythmic muscular contractions of the intestines, which move digesta along the digestive tract. Soluble fiber, found in oats, peas, beans, and many fruits, dissolves in water in the intestinal tract to produce a gel that slows the movement of food through the intestines. This may help lower blood glucose levels because it can slow the absorption of sugar. Additionally, fiber, perhaps especially that from whole grains, is thought to possibly help lessen insulin spikes, and therefore reduce the risk of type 2 diabetes. The link between increased fiber consumption and a decreased risk of colorectal cancer is still uncertain.

c, Fat

A molecule of dietary fat typically consists of several fatty acids (containing long chains of carbon and hydrogen atoms), bonded to a glycerol. They are typically found as triglycerides (three fatty acids attached to one glycerol backbone). According to Fuhrman (2014), Fats may be classified as saturated or unsaturated depending on the detailed structure of the fatty acids involved. Saturated fats have all of the carbon atoms in their fatty acid chains bonded to hydrogen atoms, whereas unsaturated fats have some of these carbon atoms double-bonded, so their molecules have relatively fewer hydrogen atoms than a saturated fatty acid of the same length. Unsaturated fats may be further classified as monounsaturated (one double bond) or polyunsaturated (many double bonds) (Fuhrman 2014).

Furthermore, depending on the location of the double bond in the fatty acid chain, unsaturated fatty acids are classified as omega-3 or omega-6 fatty acids. Trans fats are a type of unsaturated fat with trans-isomer bonds;

these are rare in nature and in foods from natural sources; they are typically created in an industrial process called (partial) hydrogenation. There are nine kilocalories in each gram of fat. Fatty acids such as conjugated linoleic acid, catalpic acid, eleostearic acid and punicic acid, in addition to providing energy, represent potent immune modulatory molecules.

Saturated fats (typically from animal sources) have been a staple in many world cultures for millennia. Unsaturated fats (e.g., vegetable oil) are considered healthier, while trans fats are to be avoided. Saturated and some trans fats are typically solid at room temperature (such as butter or lard), while unsaturated fats are typically liquids (such as olive oil or flaxseed oil). Trans fats are very rare in nature, and have been shown to be highly detrimental to human health, but have properties useful in the food processing industry, such as rancidity resistance.

d, Protein

Nestle (2013) refers to Proteins as structural materials in much of the animal body (e.g. muscles, skin, and hair). They also form the enzymes that control chemical reactions throughout the body. Each protein molecule is composed of amino acids, which are characterized by inclusion of nitrogen and sometimes sulphur (these components are responsible for the distinctive smell of burning protein, such as the keratin in hair). They assert that the body requires amino acids to produce new proteins (protein retention) and to replace damaged proteins (maintenance) (Nestle 2013). As there is no protein or amino acid storage provision, amino acids must be present in the diet.

Excess amino acids are discarded, typically in the urine. For all animals, some amino acids are essential (an animal cannot produce them internally) and some are non-essential (the animal can produce them from other nitrogen-containing compounds). About twenty amino acids are found in the human body, and about ten of these are essential and, therefore, must be included in the diet. A diet that contains adequate amounts of amino acids (especially those that are essential) is particularly important in some situations: during early development and maturation, pregnancy, lactation, or injury (a burn, for instance). A complete protein source contains all the essential amino acids; an incomplete protein source lacks one or more of the essential amino acids (Nutrition & Allergies (NDA) (2010).

It is possible with protein combinations of two incomplete protein sources (e.g., rice and beans) to make a complete protein source and characteristic combinations are the basis of distinct cultural cooking traditions. However, complementary sources of protein do not need to be eaten at the same meal to be used together by the body (American Dietetic Association; Dietitians Of, Canada, 2003). Excess amino acids from protein can be converted into glucose and used for fuel through a process called gluconeogenesis. The amino acids remaining after such conversion are discarded.

Most foods contain a mix of some or all of the nutrient types, together with other substances, such as toxins of various sorts. Some nutrients can be stored internally (e.g., the fat-soluble vitamins), while others are required more or less continuously. Poor health can be caused by a lack of required nutrients or, in extreme cases, too much of a required nutrient.

For example, both salt and water (both absolutely required) will cause illness or even death in excessive amounts.

e, Water

Water is excreted from the body in multiple forms; including urine and feces, sweating, and by water vapour in the exhaled breath. Therefore, it is necessary to adequately rehydrate to replace lost fluids. Early recommendations for the quantity of water required for maintenance of good health suggested that 6–8 glasses of water daily is the minimum to maintain proper hydration.

However, the notion that a person should consume eight glasses of water per day cannot be traced to a credible scientific source. The original water intake recommendation in 1945 by the Food and Nutrition Board of the National Research Council read: "An ordinary standard for diverse persons is 1 milliliter for each calorie of food. Most of this quantity is contained in prepared foods." More recent comparisons of well-known recommendations on fluid intake have revealed large discrepancies in the volumes of water we need to consume for good health Le (Bellego et al., 2010). Therefore, to help standardize guidelines, recommendations for water consumption are included in two recent European Food Safety Authority (EFSA) documents (2010):

- i. Food-based dietary guidelines and
- ii. Dietary reference values for water or adequate daily intakes (ADI) (NDA, 2010).

These specifications were provided by calculating adequate intakes from measured intakes in populations of individuals with “desirable osmolality values of urine and desirable water volumes per energy unit consumed” (NDA, 2010). For healthful hydration, the current EFSA guidelines recommend total water intakes of 2.0 L/day for adult females and 2.5 L/day for adult males. These reference values include water from drinking water, other beverages, and from food. About 80% of our daily water requirement comes from the beverages we drink, with the remaining 20% coming from food (Armstrong *et al.*, 2005).

Water content varies depending on the type of food consumed, with fruit and vegetables containing more than cereals, for example (FAO, 2010). These values are estimated using country-specific food balance sheets published by the Food and Agriculture Organisation of the United Nations (FAO, 2010). Other guidelines for nutrition also have implications for the beverages we consume for healthy hydration- for example, the World Health Organization (WHO) recommend that added sugars should represent no more than 10% of total energy intake (WHO, 2003).

The EFSA panel also determined intakes for different populations. Recommended intake volumes in the elderly are the same as for adults as despite lower energy consumption, the water requirement of this group is increased due to a reduction in renal concentrating capacity (NDA, 2010). Pregnant and breastfeeding women require additional fluids to stay hydrated. The EFSA panel proposes that pregnant women should consume the same volume of water as non-pregnant women, plus an increase in proportion to the higher energy requirement, equal to 300 mL/day (NDA, 2010). To

compensate for additional fluid output, breastfeeding women require an additional 700 mL/day above the recommended intake values for non-lactating women (NDA, 2010).

iii, Micronutrients

The micronutrients are minerals and vitamins (Fuhrman, 2014).

a, Minerals

Dietary minerals are inorganic chemical elements required by living organisms (Mitchell and Haroun, 2012). Other than the four elements carbon, hydrogen, nitrogen, and oxygen that are present in nearly all organic molecules. The term "mineral" is archaic, since the intent is to describe simply the less common elements in the diet. Some are heavier than the four just mentioned, including several metals, which often occur as ions in the body. Some dietitians recommend that these be supplied from foods in which they occur naturally or at least as complex compounds, or sometimes even from natural inorganic sources (such as calcium carbonate from ground oyster shells). Some minerals are absorbed much more readily in the ionic forms found in such sources. On the other hand, minerals are often artificially added to the diet as supplements; the most famous is likely iodine in iodized salt, which prevents goiter.

1. Macro minerals

Many elements are essential in relative quantity; they are usually called "bulk minerals". Some are structural, but many play a role as electrolytes (Nelson and Cox, 2000). Elements with recommended dietary allowance (RDA) greater than 150 mg/day are, in alphabetical order (with informal or folk medicine perspectives in parentheses):

- **Calcium**, a common electrolyte, but also needed structurally (for muscle and digestive system health, bone strength, some forms neutralize acidity, may help clear toxins, provides signaling ions for nerve and membrane functions)
- **Chlorine** as chloride ions; very common electrolyte; see sodium, below
- **Magnesium**, required for processing ATP and related reactions (builds bone, causes strong peristalsis, increases flexibility, increases alkalinity)
- **Phosphorus**, required component of bones; essential for energy processing (Corbridge, 1995).
- **Potassium**, a very common electrolyte (heart and nerve health)
- **Sodium**, a very common electrolyte; in general not found in dietary supplements, despite being needed in large quantities, because the ion is very common in food: typically as sodium chloride, or common salt. Excessive sodium consumption can deplete calcium and magnesium, leading to high blood pressure and osteoporosis.
- **Sulfur**, for three essential amino acids and therefore many proteins (skin, hair, nails, liver, and pancreas). Sulfur is not consumed alone, but in the form of sulfur-containing amino acids

2. Trace minerals

Many elements are required in trace amounts, usually because they play a catalytic role in enzymes (Lippar and Berg, 1994). Some trace mineral elements (RDA < 200 mg/day) are, in alphabetical order:

- **Cobalt** required for biosynthesis of vitamin B12 family of coenzymes. Animals cannot biosynthesize B12, and must obtain this cobalt-containing vitamin in their diet.

- **Copper** required component of many redox enzymes, including cytochrome c oxidase
- **Chromium** required for sugar metabolism
- **Iodine** required not only for the biosynthesis of thyroxine but also — it is presumed — for other important organs as breast, stomach, salivary glands, thymus, etc. for this reason iodine is needed in larger quantities than others in this list, and sometimes classified with the macro minerals
- **Iron** required for many enzymes, and for hemoglobin and some other proteins
- **Manganese** (processing of oxygen)
- **Molybdenum** required for xanthine oxidase and related oxidases
- **Selenium** required for peroxidase (antioxidant proteins)
- **Zinc** required for several enzymes such as carboxypeptidase, liver alcohol dehydrogenase, and carbonic anhydrase

b, Vitamins

As with the minerals discussed above, some vitamins are recognized as organic essential nutrients (Mitchell and Haroun, 2012), necessary in the diet for good health. (Vitamin D is the exception: it can be synthesized in the skin, in the presence of UVB radiation.) Certain vitamin-like compounds that are recommended in the diet, such as carnitine, are thought useful for survival and health, but these are not "essential" dietary nutrients because the human body has some capacity to produce them from other compounds.

Moreover, thousands of different phytochemicals have recently been discovered in food (particularly in fresh vegetables), which may have desirable properties including antioxidant activity (see below); however, experimental

demonstration has been suggestive but inconclusive. Other essential nutrients that are not classified as vitamins include essential amino acids (see above), choline, essential fatty acids (see above), and the minerals discussed in the preceding section.

Vitamin deficiencies may result in disease conditions, including goitre, scurvy, osteoporosis, impaired immune system, disorders of cell metabolism, certain forms of cancer, symptoms of premature aging, and poor psychological health (including eating disorders), among many others (Shils *et al.*, 2005). Excess levels of some vitamins are also dangerous to health (notably vitamin A). Deficient or excess levels of minerals can also have serious health consequence.

2.2 Historical Background and Varieties of Okoho

The origin of *Cissus populnea* can be traced to the tropical parts of Africa and has been widely spread through the tropics. It is readily found almost in every forest area of tropical Nigeria especially the middle belt area (Benue state, Kogi State and Nassarawa state) most of the plants grow wildly while some are cultivated. *Cissus populnea* is a plant associated with a myriad of medicinal uses in different parts of the world. Its extracts have been credited with antibacterial properties (Kone *et al.*, 2004), as an anti-trypanosomal plant and a source of gum powder (Atawodi *et al.*, 2002) and as a component of an herbal anti-sickling Nigerian formula (Moody *et al.*, 2003).

