ORGANOLEPTIC ATTRIBUTES AND ACCEPTABILITY OF WHOLE WHEAT BREAD FORTIFIED WITH MORINGA LEAF FLOUR

BY

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PG/M.Ed/12/63677

DEPARTMENT OF HOME ECONOMICS AND HOSPITALITY MANAGEMENT EDUCATION, FACULTY OF VOCATIONAL AND TECHNICAL EDUCATION UNIVERSITY OF NIGERIA, NSUKKA

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TITLE PAGE

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF HOME ECONOMICS AND HOSPITALITY MANAGEMENT EDUCATION, FACULTY OF VOCATIONAL AND TECHNICAL EDUCATION UNIVERSITY OF NIGERIA, NSUKKA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS IN EDUCATION (M.Ed) DEGREE IN HOME ECONOMICS (FOOD AND NUTRITION)

SUPERVISOR: DR. N.M. EZE

OCTOBER, 2016

APPROVAL PAGE

This project has been approved for the Department of Home Economics and Hospitality Management Education, University of Nigeria Nsukka.

By

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CERTIFICATION

Obichili Obioma Irene, a post graduate student in the Department of Home Economics and Hospitality Management Education with Registration Number PG/M.Ed./12/63677 has satisfactorily completed the requirements for the award of the Masters in Education (M.Ed) degree in Home Economics Education (Food and Nutrition). The work embodied in this project is original and has not been submitted in part or full for any other diploma or degree of this or any other University.

Dr. N.M. Eze	**Obichili, Obioma. I.**
(Supervisor)	**(Student)**

DEDICATION

This project work is dedicated to the Trinity in one God for his faithfulness towards me.

ACKNOWLEDGEMENTS

The researcher thanks God Almighty for His faithfulness, favour, grace and mercies throughout the period of this study. The researcher is very grateful to her supervisor, Dr N.M. Eze for her steadfast effort in making sure that the project work is standard. Words cannot express her tremendous support, steadfastness, patience and advice.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figures

Abstract

The thrust of this work was to establish the organoleptic attributes and acceptability of whole wheat bread fortified with moringa leaf flour. The study adopted an experimental research design. The experimental procedure used includes that the whole wheat grains were bought from Eke Awka market and milled. The moringa oliefera leaves were plucked, washed, shade dried and grounded into moringa leaf flour. Two kilograms of whole wheat flour and other bread ingredients were used for each sample. Then six level tablespoons of moringa oliefera leaf flour was added to the second sample alongside with other necessary ingredients for the production of moringa wheat bread. The whole wheat bread was used as a control. The organoleptic attributes were ascertained using a 9-point hedonic rating scale by thirty seven (37) panel assessors. The data generated were analyzed using mean and standard deviation. T-test statistic was used to test the null hypothesis. The result of the findings of the study showed that the introduction of moringa oliefera leaf flour on the whole wheat bread had influence on the colour, taste, texture, flavor and general acceptability of the bread product. The moringa wheat bread ranked highest in taste, flavor and general acceptability of the bread product. While the colour and texture of whole wheat bread was much preferred. In conclusion the moringa leaf flour added to the bread product was mostly accepted by the panelists. It was recommended that government, organizations and researchers should conduct seminar, conferences and workshop on the need to fortify cereals and other food products with moringa leaf flour.

CHAPTER ONE

INTRODUCTION

Background of the Study

Cereals are the most staple food consumed by people all over the world. It forms the most basic source of food for a wide population. Cereals are the most important crops in the world. A cereal is a grass, a member of the monocot family, Poaceae, cultivated for the edible components of its grain composed of the endosperm, germ and bran (National Institute of Industrial Research (NIIR) Project Consultancy Services, 2008). Cereal are grown in greater quantities and they provide more food energy worldwide than any other type of crop. An example of cereals includes maize, millet, rice, sorghum, wheat and so on. The seed of the cereals are called grains. Whole grains are grains in which the endosperm, bran and germ are retained after the grain have been processed and milled. Whole grains have all parts of the original kernel bran, germ and endosperm in the original proportions (Keri 2015).

Grains are loaded with vitamins, minerals, and nutrients. They also offer antioxidants and are high in fiber. Furthermore, NIIR (2008) pointed out that grains play an important role in meeting the nutritional need of the human population. Like any food, they are excellent sources of many nutrients, and low or void in other nutrients. The vitamin content varies from one or type of grain to another. According to the United States Department of Agriculture (USDA) (2012), a daily diet that includes a regular intake of whole grains can reduce the risk of chronic diseases, because they maintain the health and proper function of the body.

Whole grains help to lower blood pressure which is one of the most important risk factors for heart disease. Cheung (2014) and Debridge (2014) both noted that eating whole grains substantially lowers blood Cholesterol, Triglycerides, blood pressure and insulin level, any of these changes would be expected to reduce the risk of heart disease. Whole grains contain fibre

which helps to reduce the risk of Coronary heart disease. Some studies also have shown a correlation between regular whole grains intake and a reduced risk of heart disease, cancer and Diabetes (FAO, 2013; USDA, 2012; and Smith (2012). According to Cheung (2014), one gets fiber, a healthy plant based proteins, vitamins, minerals and a variety of phytochemicals that will improve your health from grains. Fiber makes one to feel fuller longer, help control blood sugar, lower high density lipoprotein HDL, or bad cholesterol and reduce colon cancer risk (Delbridge, 2014). A high fibre diet helps reduce tiredness, helps people to feed better and improves energy level. The benefits of a high fibre diet have been widely acknowledged amongst researchers and health care professionals for many years.

Other nutrients contained in whole grains includes B vitamins, Antioxidants, Iron, Magnesium, Zinc, Selenium and resistant starch. The USDA (2012) pointed out that the B-vitamins found in whole grains help in the body's metabolism by breaking down fat, protein and carbohydrate for energy which is needed for a strong nervous system. Cheung (2014) also explained that the whole grains are good sources of B vitamins, that is thiamin, Riboflavin, folate and Niacin. The whole grains include maize, rice, oats, barley, and wheat among others.

Wheat is amongst whole grain that has formed staple food for so many people. According to FAO (2013), maize, rice and wheat together accounted for 89% of all cereal production worldwide in 2012 and 43% of all food calories taken in 2009. Wheat is one of the oldest known foods that has survived centuries and spread over many countries (Lucette, 2014). The whole grain wheat is very rich in nutrients. When one eats whole grain wheat he/she benefits from many nutrients, vitamins, folic acid, iron, zinc and other minerals. Because of these richness of the grain, scientists have associated it with better physical and mental health. In its natural form wheat is a rich source of vitamins, minerals, carbohydrates, fats and oil and protein (FAO, 2009).

Whole wheat grain has three main parts: the germ, the endosperm and bran constituents of whole grain. Wheat as a type of whole grain has many other health benefits. According to Cheung (2014), it helps to control weight, redistribute fat, regulate blood sugar, deliver calcium, among others. Debridge (2014) also opined that wheat as a whole grain helps to reduce Asthma risk, lower cancer risks, protects teeth and gums, and helps one to live longer. Its fibre content helps in digestion by regulating bowel movements, helps wade off diverticulitis that is the condition in which little pouches form in the colon wall causing inflammation, constipation, diarrhea and pain. It also contains lactic acid which promotes 'good bacteria' in the large intestine.

Gross and Scott (2012) have noted the richness of whole wheat grain. Lucette (2014) associated whole wheat with better physical and mental health. Eating whole wheat grain lessens the risk of diabetes, and the presence of wheat bran fibre protects against colon cancer, and lower risk of heart diseases. Similarly, Smith (2014) supported the view that fibre intake has been associated with improved mental health, that the whole grain wheat is also said to have favorable effects on the skin, the vision and fertility. A high fibre meal gives the sensation of being quickly full and satisfied. It prevents one from having a second dose and allows one to resist the frequent snacks and sweet drinks, which are usually high in calories. Whole wheat grain is used in making bread.

Whole wheat bread is usually made with the bran, germ and endosperm of the wheat grain. Whole wheat bread is a type of bread made using flour that is entirely milled from whole wheat grains (Nutrition facts, 2014). Christensen (2015) opined that a whole wheat bread is a wonderful thing, the slices have a chewy texture with a deep nutty flavor.

On the contrary, Longo (2012) pointed out that there are health risks associated with the consumption of wheat because of its gluten content. Paleoleap (2013) pointed out that gluten is a

compound that composes about 80% of the protein found in barley, rye and wheat. This gluten found in wheat is said to upset people who suffer from diseases. Virtually all cereal grains contain toxic 'Prolamines' which are proteins that are extremely tough for humans to digest. These toxic prolamines give the plant a protection mechanism for their survival (Paleoleap 2013). Temyson (2013) pointed out that wheat contains the protein gluten, which harbors one of the worst prolamine offenders called gliadin. Gliadin has the most powerful toxic effects on the intestinal barrier and severely damages the gut lining in humans. This leads to iron deficiency which causes anaemia. However, if one is following a plant based diet or if one is challenged to get enough iron from any source, that Moringa Oleifera leaf is a good source.

Moringa tree is often regarded as tree of life and lots of awareness has been created as to its nutritional benefits to man. Moringa contains over ninety antioxidants. It gives more than 100% of the daily value of B_{12}, Riboflavin B_2 and Thiamin B, vital nutrients especially for celiac. It also contains more iron than a banana and more calcium than milk (Scoop, 2014). According to O'Byerne (2011), Moringa Oleifera is the most nutrient dense plant known to science. Two teaspoons of moringa leaf powder deliver about 2.5 grains of iron, comparable to a serving of beef or half a cup of cooked spinach. Danica (2011) described moringa as a genus of trees indigenous to southern India and Northern Africa. The leaves, flowers, bark, wood and roots of the moringa trees are used all over the world for a wide variety of medicinal, pharmacological and nutritional purposes, but it's the leaves of the species called Moringa Oleifera in particular which have become recognized in recent years as being highly beneficial to the human health. Scoop (2014) added that the leaves of the moringa tree are only recently making waves within the health community. The leaves are typically dried and ground up into a powder that is extremely rich in proteins, vitamins minerals, fatty Acids and likely a horde of other undiscovered benefits. Numerous scientific studies have journalised the nutritional

components and even antibiotic activity of moringa leaves, hence moringa is of serious benefit to celiac patients who endeavor to support their bodies nutritionally during convalescence. O'Byerne (2011) pointed out that, when moringa is dried in leaves they are incomparable source of vitamin $B_{2,}$ an essential player in the fight against anemia and that correcting a deficiency however is simple with moringa. The author emphasized that just two teaspoons of the powder provides a little over 100% of ones recommended daily allowance (RDA). In fact, moringa is currently being used to combat global poverty as its nutritional content makes it very close to a perfect food. This implies that moringa oleifera when absorbed in the body supplies so many nutrients which make the body function efficiently and free from diseases. Moringa Oliefera leaf being highly nutritious can be used to fortify some cereal foods.

Fortification is a means through which some foods deficient in one nutrient or the other can be enhanced by introducing those nutrients that has been lost during its processing. World Health Organization (WHO) and FAO (2010) defined fortification as the practice of increasing the content of an essential micro nutrient in a food before processing or not , so as to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health. It is one of the most scalable, sustainable and cost effective tools used to reduce malnutrition, enabling people to increase their nutrient intake consistently and safety, Global Alliance for Improved Nutrition (GAIN, 2015). Staple foods lack particular nutrients which may be caused due to soil of the region or inherent inadequacy of normal diet addition of micro nutrients to staple and condiments can prevent a large scale of deficiency diseases. According to FAO (2012), the most common fortified foods are cereals and cereals based products, milk and milk products, fats and oils, accessory food items, tea and other beverages and infant formulas. GAIN (2015) listed out fortified foods which includes vegetable oil with vitamin A and D, wheat and maize flour with iron, folic acid and other B vitamins and zinc, sauces and condiments such

as soy sauce with iron and salt with iodine. The combination of these nutrients in a food helps to solve public health problems. It is, therefore, important to determine the organoleptic attributes of cereals fortified with moringa oliefera leaf flour since the acceptability of a product is of utmost importance in product development.

Organoleptic attributes of food relates to the taste preference and actual food consumption. It is an experimental design and statistical analysis to be used by human senses (sight, smell, taste, touch and hearing) for the purpose of evaluating consumer products (Walker, 2004). Organoleptic attributes refers to identification of food products properties, scientific measurement of food products properties, analysis and interpretation of the identified and measured food products properties (Oliveira 2011). Eze and Mberekpe (2010) Opined that organoleptic attributes is a scientific discipline that applies principles of experimental design and statistical analysis to the use of human senses (sight, smell, taste, touch and hearing) for the purpose of evaluating consumer products. Factors such as perceived satiating or energy value of food, its health and nutritional characteristics can also contribute to ones eagerness to eat a particular food. Apart from the characteristics of the food itself and the sensations consumer experience when ingesting it, the degree of pleasure when consuming it can be influenced by consumer's attitude. Greenwood (2000) noted that the sensory aspects of food can be determined through measures of taste intensity, evaluation of flavour profile and assessments of food texture, aroma, colour, appearance and general acceptability. Sensory attributes are generally evaluated using Hedonic scale. For the purpose of this study, the organoleptic attributes of whole wheat bread fortified with moringa leaf flour, and whole wheat bread alone shall be evaluated. The attributes to measure are colour, taste, aroma, texture and general acceptability.

Acceptability on the other hand is the ability to agree with something or have a positive answer over a thing. It states or describes the degree or extent of once likeness over a product.

For any sensory evaluation to be successful, acceptable and yield good and dependable result, the product must be prepared using a standard or standardized recipe. Wheat as a whole grain is amongst the staple food that has lots of benefits apart from the gluten it contains which make people that have gluten intolerance suffer celiac disease. Whole wheat grain could help to combat such diseases when fortified with moringa leaves. As pointed out earlier when moringa is dried in leaves they are incomparable sources of vitamins B2 which helps in fighting anemia, one of the most prevalent symptoms of gluten intolerance. Therefore this study is set out to investigate into the organoleptic attributes and acceptability of whole wheat bread fortified with moringa leaf flour.

Statement of the Problem

Wheat is amongst whole grains that has formed staple food for so many people all over the world. Wheat is one of the oldest known foods that has survived centuries and spread over many countries. When eating whole grain wheat, the consumer benefits from all the following nutrients: vitamins, folic acid, iron, zinc and other minerals. However, Wheat contains gluten a protein that harbors one of the worst prolamine offenders called gliadin which has the most powerful toxic effect on the intestinal barrier, and severely damages the gut linning in humans. Many people now avoid whole wheat grain because of its gluten content.

