ANALYSIS OF NUTRITIONAL AND FUNCTIONAL PROPERTIES OF MORINGA OLEIFERA ROOT, LEAF AND SEED IN EDO STATE

Eunice Iguodala ONARIASE
PG/EDU1817355

DEPARTMENT OF HOME ECONOMICS EDUCATION
FACULTY OF VOCATIONAL AND TECHNICAL EDUCATION
UNIVERSITY OF BENIN,
BENIN CITY.

MARCH 2025

CERTIFICATION

We, the undersigned, certify that this research work was carried out by Eunice Iguodala ONARIASE (PG/EDU1817355 in the Department of Home Economics Education, Faculty of Vocational and Technical Education, University of Benin, Benin City. It is adequate in scope and content for the partial fulfillment of requirement for the award in Master of Education (M.Ed) Home Economics.

Prof. (Mrs) N.I. Nwabah Date
(Supervisor)

Dr. I. Ihensekhien Date
(Head of Department)

Prof. P.E. Mbah
External Examiner Date

DEDICATION

This dissertation is dedicated to Almighty God, my beloved husband, my understanding children, my parents, siblings, nephews and nieces.

ACKNOWLEDGEMENTS

The remarkable success of this project is as a result of many people worthy of mention. The researcher wishes to express appreciation and gratitude to her supervisor, Prof. (Mrs.) N.I. Nwabah for her industrious, constructive criticism, patience, encouragement and understanding that brought this work to the required standard. In fact she was always available and approachable at all times in spite of her crowded programmes and challenges.

Special thanks go to Prof (Mrs.) E.E. Uko-Aviomoh, who painstakingly supported in correcting the entire project from the Departmental level to Faculty level. Indeed, she is a mentor. The researcher is indebted to DR. R. O. Owenvbiugie and Prof (Mrs.) L.E. Oshio for their numerous valuable contributions.

The researcher is highly indebted to Dr. S.B Abusomwan, the post graduate coordinator of vocational and technical Education, University of Benin for his various roles in accomplishing this task. He is a role model. She is also highly indebted to Dr. (Mrs.) Ihensekhien the head for the Department for her encouragement. Also, indebted to Dr. S.O. Osuyi and Dr. S. A. Adeoye for their various roles. The researcher wishes to thank them for their kind gestures.

She equally thank all lecturers and non – academic staff in the Department of Home Economics Education for their invaluable contributions and support towards the completion of the study. The researcher is also highly indebted to late Mr. .R. Aviomoh in making this work come through. He was indeed a boss, encourager and mentor worth remembering.

Special thanks go to: Oluwagbeileke Feranmi and Dr. Mrs. Enadeghe for their guidance and assistance in the laboratory processing and analyzing of the data used for the study. My colleagues; Austin Aire, Mrs. Agatha Iyoha, Mrs. Rafat Zibril and Mrs. Maria Omoikhefe for their support in making this dream come true.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

This study analyzed the nutritional and functional properties of moringa root, leaf, and seed including the awareness and utilization of the plant among different demographic groups in Edo State.

The research adopted a mixed-method approach, combining laboratory analysis (quasi experimental design) and survey methods. The sample size for the study is 180, representing 10% of the population; 80 market women, 60 community men and 40 community youths. Proximate analysis was conducted to determine the moisture, ash, protein, fat, fiber, and carbohydrate content of moringa seeds and leaves. Additionally, the mineral composition of the leaves was examined to assess their micronutrient profile. A structured and validated questionnaire was used to evaluate the level of public awareness and demographic differences (age and gender) regarding the nutritional and functional benefits of moringa. The reliability of the instrument was determined using Cronbach Alpha Coefficient of 0.99.