In Benin Republic, it is used for its diuretic properties while in Ghana it is used as a post-harvest ethnobotanical protectant (Belmain *et al.*, 2000). The aqueous extract of its stem bark is associated with aphrodisiac / fertility potentials among the Yoruba-speaking people of South West Nigeria, where it is observed that men consume the aqueous and ethanolic extracts copiously and consistently for long periods of time either in mono or polyherbal formulations (Ojekale *et al.*, 2006)). This use of various herbal remedies,

including *C. populnea*, as an aphrodisiac and fertility enhancer amongst the males has been attributed to the declining fertility trend that has been established in this population over the years coupled with the attendant increasing levels of erectile dysfunction (Joint Report, 2004). There are relatively few reports in scientific literature that indicate potential or actual toxicity following the use of many herbs and where found, they are often single case reports involving allergic reactions or toxicity probably due to improper labeling, adulteration or an idiosyncratic reaction. There has however been a report (Geidam *et al.*, 2004) of possible toxic effects of *C. populnea*, an otherwise promising herbal therapy.



Researcher, 2017

Plate 1: Okoho plant

Okoho is the main traditional food peculiar to the Idoma people of Benue State, Central Nigeria. It is made from the plant *Cissus populnea* belonging to the family Ampelidaceae (Vitaceae) (Ibrahim *et al.*, 2011). It is a soup made from the Okoho stick, which is very slimy after preparation. It is usually prepared with bush meat (such as grass-cutter, alligator and smoked meat etc.) and best served with pounded yam (aka Onihi). It can also be eaten with semolina, eba (made from gari) and yam floor. This soup is usually

prepared without the use of oil (Ibrahim *et al.*, 2011). It is the most respected and demanded food in all Idoma events such as; traditional weddings, burial ceremonies, birthdays and other festivities. Okoho soup is highly medicinal and also known for its ability to aid digestion.

Similarly, other Nigerian tribes such as Ibos and Igalas also refer to it as Okoho, while the stick is known as Ajara or Orogbolo by the Yoruba tribes of northern and southern Nigeria. The Hausas usually call it Dafara. *Cissus Populnea* is a specie of plant belonging to the family Amplidacea (Vitaceae) the plant is 2 to 3m high semi-circular, which grows in the savannah and is widely distributed in Senegal, Sudan, Uganda, Abyssinia and Nigeria (Hutchinson and Daniel, 1958). It is commonly known as ‘okoho’ by the Idoma’s, Igbo and Igala tribes of Nigeria, ‘Dafara’ (Kano, Zaria); ‘Latutuwa’ (Katsina) by the Hausa language of the indicated towns of Northern Nigeria (Gbile, 1980); ‘Ajara’ or ‘Orogboro’ by the Yoruba tribes of Northern Nigeria and Southern Nigeria (Ibrahim *et al.*, 2011).

2.3 Health Benefits of Okoho

Cissus populnea is a plant associated with a myriad of medicinal uses in different parts of the world. It used as Laxative and it has anti-diarrhea Activity from its viscosity (Adebowale *et al.*, 2007). Some food gums have laxative and anti-diarrhea activity mainly due to their dietary fibre content. In Pharmaceutical Application, the gum of *Cissus populnea* is applied in pharmaceutical and cosmetic products as building agent and stabilizers (Adebowale *et al.*, 2004). *Cissus populnea* and other food gums with higher fibre content lower the incidence of cardiovascular disease (CVD) and cholesterol level; the symptoms of diverticular diseases are alleviated by increasing intakes of dietary fibre. Anti-diabetic effect of the extract of *cissus populnea* was reported by Adoba *et al* (1991).

Cissus populnea was shown to have antiplasmodial activity or antimalarial activity (shuaibu *et al.*, 2008). The nutritional and medicinal uses of these wild plants have been reported by several authors. *Cissus populnea* is a plant associated with multitude of medical uses in many countries across the globe. The gum obtained from it has been evaluated for its potential use as a dispersant in pharmaceutical liquid system. It is also widely used as a therapy for the treatment of venereal diseases and ingestion as drug binder. Its extracts have been credited with antibacterial properties; its use to abate hypertension; as a fertility enhancer in males and anti-sickling Nigerian formula (Onoja *et al.*, 2013).

Okoho also contains active phytochemicals like tannins, glycosides, flavonoids, carotenoids, anthroquinones and vitamin C. It has antioxidant and anti-inflammatory properties. Due to its mucilage and other active ingredients, *Cissus polpunea* stem has been used to heal traditionally in the following ways:

- As a laxative
- As an antidote to arrow wounds.
- To expel intestinal parasites.
- As aphrodisiac and to treat male erectile issues.
- To treat sore breast.
- To treat venereal diseases.

Other well-known uses of foods that have mucilage or soluble fiber are;

- To lower blood cholesterol levels by preventing the absorption of cholesterol in the intestine.
- To lower blood sugar level by regulating the absorption of carbohydrates and preventing sudden spikes in blood sugar levels.
- To regulate bowel movement.
- To prevent constipation and hemorrhoids.

- To treat inflammation of the intestinal tract and inflammatory conditions of the digestive system.
- To alleviate cramping.
- To regulate acidity of the gastrointestinal tract.
- To remove waste and toxins out of the colon.
- To protect against inflammation of all mucous membranes.
- To treat skin issues like burns, boils, psoriasis and other skin conditions.
- To treat respiratory issues.
- To treat ulcers, mouth sores, inflamed gum and sore throat

Okoho can be cooked like ogbono soup and has almost the same taste but is far more viscous. Adding this thickener to your healthy diet provides much more than you can imagine. Good Food is Good Medicine!

Man since early times had always wanted to leave progenies behind as a means of continuity of his lineage and proof of his procreative ability (Ayala, 2005). Both the ability to engage in sexual trysts and consequently impregnating females culturally leaves a man with a feeling of well-being and massages (boosts) his ego. The inability of a man to either have full penetrative sex or impregnate the opposite gender due to erectile dysfunction or infertility is becoming quite a common feature, and has been on the increase for some time now (Ojekale *et al.*, 2006).

There is growing evidence to support global declining fertility in males viz sperm concentration, motility and morphologically normal (Swan *et al.*, 1997). Various reasons including but not limited to .age, environment, exposure to/ use of GSM devices, disease conditions and others are adduced for this decline. Tangential to decreasing male fertility is a concomitant drop in libido, which is mostly but not all times age related (Kaufman and Vermeulen. (2005), other reasons such as oxidative stress, weight, disease conditions, and

lifestyle are some of the established factors that affect libido in men. There are quite a number of herbals presently available and commercially sold in the public domain in Nigeria, which the manufacturers claim to enhance both libido and spermatogenesis.

The plant *Cissus populnea* Guill&Perr (*Vitaceae*) has been reported to possess numerous biological activities (Ojekale *et al.*, 2006, Auger *et al.*, 1995 and Uchendu *et al.*, 2009). The plant is also used in the treatment of sore breast, indigestion, venereal diseases, intestinal parasites, oedema and eye problems. Previous phytochemical studies on different parts of *C. populnea* reported the presence of saponins, tannins, anthraquinones, cyanogenic glycoside, flavonoids, carotenoids, triterpenoids, and ascorbic acid [Ojekale *et al.*, 2006 and Akomolafe *et al.*, 2013]. *C. populnea* aqueous stem bark extract have been reportedly used as aphrodisiac/fertility enhancer for males among the Yoruba in South Western part of Nigeria (Ojekale *et al.*, 2006), and various possible scientific reasons adduced for these have also been reported (Smith and Ogunfeibo, 2008).

There is a global observed decline in male fertility over the years consequent on various factors affecting spermatogenesis. Some Nigerian males across various geographic and socio-economic strata employ the use of herbals such as *Cissus populnea* extracts amongst others to manage this and as herbal aphrodisiacs. A study conducted by Anthony *et al.*, (2015) assessed the spermatogenic effects of aqueous extract of *Cissus populnea* stem bark. The methodology was: *Cissus populnea* stem bark was extracted with water, concentrated and lyophilized. Male wistar rats were orally administered with 150 mg/kg body weight of aqueous extract (*Cissus populnea*) over a 64-day period. Sperm of the experimental animals was collected, and the parameters (count, motility, morphology) analyzed. Principal findings were: The oral administration of *C. populnea* extract over a 64-day period to male wistar rats resulted in a four-fold increase in sperm count in the test rats (145 ± 55) compared with the control group (44 ± 17). Testicular histology shows better packed spermatozoa in

group of rats treated with *Cissus populnea*. In Conclusion, The findings suggest that oral administration of *Cissus populnea* aqueous extract improves spermatogenesis in male wistar rats, thereby showing the efficacy of *Cissus populnea* in the spermatogenesis in male.

Gums are polymeric materials which when dissolved or dispersed in water give viscous solutions or dispersions. This definition differentiates the water-soluble gums from the oil-soluble resins. Gums which yield clear ‘‘solution’’ with water and are completely filterable are called real gums, while those that swell in water and are only partially soluble and filterable are referred to as vegetable mucilages. Water-soluble gums are referred to as hydrocolloids (Glicksman, 1969).

Hydrocolloids are higher molecular weight polymeric compounds, mostly carbohydrates, characterized by their ability to give highly viscous solutions at low concentrations (Ihekoronye and Ngoddy, 1985). They play very important roles in controlling one of the primary quality attributes of food such as texture. They improve or manipulate the texture of food products because of their ability to retard flow, modify gelling characteristics and preserved emulsion (Glicksman, 1979).

In addition to thickening and gelling, hydrocolloids have other secondary functional properties such as binding, clouding, coating, suspending and stabilizing (Lawrence, 1976). *Cissus* gum is an extract from a savannah shrub belonging to the family *Amplidaceae* (*Vitaceae*) (Ibrahim, 1991). *Cissus* mucilage from stem is traditionally used in the preparation of soups amongst the Idomas of Benue State and the Igalas of Kogi State (Iwe and Attah, 1993). *Cissus* mucilage is also used as a foam stabilizer in ‘‘akara’’ balls 14. Xanthan gum, a natural polysaccharide, is a remarkable stabilizer of suspensions and emulsions (Damodaran, 2007). Xanthan gum has been used as a binder in gluten-free dough to improve gas retention and bread structure (Snyder and Kwon, 1987).

Glicksman, (1983) also reported that the baking properties of rye and wheat flour could be improved by adding small amount of gum Arabic. Chukwu and Okpalaczinne 5 and Eichie and Amalime⁷ evaluated the binder effect of gum mucilages of *Cissus populnea* and Acacia Senegal on paracetamol tablets and concluded that both mucilages have the potential for substitution as a binder. Gums as binders modify cohesive properties of granules by promoting the formation of strong cohesive bonds (Eichie and Amalime, 2007).

Cissus gum extracted from the stem of *Cissus populnea* plant can be extracted by first scraping the stems with knife to remove the powdery ash layer covering the stem, the scraped stem, will then be washed in clean water and chopped into tiny bits ready for extraction of gum. The chopped strips will be soaked in hot water (80–90°C) for 30 min at a ratio of 23 g of chopped strips to 100 ml of water (23% w/v) and squeezed through four layers of muslin cloth to extract the gum. Then 200 ml of water will be further added to the mash and squeezed to extract more gum. In another procedure, the chopped strips will be dried in an oven at 50°C for 12 h, pulverized, soaked in hot water (80–90°C) at the ratio of 23% (w/v) for 30 min, squeezed in between four layers of muslin cloth to extract gum and the mash washed with 200 ml of water to release more gum. The gums obtained are stored in the freezer for further use. The specific gravity, pH, total solid, total soluble solid, refractive index and viscosity of the gums could be evaluated and used as an additive in wheat-cassava bread. This gum if used in bread making on comparison with a control shows better properties, such as the mass and volume of the loaves, the sensory properties of the bread and the proximate composition of the bread (90:10) (Owuno *et al.*, 2012).