In addition, wheat is among the small number of foods that contain measurable amounts of oxalates, naturally occurring substances found in plants. When these oxalates becomes too concentrated in body fluids they can crystallize and cause health problems. For this reason it is needful that whole wheat grains be fortified with some plant rich in nutrients so as to improve its nutritional value hence moringa oleifera plant could be used.

Moringa Oleifera is one of the most nutrient dense plant known to science and offers a package of complementary nutrient that works together for optimal iron absorption. However,

the acceptability and other attributes of moringa whole wheat bread when combined together is not yet certain. This study, therefore, sought to investigate the organoleptic attributes and acceptability of whole wheat bread fortified with moringa leaf flour.

Purpose of the Study

The main purpose of this study was to examine the organoleptic attributes and acceptability of whole wheat bread fortified with moringa leaf flour. Specifically, the study sought to:

1. Prepare whole wheat bread fortified with moringa leaf flour using standard recipe.
2. Prepare whole wheat bread using standard recipe.
3. Determine the organolepitc attributes of the two products (whole wheat bread and whole wheat bread fortified with moringa flour).
4. Determine the general acceptability of the two products.

Significance of the Study

The findings of this study would be of practical significance to food industry, celiac patients, families**,** researchers, dieticians, hospitals, teachers of nutrition, students, curriculum planners and home makers.

The findings of this study would be of enormous benefits to food industry as the acceptability of the moringa wheat bread would increase their customers. This would increase customers' patronage for wheat and turnover for the industry. The development of a new bakery product would surely expand the scope of the industry. The findings on the organoleptic attributes and the general acceptability of the products if discussed in workshops would equally be of great benefit to bakers; it would enable bakers to ascertain the choice of customers which would increase their productivity and help meet up to demands of individuals.

The findings of the study would be needful in diet- therapy which would help celiac patients to still consume wheat bread as the added moringa would not be harmful to their health. The celiac patients would also get the necessary health benefits contained in whole grains, this they would obtain when the dietician counsels based on the findings of this study. The findings of this study would also guide dieticians who are experts in diet after attending workshop to recommend "moringa wheat bread" for people and patients. This is because moringa is a highly nutrient dense plant with so many medicinal benefits which helps in combating, treating and preventing diseases.

Furthermore, families and home makers will through workshops or seminars that would be conducted on the findings of the study benefit from the findings on the organoleptic attributes and general acceptability of the product. The recipe used in the production would help them to bake bread at their homes, make them to be aware of nutritious products and enable them make good choice of bread products. The findings of this study, when presented at workshop and seminar's would help reduce diseases through proper nutrition as parents and home makers would be aware of the nutritive contents of wheat bread fortified with moringa leaves.

In addition, the findings of this study when discussed in conferences and workshop would be beneficial to researchers. The researchers would make good choice of baked food and expose them to various researchable topics that need to be carried out. Furthermore, the results of this study would help curriculum planners, after attending conferences and workshop centered on the finding of this study to include necessary food and nutrition program in colleges and institution curriculum especially in the areas that focuses on the use of plants in fortifying flour products.

Similarly, the findings from this study would be useful in solving micro-nutrient deficiency problems among communities, hospital and clinics because moringa oliefera leaves are highly medicinal. Both moringa and whole wheat had high nutritional value. The doctors and

health workers would use the result of this study to encourage mothers especially lactating mothers on the use of moringa to increase the flow of breast milk, and also to be used in preparing dishes in the home. Such program would practically reduce to the minimum the mortality and morbidity rate in the communities as well as improving their nutritional status.

Research Questions

The following research question guided the study.

1. What are the organoleptic attributes of whole wheat bread fortified with moringa leaf flour?
2. What are the general acceptability of whole wheat bread fortified with moringa leaf flour?

Hypotheses

The study was guided by the following null hypotheses which were tested at 0.05 level of significance:

1. There is no significant difference between the mean scores of whole wheat bread and whole wheat bread fortified with moringa leaf flour on their organoleptic attributes which include colour, taste, aroma and texture.
2. There is no significant difference between Whole wheat bread and moringa whole wheat bread on their level of acceptability

Scope of the Study

The scope of the study was delimited to organoleptic attributes and acceptability of whole wheat bread fortified with moringa oliefera leaf flour. The study was carried out at the Foods and Nutrition Laboratory, Department of Home Economics and Hospitality Management Education, Faculty of Vocational Technical Education, University of Nigeria Nsukka. The study was delimited to Post-graduate students and lecturers in the Department of Home economics and

Hospitality management Education, University of Nigeria, Nsukka. The study centered on baking whole wheat bread fortified with moringa leaf flour and baking whole wheat bread alone, and testing their organoleptic attributes Colour, taste, flavor, texture and their general acceptability.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter presents the review of literature related to this study under the sub-headings of: conceptual framework, theoretical framework, related empirical studies and summary of literature reviewed.

Conceptual Framework

- Wheat and whole wheat bread
- Moringa oleifera
- Organoleptic attributes of food products
- Fortification of food products

Theoretical Framework

- Theory of Evaluation
- Theory of consumers choice

Related Empirical Studies

Summary of Reviewed Literature

Conceptual Framework

Wheat and Whole Wheat Bread

Wheat is amongst the whole grains that has formed a staple food for many individuals. Wheat is one of the oldest known foods that has survived countries and spread over many countries (Skidmore, 2004). Maize, rice and wheat together accounted for 89% of all cereal production worldwide in 2012 and 43% of all food calories in 2009. Whole wheat grains are grains in which the endosperm, bran and germ are retained after the grain have been processed and milled. Whole wheat grains have all parts of the original kernel bran, germ and endosperm in

the original proportions (Keri 2015). The whole grain wheat is very rich in nutrient. When eating whole grain wheat we benefit from all the nutrients, vitamins, folic acid, iron, zinc and other minerals. They also offer antioxidants and are high in fiber. Furthermore National Institute of Industrial Research (2008) pointed out that wheat grain play an important role in meeting the nutritional need of the human population. Like any food, they are good to excellent sources of some nutrients and low or void in other nutrients, the vitamin content varies from one part of grain to another. According to the United States Department of Agriculture (USDA) (2012), a daily diet that includes a regular intake of whole grains can reduce the risk of chronic diseases, while maintain the health and proper function of the body.

Furthermore whole wheat grains help to lower blood pressure which is one of the most important risk factors for heart disease. Eating whole wheat grains substantially lowers blood Cholesterol, Triglycerides, blood pressure and insulin level, any of these changes would be expected to reduce the risk of heart disease. In addition, whole wheat grains contain fibre which helps reduce the risk of Coronary heart disease. Some studies also have shown a correlation between regular whole grains intake and a reduced risk of heart disease, cancer and Diabetes (FAO, 2013; USDA, 2012; and Smith (2012). Cheung (2014) viewed that one gets fiber, a healthy plant based proteins, vitamins, minerals and a variety of phytochemicals that will improve your health. Fiber is of various importance, it makes you feel fuller longer, help control blood sugar, lower low density lipoprotein LDL, or bad cholesterol and reduce colon cancer risk (Delbridge, 2014). Another Scientific research shows that a high fibre diet helps reduce tiredness, helps us to feed better and improves our energy level. The benefits of a high fibre diet have been widely acknowledged amongst researchers and health care professionals for many years.

Other nutrients contained in whole wheat grains include B vitamins, Antioxidants, Iron, Magnesium, Zinc, Selenium and resistant starch. The B- vitamins found in whole grains help with the body's metabolism by breaking own fat, protein and carbohydrate for energy which is needed for a strong nervous system. Cheung also explained that the whole grains are good sources of B vitamins that is thiamin, Riboflavin, folate and Niacin. However whole grains include maize, rice, oats, barley, wheat among others. Because of these riches of the grain, scientists have associated it with better physical and mental health. In its natural form it is a rich source of vitamins, minerals, carbohydrates, fats and oil and protein (FAO, 2009 Cheung 2014, USDA 2012)). Wheat has many other health benefits. It helps to control weight, redistribute fat, regulate blood sugar, and deliver calcium, among others. Wheat as a whole grain helps reduce Asthma risk, lower cancer risks, protects teeth and gums and helps one to live longer. Its fibre content helps in digestion by regulating bowel movements, helps wade off diverticulitis that is the condition in which little pouches form in the colon wall causing inflammation, constipation, diarrhea and pain. It also contains lactic acid which promotes 'good bacteria' in the large intestine (Cheung 2014, Debridge 2014).

Gross and Scott (2012) have noted the riches of wheat grain. Wheat has been associated with better physical and mental health. Eating whole wheat grain lessens the risk of diabetes and the presence of wheat bran fibre protects against colon cancer and that people who eat more whole grains have a lower risk of heart diseases. However, fibre intake has been associated with improved mental health, have favorable effects on the skin, the vision and fertility. A high fibre meal gives the sensation of being quickly full and satisfied. It prevents one from having a second dose and allows one to resist the frequent snacks and sweet drinks, which are usually high in calories. Whole wheat bread is usually made with the bran, germ and endosperm of the wheat grain. Whole wheat bread is a type of bread made using flour that is entirely milled from whole

wheat grains. Whole wheat bread is a wonderful thing, the slices have a chewy texture with a deep nutty flavor. (Lucette 2014, Smith (2014, Nutrition facts 2014, Christensen (2015))

Health Benefits of Wheat Grains

1. Controls obesity (especially in women) - Wheat has a natural ability to control weight in everyone, but this ability is more pronounced among women. The American Journal of Clinical Nutrition (2014) has shown through research that whole wheat, rather than refined wheat is a good choice for obese patients. Women who consumed whole wheat products over long periods showed considerably more weight loss than the others subjects.

2. Improves body metabolism- Saturated and Trans fats increase the chances of cardiovascular diseases risk. Whole grains like wheat are immensely effective on patients with metabolic disorders. Common types of metabolic syndromes include visceral obesity, also known as the "pear shaped" body, high triglycerides, low levels of protective HDL cholesterol and high blood pressure. Wheat protects against all of these conditions. Research has shown that foods made from refined grains not only tend to increase weight but they also increase the hazards of insulin resistance. Doctors recommend eating whole wheat bread and other fiber rich foods. The majority of fiber woks to help the digestive process in the body and improve the overall metabolism. Having a whole wheat diet is probably the most effective quick and enjoyable way to reduce metabolic syndrome but also to stay slim and healthy throughout one's life.

3. Prevents Type-2-diabetics- Wheat is rich in magnesium, which is a mineral that acts as a co-factor for more than 300 enzymes. These enzymes are involved in the body's functional use of insulin and glucose secretion. The FDA permits foods that contain whole grain by at least 51% weight and are also low in saturated fat and cholesterol,

which means a lower risk of coronary ailments and certain types of cancer. Moreover, regular consumption of whole grain wheat promotes healthy blood sugar. People who suffer from diabetes are able to keep their sugar levels under control by replacing rice with wheat in the diet.

4. Reduces chronic inflammation- The betaine content of wheat is what aids in the prevention of chronic inflammation. Betaine is usually found in whole wheat, beets and spinach. Inflammation is a key constituent in most types of rheumatic pains and also some rheumatic diseases. Thus, it is a good idea to eat a healthy amount of whole wheat food products that will actively reduce inflammation. Consumption of betaine affects a number of aspects in our body chemistry that assures a lower risk of chronic inflammation and other ailments like osteoporosis, heart disease, Alzheimer's disease, cognitive decline and type-2- diabetes.

5. Prevents Gallstones- In various surveys by the American Journal of Gastroenterology (2014), it has been proven that breads and cereals made from whole wheat help women to avoid gallstones. Since whole wheat is rich in insoluble fiber, it assures a quiet and smooth intestinal transit time and lowers the secretion of bile acids. Excessive bile acids are a major cause of gallstone formation. Moreover, a high intake of wheat increases insulin sensitivity and thereby lowers triglycerides or fat in the blood. Besides wheat, one also gets insoluble fibre from the edible skins of fruits and certain vegetables like cucumber, tomatoes, and squash, berries, apples and pears. Beans also provide both insoluble and soluble fiber.

6. Whole grain wheat assures a healthy lifestyle- Wheat is the most popular and easily available bulk laxative. Three cups of wheat consumption per day is enough for an individual to live a long, healthy and disease free life. When one maintains a fiber – rich

diet comprised of wheat breads and cereals that are high in bran, one can be confident that problems such as pain, flatulence, nausea, constipation and distension will be alleviated in no time. Diverticulitis often occurs due to inflammation and lower intestinal pains. This can also lead to chronic constipation and unnecessary straining, which can result in a sac or a pouch in the wall of the colon. Such cases can be easily dealt with naturally by keeping up with a fiber-rich diet and including whole grain wheat on a regular basis.

7. Promotes women's Gastrointestinal health- Benefits of wheat bran are bountiful and promoting over all women's health is yet another important role of this cereal variety. Wheat acts as an anti-carcinogenic agent, particularly in women. Wheat bran enhances the metabolic rate of estrogen, which often leads to breast cancer if left at an excessive level. In one survey of pre-menopausal women in the age group of 20 to 50, they ate 3 to 4 high fiber muffins per day made from wheat and they showed reduced blood estrogen levels by 17% in only two months. The other group of women eating corn bran did not show this result. Wheat contains Lignans which are phyto-nutrients acting as hormone-like substances. The lignans often occupy the hormone receptors of our body there by alleviating certain risk factors for breast cancer. Wheat bran considerably reduces bile acids secretion and bacterial enzymes in the stool, thereby cutting down chances of colon cancer. If you include bread, pasta and bran cereals in your daily diet , these ailments will be avoided.

8. Protective against breast cancer- Research at the UK women's cohort study found that a fiber-rich diet is extremely important for women to keep breast cancer at bay. Foods from whole grains like wheat and fruit provide significant safeguards for pre-menopausal women against breast cancer. Studies say that around 30grams of wheat consumed daily

is enough for women to reduce the risks of breast cancer. Reports say that pre-menopausal women who have consumed wheat had a 41% reduced risk of breast cancer in comparison to others who ate other forms of fiber.

9. Prevents childhood Asthma- The American Lung Association (2014) says that around 20 million Americans experience some forms of asthma. Studies have stated that whole grains and fish in the diet can lower the chances of childhood asthma to a great extent. The international study on allergy and asthma in childhood proved through numerous studies that a wheat-based diet has the capacity to lower chances of developing asthma by almost 50%. During the survey, the wheat diet was increased considerably and the mothers were given special diets high in fish and whole grains, this showed an almost 66% reduction in the possibility of becoming asthmatic. Bronchial hyper responsiveness is the key factor that encourages asthma. This condition is characterized by the narrowing of the airways and increased sensitivity. In many surveys, iit has been seen that children who eat wheat and fish in high amounts do not suffer from such ailments. The magnesium and vitamin E provided by wheat also contributes in reducing the problem of asthma. However, wheat also happens to be a food allergy closely linked with asthma.