2.4 Historical Background and Varieties of Ogbono

Names of *Irvingia Gabonensis* are English (wild mango, nativemango, duiker nut, bushmango, breadtree, African mango tree); French (Manguier Sauvage, Bobo); Hausa (Goron, Biri); Igbo (Ogbono); Trade name (Dika Nut); Yoruba (Oro) For centuries,

tribesmen from the villages of Nigeria and Cameroon in West Africa have been using seeds of *Irvingia Gabonensis*, also known as African Bush mango, for its potent health benefits. The African mango, an exotic brightly colored tropical fruit, differs from other mangoes because it produces a particular seed that the natives of Cameroon call the Dika nut (Wright, 2011).

The *Irvingia* kernels form an important part of the West and Central African diet, providing fat and protein. African mango seeds are ground into paste and most restaurants in Nigeria. Native medical treatments made use of the bark, leaves, roots and kernels of African mango tree for multitude of health ailments. The bark was known to have antibiotic qualities and was used to heal skin abrasions and to produce a remedy for toothaches when boiled. When ingested orally, shavings from the stem bark have been used to treat hyena, dysentery and even yellow fever. The juice of the fruit is made into a wine that attains 8% alcohol content when left to ferment for 28 days. *Irvingia Gabonensis* grows to a height of 15-40 m, bole slightly buttressed. It has a dense, compact crown, branchlets ending in a narrow, curved, stipular sheath covering the leaf bud. Bark greyish, smooth or very slightly scaly; slash yellowish-brown to light yellow, brittle.



Researcher, 2017

Plate 2: Ogbono Seed

Products of *Irvingia Gabonensis*

- **Food:** Fruit pulp is palatable and can be used for a fruit drink and for jam production. The kernel can be processed into flour by extraction, drying and grinding. The pounded seed is added to meat and various vegetable dishes as a sauce. Margarine and cooking oil can be obtained from the kernels.
- **Fodder:** Seeds are used as cattle cake in Ghana.
- **Timber:** Wood pale brown, very hard and fine grained, not easy to cut, which limits its usefulness. Its weight precludes it from all but the most rugged construction work, e.g. for railway ties. Useful for making canoes and pestles for yam mortars; also suitable for boards, planking, ship decking and paving blocks.
- **Tannin or dyestuff:** Reported to contain tannin in both bark and roots.
- **Lipids:** Kernels contain oil used for making soaps, cosmetics and pharmaceuticals.
- **Wax:** Contains waxes useful as an adjunct in making medicinal tablets.

- **Medicine:** Relieves diarrhoea and dysentery. Used internally as a purgative, for gastrointestinal and liver conditions, for sterility, hernias and urethral discharge, and is considered to be a powerful aphrodisiac.
- **Other products:** In its native range, the seed is a valuable source of cash income. In southern Cameroon, the seeds could be described as the most important, legal, non-timber forest product from the area.

Ogbono (Ibo) or Apon (Yoruba) is the seed of the African wild mango (Oro). The seed is dried and then milled with some crayfish in order to make *Ogbono* soup. Ogbono soup (Igbo: *bush mango*) is a Nigerian dish made with ground ogbonoseeds, with considerable local variation. The ground ogbono seeds are used as a thickener, and give the soup a black coloration. Besides seeds, water and palm oil, it typically contains meat, seasonings such as pepper, leaf and other vegetables. Typical leaf vegetables include bitterleaf and celosia. Typical other vegetables include tomatoes and okra. Typical seasonings include chiles, onions, and iru (fermented locust beans) (Wright, 2011). Typical meats include beef, goat, fish chicken, bush meat, shrimp, or crayfish. It can be eaten with fufu, pounded yam, or with rice.

In other countries, the soup may be available in packaged prepared form in some markets that specialize in Western African foods. Ogbono soup has a mucilaginous (slimy) texture, similar to okra soup (Wright, 2011). *Irvingia Gabonensis* is a species of African trees in the genus *Irvingia*, sometimes known by the common names wild mango, African mango, bush mango, dika or ogbono. They bear edible mango-like fruits, and are especially valued for their fat- and protein-rich nuts.

2.5 Health Benefits of Ogbono

Several studies have been carried out to ascertain the medicinal, nutritional and other benefits of *Irvingia Gabonensis*. Anegbeh et al., (2003) agree that the *Irvingia* fruits are utilised both in modern and traditional medicine for treating several diseases. Some benefits of ogbono include;

i, Edible purpose

Irvingia Gabonensis fruit can be eaten as fresh fruit. The sweet pulp can be juiced or used for making smoothie, jelly, jam and wine. The seeds can be pressed for vegetable oil or margarine. The dried ogbono seeds can be ground and used for preparing ogbono soup, stew, Gabon chocolate and Dika bread.

iii. Antidiabetic Properties

Diabetes has remained a challenging health condition that has caused the loss of several lives. Ngondi *et al.*, (2005) agree that ogbono seed is capable of reducing fasting blood glucose levels in obese beings. Furthermore, Sulaimon *et al.*, (2015) study evaluated the antidiabetic properties of *Irvingia Gabonensis* leaf and bark extracts on alloxan induced diabetic rats. The study showed that the aqueous extracts of leaf and bark of *Irvingia Gabonensis* had more anti-diabetic activity than the ethanolic extracts. However, the researchers recommended further studies to determine the toxicity of *Irvingia Gabonensis* leaf and bark extracts.

iii, Weight Management

Studies on African mango reveals that it suppresses hunger and as such very essential for people that want to minimise their food intake. Reduction of food and caloric intakes help to maintain a healthy weight.

iv, Analgesic Properties

Ngondi *et al.*, (2005) evaluated the efficacy of *Irvingia Gabonensis* seeds in the obesity management. This was carried out as a double-blind randomised study using 40 subjects. 28 subjects received *Irvingia Gabonensis* 1.05 g three times a day for one month while 12 subjects were on placebo and the same schedule. The obese patients given *Irvingia Gabonensis* had a significant decrease in triglycerides, total cholesterol, LDL-cholesterol with an increase in HDL-cholesterol. However, the placebo group showed no changes in blood lipid components. This suggests that *Irvingia Gabonensis* seed is suitable for weight management.

Okolo *et al.*, (1995) screened the water and ethanol extracts of the powdered stem bark to ascertain the analgesic effects of this fruit. The results were further compared with standard analgesic drugs. The study suggests that the water extract has analgesic effects similar to a narcotic analgesic.

v, Medicinal Tablets Production

Ogbono contains sticky wax (mucilage) that is useful for making medicinal tablets. The wax acts as a binding agent during tablets production. Studies reveal that tablets manufactured with bush mango have increased brittleness and reduced tensile strength when compared to gelatin tablets.

vi, Regulates Serum Cholesterol Levels

Ngondi *et al.*, (2005) study validates that obese patients given *Irvingia Gabonensis* had a significant decrease in LDL cholesterol, triglycerides, total cholesterol with an increase in HDL cholesterol. This suggests that *Irvingia Gabonensis* is suitable for regulating the serum cholesterol levels.

vii, Dysentery Treatment

The bark can be decocted and used for treating dysentery and diarrhoea. The bark can also be combined together with palm oil for treating diarrhoea.

Viii, Antibacterial and Antifungal Properties

Kuete *et al.*, (2007) support that the methanolic extract of *Irvingia Gabonensis* can be used for treating bacterial and fungal infections. The kernels of *Irvingia* contains 54-64% of fatty matter. Thus, *Irvingia* can be classify as an oil crop. The kernel serves as condiments used in thickening and flavouring soups. The more the ground kernel “draws” in soup the more acceptable it is. Thus, *Irvingia gabonensis* var. excels which “draws” more than var. gabonensis is more acceptable in soup making.

The fresh fruit of the *I. gabonensis* is sweet and edible, and is suitable in the manufacture of jams jellies and fruit juices. The pulp of the var excelsa is bitter and inedible. The kernel of *Irvingia* is used in making a fatty paste called “dika”. This is the principal ingredient in the making of “Gabon chocolate” or “Dika Bread”. Thus, the *Irvingia* fruit is often called “Dika Nut”. When fully dried, the kernel shells are good firing materials. The bark of the tree is bitter and is added to palm wine as preservative.

In traditional religion, some tribes use the split shells of the fruit in divination; giving a favourable omen if one falls flat and the other cover side up. The wood is pale brown, very hard, fine grained and immune to termites. It is used in building canoes from the trunk; pestles for yam mortars; house posts etc. the tree is useful for afforestation and erosion control. The fruit pulp can be used for producing black dye for dying clothes. Both the roots and barks also contain tannin which suitable for dying.

The most important product of both species is processed seed cake, which is widely used in soups and stews. The nut is cracked open to release the kernel. The kernels fresh, sun-dried or smoke-dried depending on the end product can then be ground and crushed to make paste (fresh kernels) or cake (dry kernels) both used to add consistency to soups and stews. Bush mango is also fed to cattle. Kernel oil is used in cooking while the defatted paste is added to soups as a condiment to produce a desirable sticky consistency. It constitutes an alternative condiment to okra (*Hibiscus esculentus*), groundnut (*Arachis hypogea*) and egusi seeds (*Cucurbita* sp.), all three widely used in traditional cuisine in West and Central Africa.

Ogbono soup (Igbo: bush mango) is a Nigerian dish made with ground ogbono seeds (Wright, 2011), with considerable local variation. The ground ogbono seeds are used as a thickener, and give the soup a black coloration (Wright, 2011). Besides seeds, water and palm oil, it typically contains meat, seasonings such as chili pepper, leaf vegetables and other vegetables. Typical leaf vegetables include bitterleaf and celosia. Typical other vegetables include tomatoes and okra. Typical seasonings include chiles, onions, and iru (fermented locust beans). Typical meats include beef, goat, fish (Wright, 2011), chicken, bush meat, shrimp, or crayfish. It can be eaten with fufu (Wright, 2011), pounded yam, or with rice. In other countries, the soup may be available in packaged prepared form in some markets that specialize in Western African foods (Wright, 2011), Ogbono soup has a mucilaginous (slimy) texture, similar to okra soup.

2.6 Sensory Evaluation/ Acceptability

Sensory evaluation is a scientific discipline that analyses and measures human responses to the composition and nature of foods and drink. Sensory evaluation does not just deal with "likes and dislikes, " "OK or not OK" but the process scientifically elicits, measures, analyses and interprets psychological and / or physiological responses to physical stimuli produced by a food product. 'A scientific discipline used to evoke measure, analyze and interpret reactions to those characteristics of food and materials, as they are perceived by senses of sight, smell, taste, touch and hearing. 'Sense' may be described as the physiological perception of stimuli.

There are five senses in human beings:

- Sight: Ability of the eye and brain to detect electromagnetic waves within the visible range of light and interpret the image.
- Hearing: Sense of sound. When vibrations propagating through a medium (e.g. air) are detected by the brain, sound is perceived.
- Smell: Perceiving aroma, odour and scent by the means of the organ in the nose.
- Touch: Sense of pressure perception, mostly in the skin / tongue.
- Taste / Gustation: This is a "chemical" sense. The receptors (buds) in the tongue can distinguish five tastes: Sweet, Salt, Sour, Bitter and Umami, which is a savoury, and subtle taste that is associated with a soupy or brothy note. The receptors on the tongue identify the glutamic acid residues in the food.

2.7 Review of Related Empirical Studies

Judith (2005) conducted a research on the effect of *Irvingia Gabonensis* seeds on body weight and blood. *Lipids in Health and Disease*. Obese patients placed under *Irvingia Gabonensis* treatment had a significant decrease of total cholesterol, LDL-

cholesterol, triglycerides, and an increase of HDL-cholesterol. On the other hand, the some individuals might not manifest any changes in blood lipid components. *Irvingia Gabonensis* seed may find application in weight loss. *Cissus populnea* has also be shown to cause significant increase in serum alkaline and total acid phosphatase only as a result of diabetes induction, however there might be no significant differences in the levels of aspartate and alanine aminotransferases as a result of both diabetes induction and *Cissus Populnea* treatment. The addition of *Cissus populnea* gum increases the loaf volume of the composite bread and did not affect values for proximate composition. The researcher observed that the above work did not test for the nutritional contents of the gum before adding it into the bread. The researcher should have examine the nutritional contents before using it to bake, which makes this present work to be different because it will test for the nutritional value before working with it. The gap the researcher intends to fill here is to test for the nutritional composition of the *cissus populnea* (okoho).

Ekpe, (2007) studied the Effect of a Typical Rural Processing method on the Proximate Composition and Amino Acid Profile of Bush Mango seeds (*Irvingia Gabonensis*). This study was therefore aimed at increasing the body of available information on nutrient composition, with particular reference to proximate composition and amino acid profile of *Irvingia Gabonensis* seed and a processed product called “Itugha” by Agoi Ibami Community of Nigeria. Itugha is a very popular indigenous foodstuff obtained using a typical traditional food processing technique involving pounding and fermentation used together as a unit process. The high nutritive quality of the *Irvingia Gabonensis* (Var *Gabonensis*) based product as compared with its seeds implies that appropriate food-processing technique is another approach to improve plant foods’ quality. Since storage is one of the major problems associated with, handling fresh *Irvingia* seeds, processing these seeds fresh using pounding and fermentation, not only arrest spoilage but

also improve its nutritive value. This should then encourage farmers to respond positively to Agroforestry's campaign for increased *Irvingia Gabonensis* plantation establishment, and value adding activities to obtain products of higher nutritional quality and longer shelf life. In the entire process, the seed cracking to extract the cotyledons was most laborious and difficult. From Gabon to Cameroon and Nigeria, people utilize different techniques to extract these *Irvingia* kernels. As was the case with this work, fruits were allowed to ferment and the kernel extracted wet. Alternatively, they can be extracted from fruits in the fresh state or fruits are fermented and sun-dried before extracting. For the fresh fruits, sharp knives are used to cut the fruit open while in the fermented and/or dried state, heavy objects (especially stones) are used to crack the nut. All these methods are hazardous and so the vegetative propagation of *Irvingia Gabonensis* should be directed towards varieties whose nuts slip open naturally. The study did not compare the nutrient composition of *Irvingia Gabonensis* to that of *Cissus polpulnea* and there was no check on its acceptability whereas the present work tests for the nutritional content and their acceptability.

Study on the Evaluation of Elemental Contents of Wild Mango (*Irvingia Gabonensis*) Fruit in Ghana by Ayivor, (2011), aimed at providing preliminary information on the elemental composition of the *Irvingia Gabonensis*. This study examines the elemental contents of the mesocarp, endocarp and the seed of wild mango in Ghana. The macro and micro elemental content in wild mango within ranges of common tropical fruits. The distribution of element in the fruit suggests that with the exception of Magnesium and Copper the seed coat (endocarp) contains the highest concentration of all elements considered in this study. With the exception of Arsenic captured in the analysis, no other toxic element was detected. The presence of Arsenic could be attributed to either contamination or pollutions from soil and environmental conditions of where they were cultivated with the latter being prominent since Instrumental Neutron Activation Analysis

does not require any chemical treatment of samples. Instrumental Neutron Activation Analysis therefore is a useful tool in multi-elemental analysis in fruit samples. The trace elements in these parts of the African bush mango can thus be further researched into to explore the possible uses and development of this fruit. This research work did not test for the nutritional value and did not say anything about it, which will make the present work different because it will test for the nutritional value before using it in the lab.

Recently the effect of *Irvingia Gabonensis* seeds, on the liver and gonads of male albino rats, was investigated by Abu and Ibrahim, (2012). This investigation was prompted by the increasing international acceptance of the seeds of the African bush mango as being an effective weight reducing herbal medication. The research primary objective was to ascertain if any the effect of the seeds on the histology of the liver and the gonads in male albino rats. The seed extract of *Irvingia Gabonensis* had a dose-dependent effect on the organs (Hannah et al., 2014). Some of the histopathological effects observed in the liver were, sinusoidal dilations (SD), hemorrhaging of the central vein (HCV), inflammation (I) and abnormal distribution of hepatocyte (ADH). Others were macrosteatosis (M) and macrovesicular fatty infiltrations (MFI). In the testes, arrested spermatogenesis (AS), degenerated germinal epithelium (DGE), absent interstitial cells (AIC), hardened basal cells (HBC) and empty seminiferous tubules(EST) were some of the effects of the seed extract observed. This indicates that seed extracts of *Irvingia Gabonensis* could cause degeneration of both liver and testes in the male mammal at high concentrations (Hannah et al., 2014). From the researcher view the above work did not mention the nutrients present that serves as the weight reducing agent whereas the present research will look into nutritional contents.

The phytochemicals in the stem and root of *Cissus populnea* were examined by Michael and Emmanuel, (2012). This research examines the phytochemicals present in the stem and

root of *Cissus populnea*, with a primary objective of determining the actual content of each phytochemical found responsible for traditional management of ailments, where it was revealed that both plant parts contain alkaloids, flavonoids, saponins, and tannins in large quantity. The stem and root of *Cissus populnea* are rich in plant compounds. The occurrence and quantity of other phytochemicals, as recorded in this study, also suggest that *C. populnea* may serve as a potential source of useful drugs in the near future. As seen the researcher did not say anything about the nutritional contents present in the *Cissus Populnea* it only checked the flavonoids alkaloids saponins and tannins. The researcher here also did not test for the nutritional value it only tested flavonoids alkaloids saponins and tannins. As such, this present work will be different because it will check the nutritional value.

Similarly, Onajah, Salawu and Umar (2013) worked on the Effects of *Cissus populnea* and *Panax ginseng* on Flutamide-Induced Testicular Defect in Pre-Pubertal Male Rats. This study was carried out to determine the effects of *Cissus populnea* and *Panax ginseng* on flutamide induced testicular toxicities in pre-pubertal rats. There were no statistically significant differences in serum testosterone levels in all three treatment groups when compared with the control group. There was a significant increase in the serum LH level in group D when compared with the control group ($p < 0.05$). Serum FSH level in group B showed a significant increase when compared with the control group ($p < 0.05$). The histological evidences of testis in group D showed a reduction in lining cells of the seminiferous tubules; however, in the other three treatment groups they were similar to the control group. Flutamide is detrimental to spermatogenesis and alters the HPG axis but a concomitant use of adapt gens like *Cissus populnea* or *Panax ginseng* can preserve cellular morphology of testes and reproductive functions. The results suggest that *Cissus populnea* and *Panax ginseng* ameliorates the adverse effects of flutamide on the testis. The researcher

also observed here that this research did not test for the nutritional value before testing it. While this present work will look into the nutritional content before testing for it acceptability.

Ogori and Gana, (2013) studied the Effect of Cassava Starch Flour Seeding on Functional Properties of Cissus Gum Stem and Root (*Cissum Populnea*). The research work seeks to establish hot water extraction of cissum popula gum mucilages from Cissus plant stem and root and also determine the effect of cassava starch seeding on Cissus gum functionalities. The present work revealed that seeding of Cissus gum for stem and roots with cassava starch flour reduces its functionality like water absorption capacity, oil absorption capacity emulsifying property, bulk density pH and hydroscopicity, which may be beneficial in other food processing and pharmaceutical industries as binder, colloidal surfactant, substrate stock for microbial culture and rheological enhancing quality in food processing. In a similar way, this research work did not still test for the nutritional value before using the Cissus gum which will make the present work different because the present will test for the nutritional value.

In another study, Aguoru, (2014) worked on the Comparative Phytochemical Studies on the Presence and Quantification of Various Bioactive Compounds in the three Major Organs of Okoho Plant (*Cissus Populnea* Guill & Perr) in Benue State North Central Nigeria, Western Africa. The overall aim of this study was to test and quantify the presence of alkaloid, tannins, saponins, anthraquinone and flavonoids in the root, leaves and stem of Cissus populnea in different locations in Benue State Nigeria where the plant is in high demand as a delicacy. Cissus populnea leaves, stem and root appear to be rich in bioactive compounds which are widely used for various activities including traditional medicines. Though statistically not significant, graphically and descriptive analyses have revealed that the leaf, stem and root should be exploited for their immense values embedded in saponins,

alkaloids and flavonoids respectively. The researcher observed that this research work did not test for the nutritional value while the present research will look into it.

Phytochemistry and Spermatogenic Potentials of Aqueous Extract of *Cissus populnea* (Guill. And Per) Stem Bark and proximate and Phytochemical Screening of *Cissus Populnea* was examined by Anthony, Oladipupo, Peter, Jamiu and Latifat (2015). The objective of the present study was to evaluate/find justification in the purported spermatogenic potentials of the stem bark extract of *C. populnea* via in-vivo clinical trials, antimicrobial screening against fertility implicating microbes, and comprehensive phytochemistry of the extracts. *Cissus populnea* (Guill. and Per) Stem Bark has been shown not to possess significant spermatogenic potentials, it was shown that continuous exposure of male subjects to the extracts over a given period did not significantly alter sperm count, morphology, motility, or volume. Antimicrobial screening of the extract against some selected microbial isolates secondarily implicated in male infertility revealed total inactivity against the microbial isolates screened, i.e., *Staphylococcus aureus*, *Salmonella paratyphi*, *Escherichia coli*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Candida albicans*, and *Klebsiellasp*. Phytochemistry revealed the presence of tannins, flavonoids, saponins, and steroids. The presence of these secondary metabolites was confirmed by thin layer chromatography. *Cissus populnea* spices contain crude protein (37% - 21%), crude fibre (23 — 22%), crude fat (3.10 — 20%), carbohydrate (16 — 24%) total ash content (2.0 — 3. 10%), Moisture (1.68 — 1.82%). *Cissus populnea* spices are sources of minerals comprising of calcium, Iron Zinc, Copper, Magnesium, Sodium and Potassium. Phytochemical screening revealed the presence of saponins, flavonoids as well as hydrogen sulphanamides. These bioactive substances may be responsible for the biological properties of the plants. The research work is closely related to the present work the researcher intend

to carry out, the only difference here is that the present work will compare the nutritional contents of okoho and ogbono.