10. Protects against coronary diseases- Plant lignans, a type of phytonutreint is abundant in whole wheat. These lignans are converted by responsive flora in the human intestines into mammalian lignans. One of these lignans is called enterolactone, which protects against breast and other hormone dependent cancers,as well as heart disease. Wheat is not the only source of lignans, as well as various other vegetables, fruits and beverages like coffee, tea and wine. A Danish Journal published in a recent article that women eating the most whole grains were found to have considerably higher blood levels of this defensive lignin.

11. Improves Cardiovascular system on post menopausal women- Whole wheat is supposed to be a primary element in the diet of post menopausal women so as to avoid any kind of cardiovascular problems. Daily intake of this whole grain cereal is the best way to avoid such ailments. Doctors prescribe a high wheat intake diet for women who are dealing with conditions like high blood pressure, high cholesterol, or other signs of cardiovascular syndrome. A survey has conducted that this kind of diet slows down the progression of atherosclerosis, which is the building plaque in the arteries and blood vessels as well as reducing the frequency of heart attacks and strokes.

12. Prevents heart attack- In United States, heart failure is the prime cause of hospitalization and death of elderly people. The medicinal drugs have been successful in certain cases, but natural remedies work much faster and with less of an impact on the rest of the body's systems. Hospitals use ACE inhibitors and beta- blockers, but the long term effect are not yet clear. Whole grain products and dietary fiber have been shown to considerably reduce blood pressure levels, therby checking the possibility of a heart attack. Of course, confounding factors like age, alcohol consumption, smoking, exercise and proper nutrition are equally important. Ample vitamins, vegetables and fruits are extremely important in such cases as well. There are various other forms in which one can serve wheat like bread, puddings and variety of baked good, (Martorell,2014, Anozie,2014, Delbridge,2014, Organic information services, 2015).

The health benefits of wheat are no longer unknown and people all over the world have experienced them by including wheat in their daily diet. This 'health food' reputation is due to the important B vitamins such as thiamin, folate and vitamins B6 and minerals magnesium, zinc and manganese content. Wheat can be easily integrated into cakes, burritos, brownies, waffles, bread, muffins, patties and pancakes or simply sprinkled over a favorite cereal or yogurt. Wheat

is probably the most common cereal available all over the world and is in even higher demand in recent years due to its abundant health benefits. Over the years wheat has shown itself to be one of the most successful and sustainable cereal crops in the world. It originated in south western Asia, but today it s grown in countless countries. Commonly, wheat cultivation is done at highest latitudes and primarily used for baking bread products. Foods like pasta, crackers, bagels, cakes and muffins are just a few common examples of wheat sources. Wheat is believed to be one of the most wholesome food items and it ensures a diet rich in nutrients.

Research has already proven that wheat is extremely beneficial for healthy living. Wheat considerably lowers the hazards of heart diseases owing to its comparatively low fat content. It also regulates blood glucose levels in diabetic patients. Wheat is able to provide one with an immense energy source due in all parts of the grain kernel including the Bran, Germ, and endosperm. The nutrient value of wheat is retained even after processing it into flour. However, if one wish to get the maximum benefit out of wheat products, its advisable to choose wheat products that are made from whole wheat flour rather than refined varieties,(Anozie,2014)

Wheat Varieties

The health benefits of wheat greatly depend on the form in which one consumes it. While whole wheat is extremely nutritious the benefits of wheat are reduced if one eat bleached white flour which is obtained by processing after only 60% extraction, this is observed in noodles, breads and pasta, as well as in baked goods like rolls, biscuits and cookies. In these food 40% of the original wheat grain was removed and one get only the remaining 60%. Usually the 40% that is removed- the outer brown layer contains the highly nutritious bran and the germ of the wheat grain. In the process of making 60% abstraction flour, more than half of the vitamin $B_{1,}B_{2,}B_{3,}$E, calcium, phosphorus, folic acid, copper, zinc, iron and fibres are lost. If one buys 100% whole wheat products, one is assured of all the nutrients of the bran and the germ, as well as the

endosperm. In recent years, the nutritional value of whole wheat is being recognized by consumers. Low- carbohydrate diets and an increase in the whole wheat cereal market are prevalent around the world, especially in the Mediterranean. Just like in whole wheat, wheat germ is a rich source of nutrients. Wheat germ has an abundance of vitamins and minerals, but it is particularly rich in Vitamin E. Wheat germ is known to be a main source of the vitamin B complex in dietary structures throughout the world and includes vitamins like thiamin, folic acid, vitamin B_6 and minerals like Manganese, magnesium and zinc. The wheat germ oil improves strength and increases life span, (Delbridge, 2014, Dick, 2015, FAO, 2009).

Nutritional Value of Wheat

Wheat is rich in Catalytic elements, mineral salts, calcium, magnesium, potassium, sulfur, chlorine, arsenic, silicon, manganese, zinc, iodide, copper, vitamin B and vitamin E. this wealth of nutrients is why wheat is often used as a cultural base or foundation of nourishment. Issues like anemia, mineral deficiencies, gall stones, breast cancer, chronic inflammation, obesity, asthenia, tuberculosis, pregnancy problems and breast feeding problems are quickly improved by consuming whole wheat. Wheat is also recommended to treat sterility. Since germinated wheat comprises 2 or 3 times more vitamin B than common wheat, the seeds are used for useful for treating gastro intestinal conditions, skin diseases, respiratory illnesses and cardio vascular ailments. Wheat is also known to help balance cholesterol levels and protect the heart, (Organic information services, 2015).

1. Bread- Bread of the products made from wheat grain. Bread making can be said to be an art which is carried out scientifically. The ingredients used in making bread should be of good quality, and also the optimum temperatures and humidity levels should be strictly maintained. Every ingredient used in the making of bread has a particular role to play in achieving the final, desired product. These ingredients however, perform well only when

certain conditions are met and are highly dependent on each other to perform that particular function to the desired level. For example, yeast performs well in the presence of sugar as well as moisture. Thus, it becomes essential to understand the nature of each of these ingredients in detail, how they will affect the final product, and how to manipulate these materials to achieve the desired products. The ingredients used in bread making includes;

2. **Flour**- it is the main ingredients used in making breads. Usually strong flours are used in bread making. Whole wheat flours have lesser concentration of gluten as the bran content is increased. Whole wheat flour is milled from the entire wheat kernel, this is light brown in colour and contains all of wheat natural nutrients. A healthy addition to bread This causes a weaker structure in the bread. Since the bran particles are slightly abrasive, they cut the gluten fibres resulting in a loaf with a smaller crumb. The presence of the bran particles also allows a higher moisture absorption, resulting in a short fermentation time. When the germ is present in the flour there is a higher enzyme activity, as a result of which the gluten develops faster and the breads are made with a shorter fermentation time.

3. **Water**- water is the most commonly used liquid in bread making. It moistens the flour and helps in forming the dough. It also aids in the baking process. Water performs the following three main functions in bread dough; helps hydrate and moisten the insoluble proteins; disperses the yeast amongst the entire dough; binds the flour and other ingredients into dough. It is observed that the water content in the dough greatly affects the rate of fermentation. The speed of fermentation is greater in ferment and dough process as compared to sponge and dough process, which have an increasing level of hydration. As the fermentation time increases it becomes essential to reduce the water

content to effect a higher ripening of the dough. The amount of water present will also greatly affect the texture of the final dough obtained. Hard water has a higher alkalinity. As yeast works best in an acidic medium, fermentation can be slower in the initial stages if hard water is used. However, as the fermentation proceeds the acids produced will neutralize this alkalinity and then the fermentation will continue at a brisk pace. Also, the alkalinity and the mineral salts will tighten the gluten and thus the dough will be firmer. Very hard water also has magnesium sulphate which has a retarding action on the yeast. Breads can be made with both hard and soft water, provided the physical adjustments are made. When the dough is kneaded for longer duration of time, the temperature in the dough increases due to friction. This has to be watched carefully as the temperature of the dough should not go beyond 25°C for the yeast to start working. In such cases a baker often uses ice to make the dough. Ice keeps the fermentation activity of yeast at an ideal rate for gluten ripening. The quantity used will vary depending upon the time of kneading of the dough or the friction factor, and the dough temperature required. Ice used must be in the form of flaked ice so that it is evenly distributed in the bread dough and causes an even cooling of the dough. It can be safely said that 5 kg of ice will be equivalent to 4 litres of water.

4. **Yeast-** yeast is a single cell micro organism which causes the leavening in the dough. It converts the natural sugar in the flour into tiny bubbles of carbondioxide that are trapped in the dough. During baking these bubbles to give the texture and lightness to the dough. Yeast is available in two forms dry and compressed. The ideal tempenrature for yeast to act is 25°C. The primary function of yeast is to change sugar into carbondioxide so that the dough is aerated. When dispersed in water with yeast food, the yeast exudes an enzyme that changes sucrose into dextrose, which is then absorbed by the yeast cell.

Inside the cell, this is broken down into carbon dioxide and other by-products. Yeast also has enzymes which change protein into simpler compounds which can pass through the yeast cell membrane. Yeast works best within a temperature range of 25 to 40°C. Above this, fermentation becomes rapid but the yeast gets weaker successively and is finally killed at 70°C. At this temperature, yeast is completely retarded though it is damaged. Yeast can never dissolve completely in water, though it is just dispersed well into it. One could use a whisk to effectively distribute. Compressed yeast must be cold to touch and must possess a creamy colour breaking with a clean fracture. If it is light in colour, and is dry, warm, with a pungent odour, it is in poor condition and the quality of bread might not be good. If it is dark brown in colour with a soft sticky consistency and an unpleasant odour, it is unsuitable for use.

5. **Salt**- the main function of salt is to control the action of yeast as it slows down fermentation process. It should be mixed with flour for best results. It also provides flavor to the bread. It also affects the quality of the crumb, crust and colour of the baked product. So salt mainly performs the following functions; imparts flavor; gives stability to gluten; controls the rate of fermentation; retains and of moisture and affects the crust colour and crumb, due to control on the rate of fermentation. More salt or less salt will adversely affect the final products. Less salt has this effect on the bread product, large volume as there is more breakdown of sugar into carbon dioxide, less crust colour, weak crumb structure, where as excessive salt tightens the gluten to give a dense structure, dark crust colour as sugars are not broken down, crumb structure resembles cheese, as not enough gas is produced.
6. **Sugar**- the main function of sugar is to act as food for yeast. It helps in developing flavor and colour. Sugar is the primary food that the yeast feeds onto produce alcohol and

carbon dioxide. With the exception of lactose, yeast can break down all the other sugars present in the dough, either naturally in the flour or as an addition sugar, mainly sucrose or sometimes, maltose. Flour naturally contains about two and a half to three per cent of sugar in the form of sucrose and maltose. This is enough for the yeast in the initial parts of the fermentation. However in the final proof when maximum of the sugar is required to be broken down for an optimum rise, the natural sugars are exhausted and the addition of sucrose or maltose is required. Like salt, too much sugar or less sugar will impact the dough texture. Sugar has a solvent effect on gluten and this greatly affects the quality of the crumb in bread loaves. To counteract this, a mineral improver is used and excess salt is used as salt has a stabilizing effect on the gluten. Sugar has many roles to play in dough which are as follows; sugar is the primary food for the yeast; it helps improve the crust colour; sugar also acts as preservative and this behaves as an anti-staling agent; some sugars acts as bread improvers; sugar helps the bread to retain moisture, thereby keeping the bread moist; some sugars imparts flavors, for example, treacle, honey and demerara sugar.

7. **Milk**- it makes the bread whiter and softer and provides moisture and a distinct flavor. Milk also has a physical effect on bread in the form of the tightening effect of gluten by the action of ‘casein’ or the milk protein. However boiling or pasteurization neutralizes the effect to a great extent. Lactose or milk sugar is the only sugar which cannot be fermented by yeast and hence it remains in the dough right till the end, resulting in a good crust colour. Milk is generally used in powdered and skimmed form and hence the amount of water taken up in the dough is slightly more, though not considerably.
8. **Egg**- eggs are used for richness and to give lightness andcolour. Eggs are again rich in protein and hence will tighten the gluten strands, but this effects gets balanced, as the fat

in a yolk helps to soften the gluten as well. The use of eggs will yield softer bread. In many types of bread where a hard structure is required like hard structure is required like hard rolls, one does not use eggs in the recipe.

9. **Oil/ fat**- it is used to provide flavor and softness to the texture. Different kinds of fats are used for different breads such as olive oil for focaci (Italian bread). Fats have a physical effect on breads rather than any chemical reaction. Fat being a shortening agent reduces the toughness of the gluten and mellows the final product. Fat also has lubricating effect on the fine gluten strands giving extra volume to the final product. These strands begin to slip over each other and thus affect the final quality. As the amount of fat increases, the fermentation rate decreases. This is because the fat will form a thin layer on the yeast cell membrane hindering the release and the absorption of the materials. Thus yeast quantity is slightly increased. The effects of using fat are as follows; it increases the nutritious value of the bread; it reduces elasticity, softens the crust and crumb; it helps retain moisture in the baked product, thereby keeping it moist, it increase volume if used extensively; fats such as butter and lard give flavor to the product; if used in large amounts, it retards fermentation.

10. **Bread improvers**- flour is of variable quality and hence it becomes necessary at times to add bread improvers to the dough to bring the final product to a set standard. Bread improvers may be divided into three main categories. They include: those of mineral nature, those of organic nature mainly enriching agents; those of the mineral and organic categories which are also foods for yeast. Mineral improvers are popular because they increase the yield of the bread by necessitating the use of extra water. Some of the mineral improvers have a slight drying effect on the crumb.

Moringa Oleifera

Leafy green vegetables are essential sources of vitamins and minerals which are needful in promoting individuals health. Moringa is among green leafy vegetables whose nutritional benefits are widely known and used. Moringa Oleifera is the most nutrient dense plant known to science, (Neteam, 2014). Moringa Oleifera is one of the vegetables of the Brassica order and belongs to the family moringaceae. The moringaceae is a single genus family with B known species (Khawaja, Tahira and Ikram, 2010). Moringa Oleifera is a tropical tree possessing numerous economic applications, plus growing in international interest. Moringa tree is cultivated and used as a vegetable (leaves, green pods, flowers, roasted seeds) and as a medicinal plant (all plant organs), (Rebecca and Sharon 2006). Kasolo, Bimenya and Ojok (2010) pointed out that moringa oleifera is a highly valuable plant, distributed in many tropical and subtropical countries. It has an impressive range of medicinal uses with high nutritional value; different parts of this plant contain a profile of important mineral and are a good source for proteins, vitamins and Beta-Carotene, amino acids and various phenolics as well as antioxidant, anti-inflammatory nutrients and omega 3 and 6 fatty acids.

Moringa Oleifera contains various essential nutrients. Moringa plant provides a rich and fare combination of zeatin, qurcetin, Kuempferol and many other phytochemical. According to Alkharusi, Elmardi and Ali (2009) Moringa leaves contains high source of vitamin C, Clacuim, B-Carotene, potassium as well as protein. It works as an effective source of natural antioxidants, due to the preserve of several sorts of antioxidants such as flavonoids, ascorbic acid, carotenoids, and Phenolics, (Dillard and German, 2000). Tumer and Rojas, (2015) pointed out that moringa leaves contains a potent mixture of direct and indirect antioxidants that can explain its various health promoting nutritional content of a plant is used to measure its function in medicinal, nutritional and therapeutic properties (Alkharusim et al, 2009) moringa leaves contains high

source of vitamin C, B-carotene, potassium, calcium and protein. Siddhuraju and Becker (2003), pointed out that moringa leaf is able to extend the period of safety in the food containing fats.

Moringa Oleifera has so many health benefits. Over the past 40 years, the world health organization has been studying and using the moringa plant as a low-cost health enhancing food for third world countries where malnutrition and hunger are wide spread. The Neteam (2014) pointed out that India's natural Ayurvedic medicine uses moringa leaves to prevent and treat over 300 diseases, because it contains complete proteins which are rare to find in the plant kingdom. Moringa Oleifera leaves are rich source of Zeatin, Zeatin a member of the plant hormone family known as cytokinins. These cytokinnins induce cell division and growth and delay cell aging (Neteam, 2014). In addition, a study published in Rejuveratin Research shows the undeniable youth preserving effects of Zeatin on aging human skin, Zeatin has recently become increasingly sought after because of its powerful anti-aging properties; it defends cells against free radical damage, protects healthy cells from the effects or stress, helps the body replace dying cells more rapidly and strengthens living cells, thereby slowing the aging process no plant has a greater abundance of zeatin than the moringa plant. Infact moringa Oleifera leave has several thousand times more zeatin than another known plant. O'Byrne (2014) explained further that the human body has approximately 19 million skin cells at any given time; however 30000 to 40000 skin cells die every minute, new skin cells make their way to the upper skin layers as old skin cells flakes off and die, but with the zeatin contained in moringa, new skin cells grow at a faster rate than old skin cells die thus results in a marked reduction of wrinkles on the face and other parts of the body and a more youthful skin appearance.

Furthermore, Scoop (2014) pointed out that moringa is packed with 18 amino acids which includes tryptophan (to help one sleep), lysine (for help in healing cancer sores), tyrosine (to help the body synthesize proteins) and proline (to keep you looking young). It also gives a

mental clarity and has a cleansing effect on the body when used regularly. The Neteam (2014) further listed the following as the medicinal benefits of moringa oleifera leaves; supports normal blood sugar levels, promotes proper digestion, nourishes the eyes and brain, beautifies the skin, acts as an anti-inflammatory agent and acts as a perfect supplements. Scoop (2014) noted that moringa oleifera leaves are currently being used to combat global poverty as its nutritional content makes it very close to a perfect food; it has an antibiotic characteristic and hence could be of serious benefit to celiac patients who endeavor to support their bodies nutritionally during convalescence. According to Mercola (2015) Moringa Oliefera is a fast growing tree native to south Asia and known for throughout the tropics. Its leaves have been used as part of traditional medicine for centuries and the Ayurdevic system of medicine associates it with the cure or prevention of about 300 diseases.

Moringa as a Superfood

There are some noted points why Moringa oliefera is regarded as a super food, they include the following points;

1. A rich Nutritional profile- Moringa leaves are loaded with lots of vitamins, minerals, essential amino acids and more. One hundred grams of dry moringa contains; 9 times the protein of yogurt; 10 times the vitamin A of carrots; 15 times the potassium of bananas; 17 times the calcium of milk; 12 times the vitamin C of oranges; 25 times the iron of spinach.
2. Antioxidants Galore- Moringa leaves are rich in anti oxidants including vitamin C, Beta-carotene, quercetin and chlorogenic acid. The latter, chlorogenic acid has been shown to slow cells absorption of sugar and animal studies have found it to lower blood sugar levels. As noted in the Asian Pacific Journal of Cancer Prevention (2015), ‘the moringa leaves of the moringa oleifera tree have been reported to demonstrate anti-oxidant

activities due to its high amount of polyphenols. Moringa oliefera extracts of both mature and tender leaves exhibit strong anti oxidants activity against free radicals, prevent oxidative damage to major bio-molecules and give significant protection against oxidative damage. Further in a study of women taking 1.5 teaspoon of moringa leaf powder daily for three months, blood levels of anti oxidants increased significantly.

3. Lower blood sugar levels- Moringa appears to have anti diabetic effects, likely due to beneficial plant compounds contained in the leaves including isothiocyanates. One study found women who took seven grams of moringa leaf powder daily for three months reduced their fasting blood sugar levels by 13.5 percent. Separate research revealed that adding 50g of moringa leaf to a meal reduced the risk in blood sugar by 21 percent among diabetic patients.

4. Reduce inflammation- The isothiocyanates flavonoids and phenolic acids in moringa leaves, pods and seeds also have anti-inflammatory properties. According to the Epoch times (2014) 'The tree's strong anti-inflammatory action is traditionally used to treat stomach ulcers'. Moringa oil (sometimes called Ben oil) has been shown to protect the liver from chronic inflammation. The oil is unique in that, unlike most vegetable oils, moringa resists rancidity. This quality makes it a good preservative for foods that can spoil quickly. This sweet oil is used for both frying or in a salad dressing. It is also used topically to treat anti fungal problems, arthritis and is an excellent skin moisturizer.

5. Maintain healthy cholesterol levels- Moringa have cholesterol lowering properties and one animal study found its effects were comparable to those of the cholesterol-lowering drug simvastatin. As noted in the Journal of Ethnopharmacology (2014), moringa oliefera is used in recent Thai traditional medicine as Cardiotonic hypocholesterolemic effect. In hypocholesterol fed rabbits, at 12weeks of treatment, it significantly ($p < 0.05$) lowered

the cholesterol levels and reduced the atherosclerotic plaque formation to about 50% and 86% respectively. There effects were at degrees comparable to those of simvastatin. The results indicate that this plant possesses antioxidant, hypolipidaemic and antiatherosclerotic activity and has therapeutic potential for the prevention of cardio vascular diseases.

6. Protects against Arsenic Toxicity- The leaves and seeds of moringa may protect against some of the effects of arsenic toxicity, which is especially important in light of news that common staple foods such as rice, may be contaminated. Contamination of ground water by arsenic has also become a cause of global public health concern and the study revealed, 'Co-administration of moringa oleifera seed powder(250 & 500mg/kg orally) with arsenic significantly increased the activity of SOD (superoxide dismutase), catalase, and GP with elevation in reduced GSH levels in tissues(liver, kidney and brain). These changes were accompanied by approximately 57%,64%, and !7% decrease in blood ROS(reactive oxygen species) liver metallothionem (MT) and lipid peroxidation respectively in animal co administered with moringa oleifera and arsenic. Another interesting observation has been the reduced uptake of arsenic in soft tissues (55% in blood, 65% in liver, 54% in kidneys and 34% in bran) following administration of moringa oliefera seed powder(particularly at the dose of 500mg/kg). It can thus be concluded from the present study that concomitant administration of moringa oleifera seed powder with arsenic could significantly protect animals from oxidative stress and in reducing tissue arsenic concentration. Administration of moringa oliefera seed powder thus could also be beneficial during chelation therapy, (Epoch times, 2015). Furthermore, the miracle of moringa tree leaves (MO) commonly called the "drumstick tree" and horse radish tree is native to India but has been planted around the world and is naturalized in

many locales. Moringa is one of the most powerful health enhancing plants. While many things found in nature can have one or two health benefits, moringa has many. India's ancient tradition of Ayurveda medicine sites 300 diseases that are treated with the leaves of the moringa tree. Recent scientific research has proven that these humble leaves are in fact a power house of nutritional value. Moringa leaves are best known as an excellent source of nutrition and natural energy booster. This energy boost is not based on sugar and so it is sustained. Moringa is also soothing; it helps lower blood pressure and is a sleep aid. Its detoxifying effect may come from moringa's ability to purify water. Moringa acts as a coagulant attaching itself to harmful material and bacteria. It is believed that this process is taking place in a body as well. While the continued use of moringa for food and medicinal purposes by cultures in separate and distant parts of the world attest to its beneficial effects, moringa is a recent "discovery" of modern science.

In addition, the leaves of moringa oliefera are natures multi-vitamin providing seven times the vitamin C of oranges, four times the calcium of milk, four times the vitamin A of carrots, three times the potassium of bananas and two times the protein of yogurt. On top of that, science is providing moringa to be a power house of nutrients, 90 are known to date, with the possibility of more yet to be identified. If that were not enough, moringa has no known impurities with no adverse reactions ever recorded, (Monica, 2014).

Medicinal Qualities of Moringa Leaves

1. Juice from the leaves is believed to have a stabilizing effect on blood pressure and is used to treat anxiety. It is believed to control glucose levels in cases of diabetes.
2. Mixed with honey and followed by a drink of coconut milk 2/3 times a day, leaves are used as a remedy for diarrhea, dysentery and colitis.

3. Leaf juices, sometimes with carrot juice added is used as a Diuretic. Eating leave is recommended in cases of Gonorrhea because of diuretic action.
4. Leaves and buds are rubbed on the temples for headache.
5. A poultice is made from fresh leaves and applied to reduce glandular swelling.
6. Leaf juice is used as a skin antiseptic
7. Leaves are used to treat fevers, bronchitis, eye and ear infections, scurvy and catarrh(inflammation of the mucus membrane)
8. Leaves are considered to be anthelmintic (able to kill intestinal worms).
9. Leaves are used as a purgative.
10. Eating leaves is believed to increase a woman's milk production and is sometimes prescribed for anemia.

Better Protein than Soy

Moringa is considered to have the highest protein ratio of any plant so far identified, with the protein in moringa being comparable in quality to that of soy. Food scientists once believed that only soy had protein comparable to meat, dairy and eggs. Now they have added moringa to that very short list. Some even consider moringa protein better than soy protein as it is non-allergic. Protein are digested into smaller units known as amino acids found in meat production. The body cannot manufacture those eight essential amino acids and must get them through the food we eat. Moringa is one of very few plants that contain all eight.

More Impressive than Olive Oil

Olifera is a latin term meaning oil containing. The moringa oil known as Ben oil (due to the high concentration of behenic acid contained in the oil) is extracted from the seeds. Moringa olifera seeds contain 35-40% oil by weight and can yield more oil per hectare than sun flower or peanuts. The oil has more impressive attributes than olive oil. It is used in cooking and cosmetics

and because it wont spoil and turn rancid, it is also used as a preservative and machinery lubricant, even being used as a lubricant in fine watches. What's left after the oil has been extracted from the seeds is called seed cake, which is used as feed to increase milk production in cows, (Kolowale et al, (2013), Danica, (2011), Pure healing foods, 2015).

Organoleptic Attributes

Organoleptic attributes still referred to as sensory attributes involves a scientific and statistical analysis which measures human responses to the composition of food, which applies to human senses of sight, smell, hearing, taste and touch. Joel (2004) stated that organoleptic attributes could be viewed as a scientific discipline used to evoke, measure analyze and interpret reactions to those characteristics of foods and materials as they are perceived by the senses of sight, smell, taste, touch and hearing. Organoleptic attributes involves the aspects of food or other substance as experienced by the sense, including taste, sight, smell and touch in cases where moisture, dryness and state fresh factors are to be considered, (Womach, 2005). The exact means through which organoleptic attributes are tested is through the sense organ. In support of this view Oliveira (2011) pointed out that organoleptic attributes is perceived through the five senses; sight (e.g colour of a food product); smell (e.g presence of rancidity in a product); taste (e.g. intensity of sweetness); touch (e.g. firmness of a muscle food) and hearing (e.g. crunchiness of a potato chip). Furthermore, sensory analysis uses human senses to consistently measure such food characteristics as taste, texture, smell and appearance in a controlled environment (College of Agricultural Science, 2014).

Organoleptic attributes are used to compare differences in dishes. British Nutrition Foundation (BNF) (2014) pointed that organoleptic attributes can be used to: compare similarities/differences in a range of dishes/products; analyses of food samples for improvements, gauge responses to a dish/product, e.g. acceptable vs unacceptable; explore

specific characteristics of an ingredient or dish/food products; check whether a final dish/food product meets its original specification provide objective and subjective feedback data to enable informed decisions to be made. The food industries finds sensory evaluation as important as it enables them to assess the qualities of their products. Walker (2004) shows that sensory evaluation is used in food industry for: shelf life studies, product mapping, product matching, specification and quality control, product reformulation, measuring taint and off odour, and assessing product quality. However, the testing and judgement of these products compared are done by individuals known as panelist.

According to Gengler (2014), various ways of training panelists have been developed, and the method are referred to as descriptive analysis, which is the most analytical method that describes attribute intensities without assessing liking for them; the other human response to products is liking or acceptability, these tests are usually referred to as acceptance tests which are best done with a large group of respondents because of the subjective nature of the response. Allen (2015) noted that the third broad category of sensory tests is decimation tests, often referred to as difference tests; these are designed to measure the likelihood that two products are perceptibly different. These attributes or tests are usually evaluated using a scale known as Hedonic scale. This Hedonic Scale is needful for this study; the scale makes use of 9-point scale ranging from 1= dislike extremely to 9 = like extremely with 5 = neither like nor dislike (Anozie, China and Beleya, 2014). As orgnanoleptic attributes of a product has to do with sense organs, every product thereby has some distinct characteristics which when evaluated using these attributes it will be generally accepted. The qualities regarding their organoleptic attributes are as follows:

- Colour: this is the appearance of the outside surface and interior surface. It should be rounded top, free of cracks, thin crust, and uniform characteristic colour throughout depending on the type of ingredients used.
- Taste: Shows the mouth feel of the bread products. It should melt easily in the mouth, offer no resistance when bitten, breaks apart without difficulty and no burnt taste should be observed.
- Texture: This indicates the hand feel of the bread. It should be light but not crumbly, soft, velvety and moist. It should be filled with small, thin – walled air cells and not sticky, (Brownlie 2012).
- Flavour: this is the aroma of the bread products. It should be delicate, sweet and well blended. Flavor is an important attribute used in judging of food by consumers in a sensory evaluation. Flavor plays a major role in a consumer's judgment of a product as acceptable, (Anozie, 2014).