2.8 Summary of Reviewed Related Literature

Attempts were made to highlight and analyze the opinions of different panelists. The chapter reviewed concept of nutritional value, historical background and varieties of Okoho, concept of Okoho soup and acceptability of Okoho soup. The study also reviewed historical background and varieties of Ogbono, concept of Ogbono soup and acceptability of Ogbono soup. The health benefits of Okoho and Ogbono as well as sensory evaluation were also captured. The literature also reviewed nine empirical studies where the perceptions and views of the researchers on nutritional values and acceptability of Okoho and Ogbono soups were examined and criticized. None of the researches reviewed has addressed the issue of nutritional values and acceptability of Okoho and Ogbono soups among families in Kaduna State. Therefore for the above reason and the dearth of literature on nutritional value and acceptability of Okoho and Ogbono soups are the major gaps this research study intends to fill.

CHAPTER THREE

MATERIALS AND METHODS

This study is aimed at comparing the nutritional value and acceptability of “Ogbono” *I. gabonensis* and “Okoho” *Cissus populnea* soup among families in Kaduna State. This chapter specifically describes the materials and methods to be used for the study under the following sub-headings

3.1 Research Design

3.2 Panel of judges

3.3 Sources of Raw Materials

3.4 Instrument for Data Collection

3.5 Evaluation of Products

3.6 Procedure for Data Analysis

3.7 Proximate analysis

3.1 Research Design

This study used the experimental research design. Experimentation is the practical demonstration of concepts whether relationships exist among identifiable variables. Uzoagulu (2011) defined experimental research design as a design that provides systematic and logical procedures of identifying and evaluating the relationship between variables that create a particular state of affairs under controlled condition.

3.2 Panel of Judges

The panel of judges for this research work are made up of nineteen people who are workers and students of Federal College of Education Zaria. The panelist were those who are willing to assess the product and are also familiar with the soups under study. This is because it has to do with food as such the available people on ground form members of the panelist, from ages eighteen and above.

3.3 Sources of Raw Materials

The okoho was collected from the southern part of Kaduna state while the ogbono sample was bought from Opanda village in Apa Local Government Area of Benue state. All other ingredients were purchased from Sabon Gari market. Some of the *Cissus populnea* (Okoho) was air-dried and pounded into powder form to be able to present to the panels the number of options of soups to choose from.

3.4 Instrument /Procedure for Data Collection

Structured score card for assessment was administered to the panel so as to obtain information on the physical properties and acceptability of the food product under study. The distribution of score card to the panel was carried out by the researcher. The researcher started by enlightening the respondents on how to fill the score card using the keys provided and then the researcher presented the products.

3.5 Assessment of Products

The products were evaluated in three stages: The physical properties which has to do with the viscosity, appearance, aroma and taste and the hedonic scale were all evaluated by the panelist. The soup was served with semovita as an accompaniment this is because in this part of country, soups are not taken without an accompaniment.

While the proximate analyses was done following the methods recognized by the Association of Official Analytical Chemist (AOAC,1999) to test for the presence of ash, carbohydrate, fibre, lipids moisture and protein

3.6 Procedure for Data Analysis

The data collected were analyzed using frequency and percentages to analyze the bio-data of the respondents. Mean and standard deviation were used to answer all the research questions while ANOVA statistical tool was employed to test all null hypotheses at 0.05 level of significance.

Decision Rule: In answering the research questions, any items that scored 3.0 – 5.0 was considered highly acceptable. The items that score 2.5 – 2.9 was considered acceptable, 2.0 – 2.49 manageable and 0.0 – 1.9 unacceptable. During the test of hypotheses, if the calculated p- value is less than the alpha value of 0.05, the hypotheses will be rejected and if more than will be retained.

3.7. Proximate Analyses.

Proximate composition: This was done following the methods recognized by the Association of Official Analytical Chemists (AOAC, 1999) to test for the presence of ash, carbohydrates, fibre, lipids, moisture and protein.

3.8 Ingredients and methods of preparation

Ingredients and methods of preparation of Fresh Okoho soup

RECIPE

1. Short stem of Okoho	(0.5kg)
2. Beef or bush Meat	500g
3. Palmoil	125ml
4. Smoked fish	250g
5. Medium Stock Fish	150g
6. Cow tripe	150g
7. Grinded Cray Fish	50g
8. Locus Beans/Okpehe	45g
9. Pepper and Salt	to taste
10. Ginger/Unziza	25g
11. Grounded Melon	250ml
12. Maggi/knor	2 cubes
13. Water	2 liters

Procedure for Preparation

Stage One:

1. Scrap off white part of the back of Okoho stem.
2. Shred off the flesh into strands, tie the flesh together and place in a pot.
3. Add a cup of water boil for five minutes.
4. Using washed hands, marsh the until the gum is thick then squeeze out the gum into a clean container.
5. Strain the gum and set aside.

Stage Two: Preparation of Egusi Balls.

1. Grind Egusi add four table spoon warm water, one tea spoon pepper, one tea spoon cray fish and knead together into a thick ball.
2. Roll the egusi into small balls and put in boiling water.
3. Cook for twenty minutes and set aside.

Stage Three: Preparation of Stock

1. Mix the meat, stockfish and prepared dried fish together.
2. Place in pot and add all the seasoning, add 2 liters of water.
3. Add palm oil and boil for 20-25 minutes until meat, stockfish, cow tripe are soft.
4. Remove the egusi balls from warm water and add to the stock.
5. Boil for five minutes then put off the heat.
6. Remove everything from the stock and set aside.
7. Pour okoho gum into stock and mix vigorously till well mixed with stock.
8. Return everything packed out of stock and mix gently so they don't break
9. Serve with pounded yam, amala or semovita.

Ingredients and methods of preparation of Dried Okoho soup

RECIPE

1. Dried okoho powder	40g
2. Palmoil	125ml
3. Vegetable: <i>Ugu</i>	30g
4. Beef or bush Meat	500g
5. Smoked fish	250g
6. Stock Fish	150g
7. Cow stripe	150g
8. Grind Cray Fish	50g
9. Locus Beans/Okpehe	45g
10. Pepper and Salt	to taste
11. Ginger/Unziza	25g
12. Grounded Melon	2table spoons
13. Maggi/knor	2 cubes
14. Water	2 liters

Procedure for Preparation

1. Pound the dried okoho stick in a mortar sieve out the powder.
2. Cook the assorted meat with the Maggi cubes and onion (If you will use Shaki, remember to start cooking that first, then add beef when almost cooked).
3. Add the assorted meat and fish, ground crayfish, salt and pepper to taste.
4. Use your cooking spoon to dissolve the 40g Okoho in the oil. When all the Okoho powder has completely mixed with the oil, add into the meat/fish stock.
5. Set the heat of your cooker to low and start stirring. You will notice the Okoho will start to thicken and draw. Keep stirring until the Okoho has completely absorbed the

meat stock. Add a small quantity of hot water and stir until the Okoho has mixed properly with the water.

6. Repeat this process until you get a required consistency. Making sure that your heat is set to low, put the lid of the pot and start cooking. Once it starts to simmer, stir every 2-3 minutes for 10-20 minutes intermittently.
7. After 20 minutes, the Okoho should be well cooked and you will begin to perceive its nice flavour and aroma if the Okoho soup becomes thicker than is required, add a little bit more water and stir very well.
8. Add the vegetable (if desired). Stir very well, cover the pot and turn off the heat.

Ingredients and methods of preparation of Ogbono Soup

RECIPE

- | | |
|--------------------------|---------------|
| 1. Grinded ogbono | 40g |
| 2. Palmoil | 125ml |
| 3. Vegetable: <i>Ugu</i> | 30g |
| 4. Beef or bush Meat | 500g |
| 5. Smoked fish | 250g |
| 6. Stock Fish | 150g |
| 7. Cow stripe | 150g |
| 8. Grind Cray Fish | 50g |
| 9. Locus Beans/Okpehe | 45g |
| 10. Pepper and Salt | to taste |
| 11. Ginger/Unziza | 25g |
| 12. Grounded Melon | 2table spoons |
| 13. Maggi/knor | 2 cubes |
| 14. Water | 2 liters |

Procedure of preparation

1. Grind the dried ogbono using a blender.
2. Cook the assorted meat with the Maggi cubes and onion (If you will use Shaki, remember to start cooking that first, then add beef when almost done).
3. Pour the palm oil into a clean dry stainless steel or aluminium plate and add the Ogbono. Use your cooking spoon to dissolve the Ogbono in the oil.
4. When all the Ogbono has completely mixed with the oil, add into the meat/fish stock (water from cooking the assorted meat and fish). Set the heat of your cooker to low and start stirring. You will notice the Ogbono start to thicken and draw. Keep stirring till the Ogbono has completely absorbed the meat stock.
5. Once it starts to simmer, stir every 2-3 minutes for 10 minutes. So what you'll do is: every 3 minutes or so, open the pot, stir every well, scraping the Ogbono that sticks to the base of the pot, cover the pot and cook for another 3 minutes.
6. After 10 minutes, the Ogbono should be well cooked and you will begin to perceive its nice flavour and aroma. The Ogbono may have become thicker from the cooking. If so, add a little bit more water and stir very well.
7. Cover and cook till the contents of the pot is well heated up when the contents of the pot have heated up, add the vegetable (if desired). Stir very well, cover the pot and turn off the heat.

For the purpose of this work, in order to avoid being biased the researcher prepared all the stock together in one pot and when the stock was ready it was sheared into three equal parts measuring 2 liters each. Then the thickeners were added.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

This research work compared the nutritional value and acceptability of Ogbono and Okoho Soups among families in Kaduna State. The chapter presented and analyzed the data collected in the course of the study under the following headings:

4.1 Answers to Research Questions

4.2 Test of Null Hypotheses

4.3 Summary of Major Findings

4.4 Discussions of Major Findings

4.1 Answers to Research Questions

The analysis of data used to answer the three research questions is as presented in

Table 4.1 to 4.4

Research Question One: What is the proximate composition of *Cissus populnea* (Okoho) and *Irvingia gabonensis* (Ogbono)?

Table 4.1: Percentage Mean of proximate composition of *Cissus populnea* (Okoho) and *Irvingia gabonensis* (Ogbono)

	MC	AC	PC	LC	FC	CHOC	MC	Decision
Ogbono	5.56	11.61	7.77	68.2	1.44	6.85	0.619	
Dried Okoho	2.77	5.02	3.9	11.9	3.63	76.7	1.401	Fresh Okoho plants is better
Fresh Okoho	53.7	0.76	26.86	11.94	0.093	4.60	2.661	

Key: MC=Moisture Content, AC=Ash Content, PC=Protein Content, LC=Lipid Content, CHO=Carbohydrate Content, MC=Mineral Content

Table 4.1 showed the percentage mean of proximate analysis of nutrient composition of Ogbono, dried Okoho and fresh Okoho. The results revealed that Ogbono contained 5.56% moisture, 11.61% ash, 7.77% protein, 68.2% lipid, 1.44% fibre, 6.85% carbohydrates and 0.619 minerals. Dried Okoho contained 2.77% moisture, 5.02% ash, 3.9% protein, 11.9% lipid, 3.63% fibre, 76.7% carbohydrates and 1.401 minerals. And fresh Okoho contained

53.7% moisture, 0.76% ash, 26.86% protein, 11.94% lipid, 0.093% fibre, 4.60% carbohydrates and 2.661. The results therefore, showed that there is difference in moisture, ash, protein, lipid, fibre, carbohydrates and mineral compositions of Ogbono, dried and fresh Okoho. The analysis of hypothesis one will show whether the differences that exist in proximate compositions of Ogbono, dried and fresh Okoho are statistically significant.

Research Question Two: What is the difference in proximate composition of Okoho and Ogbono soups?