Acceptability on the other hand is been able to agree with something or have a positive answer over a thing. It states or describes the degree or extent of once likeness over a product. Anozie (2014) noted that assessing human responses using sensory acceptability test in new product development is inevitable activity besides looking for the nutritional safety and convenience of a given product. Sensory quality such as colour, taste and aroma is important parameter that determines to a great extent the acceptability of a product. Olievera (2011) pointed out that appearance of food evokes initial response and that flavor determines the final acceptance or rejection by the consumer. Oyeyinka and Oyeyinka (2016) also stated that sensory evaluation provides an index of overall acceptability of food stuffs, which depends on its appearance, flavour, taste, after taste and overall acceptability. For the purpose of this study, the

organoleptic attributes that will be evaluated include colour, taste, flavor, texture and general acceptability.

Fortification of Food Products

Fortification is a means through which some foods deficient in one nutrient or the other can be enhanced by introducing those nutrients that has been lost during its processing. World Health Organization (WHO), and FAO (2010) defined fortification as the practice of deliberately increasing the content of an essential micro nutrient in a food before processing or not , so as to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health. Oyeyinka and Oyeyinka (2016) viewed food fortification as the addition of essential nutrients such as vitamins and minerals to staple foods to improve their nutritional values. It is one of the most scalable, sustainable and cost effective tools used to reduce malnutrition, enabling people to increase their nutrient intake consistently and safety. Staple foods lack particular nutrients which may be caused due to soil of the region or inherent inadequacy of normal diet addition of micro nutrients to staple and condiments can prevent a large scale of deficiency diseases. The most common fortified foods are cereals and cereals based products, milk and milk products, fats and oils, accessory food items, tea and other beverages and infant formulas. Oyeyinka and Oyeyinka (2016) also stated food to be fortified must be consumed adequately by a large proportion of the target individuals in a population. Fortified foods includes vegetable oil with vitamin A and D, wheat and maize flour with iron, folic acid and other B vitamins and zinc, sauces and condiments such as soy sauce with iron and salt with iodine, (GAIN, 2015, FAO 2012)) The addition of these nutrients helps to solve public health problem and leads to rapid improvements in the micro nutrient status of the population at a reasonable cost.

Fortification as part of a country's nutrition strategy is supported by global organization such as UNICEF, the WHO, the U.S Centers for Disease Control and Prevention (CDC), the Global Alliance for Disease Control and Prevention (GAIN) and the Micronutrient Initiative (MI).. Brazil, like most countries in the Americans has been fortifying wheat flour for decades. Throughout the world, people generally consume wheat flour, maize flour are rice as a staple part of their diets. Fortifying one or more of these grains is a cost-effective way to improve the population nutrient intake.

In addition Oyeyinka and Oyeyinka(2016) pointed out that food fortification can take several forms such as mass fortification, targeted fortification or market driven fortification. However no matter the reason for fortification it should be noted that the food to be fortified and the fortificant should be compatible. The fortificant must be such that it does not improve nutritional value of the food at the expense of the sensory properties. This is very important since consumers are first attracted by what they see and this can play a large role in determining the continous patronange for such food commodity, (Oyeyinka and Oyeyinka, 2016).

Reasons for Fortifying Foods

Vitamins and minerals are added to grain products primarily to prevent anemia caused by nutritional deficiencies and neural tube defects caused by insufficient folic acid. Enhanced nutrition also strengthens immune systems and improves productivity and cognitive development. Fortifying wheat flour, maize flour and rice is successful because it makes community eaten foods more nutritious without relying on consumers to change their habits.

Four benefits of fortifying are-

1. Prevent nutritional anemia
2. Prevent neural tube birth defects
3. Increased productivity

4. Economic progress.

Prevent Nutritional Anemia

Anemia caused by deficiencies of iron, riboflavin, folic acid, zinc, vitamins B12 and other nutrients is called nutritional anemia. Fortifying wheat flour, maize flour and rice with these nutrients can lower the risk of anemia. In Costa Rica for example, fortification is credited with declines in anemia in women and children. Also each year of flour fortification is associated with a 2-4% decrease in anemia prevalence among non-pregnant women. In the United States, fortification with folic acid has nearly eliminated folic acid deficiency Anemia.

Iron- iron deficiency is the most common nutritional cause of anemia. All people need iron to make hemoglobin which carries oxygen to tissues and muscles. Iron improves an individual's capacity for physical activity and productivity. Iron also helps children develop physically and mentally, and it improves the health of pregnant women. Yet iron deficiency is one of the most prevalent nutritional deficiency in the world affecting an estimated 2 billion people. In total 200,000(1.5%) of deaths worldwide are attributable to iron deficiency according to the (World Health Organization, 2012).

Animal foods are the best natural source of iron but many people do not eat meat due to personal beliefs. Meat may be too expensive for others. Women of child bearing age are more prone to iron deficiency due to blood loss during their menstrual cycles. Vitamin C can help people absorb iron. In contrast, several dietary factors limit iron absorption.

Iron inhibitors includes-

a. Tannins in tea

b. Polyphenols in honey, legumes and many fruits.

c. Phytates in legumes and whole grains

Fortifying foods with iron helps consumers avoid the consequences of iron deficiency with "remarkably little risk of adverse health effects". Other vitamins and minerals used in fortification and their role in health includes:

- Zinc helps children develop, strengthens immune systems and lessens complications from diarrhea.
- Niacin (vitamin B3) prevents the skin disease known as Pellagra.
- Riboflavin (vitamin B2) helps with metabolism of fats, carbohydrates and proteins.
- Thiamin (vitamin B1) prevents the nervous system disease called beri-beri.
- Vitamin B 12 maintains functions of the brain and nervous system.
- Vitamin D helps bodies absorb calcium which improves bone health.
- Vitamin A deficiency is the leading cause of childhood blindness. It also diminishes an individuals ability to fight infections. Vitamin A can be added to wheat or maize flour, but it is often added to rice, cooking oil, margarine or sugar instead.

Prevent Neural Tube Defects

Grains are commonly fortified with folic acid (Vitamin B9) to reduce the risk of neural tube defects such as Spina bifida and anencephaly. These birth defects are permanently disabling or fatal. One meta-analysis showed that fortifying wheat flour with folic acid reduced the incidence of these birth defects by an average of 46%. All people need folic acid to produce and maintain healthy cells. Women who might become pregnant need 400 micrograms of folic acid daily at least one month before conception and in early stages of pregnancy. This can prevent the majority of neural tube defects (NTDs) folic acid supplements are recommended for women who may become pregnant. Some women are not aware of this advice and other forget to take supplements. Women who do not plan a pregnancy may not follow the recommendation. A baby's neural tube forms within the first four weeks of pregnancy. If women wait until they learn

they are pregnant to take folic acid supplements, the baby's neural tube may already be formed. Then it is now too late for folic acid to have the protective effect. The most common NTD is spina bifida in which the baby's spine does not form correctly. In mild cases, permanent loss of some sensation or movement occurs. Severe cases include paralysis and varying degrees of loss of bowel and bladder control. Children born with spina bifida will undergo a lifetime of surgeries and face many health issues. Spina bifida cannot be cured, (US Centers for Disease Control and Prevention CDC) 2015).

Another NTD is anencephaly in which the brain does not form properly. Pregnancies affected by anencephaly are often miscarried. Babies born with anencephaly die shortly after birth. A rare NTD is encephalocele in which part of the brain protrudes through the skull. The March times estimates that more than 300,000 babies are born with an NTD every year for a global birth prevalence of 24/1000. Fortified flour with folic acid is credited with preventing at least 38,417 of these birth defects a year or 105 a day. Only about one third of the world's flour from industrial mills is fortified, however, so this is only 15% of the NTDs that might be prevented. Countries which track birth defects generally find that their NTD prevalence drops to less than 10 per 10,000 live births after they begin fortifying flour with folic acid.

Some foods such as spinach and liver are rich in vitamin B9. However, the body does not absorb all of this; consequently it is virtually impossible to consume the equivalent of 400 micrograms of folic acid daily from unfortified foods. For, example to consume the equivalent of 400 microgram of folic acid a day, a person would need to eat;

- Four slices of beef liver or
- 14 cups of raw broccoli or
- 19 cups of raw green beans or
- 200 medium red apples.

By eating foods fortified with folic acid women are more likely to consume adequate amounts of this essential nutrient. Some people have been told to avoid folic acid because they have a variation of the MTHFR (methyl tetrahydrofolate reductase) enzyme. However, these individuals simply process folic acid more slowly than those without the variation.

Increased Productivity

Ortifying wheat and maize flour and rice with essential vitamins and minerals provides extra health benefits through commonly eaten foods. Over time this leads to consumers with increased capacity for physical activity and productivity.

Anemia

It is defined as low hemoglobin and result in lethargy and decreased productivity. Anemia is estimated to contribute to 17% lower productivity in heavy manual labour and 5% lower productivity in other manual labour. Studies throughout the years have confirmed the link between iron status and productivity. In a 2012 a systematic review of research literature about the relationship between the effect of iron deficiency anemia and work capacity. The authors found that the effect of iron deficiency anemia on work capacity justifies intervention to improve iron status. In children, iron limits physical growth and mental development and these losses are never recovered. Children who do not reach their full physical potential and academic potential will have limited future opportunities.

Folic Acid

Folic acid (vitamin B9) is included in fortification to help prevent neural tube defects. Spina bifida is the most common of these birth defects. Adults who care for children with spina bifida spend time making medical appointments, taking children for treatments and helping children with many daily activities such as toileting and mobility. Adults with spina bifida are very often independent and productive but they usually require ongoing and often intensive

medical care. A study of 88 people in Germany with spina bifida found that physiotherapy was the most used health care resource and more than half the study participants used wheel chair. The authors concluded that their care givers might have to either adjust their careers overall or adjust their working schedule, resulting in productivity losses, (Davidsnyder 2015, Hass, Jere 2012, Edgerton 2010, Horton 2012).

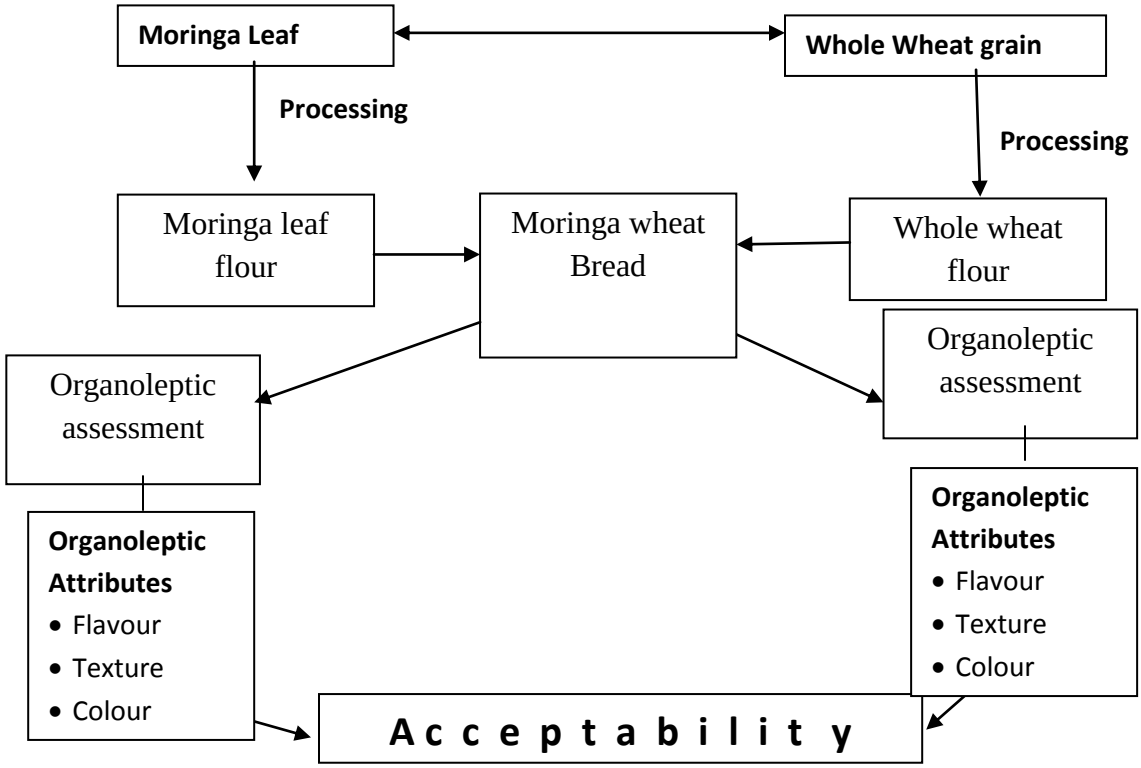
Economic Productivity

The economic benefits a country experiences as a result of improving nutrition are tremendous. Each dollar spent on reducing chronic under nutrition has a $30 pay off, according to the 2012 Copenhagen Consensus. The nutrient most commonlt used in grain fortification are iron and folic acid. The economic benefits associated with these are below:

Iron

The mental capacity that is undeveloped when children are iron deficient is never regained. Anemia affects their academic performance and future earnings potential. Consequently childhood anemia is associated with a 2.5% drop in wages in adulthood. The median value of annual physical productivity losses due to iron deficiency is $2.32 per capita, (Gross and Scott, 2012, Brownlie and Thomas, 2012).

Schematic Representation of Conceptual Framework



(Fig 1) Source: Researcher, 2015.

Fresh Moringa oliefera leaves were plucked, washed and shade dried, then grounded to obtain moringa leaf flour. Whole wheat grain was processed and moringa leaf flour added to it and baked to obtain moringa wheat bread, which its organoleptic attributes and general acceptability were determined. When moringa is added to whole wheat bread it may improve its organoleptic attributes or not, and may equally be preferable to the already existing wheat bread or not.

Theoretical Framework

This section reviews some theories that are related to the study as follows:

Evaluation Theory

Evaluation is a means through which judgments are drawn from series of choices. Evaluation theory was propounded by Ralph Tyler in the year 1940. The theory states that measurements using people as the instruments to evaluate the product are sometimes necessary. The flavor and texture sensory attributes of food could not be easily measured; therefore the food industry had need to develop the evaluation measurement tool. The evaluation of food are usually done with group of respondents called evaluators or panelist which could be trained. This theory enables the panelist to evaluate samples such as bread and placed in rank order according to the presence or absence of the attribute from like extreme to dislike extreme and responses are recorded.

The essence of using evaluation measurement as an instrument of analysis is to maintain a product with same sensorial characteristics (flavor, texture, taste), so that consumer of the product will continue patronizing it; to determine the products market value, determine its Shell life, determine its storage conditions, determine its ingredients substation in its formulation which may cause acceptability by consumers. This theory is related to the present study because the panelists will be used as instrument to evaluate the product (bread) made from whole wheat grains fortified with moringa leaf flour, to determine its organoleptic attributes and general acceptability.

Consumer Food Choice Theory

Shepherd Sparks and Guthrie (1995) propounded the theory of consumer food choice. This theory states that human food choice is a complex phenomenon which is influenced by a wide range of factors categorized as those related to the food; to the person making the choice

and to the external economic and social environment within which the choice is made. This theory stresses that choice of foods is an area of concern for many people which in turn affects the production and distribution of the food mainly concerned with nutrition and health education. Though little is known about how and why people choose the foods and constitute the diets and how their choices are been influenced in an effective ways. However, perceiving the sensory attributes (flavor, textures, appearance) in a food does not necessarily mean that a person will or will not choose to consume the food. It is an individuals liking for that attribute in that particular food that will determine whether or not the food is chosen; other components in the food will have effects upon the person e.g. reducing hunger and the level of the association between the sensor attributes of a food and its post-ingestional consequence appears to be major mechanism by which preferences develop. Marketing and economic variables as well as social cultural, religious or demographic factors are also likely to be very important. This theory is therefore related to this work because it involves the judges making their choice over the most preferred food which the liking of the attributes in the food will determine the level of its acceptability.

Related Empirical Studies

Several studies related to this study were reviewed to add further empirical evidence to the study as follows:

Karim, Kayode, Oyeyinka (2013) conducted a study on Proximate, Mineral and sensory qualities of "Amala" prepared from yam flour fortified with Moringa leaf powder. The purpose of the study was to determine the proximate, mineral and sensory qualities of amala prepared from yam flour fortified with moringa oleifera leaf power (MOLP). The moringa oleifera leaves were dried, milled, sieved and added to yam flour in different proportions (0%, 2.5%, 5%, 7.5% and 10%). Samples were mixed to ensure uniform distribution of the leaves within the flour and subsequently prepared into amala. Generally the proximate composition except for moisture and

carbohydrate content of all the samples increased significantly with an increase in the level of MOLP with values ranging from 0.34-1.99% for crude fat, 1.10 -2.21% for crude fibre, 1.74 - 2.78 for ash and 5.73-8.46% for crude protein and carbohydrate values from 8.35 -12.38%. Reduction in moisture content was observed from 78.38%-76.21% and 12.37-8.35% for carbohydrate. The mineral composition ranged between (198.72-292.45mg/100g), (140.23-159.00mg/100g), (3.64-5.04ppm) 127.85mg (127.76-147.93ppm), (3.64-693ppm) and 4.77-5.54ppm) for calcium (ca), Magnesium (Mg), Potassium (K), sodium (Na), iron (fe), Phosphorus (p), Manganese (mn) and copper (cu) respectively. Generally, the mineral profile of the fortified "amala" increased significantly ($p \leq 0.05$) with increase in addition of MOLP. There was no significant difference ($p<0.05$) among the samples of the sensory qualities of colour, mouldabiity and mouth feel except for sample fortified with 10% MOLP. However, the addition of MOLP greatly affected the aroma and over all acceptability of the sample. The sample prepared from yam flour fortified with 2.5% MOLP compared favourably well with the control in all sensory attributes. It was apparent that the fortification of yam flour with MOLP at 2.5% level improved the proximate and mineral composition without affecting the overall acceptability and hence, could be used to improve the nutritional status of people and serves as an opportunity for the utilization of moringa Oleifera leaves. The previuos study is related to the present study because they both are based on sensory evaluation of food fortified with moringa leaf flour. However, the present study defers from the previous because it focuses on organoleptic attributes and acceptability of whole wheat bread fortified with moringa leaf flour. Therefore the result of the study reviewed cannot be used to explain the present study at hand.

Similarly, Duchana, Rajive, Indrani and Prakash (2013) carried out another study on Effect of Dried Moringa (Moringa Oleifera lam) leaves on Rheological, Micro structural, Nutritional, textural and organoleptic characteristics of cookies. Effect of replacement of wheat

flour with 5%, 10% and 15% dried moringa leaves (DML) on the rheological, micro structural, nutritional and quality characteristics of cookies was studied incorporation of increasing amount of DML. From 0 to 15% increased farinography water absorption and decreased dough stability, amyl graph pasting temperature and peak viscosity. Use of DML increased dough hardness and decreased cohesiveness and spread ratio of cookies. Sensory evaluation showed that cookies incorporated with 10% DML power were acceptable. Microstructure studies showed calcium oxalate crystals in both DML powder and cookies with DML. The starch granules appeared wrapped in cookies with 10% and 15% DML. Protein, iron calcium, beta-carotene and dietary fiber contents increased with increasing amount of DML from 0 to 15%. The results showed the possibility of utilizing DML to improve the nutritional characteristics of cookies. The reviewed study is related to the present study because both are interested on the sensory evaluation of foods fortified with Moringa leaf flour. However, the study reviewed cannot be used to explain the present study at hand because the present study is set out to investigate the organoleptic attributes and acceptability of whole wheat bread fortified with moringa leaf flour.

Furthermore, Abioye and Aka (2015) determined the proximate composition and sensory properties of Moringa fortified Maize –"Ogi". The effects of moringa leaves fortification on the nutritional value and consumer acceptability of maize ogi was investigated. The "Ogi" produced from maize was fortified with moringa leaves at substitution levels of 0, 10%. The proximate content, mineral and vitamins content, swelling capacity, beta-carotene and the sensory properties of the Ogi samples were determined. There was about 94% increase in protein content with 10% substitution of moringa leave. The values of the mineral content and the crude fibre increased with increase in the level of substitution from 1.67 to 3.10 and 2.57% respectively. There was increase in the values of the mineral contents of the Ogi samples with increase in the level of moringa leaf substitution, calcium content (125.01-445.1mg100g) magnesium (36.67-

13.01mg/100g), iron (4.67-12077mg/1009), Potassium (21.67-233.33mg/100g), zinc (0.23-063mg/100g) and copper (0.37.053mg/100g., Beta-Carotene of 1058.33ug/100g was obtained with 15% moringa leaf substitution. The swelling capacity decreased with increase in the level of moringa leaf substitution was rated close to the unfortified Ogi sample the study revealed that fortification of Ogi with moringa leaves had effects on the nutritional and sensory attributes of the Ogi samples. This study is related to the present study because both of them are interested in the sensory evaluation of cereal fortified with moringa leaf. However the present study differs from the previous because it investigated the organoleptic attributes and acceptability of whole wheat bread fortified with moringa leaf flour.

In the same vein, Dooshona, Michael and Dick (2015) conducted a study on Nutritional Evaluation of Complementary food formulations from maize, soybean and peanut fortified with moringa oleifera leaf flour. Nutritional evaluation of complementary food formulations from maize soybean and peanut fortified with Moringa Oleifera leaf powder was carried out. Maize, soybean and peanut were blended in a ratio of 60:30:10 to produce a complementary food, which was then fortified. While the unfortified food product (sample A) served as control, the other three formulations were fortified with 5%, 10% and 15% moringa leaf powder to give three samples (B,C and D respectively) of fortified food. Nutritional composition determination and feeding trials were then carried out, using two weeks old male albino rats to determine the performance of the food formulations. While the crude protein, crude fibre and ash contents of the diets increased significantly ($p<0.05$) with fortification, with values ranging from 16.04% to 17,59%, 2.25% to 4.42% and 1.40% to 2.50% respectively, crude fat and carbohydrate decreased significantly ($p<0.05$) with concomitant decrease in energy, with value ranging from 23.48% to 20.80%, 49.32% to 47.63% and 472 -76% to 448.08kcall/100g respectively in samples A to D. PER values significantly ($p<0.05$) improved up to 10% substitution, from 1.7 in an fortified

(samples A to 1% to 10% fortified (sample C) but declined at 15% substitution (sample D) TO 1,69. Similarly, NPR values increased from 0.71 to 0.76 and 0.68. However, all the PER values including that of Nestle Cerelac (204) were lower than, though within the same range, with the value of 2.10 recommended by the Protein Advising Group (PAG) for complementary foods sample C (10% Moringa flour blend) gave the best performance after rat feeding trials. This previous study is related to the present one because it investigated the organoleptic attributes of complementary foods made from grain fortified with moringa leaf flour. However, the previous study differs from the present because the present investigated the organoleptic attributes and acceptability of whole wheat bread fortified with moringa leaf flour.

Also, Kolawole, Balogun, Oaleke, and Amali (2013) conducted a study on an evaluation of nutritional and sensory qualities of wheat moringa cake. The nutritional and sensory attributes of wheat moringa cake were evaluated. Cakes were produced from wheat flour and different quantities of moringa leaf (2g, 4g, 6g and 10g) respectively with cake from 100% wheat flour used as control. Nutrition analyses carried out on the cake samples include crude protein, crude fat, crude fibre, total ash a moisture content. Nutrient contents and sensory attributes of samples were carried out within 24 hours of cake sample production. All parameters determined, showed a significant difference ($p<0.05$) in cake samples. Moisture (7.35-9.0%), crude protein (7.21-11.20%), crude fibre (3.56-5.20%) and total ash (1.50-2.75%) showed an increase in value with increase in addition of moringa, while crude fat (5.95-4.00%) and carbohydrate (74.57-67.82%) showed a decrease in value with increased addition. Sensory evaluation showed significant difference ($p<0.05$) between the control (100% wheat) and other samples in colour, taste, aroma and general acceptability. The cake sample with 4g moringa addition was the most preferred in terms of colour, taste, aroma and general acceptability. The present study is related to previous because it evaluated the sensory qualities of wheat moringa products. However the present study

differ from the previous because the present study investigated the organoleptic attributes and acceptability of wheat bread fortified with moringa leaf flour.

In a similar vein, Haneen (2015) conducted a study on effect of dried moringa oleifera leaves on the Nutritional and organoleptic characteristics of cookies. In the study dried moringa oleifera leaves powder (DMLP), were incorporated at different levels (5, 10 and 15%) in cookies and their sensory and nutritional properties were evaluated. The results revealed that the content of protein, dietary fiber, minerals in cookies increased with incorporation of increasing levels of DMLP. Sensory evaluation showed that cookies with acceptable quality and typical moringa leaf flavor could be obtained by incorporating DMLP up to 10%. Thus the nutritional quality of cookies could be enhanced by incorporating DMLP in a close dependent manner. This present study is related to the previous because it investigated the effect of Moringa Oleifera leaves on the nutritional and Organoleptic attributes of cookies, a flour product; but differs because this present study is centred on organoleptic attributes and acceptability of wheat bread fortified with moringa leaf flour.

Summary of Literature Reviewed

The literature reviewed revealed that Cereals are the most staple food consumed by individuals. It forms the most basic source of food for a wide population. Wheat is amongst whole grain that has formed a staple food for so many people. The whole grain wheat is very rich in nutrient. When eating whole grain wheat we benefit from all the nutrients, vitamins, folic acid, iron, zinc and other minerals. However there are health risks associated with the consumption of wheat as well as there are nutritional benefits associated with it because of its gluten content. This poses a problem to people as on how to totally abstain from gluten thereby making them miss out greatly on the nutritional benefits of whole grains. It was gathered from literature that Fortification is the practice of deliberately increasing the content of an essential micro nutrient in

a food before processing or not, so as to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health.

The authors reviewed were in agreement that Moringa Oleifera is the most nutrient dense plant known to science. The leaves, flowers, bark, wood and roots of the moringa trees are used all over the world for a wide variety of medicinal, pharmacological and nutritional purposes. Literature also revealed that the nutritional components and even antibiotic activity of moringa leaves is of serious benefit to celiac patients who endeavor to support their bodies nutritionally during convalescence.

The literature reviewed, further showed that the organoleptic and acceptability of foods so much depends on the Evaluation theory and the theory of consumer's choice. The propounders believed so well that food nutrient are very essential in the body as they help in keeping the body in good state, while human feelings over a particular products helps them in decision making as to accept the food or not. Many empirical studies were also reviewed. Some foods were fortified with moringa oliefera leaves and its nutritional and organoleptic attributes analysed. However, none of them or any other work known to the researcher was conducted on the organoleptic attributes and acceptability of whole wheat bread fortified with moringa leaf flour, which is the gap this study sought to fill.

CHAPTER THREE

METHODOLOGY

This chapter presents the procedure adopted in conducting the study. The procedure was arranged under the following sub-headings: Design of the Study, Area of the study, Organoleptic evaluation, Population for the study, Instrument for organoleptic evaluation, Method of data collection and Method of data analysis.

Design of the Study

The study adopted experimental research design. According to Anaekwe (2007), experimental research designs are those studies which are mainly concerned with identifying cause and effects relationship. This occurs where the researcher manipulates one variable and controls the rest of the variables. It has a control group which will not receive any treatment. The design is considered suitable for this study because the study intended to investigate the Organolepitc attributes and acceptability of whole wheat bread fortified with Moringa leaf flour.

Experimental procedure- the experiment was conducted in phases for better presentation of information. Each phase was broken as follows:

Phase 1:- Experimental material: this was grouped into two-

- The experimental tools which includes- electric oven, electric kneading machine, mixing bowls, bread tins, burner, sieve, measuring spoons, baking trays.
- Baking of food product; this involved the following baking Ingredients: whole wheat flour, fat, sugar, yeast, moringa leaf flour, flavor, water.

Phase 2: Experimental method: the method involved in this experiment includes:

- Preparing of baking ingredients
- Development of food products from the prepared ingredients
- Coding of the food product

- Controlling of extraneous variables.

STEP 1: Preparation of Bread Ingredients

The whole wheat grains was bought and milled at the milling industry, and other ingredients such as margarine, sugar, egg, yeast, flavor, and milk were purchased at Eke Awka market. The moringa leaves were plucked from the researchers vegetable garden. It was washed, shade dried and grounded to powder flour.

STEP 2: Development of Food Products from the Food Ingredients

Recipe 1: Whole wheat bread

$1^{1}/^{3}$ cups of whole wheat flour

¼ cup of margarine

$2^{1}/^{2}$ table spoons of sugar

2 teaspoons of powdered milk

1 whole fresh egg.