Table 4.2: Mean percentage differences in proximate composition of Okoho and Ogbono soups

	MC	AC	PC	LC	FC	CHOC	MC	Decision
Ogbono	24.79	1.34	9.62	51.27	0.35	13.31	0.774	Fresh Okoho soup contains more nutrients
Dried Okoho	27.9	1.25	15.5	50.7	0.21	4.63	1.47	
Fresh Okoho	30.1	1.06	15.89	51.07	0.42	1.61	2.176	

Key: *MC=Moisture Content, AC=Ash Content, PC=Protein Content, LC=Lipid Content, CHO=Carbohydrate Content, MC=Mineral Content*

Table 4.2 showed the mean percentage differences in proximate analysis of nutrient composition of Ogbono, dried Okoho and fresh Okoho soups. The results revealed that Ogbono soup contained 24.79% moisture, 1.34% ash, 9.62% protein, 51.27% lipid, 0.35% fibre, 13.31% carbohydrates and 0.774 minerals. Dried Okoho soup contained 27.9% moisture, 1.25% ash, 15.5% protein, 50.7% lipid, 0.21% fibre, 4.63 % carbohydrates and 1.47 minerals. And fresh Okoho soup contained 30.1% moisture, 1.06% ash, 15.89% protein, 51.07% lipid, 0.42% fibre, 1.61% carbohydrates and 2.176 minerals. The results therefore, showed that there is difference in moisture, ash, protein, lipid, fibre, carbohydrates and mineral compositions of Ogbono, dried and fresh Okoho soups. The analysis of hypothesis one will further show whether the differences that exist in proximate compositions of Ogbono, dried and fresh Okoho soups are statistically significant.

Research Question Three: What is the difference in the physical properties of Okoho and Ogbono soups?

Table 4.3: Mean scores for the physical properties of Ogbono, dried and fresh Okoho soups

Viscosity	V V 4*	V 3*	IV 2*	VIV 1*	Total	\bar{X}	SD	Decision
Ogbono	5 (20)	9 (27)	5(10)	0(0)	57	3.0	.67	Fresh
Dried Okoho	8(32)	8(24)	2(4)	1(1)	61	3.2	.74	Okoho is VV
Fresh Okoho	10(40)	8(24)	1(1)	0(0)	65	3.4	.53	
Appearance	HA 4*	A 3*	FA 2*	NA 1*				
Ogbono	9(36)	7(21)	1(2)	2(2)	61	3.2	.84	Fresh
Okoho	8(32)	6(18)	4(8)	1(1)	59	3.1	.93	Okoho is HA
Fresh Okoho	12(48)	6(18)	1(1)	0(0)	67	3.5	.50	
Aroma	HA 4*	A 3*	M 2*	U 1*				
Ogbono	7(28)	8(24)	2(4)	2(2)	58	2.8	.68	Fresh
Dried Okoho	8(32)	4(12)	4(8)	3(3)	55	2.9	.85	Okoho is HA
Fresh Okoho	11(44)	7(21)	1(1)	0(0)	66	3.4	.52	
Taste	HA 4*	A 3*	M 2*	U 1*				
Ogbono	4(16)	7(21)	6(12)	2(2)	51	2.9	.87	Fresh
Dried Okoho	9(36)	7(21)	3(6)	0(0)	63	3.3	.95	Okoho is HA
Fresh Okoho	13(52)	5(15)	1(1)	0(0)	68	3.6	.49	

Keys; VV= Very viscid, V= Viscid, IV=In-viscid, VIV=Very in-viscid, HA=Highly attractive, A=Attractive, FA=Fairly attractive, NA=Not attractive, M=Manageable, U=Unacceptable

The analysis of results in Table 4.4 showed the physical properties of Ogbono, dried and fresh Okoho soups among families in Kaduna State. The results revealed mean scores of 3.0, 3.2 and 3.4 for viscosity of Ogbono, dried and fresh Okoho soups respectively. Mean score of 3.2, 3.1 and 3.5 were also obtained for appearance of Ogbono, dried and fresh Okoho soups. For the aroma, Ogbono soup has 3.0, dried Okoho soup has 2.9 while fresh Okoho soup has 3.4. Regarding the taste, Ogbono soup had 2.9 mean score, dried Okoho soup had 3.3 while fresh Okoho soup scored 3.5 mean. This implied that the viscosities of the three soups are highly acceptable. The appearances of all soups are also highly acceptable, but the aroma of fresh Okoho soup is highly acceptable than dried

Okoho and Ogbono. The taste of fresh Okoho soup is also highly acceptable than the others as observed by the family members.

Research Question Four: What is the difference in the general acceptability of Ogbono, dried and fresh Okoho soups among families?

Table 4.4: Mean scores for general acceptability of Okoho and Ogbono soups

Acceptability	HA 4*	A 3*	M 2*	U1*	Total	\bar{X}	SD	Decision
Ogbono	5(20)	7(21)	4(8)	3(3)	52	2.7	.68	Fresh Okoho soup is more acceptable
Dried Okoho	10(40)	8(24)	1(1)	0(0)	66	3.4	.75	
Fresh Okoho	14(56)	4(12)	1(1)	0(0)	69	3.6	.50	

Keys;HA=Highly attractive, A=Attractive, FA=Fairly attractive, NA=Not attractive, M=Manageable, U=Unacceptable

The analysis of results in Table 4.4 showed the general acceptability of Ogbono, dried and fresh Okoho soups among families. The results revealed mean score of 2.7 for Ogbono soup, 3.4 for dried Okoho soup and 3.6 for fresh Okoho soup. This implied that all the soups are good (acceptable) but fresh Okoho soup is highly acceptable than Ogbono and dried Okoho soups by the family members.

4.2 Test of Null Hypotheses

Results of test of null hypotheses were presented in Table 4.6 to 4.9.

HO₁: There is no significant difference in the proximate composition of *Cissus populnea* (Okoho) and *Irvingia gabonensis* (Ogbono)

Table 4.5: ANOVA statistics on differences in proximate composition of *Cissus populnea* (Okoho) and *Irvingiagabonensis* (Ogbono)

Sample	X	SD	Sum of Square	Mean Square	F	Sig.	Decision
Ogbono	14.578	23.940					Retained
Dried Okoho	15.049	27.395					
Fresh Okoho	14.373	19.707					
Between Groups			1.663	.831			
Within Groups			10272.434	570.691	.001	.999	

Table 4.5 shows the differences in the proximate compositions of *Cissus populnea* (Okoho) and *Irvingiagabonesis* (Ogbono). The result revealed mean score of 14.578 for Ogbono, 15.0500 for dried Okoho and 14.373 for fresh Okoho. The F-cal. value of .001 at significant p-value of .999 was obtained. The mean scores of the 3 sample showed differences in the proximate compositions but the difference is not statistically significant since p-value of .999 is greater than alpha value of 0.05 level of significance. Hence, the null hypothesis that says there is no significant difference in the proximate composition of *Cissus populnea* (Okoho) and *Irvingia gabonesis* (Ogbono) is retained and the alternate hypothesis was rejected. This means that the proximate compositions of Ogbono, dried Okoho and fresh Okoho are the same.

HO₂: There is no significant difference in the proximate composition of Okoho and Ogbono soups

Table 4.6: ANOVA statistics on difference in the proximate composition of Okoho and Ogbono soups

Soups	X	SD	Sum of Square	Mean Square	F	Sig.	Decision
Ogbono	14.4934	18.461					
Dried Okoho	14.5229	18.876					
Fresh Okoho	14.6180	19.4913					
Between Groups			.059	.030	12.00	.967	Retained
Within Groups			6462.392	359.022			

Table 4.6 shows the differences in the proximate compositions of Ogbono, dried Okoho and fresh Okoho soups. The result revealed mean score of 14.4934 for Ogbono, 14.5229 for dried Okoho and 14.6180 for fresh Okoho. The F-cal. value of 12.00 at significant p-value of .967 was obtained. The mean scores showed little difference in the proximate compositions of the 3 soups but the difference is not statistically significant since calculated p-value of .967 is greater than alpha value of 0.05 level of significance. Hence,

the null hypothesis that says there is no significant difference in the proximate composition of Okoho and Ogbono soups is retained and the alternate hypothesis was rejected. This means that the proximate compositions of Ogbono, dried Okoho and fresh Okoho soups are proximately the same.

HO₃: There is no significant difference in the physical properties of Okoho and Ogbono soups

Table 4.7: ANOVA statistics on difference in the physical properties of Okoho and Ogbono soups

Soups	X	SD	Sum of Square	Mean Square	F	Sig.	Decision
Ogbono	2.7053	.684					
Dried Okoho	3.4053	.758					
Fresh Okoho	3.6000	.500					
Between Groups			34.140	17.070	121.625	.000	Rejected
Within Groups			7.579	.140			

Table 4.7 shows the differences in the physical properties of Ogbono, dried Okoho and fresh Okoho soups. The result revealed mean score of 2.1053 for Ogbono, 3.1053 for dried Okoho and 4.0000 for fresh Okoho. The F-cal. value of 121.625 at significant p-value of .000 was obtained. The mean scores showed variations in the physical properties of the 3 soups and the difference that exists is statistically significant since calculated p-value of .000 is less than alpha value of 0.05 level of significance. Hence, the null hypothesis that says there is no significant difference in the physical properties of Ogbono, dried Okoho and fresh Okoho soups is rejected and the alternate hypothesis was retained. This means that the physical properties of Ogbono, dried Okoho and fresh Okoho soups are not the same.

HO₄: There is no significant difference in the general acceptability of Okoho and Ogbono soups among families in Kaduna State

Table 4.8: ANOVA statistics on difference in the general acceptability of Okoho and Ogbono soups among families in Kaduna State

Soups	X	SD	Sum of Square	Mean Square	F	Sig.	Decision
Ogbono	2.7158	.68757					
Dried Okoho	3.5474	.75126					
Fresh Okoho	2.5263	.50299					
Between Groups			13.930	6.965	23.820	.000	Rejected
Within Groups			15.789	.292			

Table 4.8 shows the differences in the general acceptability of Ogbono, dried Okoho and fresh Okoho soups. The result revealed mean score of 2.7158 for Ogbono, 3.5474 for dried Okoho and 2.5263 for fresh Okoho. The F-cal. value of 23.820 at significant p-value of .000 was obtained. The mean scores showed variations in the general acceptability of the 3 soups and the difference that exists is statistically significant since calculated p-value of .000 is less than alpha value of 0.05 level of significance. Hence, the null hypothesis that says there is no significant difference in the general acceptability of Ogbono, dried Okoho and fresh Okoho soups is rejected and the alternate hypothesis was retained. This means that dried Okoho soup is more acceptable than Ogbono and fresh Okoho soups.

4.3 Summary of Major Findings

Based on the analysis of data collected from the study, the summary of the major findings were as follows:-

1. Ogbono, dried Okoho and fresh Okoho contained varying percentages of Moisture, Ash, Protein, Lipids, Fibre, Carbohydrates and Minerals but the variation is not significant (F-cal.=.001, P=.999).

2. Ogbono, dried Okoho and fresh Okoho soups varied in the proximate composition but the proximate variation of the soups is not significant (F-cal.=12.00, P=.967).
3. Ogbono, dried Okoho and fresh Okoho soups are different in physical properties and the difference that exists in the physical properties is significant (F-cal.=121.625, P=.000).
4. There exists difference in the general acceptability of Ogbono, dried Okoho and fresh Okoho soups. Dried Okoho soup is more acceptable than Ogbono and fresh Okoho soups among family members in Kaduna state (F-cal.=23.820, P=.000).

4.4 Discussion of Findings

The finding of the study revealed that Ogbono, dried Okoho and fresh Okoho contained varying percentages of moisture, ash, protein, lipids, fibre, carbohydrates and minerals but the variation is not significant. This finding concurs with the report of Kone (2004) who found that Okoho plant contains many nutritional values and the extracts have been credited with antibacterial properties as an anti-trypanosomal plant and a source of gum powder. Atawodi (2002) also reported that in addition to nutritional benefits, Okoho has a component of herbal anti-sickling Nigerian formula. Moody (2003) lamented that in Benin Republic, Okoho is used as food and it contains diuretic properties which increase the amount or frequency of urination.

Moody (2003) further reported that in Ghana Okoho is used as a post-harvest ethnobotanical protectant. Belmain (2000) further stressed that the aqueous extract of Okoho stem bark is associated with aphrodisiac/fertility potentials among the Yoruba-speaking people of South West Nigeria, where it is observed that men consume the aqueous and ethanolic extracts copiously and consistently for long periods of time either in mono or polyherbal formulations. Similarly, Wright (2011) reported that Ogbono is a palatable plant eaten by many people which some classes of food and can be used for a fruit drink and for

jam production. The kernel can be processed into flour by extraction, drying and grinding. The pounded seed is added to meat and various vegetable dishes as a sauce. Margarine and cooking oil can be obtained from the kernels. *Cissus populnea* is a plant associated with a myriad of medicinal uses in different parts of the world. It used as Laxative and it has anti-diarrhea Activity from its viscosity (Adebowale *et al.*, 2007). Some food gums have laxative and anti-diarrhea activity mainly due to their dietary fibre content. In Pharmaceutical Application, the gum of *Cissus populnea* is applied in pharmaceutical and cosmetic products as building agent and stabilizers (Adebowale *et al.*, 2004). *Cissus populnea* and other food gums with higher fibre content lower the incidence of cardiovascular disease (CVD) and cholesterol level; the symptoms of diverticular diseases are alleviated by increasing intakes of dietary fibre.

Another finding of this research study revealed that Ogbono, dried Okoho and fresh Okoho soups varied in the proximate composition but the proximate variation of the soups is not significant. This is further confirmed by the report of Nestle (2013) and Fuhrman (2014) which stated that the nutritional values of slimy plants which are used as food or soups are almost the same ranging from carbohydrate, fat, protein, water, vitamins and mineral contents.

The finding of this study also revealed that Ogbono, dried Okoho and fresh Okoho soups are different in physical properties and the difference that exists in the physical properties is significant. This is in line with the report of Ibrahim (2011) who lamented that Okoho is the main traditional food peculiar to the Idoma people of Benue State, Central Nigeria. It is made from the plant *Cissus populnea* belonging to the family Ampelidaceae (Vitaceae). It is a soup made from the Okoho stick which is very slimy after preparation. It is usually prepared with bush meat (such as grass-cutter, alligator and smoked meat etc.) and best served with pounded yam (aka Onihi). It can also be eaten with semolina, eba

(made from gari) and yam floor. This soup is usually prepared without the use of oil (Ibrahim *et al.*, 2011). It is the most respected and demanded food in all Idoma events such as; traditional weddings, burial ceremonies, birthdays and other festivities. Okoho soup is highly medicinal and also known for its ability to aid digestion. Other Nigerian tribes such as Ibos and Igalas also refer to it as Okoho, while the stick is known as Ajara or Orogbolo by the Yoruba tribes of northern and southern Nigeria. The Hausas usually call it Dafara. Okoho is a species of plant grows in the savannah and is widely distributed in Senegal, Sudan, Uganda, Abyssinia and Nigeria. It is commonly known as 'okoho' by the Idoma's, Igbo and Igala tribes of Nigeria, 'Dafara' (Kano, Zaria); 'Latutuwa' (Katsina) by the Hausa language of the indicated towns of Northern Nigeria 'Ajara' or 'Orogboro' by the Yoruba tribes of Northern Nigeria and Southern Nigeria.

The finding of this study also revealed that there exists difference in the general acceptability of Ogbono, dried Okoho and fresh Okoho soups. Dried Okoho soup is more acceptable than Ogbono and fresh Okoho soups among family members in Kaduna state. This is in line with the report of Ibrahim (2011) who stressed that Okoho soup most especially the dried one today is more acceptable even among other tribes and societies other than Idoma.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter was presented under the following sub-headings

- 5.1 Summary
- 5.2 Conclusion
- 5.3 Contributions to Knowledge
- 5.4 Recommendations
- 5.5 Suggestions for further study

5.1 Summary

The research work was on comparative study of the nutritional value and acceptability of ‘Ogbono’ “*Irvingia gabonensis*” and ‘Okoho’ “*cissus populnea*” soups among families in Kaduna State, Nigeria. The study had three specific objectives, three research questions and two null hypotheses. The study discussed nutritional values and benefits of Ogbono and Okoho plants as well as sensory evaluation. The researcher adopted experimental design. The population of the study was all families in Kaduna state. Nineteen (19) panelists were used as sample for the study. Okoho was collected from the southern part of Kaduna state while the Ogbono sample was brought from Opanda village in Apa Local Government Area of Benue state. Proximate analysis was used to obtain the nutritional compositions of Okoho and Ogbono while structured score card was used to obtain data on acceptability of the food product under study.

Experts from Home Economics Department validated the instrument and it was pilot tested in food laboratory, Department of Home Economics, Ahmadu Bello University Zaria. Frequency and percentages were used to describe the bio-data of the respondents and mean scores and standard deviation were used to answer all research questions. ANOVA used to test all the null hypotheses at significant level of 0.05. Based on the findings the revealed

that Ogbono, dried Okoho and fresh Okoho contained varying percentages of moisture, ash, protein, lipids, fibre, carbohydrates and minerals but the variation is not significant. Ogbono, dried Okoho and fresh Okoho soups varied in the proximate composition but the proximate variation of the soups is not significant. Ogbono, dried Okoho and fresh Okoho soups are different in physical properties and the difference that exists in the physical properties is significant. There exists difference in the general acceptability of Ogbono, dried Okoho and fresh Okoho soups. Dried Okoho soup is more acceptable than Ogbono and fresh Okoho soups among family members in Kaduna state.

5.2 Conclusion

Based on the findings of this study, it is concluded that the nutritional compositions of fresh and dried Okoho and Ogbono plants are not significantly different and fresh Okoho soup is more attractive and highly acceptable than dried Okoho and Ogbono soups among families in Kaduna.

5.3 Contributions to Knowledge

Based on the findings of this study, the following contributions to knowledge were established:

1. Fresh Okoho soup is more viscos than dried Okoho and Ogbono soups.
2. Dried Okoho soup contains more fibre than fresh Okoho and Ogbono soups.
3. Ogbono soup has a taste which fresh Okoho and dried Okoho soups do not have.
4. Fresh Okoho soup is more accepted by families in Kaduna State over dried Okoho and Ogbono soups.
5. Fresh Okoho soup has more aroma and more tasty than dried Okoho and Ogbono soups.

5.4 Recommendations

Based on the findings of the study, the following recommendations were made.

1. Consumers should be enlightened that the nutritional compositions of Ogbono as well as fresh and dried Okoho are the same. They can be used to substitute one another
2. Consumers should be educated on the health benefits of consuming Ogbono, dried Okoho and fresh Okoho and their ability to substitute one for the other.
3. Due to the differences in the physical properties of Ogbono, dried Okoho and fresh Okoho, farmers, distributors/sellers and consumers should be enlightened on their handling for longevity.
4. There should be awareness campaign by Home Economist and Nutritionist on the nutritional contents and benefits of fresh Okoho and Ogbono as supplements that can cater for the nutritional deficiency of individuals.

5.5 Suggestions for Further Studies

The researcher suggested that further studies should be conducted on:-

1. Comparative study of the nutritional value and acceptability of 'Ogbono' "*Irvingia gabonensis*" and 'Okoho' "*cissus populnea*" soups among families should be conducted in other states for comparism.
2. More researches should be conducted to identify mineral contents other the ones identified in this study.
3. Further study should be conducted on the health benefits of Okoho and Ogbono and how it can alleviate nutritional disorder.

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APPENDIX I



DEPARTMENT OF VOCATIONAL & TECHNICAL EDUCATION
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HEAD OF DEPARTMENT: **Prof. E.E. Adamu**, OND (Kad Poly), B.Sc (Hons) ISU (USA) PGDE (ABU) M.ED (ABU) Ph.D. (ABU)

Your Ref: _____
P14EDVE8023
Our Ref: _____

19th October, 2016

Date: _____

Letter of Introduction

CHRISTIANA OYIGOWO ADAJI - P14EDVE8023

This is to certify that the above mentioned name is a Postgraduate student (M.Ed Home Economics) in the Department of Vocational and Technical Education, Faculty of Education, Ahmadu Bello University, Zaria, carrying out a research topic; ***Comparative Study of the Nutritional Value of "Ogbono" and "Okoho" Soups Among Families in KADUNA State, Nigeria.***

Please, kindly give her every assistance she may require.



Professor E.E. Adamu
HEAD OF DEPARTMENT

APPENDIX II

Department of Home Economics,

Faculty of Education,

Ahmadu Bello University, Zaria.

13thDec., 2017.

Dear Sir/Ma

REQUEST TO RESPOND TO A SCORE CARD

I am a postgraduate student of the above institution, conducting a research on “Comparative Study of the Nutritional Value and Acceptability of Ogbono” “*irvingia gabonensis*” and “Okoho” “*cissus pulpunea*” Soups among families in Kaduna state Nigeria”. Kindly respond to attached score card objectively in the sensory evaluation of the products. The information will be treated confidentially and mainly be used for research purpose.

Yours faithfully,

Christiana Oyigowo ADAJI
P14EDVE8023

APPENDIX III

SCORING CARD FOR ACCESSING THE PHYSICAL PROPERTIES AND ACCEPTABILITY OF OKOHO AND OGBONO AMONG FAMILIES IN KADUNA STATE.

Instruction: before you are samples of soup. Please evaluate and record your opinion and comment on the scorecard using the keys with the corresponding numbers to represent your observation.

Keys; VV= Very viscid (4), V= Viscid (3), IV=In-viscid (2), VIV=Very in-viscid (1), HA=Highly attractive (4), A=Attractive (3), FA=Fairly attractive (2), NA=Not attractive (1), HA= highly acceptable (4), A=Acceptable (3), M=Manageable (2), U=Unacceptable (1)

S/N	VARIABLES	SAMPLE A	SAMPLE B	SAMPLE C
1	VISCOSITY			
	Very viscid			
	Viscid			
	Inviscid			
	Very inviscid			
2	APPEARANCE			
	Highly attractive			
	Attractive			
	Fairly attractive			
	Not attractive			
3	AROMA			
	Highly acceptable			
	Acceptable			
	Manageable			
	Unacceptable			
4	TASTE			
	Highly acceptable			
	Acceptable			
	Manageable			
	Unacceptable			

	ACCEPTABILITY			
	Highly acceptable			
	Acceptable			
	Manageable			
	Unacceptable			

NEW FILE.

DATASET NAME DataSet1 WINDOW=FRONT.

DATASET ACTIVATE DataSet0.

T-TEST PAIRS=OGBONO WITH OKOHO (PAIRED)

/CRITERIA=CI (.9500)

/MISSING=ANALYSIS.