2 tablespoons vanilla flavor

2 teaspoons of yeast

$1^{1/3}$ teaspoon of salt

$1^{1/4}$ cups of water

Source (Donna Rathmell 1991).

Recipe 2: Moringa wheat bread

$1^{1}/^{3}$ cups of whole wheat flour

¼ cup of margarine

$2^{1}/^{2}$ table spoons of sugar

2 teaspoons of powdered milk

1 whole fresh egg.

2 tablespoons vanilla flavor

2 teaspoons of yeast

$1^{1/3}$ teaspoon of salt

$1^{1/4}$ cups of water

6 tablespoons of moringa leaf flour.

Source (Donna Rathmell 1991)

Method of Wheat Bread Preparation

Each of the bread was prepared using rubbing in method.

1. Pre-heat with 300◦F/180◦C/Gas 4 oven. Line a 10×4(25×10cm) ring mould with greased margarine.
2. In a bowl, sift together the flour and rub in the margarine. In another little deep plate add warm water and prove the yeast and add a little part of sugar to it.
3. Add the proven yeast to the mixture and mix thoroughly, add the remaining sugar and other ingredients. Add water gradually until the desired consistency is obtained.
4. Knead the dough very well and allow to rise in a warm temperature for around 30 minutes.
5. Knock off and knead thoroughly, mould the dough to the desired shape, add to well greased bread tins, leave to stand for 15 minutes.
6. Pre heat the oven, and then bake at the temperature of 350^0f/180^0c. Allow to stand for 5 minutes then unmold and transfer to a cooking rack.

The procedure was adopted to produce two different whole wheat bread products respectively. **STEP 3: Coding of the food products**

The two food products were coded as follows;

Sample A = WWB (whole wheat bread)

Sample B = MWB (Moringa wheat bread)

STEP 4: Controlling of Extraneous Variables

These are the following variables that have carryover effect on the consumers mouth, hands, or eyes etc. They alter the results of the experiment if not controlled. The extraneous variables includes: previous food consumed by the evaluator, time of food consumption and evaluation environment. These variables were controlled by making sure that the evaluation centre was well ventilated having no odour and dark light. The evaluation thereby was done in a day light. The evaluators were provided with water to wash their hands and clean their mouth before tasting the food products. After tasting each sample they rinsed their mouth with water and shewed carrot before going over to the next sample.

Area of the Study

The study was carried out in Foods and Nutrition laboratory, Department of Home Economics and Hospitality Management Education, Vocational and Technical Education (VTE) Faculty, University of Nigeria Nsukka.

Population for the Study

The population for the study was made up of forty (40) evaluators. The population was made up of two categories of evaluators. They are 8 lecturers and 32 registered post graduate students in the Department of Home Economics (VTE General Office UNN, 2015). The rationale for the choice of this population was based on the assumption that the lecturers and Post graduate students in Department of Home Economics, are experienced and capable of determining the organoleptic attributes of food substances. The entire population was used for the study hence no sampling. This was due to the fact that the population is manageable hence forty (40) panels of judges.

Instrument for Data Collection

Organoleptic evaluation adopted the 9 –point hedonic scale. It is a standard instrument, and therefore needs no validation. The scale ranged from: (9) like extremely, (8) like very much, (7) like moderately, (6) like slightly, (5) neither like nor dislike, (4) dislike slightly, (3) dislike moderately, (2) dislike very much, (1) dislike extremely. This scale defined the organoleptic attributes of whole wheat bread and moringa wheat bread. Each of them had a code used in identifying the sample. The format for the organoleptic attributes includes colour, taste, aroma, texture and general acceptability. This guided the panelists to score appropriately. The features of the format included

Section A: - Organoleptic Attributes of bread samples:

1. Category of the evaluators (students) or (lecturers)
2. Name of the food product and code.
3. Food processing technique that was employed

Section B: Organoleptic Attributes:

1. Code of Bread products: the bread was coded to differentiate them from each other, (WWB,MWB)
2. Organoleptic qualities to be measured
3. Question items
4. Choice scale
5. Food sample

Method of Data Collection

The data collection involved the evaluation of the food samples and a rating scale instrument was used to record the scores of each food sample. The panelists were required to rate the food product in a given order as follows colour, taste, texture, aroma and general

acceptability of each of the food. They were expected to rate each of the attributes on the rating scale that was provided. After eating the first sample, carrot or water was taken to rinse the mouth after each rating. This helped them in distinguishing the various tastes. The researcher then collected the completed rating forms from the panelists. The mean ratings and standard deviation of the scores for each attributes were then determined and presented in chapter four.

Method of Data Analysis

The data that was generated from all the sensory evaluation was analyzed using mean and standard deviation for the research questions. T-test Statistics was used to test the Null hypothesis at 0.05 level of significance.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

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

Research Question 1

What are the organoleptic attributes of whole wheat bread and whole wheat bread fortified with moringa leaf flour?

This research question was answered using mean and standard deviation obtained from the sensory evaluation.

Table 1: Organoleptic attributes of whole wheat bread and moringa wheat bread.

Attributes	WWS (N)	X_1	SD_1	MWB (N)	X_2	SD_2	df	t-test	sig 2-tailed	Remarks
Colour	37	3.57	1.19	37	7.16	1.46	72	1.307	0.195	NS
Taste	37	7.23	1.32	37	7.51	1.17	72	-1.027	0.308	NS
Flavor	37	6.75	1.47	37	7.16	1.24	72	-1.372	0.174	NS
Texture	37	7.43	0.96	37	6.86	1.65	72	1.807	0.075	NS

Keys: **NS**= Not significant; S = Significant; df = Degree of freedom; t-test = Calculated values of t-test with SPSS; SD1 – Standard deviation; X1= Mean of WWB respondents for each of the attributes; X2 = Mean of MWB respondents for each of the attributes. N= Number of respondents; Level of significance = 0.05.

The mean ratings for colour of the two different samples ranged from 7.16 – 7.57. Whole wheat bread had the highest value in terms of colour with value of 7.57, while moringa wheat bread had the value of 7.16. There was no significant difference between the two samples at $p<0.05$ level of significance.

The mean ratings for taste of the two bread samples ranged from 7.23 – 7.51. Moringa whole wheat bread has the highest taste value (7.51) while whole wheat bread taste value was 7.23. However there was no significant difference between the two samples, ($p<0.05$). In addition, the mean ratings for flavor of the bread samples ranged from 6.73 – 7.16. Moringa wheat bread has the highest flavor value of 6.73. There was no significant difference between the two bread sample as $p < 0.05$ level of significance.

Moreover, the mean ratings for texture of the two bread samples ranged from 6.86- 7.43. Whole wheat bread has the highest texture value of 7.43 while moringa wheat bread has texture value of 6.86. There was no significant difference between the two bread samples at $p<0.05$ level of significance.

Research Question 2

What are the general acceptability of whole wheat bread and whole wheat bread fortified with moringa leaf flour?

Table 2: General acceptability of whole wheat bread and moringa wheat bread

Attributes	WWS (N)	X1	SD1	MWB (N)	X2	SD2	df	t-test	sig 2-tailed	Remarks
GENERAL ACCEPTABILITY	37	17.46	28.79	37	12.54	20.98	72	0.840	0.404	NS

From table 2 above, the mean ratings for the general acceptability of the two bread samples ranged from 17.46 – 20.98. Moringa wheat bread had the highest level of general acceptability with 20.98 values where as whole wheat bread had 17.46 level of acceptability. There was no significant difference between the two bread sample on their level of acceptability where $p< 0.05$.

Hypotheses 1

There is no significant difference in the mean scores of whole wheat bread and with whole wheat bread fortified with moringa wheat flour in their organoleptic attributes which includes colour, taste, flavor and texture.

TABLE 3: t-test table for the organoleptic attributes of the two bread products.

ATTRIBUTES	t-test	DF	SIG 2-TAILED
COLOUR	1.307	72	0.195
TASTE	-1.027	72	0.308
FLAVOR	-1.372	72	0.174
TEXTURE	1.807	72	0.075

The table above shows that there was no significant difference between the colour (0.195), taste (0.308), flavor (0.174), texture (0.075) of whole wheat bread and moringa wheat bread.

Hypotheses 2

Whole wheat bread does not significantly differ from moringa wheat bread on their level of acceptability.

Table 4: t-test table for level of acceptability of the two bread products

Attributes	WWS (N)	X1	SD1	MWB (N)	X2	SD2	df	t-test	sig 2-tailed
GENERAL ACCEPTABILITY	**37**	**17.46**	**28.79**	**37**	**12.54**	**20.98**	**72**	**0.840**	**0.404**

The table above shows that there was no significant difference between the level of acceptability (0.404) of whole wheat bread and moringa wheat bread at $p < 0.05$ level of significance.

Major Findings

The findings of this study were presented based on the organoleptic results.

Organoleptic evaluations of the food products

1. The findings of the study showed that there was a slight variation in the two food products. Results of the sensory evaluation showed that the whole wheat bread had the highest value in terms of colour which may be due to the fact that the natural chocolate colour of wheat grains were preferable to the respondents.
2. The findings of the study showed that moringa wheat bread has the highest value in terms of taste. This may be due to the additional pleasant neutral taste of moringa in the product. The panelist preferred the flavor of moringa wheat bread over the whole wheat bread. This may be as a result of the sweet appealing flavor attribute of moringa leaves.
3. However, the panelists preferred the texture of whole wheat bread over moringa wheat bread. This is in line with Duchana et al (2013) that revealed that the use of dried moringa leaf increases dough hardness and decreases cohesiveness and spread ratio of cookies.
4. Generally, the levels of acceptability of the two products were not significant which shows that moringa wheat bread product was accepted. From the results of the findings, the introduction of moringa leaf flour played a vital role in the sensory attributes of bread products.

Discussion of the Findings

The organoleptic attributes of moringa wheat bread were summarized in table 1. The sensory scores for colour, taste, texture, flavor and general acceptability differed from that of whole wheat bread. The colour of moringa wheat bread changed from brownish white to greenish brown. This is in line with the view of Karim et al (2013), that moringa oliefera leaf

powder has a deep green colour which may be attributed to its high chlorophyll content and may mask the colour of most foods when added in large quantities. The texture of moringa wheat bread was a bit harder than whole wheat bread. This is line with the findings of Abioye and Aka (2015) that lower texture rating of 'Ogi' fortified with moringa leaf powder mixtures may be attributed to the lower viscosities of the mixtures as revealed by the pasting properties. The taste, flavor and general acceptability of the two bread product do not differ significantly. This reveals that incorporation of moringa leaf flour in foods could improve the attractiveness. This supports the opinion of Olievera (2011) that appearance of food evokes initial response and that flavor determines the final acceptance or rejection by the consumer.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMMENDATIONS

Restatement of the Problem

Wheat is amongst the whole grains that has formed staple food for so many people. Wheat is one of the oldest known foods that has survived centuries and spread over many countries. The whole grain wheat is very rich in nutrients. When eating whole grain wheat, the consumer benefits from all the following nutrients: vitamins, folic acid, iron, zinc and other minerals. However, Wheat contains gluten a protein that harbors one of the worst prolamine offenders called gliadin which has the most powerful toxic effect on the intestinal barrier and severely damages the gut linning in humans. Many people now run away entirely from whole wheat grain because of its gluten content which leads to celiac diseases. Celiac disease is an autoimmune disorder in which the body mistakenly reacts to gluten, a protein found in wheat, as if it were a poison. When people with celiac disease eat foods that contain gluten, their immune system is uniquely programmed to recognize it as a threat and react by damaging the tissue linning the small intestine. Anaemia amongst other symptoms is common with celiac, as the chronic digestive disorder leads to malabsorption of minerals and nutrients.

Moringa Oleifera is the most nutrient dense plant known to science and offers a package of complementary nutrient that works together for optimal iron absorption and especially as it is. Thus this study set out to investigate the organoleptic attributes and acceptability of whole wheat bread fortified with moringa leaf flour. This was because no work in literature has researched on it hence the problem of the study. This study sought to determine the:

1) organolepitc attributes of the two products (whole wheat bread and whole wheat bread fortified with moringa leaf flour).
2) general acceptability of the two products (whole wheat bread and whole wheat bread fortified with moringa leaf flour).

Summary of Procedure Used in the Study

The design of the study was an experimental research design which comprised of two phases: (A) Experimental materials and (B) Experimental method. The experimental material phase involved the experimental tools used in preparing the products which includes kneading machine, bread tins, mixing bowls amongst other tools; and Development of food products from the food ingredients used in preparing whole wheat bread such as whole wheat flour, magarine, sugar and others.

The experimental method phase involved preparation of bread ingredients where the whole wheat grain was bought and milled, the moringa leaf was plucked, washed, shade dried and grounded to powder flour. The two bread products were mixed with other ingredients and produced, then coded and the organoleptic attributes of colour, flavor, taste, texture and general acceptability were rated. The organoleptic evaluation panel comprised of thirty seven (37) panelist out of the proposed forty (40) panelist, which included Lecturers and Post graduate students of Department of Home economics and Hospitality Management, University of Nigeria Nsukka. Each of the panelists was given a 9-point hedonic rating scale to score. The data collected were analyzed using mean (X) and Standard deviation (SD) and t-test statistic. The special package for social sciences (SPSS) version 20 was used for the analysis of data.

Summary of Findings

- Moringa wheat bread had the highest taste value over whole wheat bread.
- The flavor of moringa wheat bread was ranked highest over whole wheat bread.
- Whole wheat bread ranked highest in colour value than moringa wheat bread.
- The texture attribute of whole wheat bread was preferred to that of moringa wheat bread.

- The general acceptability level of moringa wheat bread was higher than that of whole wheat bread.

Implication of the Findings

The findings of this research have far reaching implications as follows:

- The result of this study showed that "bread" fortified with moringa leaf flour had the highest taste value which has implications for the food industries, dieticians, families as well as home makers. This would enable the food industries to ascertain the choice of customers which would increase their productivity and help meet up to the demands of individuals. The dieticians would now recommend 'moringa wheat bread' for people and patients. The home makers will make use of the recipe to prepare home- made moringa wheat bread.
- The use of moringa leaf in the family menu mainly in preparing baked products will help to introduce variety and increase the nutritive value of food consumed in the home.
- From the findings of this study, Food industries can now introduce moringa leaf flour in preparing baked products. This would increase customers patronage for whole wheat and turn over for the industry.
- Moringa leaf flour should be used in fortifying cereals as well as introduced in preparing other dishes to improve the general acceptability and nutritive values of such foods.
- Awareness should be created on the use of moringa oliefera leaves as a spice in preparing dishes especially for special groups of individuals in the family to ensure that the right nutritional needs of each group are met.