T-Test

[DataSet0]

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Pair OGBONO	14.5784	7	23.94084	9.04879
1 OKOHO	15.0500	7	27.40683	10.35881

Paired Samples Test

	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair OGBONO - 1 OKOHO	-.47157	36.79434	13.90696	-34.50066	33.55752	-.034	6	.974

DATASET ACTIVATE DataSet1.

T-TEST PAIRS=OGBONO.ACCEPTABILITY WITH OKOHO.ACCEPTABILITY (PAIRED)

/CRITERIA=CI (.9500)

/MISSING=ANALYSIS.

T-Test

[DataSet1]

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1 OGBONO.ACCEPTABILITY	2.5263	19	.61178	.14035
OKOHO.ACCEPTABILITY	3.3684	19	.59726	.13702

Paired Samples Test

	Paired Differences					T	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 OGBONO.ACCEPTABILITY - OKOHO.ACCEPTABILITY	-.84211	.76472	.17544	-1.21069	-.47352	-4.800	18	.000

APPENDIX IV



INSTITUTE FOR AGRICULTURAL RESEARCH, SAMARU

Ahmadu Bello University, P.M.B. 1044 Zaria - Nigeria

PRODUCT DEVELOPMENT RESEARCH PROGRAMME

website: www.iar-samaru.org

e-mail: iar20002001@yahoo.com

22nd June, 2017

Name of Department: Home Economics

Name of the Product tested: Ogbono and Okoho

Source of Product: Commercial

Title under which evaluation was conducted: proximate analysis

Objective of the test: Comparative Analysis

Year the test was conducted: 2017

Name(s) of lead and other evaluators of the product: Christina oyigowo Adaji, Ajayi S.L., Adamu E.E.

Proximate Analysis of Ogbonu and Okoho

S/N	Sample Name	% Moisture	% Ash	% Protein	% Lipid	% Fiber	% CHO
1	Ogbonu A	5.66	11.80	8.75	67.70	1.40	6.09
2	Ogbonu B	5.65	11.34	7.30	68.90	1.37	6.81
3	Ogbonu C	5.37	11.70	7.27	68.00	1.56	7.66
4	Okoho A	2.89	5.24	3.50	11.90	3.74	77.47
5	Okoho B	2.86	5.23	4.37	11.60	3.55	75.94
6	Okoho C	2.58	4.59	3.83	12.20	3.60	76.80


Dr A.D Halilu

Programme Leader



INSTITUTE FOR AGRICULTURAL RESEARCH, SAMARU

Ahmadu Bello University, P.M.B. 1044 Zaria - Nigeria

PRODUCT DEVELOPMENT RESEARCH PROGRAMME

website: www.iar-samaru.org

e-mail: iar20002001@yahoo.com

Name of Dept: Home Economics, A.B.U, Zaria


Name of the product: Ogbono and Okoho

Title in which the analysis was conducted: Proximate Analysis

Year the Analysis was conducted: 2018

Name(s) of lead and other evaluators of the product: Christiana Oyigowo Adaji, S.L Ajayi and E.E Adamu.

S/N	Sample Name	% Moisture	% Ash	% Protein	% Lipid	% Fibre	% CHO
1.	Sample A Ogb 1	24.80	1.35	9.43	51.29	0.40	13.13
2.	Sample A Ogb 2	24.58	1.30	9.75	51.36	0.30	13.01
3.	Sample A Ogb 3	25.00	1.36	9.70	51.15	0.36	12.79
4.	Sample B DO 1	27.78	1.28	15.50	50.78	0.20	4.66
5.	Sample B DO 2	28.00	1.24	15.50	50.55	0.24	4.71
6.	Sample B DO 3	28.14	1.25	15.45	50.64	0.20	4.52
7.	Sample C FO 1	30.45	1.00	15.25	51.22	0.40	2.08
8.	Sample C FO 2	30.05	1.10	16.00	51.00	0.40	1.25
9.	Sample C FO 3	30.00	1.09	16.40	51.00	0.45	1.51
10.	Sample D OG 1	53.41	0.71	26.93	11.91	0.10	7.04
11.	Sample D OG 2	54.01	0.86	26.95	11.94	0.09	6.24
12.	Sample D OG 3	53.74	0.70	26.80	11.99	0.09	6.77


Dr. S. M Bugaje

Ag. Programme Leader



INSTITUTE FOR AGRICULTURAL RESEARCH, SAMARU

Ahmadu Bello University, P.M.B. 1044 Zaria - Nigeria

PRODUCT DEVELOPMENT RESEARCH PROGRAMME

website: www.iar-samaru.org

e-mail: iar20002001@yahoo.com

Name of Dept: Home Economics, A.B.U, Zaria

Name of the product: Ogbono and Okoho

Title in which the analysis was conducted: Mineral Analysis

Year the Analysis was conducted: 2018

Name(s) of lead and other evaluators of the product: Christiana Oyigowo Adaji, S.L Ajayi and E.E Adamu.

S/N	Sample Name	P. Mg/L	K. Mg/L	Na. Mg/L	Ca. Mg/L
1.	Sample A Ogb 1	640.90	4000.00	15000.00	2800.00
2.	Sample A Ogb 2	641.94	4014.00	15000.00	2750.00
3.	Sample B DO 1	789.93	704.00	26000.00	1725.00
4.	Sample B DO 2	788.90	709.00	26110.00	1700.00
5.	Sample C FO 1	849.55	955.00	41000.00	1850.00
6.	Sample C FO 2	845.54	950.00	41200.00	1850.00
7.	Sample D OG 1	372.61	2750.00	16250.00	1395.00
8.	Sample D OG 2	373.67	2740.00	16274.00	1395.00


Dr. S. M Bugaje

Ag. Programme Leader



FACULTY OF AGRICULTURE
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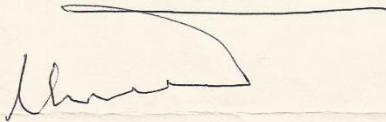
Your Ref.....

(Mg/Kg)

Our Ref.....

.....19.....

	Ca	K	Na	P
OKORO -	39500	13400	575	1863.05
OKOTO -	40500	13700	555	1937.57
OGBONSO -	17200	4525	142.50	3129.92
OGBOND -	16950	4450	133.75	3055.40



24-1-18

PROCEDURES OF PROXIMATE ANALYSIS

1 :) Determination of Moisture content (AOAC 1980)

Aluminum or plastic dishes were washed and dried to a constant weight in an oven at 100°C. They were later removed and cooled in a desiccator and weighed (W1). 2grams of the grounded (powder) sample was placed in the weighed moisture dish (W2). The dish containing the sample was kept in an oven for about 3hours, the sample were removed and cooled in the desiccator and weighed W3.

The % of moisture was calculated as:
$$\frac{W2-W3}{W2-W1} \times 100$$

2 :) Determination of Ash content

Crucibles were cleansed and dried in the oven, after drying; they were cooled in the desiccator and weighed (W1). 2grams of the grounded (powder) sample was placed in the crucibles and weighed (W2). They were transferred into the Muffle Furnace for about 550° C, then removed and cooled in the desiccator and weighed (W3).

The % of Ash was calculated as:
$$\frac{W3-W1}{W2-W1} \times 100$$

3:) Determination of Fibre

2grams of the sample was placed in a beaker containing 1.2ml of H₂SO₄ per 100ml of solution and boiled for about 30minutes, the residue was filtered and wash with hot water, the residue was transferred to a beaker containing 1.2gram of NaOH per 100ml of solution and boiled for about 30minutes, the residue was washed with hot water and dried in an oven and weighed (C2), the weighed sample was incinerated in a Furnace for about 550°C, remove and allow to cool, and weigh (C3).

The % of Fibre was calculated as: $\frac{C2-C3}{W} \times 100$

4:) Determination of Lipids (Fat)

- Dry 250ml clean boiling flask in oven, transfer into dessicator and allow cooling.
- Weigh empty filter paper and labeled W1
- Weigh 2gram of sample into labeled thimbles (filter paper). W2
- Fill the boiling flask with petroleum spirit or N-hexane.
- Assemble the soxhlet apparatus and allow refluxing for 8hours.
- Remove and transfer to an oven to dry.
- Transfer from the oven into a dessicator and allow cooling then weighing.

W3

The % of Fat was calculated as: $\frac{W2-W3}{W2-W1} \times 100$

W2-W1

5:) Determination of Protein

Digestion:

- Weigh out 0.5- 2gram of sample into a kjeldahl flask.
- Add catalyst (copper) and 15ml conc. Sulfuric Acid (H₂SO₄).
- In the fume cupboard, heat till solution assumes a green colour.
- Cool and wash down any black particles showing at the mouth and neck of the flask with distilled water.
- After cooling, transfer the digest with several washings into 100ml with distilled water.

Distillation:

- Before use, steam through the Markham distillation apparatus for about 15minutes.

- Under the condenser, place a 100ml conical flask containing 10ml of Boric indicator.
- Pipette 10ml of the digest into the body of the apparatus via the small funnel aperture; wash down with distilled water followed by 10ml of 40% NaOH solution.
- Steam through for about 5-7 minutes to collect ammonium sulphate. (about 30-40ml)
- Removed the receiving flask and wash down the tip of the condenser into the flask.

Titration:

Titrate the solution in the receiving flask using N/100 (0.01N) hydrochloric acid and calculate the Nitrogen content and hence the Protein content of the sample.

NB: Always run a blank through along with the sample.

The % of protein was calculated as: Final reading –Initial reading-blank (0.2) x standard number of Nitrogen (1.4) divide by initial weight (0.5) x standard number of protein (6.25)

6:) Determination of Carbohydrate (CHO) (Pearson 1976)

By difference, in this method carbohydrate content is obtained by calculations having estimated all other fractions by proximate analysis i.e.

$$=100- (\% \text{ of moisture} + \% \text{Ash} + \% \text{Protein} + \% \text{Fat})$$

APPENDIXV



Ingredients



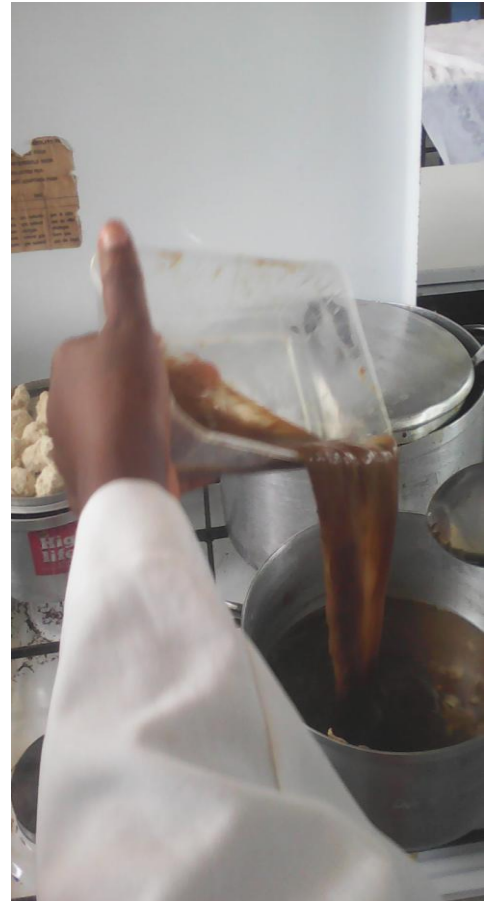
Before preparation



Ogbono soup



Dry okoho soup



Fresh Okoho



Fresh okoho



After preparation



Researcher with her supervisors



Researcher with some members of the panelists