Conclusion

A good quality and nutritious bread can be produced from whole wheat moringa blend. Moringa oliefera leaves which are normally consumed as vegetables and as food supplements are rich in macro nutrients and micro nutrients required for proper growth and good health for human.

"Bread" prepared /fortified with vegetables such as Moringa leaf flour had good taste, flavor and generally accepted. The organoleptic attributes of bread fortified with moringa leaf flour are high. However, the texture of whole wheat bread was preferred to the texture of moringa wheat bread. The results from this study suggest that fortification of local staples with moringa oliefera leaf flour can provide nutritious foods suitable and cost effective diets for individuals.

Recommendations

The following recommendations were made from the findings of this study:

- Food industries should be enlightened on the use of moringa leaf flour in preparing baked products.
- The government should create awareness and supervise the fortification processes of food products ensuring that cereals are fortified properly with moringa leaf flour before packaging and distribution of products.
- Individuals and home- makers should be enlightened on the use of moringa leaf flour in preparing different dishes at the comfort of their homes.
- Different organization such as Nutrition associations should conduct campaign, conferences, workshops and seminars on the need to fortify cereals with and use moringa leaf flour in the preparation of food products.

Suggestions for Further Studies

- A replication of the study could be carried out using refined wheat flour in preparing baked products to determine its organoleptic attributes.
- A study to determine the organoleptic attributes and acceptability of confectionaries enriched with moringa leaf powder should be conducted.

References

Abioye, O. and Aka, L. (2015). Proximate composition and sensory properties of moringa fortified maize ogi. *Journal of Agriculture and Social Research* (JASR) 1(53),25-26.

Al-kharusi, L. Elmardi, M. and Ali, A. (2009). Effect of mineral and organic fertilizers on the chemical characteristics and quality of date fruits. *International Journal of Agric Biol*, 11(67), 290-291.

Anaekwe, C. (2007). *Basic research methods and statistics in education and social sciences*, Anambra. Sofie Publicity and Printing Limited.

Anozie, F. China, S. and Beleya, S. (2014).Sensory evaluation and proximate composition of snacks produced from composite flour of dioscorea alata and telfairia occidental's seeds. *Journal of Home Economics Research* 20(54), 100-108.

Austen, P. (2014). *Nutritional quality of plant foods*. Retrieved from http://www.biochemistrybenin.org.bc/chem.htm.

Barkley, J. Wheeler, K (2014). Anemia prevalence may b e reduced among countries that fortify flour. British Journal of Nutrition on doi:10. 1017/50071145/5001646.

British Nutrition Foundation (2014). *Sensory evaluation a guide to experimental research*, Retrieved from http://www.foodsafactoflife.org.uk/nutrition foundation.htm.

Brittenham, G. (2014) The Safety of flour fortification with iron. Columbia University paper presented at workshop for the flour fortification initiative.

Brownlie, G. and Thomas, H. (2012) fortification a means of eradicating diseases. *Journal of food science and technology.* Vol 52 (11) pp 456-458.

Canadian Celiac Association (2014). *A report of Celiac disease spread*. Retrieved from http://celiacdiseasesremedy.org.cd/celiacassociation.htm

Celiac Disease Centre (2015). Diet and health. Retrieved from http:www.diethealth.net/index.html

Cheung. L. (2014, February 21). Young living, Harvard school of public health. *The bulletin, pp 14-15.*

Christensen, E. (2015). The value of confectionary consumption amongst American households. *Bureau of applied research in anthropoly.* 17(7), 234-245. http:/dx.an.org/10.111/ J.1243-1244. 2008.00787.

Danica, C. (2011, July 26). Forestation: Domestication of moringa trees some exploitable intra-specific variation in west and central Africa. The Guide, pp 13-15

David,S. (2015) Enhancing grain for healthier life. *Asian pacific journal of cancer prevention, 45 (3-6), 212-215*

Delbridge, E. (2014). *Health and cereals*. Health is wealth. Health Company Incorporation., HCI.

Dick, F., Dooshina, C. and Michael, G. (2015). Nutritional evaluation of complementary food formulations form maize, soybean and peanut fortified with moringa oleifera leaf flour. *Journal of Food and Agricultural Sciences, 56 (4-5), 243-245.*

Dillard, C. and German, J. (2000). Review phytochemicals: Nutraceuticals and human health. *Journal of Science and Food Agric*, 80(7) , 174-176.

Donna, R. (1991). The bread machine cookbook. nittygritty cookbooks. Bristol publishing enterprises, Inc. San Leandro California.

Duchana, J.; Rafive, T.; Indrani, V. and Prakash (2013). *Effect of dried moringa leaves on Rheological, micro structural, nutritional, textural and organoleptic characteristics of cookies: Food product development.* Wood-head Publishing Limited: Wood-head Publishing in Food Science and Technology, Cambridge.

Edgerton, V. (2010). Iron deficiency anemia and its effect on workers' productivity and activity pattern. British medical journal, 2: 1546-1549.

Epoch times March 27, 2015 *Moringa the mother of nutrients.*

Ethnopharmacol, (2008), Colloids and Surfaces: *Physiochemical And Engineering Aspects*, vol 460, oct 20, pp 460- 467.

Eze .N.M. and Mberekpe. P.B.(2010), Maximizing the potentials of nutrition in curbing the problem of the aged. NSN 41st Annual conference and scientific meeting conference book of proceeding Kaduna.

Food and Agricultural Organization, (1999). *Harvesting of cereals.* Retrieved from www.fao.org/forestry/en/publication on 12/6/1999.

Food and Agricultural Organization, (2009). *Diet, nutrition and prevention of chronic diseases: Global and regional food consumption patterns and treads*. Retrieved from www.fao.org/ag/portal/index-en.html. 0n 22/7/2009.

FAO, (2012). *Global food and consumption rate: Extent and availability,* Retrieved from http://www.fao.org/docrep/014/mbo60e/mbo60e00.pdf.

Gengler, I. (2004). *When people are instrument: Sensory evaluation methods, sensory testing service Inc*. Retrieved from http://sensorytestingservice.com/index.html on 14/12/2014.

Global Alliance for Improved Nutrition (GAIN)Conference(2015) *Nutritional health.*

United Kingdom government corporation service.

Gross, F. and Scott, M. (2012) Impact of spina bifida on parental care givers: findings from a survey of Arkansas families. *Journal of child and family studies*, 18. 574-581

Hass, D. and Jere, T. (2012) *Iron Deficiency Anemia and reduced work capacity:* A critical review that research to determine a causal relationship. American society for nutritional science .131:6765-6905

Joel, A. (2004). *Introduction to sensory evaluation:* Evaluation Practices. Caston limited (3rd. Edition).

Jordan, F. (2012). *Gluten a threat to celiac patients.* Retrieved from http://www.jordanhealth.org/mbo60coo.pdf.

Kasolo, J.; Bimenya, G. and Ojok, L.(2010). Phytochemicals and uses of moringa oleifera leaves in Ugandan rural communities. *Journal of Medicinal Plants Res,* 4(3), 753-577.

Keri, G. (2015). *The value of whole grains*.: Rome Library Cataloguing in Publication Data.

Khawaja, T. Tahira, M. and Ikram, U. (2010). Moringa oleifera: A natural gift-A review. *J. Pharm Sci Res*, 2(3), 775-781.

Kolawale, T.; Balogun, W. and Olaeke, T. (2013). *Moringa leaves and health*. Department of Home Economics and Food Science, University of Ilorin (Agro Research Center).

Longo, N. (2012). *Gluten vs health* Retrieved from *www.natashalongoawarness. at/monthly/2011/pdf.*

Lucette, S. (2014). *Obesity and wheat*. NLP Conference Published Issue 104.

March of Dimes Birth Defect Foundation, (2013) Global report on birth defects.

Martorell, R. et.al (2014). Effectiveness evaluation of the food fortification programme of Costa Rica: *impact on anemia prevalence and hemoglobin concentrations in women and children. American journal of clinical Nutrition*,(44),(3), 191-195

Monica, T. (2014) Wheat role in combating chronic diseases. *American Journal Of Gastroenterology*,67 (6), 212-214

Nadivour, M, (2015). *Prevalence of celiac disease* retrieved from http://www.nadivourmedia. org.htm.

Neteam (2014). *Campaign against Anaemia*. Retrieved from *www.neteamdiseases.com.org.htm*

NIIR, (2008). *Composition of cereals.* National Institute of Industrial Project Consultancy services.

Nordquist, C. (2015). Celiac and Diet*: Institutional health management*: India: New Age International Limited.

Nutrition Facts, (2014). *Bread making enhanced techniques.* Retrieved from www.nutritionfact.org.

Nutritional Anemia (2007). Sight and life press.

Odewole, O. (2013) Near elimination of folate- *Deficiency anemia by mandatory folic acid fortification in older US adults: reasons for geographic and racial differences in stroke study*. American Journal of Clinical Nutrition, published online 14 August 2013.

O'Byrene, A. (2011). *Moringa oleifera benefit.* Retrieved from www.annao'byrene health consultation.org.

Olivera, F. (2011,august 12). Sensory evaluation techniques: 18th Annual. IAOM Conference (MEA District) Muscatoman. pp. 4-6

Oyeyinka,A.T., Oyeyinka,S.A.(2016) *Moringa oliefera* as a food fortificant: Recent trends and prospects. Journal of the Saudi society of Agricultural Science(2016), http://dx.doi.org/10.1016/jssas.2016.02.002.

Paleoleap, P. (2013). *Gluten protein*. Retrieved from www.paleoleap.comltopic/422896/ on 11/11/2013.

Parchon, K. (2014). Dietary supplement fact sheet: national institutes of health. Retrieved from http:/fdfortification.net/index.html

Rebecca,U. Sharon, M. (2006). Moringa oleifera: Medicinal and Socio-economic uses. *International Course on Economic Botany.* National Herbarium Leiden, Netherlands S.P.P., 2-6.

Smith, A. (2014). Australians grain foods food science text series. *British Food Journal*, 11(5), 885-889. retrieved from http//www.foodjournal.org.bj/bfj.htm

Tennyson, A. (2013). *Wheat and health*. Retrieved from http://www.wealthyhealth.org.

Tumer, T. and Rojas.V, (2015). *Direct and indirect antioxidant activity of polyphenol-and isothiocyanate-enriched fractions from moringa oleifera*. *Journal of Agric Food Chem*. 63(5), 1505-1513.

U.S centers for disease control and prevention (2015). Folic acid helps prevent Neural Tube Defects.

Walker, G. (2004). *Introduction to sensory analysis*: Retrieved from www.ssf.web.ac.uk/external

/u0000504/notes/sensory/intro.htm.

Womach, J. (2005). *Congregational research service document report for congress.* Agricultural Glossary of Tenna, Programs and Laws 2005 Edition.

World health Report (2012) - Reducing risks, promoting healthy life. World health Organisation

Ziga , F. (2011). *Gluten intolerance.* http// www.zigafied.org.au/allergy.htm

APPENDIX 1

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Part 1

Instruction

Please supply the following information by checking (✓) where appropriate.

Instrument for Organoleptic Evaluation

Section A: Organoleptic (Sensory properties) of bread sample.

Instructions: Rate the bread samples (A and B) presented in line with the characteristics/properties indicated in the table below. Note you are free to taste, touch/feel, smell and even cut the samples to determine the properties as appropriate. Use the following scale in rating the properties.

Scale:

Liked Extremely (LE)	=	9
Liked Very Much (LVM)	=	8
Liked Moderately (LM)	=	7
Liked Slightly (LS)	=	6
Neither Liked nor Disliked (NLD)	=	5
Disliked Slightly (DS)	=	4
Disliked Moderately (DM)	=	3
Disliked Very Much (DVM)	=	2
Disliked Extremely (DE)	=	1

Organoleptic (Sensory) Attributes of Bread Samples

SAMPLES A

S/N	Organolepic attributes	Liked Extremely 9	Liked Very Much 8	Liked moderately 7	Liked Slightly 6	Neither Liked nor Disliked 5	Disliked Slightly 4	Disliked Moderately 3	Disliked Very Much 2	Disliked Extremely 1
1	Colour									
2	Taste									
3	Flavor									
4	Texture									
5	General acceptability									

SAMPLES B

S/N	Organoleptic attributes	Liked Extremely 9	Liked Very Much 8	Liked moderately 7	Liked Slightly 6	Neither Liked nor Disliked 5	Disliked Slightly 4	Disliked Moderately 3	Disliked Very Much 2	Disliked Extremely 1
1	Colour									
2	Taste									
3	Flavor									
4	Texture									
5	General acceptability									

WHOLE WHEAT FLOUR

FRESH MORINGA LEAVES

DRIED MORINGA LEAVES

MORINGA LEAF FLOUR

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RESEARCHER READY FOR SENSORY EVALUATION

WHOLE WHEAT BREAD

MORINGA WHEAT BREAD

A CROSS SECTION OF THE PANEL OF ASSESSORS

Group Statistics

	SAMPLES	N	Mean	Std. Deviation	Std. Error Mean
Colour	WWB	37	7.5676	1.19118	.19583
	MWB	37	7.1622	1.46275	.24047
Taste	WWB	37	7.2162	1.31519	.21622
	MWB	37	7.5135	1.16956	.19227
Flavor	WWB	37	6.7297	1.46531	.24090
	MWB	37	7.1622	1.23634	.20325
Texture	WWB	37	7.4324	.95860	.15759
	MWB	37	6.8649	1.65264	.27169
General_Acceptability	WWB	37	17.4595	28.79486	4.73385
	MWB	37	12.5405	20.97829	3.44881

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Colour	Equal variances assumed	.000	.988	1.307	72	.195	.40541	.31012	-.21282	1.02363
	Equal variances not assumed			1.307	69.163	.195	.40541	.31012	-.21325	1.02406
Taste	Equal variances assumed	.275	.601	-1.027	72	.308	-.29730	.28934	-.87409	.27950
	Equal variances not assumed			-1.027	71.031	.308	-.29730	.28934	-.87422	.27963
Flavor	Equal variances assumed	1.205	.276	-1.372	72	.174	-.43243	.31519	-1.06075	.19588
	Equal variances not assumed			-1.372	70.017	.174	-.43243	.31519	-1.06105	.19618
Texture	Equal variances assumed	1.716	.194	1.807	72	.075	.56757	.31409	-.05856	1.19370
	Equal variances not assumed			1.807	57.761	.076	.56757	.31409	-.06121	1.19634
General_Acceptability	Equal variances assumed	2.952	.090	.840	72	.404	4.91892	5.85693	-6.75665	16.59449
	Equal variances not assumed			.840	65.816	.404	4.91892	5.85693	-6.77542	16.61326