Findings from the study indicated that moringa is rich in essential nutrients, including vitamins (A, B, C, D, and E), minerals (calcium 641.2mg/100, iron 18.14mg/100, phosphorus 71.1mg/100, potassium 26.1.1mg/100), proteins 27.61%, crude fat 2.5%, carbohydrate 47.09%, Ash content 9.25%, fibre fat 10.11% and antioxidants (Alkaloids, tannins, phenolics, saponins, flavonoids and steriods. The functional properties of moringa include antioxidant, antimicrobial, anti-inflammatory, anti-diabetic, and anti-cancer effects, making it highly beneficial for human health. Despite these benefits, public awareness and utilization remain significantly low, particularly among younger demographics (15-20years). Indicating that the awareness increases significantly with age, (aged 45 and above). The study also revealed that moringa can serve as a viable alternative for addressing malnutrition ($\bar{x}$ = 2.86), terminal

ailments ($\bar{x}$ = 2.87), lactation ($\bar{x}$ = 2.93), cooking ($\bar{x}$ = 2.92), tea ($\bar{x}$ =3.13), improving food security, and enhancing economic development through commercial cultivation and product fortification. Based on these findings, the study recommended amongst others; increased public awareness campaigns, integration of moringa into government nutrition programs, promotion of large-scale cultivation, and encouragement of moringa-based industries for food, cosmetics, and pharmaceuticals.

CHAPTER ONE

INTRODUCTION

Background to the Study

Moringa Oleifera is a soft wooden tree which fruits, roots, seeds and leaves have been advocated to be one of the world's most useful vegetable plant for food, medication in most countries. (Mbah, Salami, Azubuike & Apugo, 2015). All parts of moringa oleifera have significant levels of monounsaturated / saturated fatty acids (MUFA/SFA), sterol and tocopherols, as well as proteins with a high sulfated amino acid content, making them interesting resources for both food and non-food uses, substantial amount of minerals (calcium, iron), phosphorus, carotenoids, proteins, vitamins (A, B, C, D and E) are present in Moringa Oleifera. The plant contains various essential phytochemicals in its leaves, seeds and pods, and it is one of the effective remedy for malnutrition.

Muhammed and Tahuir (2021) stated that Moringa Oleifera was well known to ancient world, but only recently has it been rediscovered as a multi-purpose tree with a tremendous variety of potential uses. The edible oil which can be extracted from seeds of Moringa peregrine was highly valued by the ancient Roman, Greek, and Egyptian civilization for use in making perfume as well as a skin lotion. During 19th century, Moringa Oleifera plantations in the west indies were exploring the seed oil (known as Ben oil) to Europe or use as lubricant for fine machinery. Moringa has long been cultivated for its edible fruit. Today, there are exported fresh and in tins to consumers in Asia and Europe. The edible leaves of the tree are very nutritious, and are consumed throughout West Africa, in parts of Ethiopia and in some countries of Asia.

It is also imperative to note that moringa Oleifera has compounds with antibiotic, activity such as the glucosinolate, 4alpha-rhammoxyloxy, benzyl iso thiolyganate river. India and Africa have known about the medicinal properties of the tree for generations and have thus used it to cure various diseases. However, the knowledge is considered as alternative science and herbal remedy. Suffice to state that, the plant's root, leaves and seeds have remarkable functional, nutraceutical and nutritional properties that make the plant diverse biomaterial for food and allied uses. Sa'a du (2016), indicated that Moringa Oleifera tree has a unique property that makes it one of the most versatile on the planet and known to many as the miracle tree. Therefore, the production in Nigeria is being dominated by small scale farmers, despite the nutritional value attached with the consumption. Its consumption, production, processing and marketing is fondly inadequate because the crop is mostly used as a border Crop or background tree, thus serving as fence to most of its farmers.

Moringa leaves are consumed locally, especially in Northern Nigeria as vegetables and local salad, it is also widely used as fodder for livestock. The plant is described as the most reliable vegetables and fodder, because of its nutritional value. It was also revealed that the leaves could be eaten fresh or dried, and very good for Children aged 1-3years. In developing Countries (and particularly in Nigeria), moringa has potential to improve nutrition, reduce malnutrition among children and women, boost food security, foster rural development, support sustainable land use, improve the health status of the people both male and female due to its medicinal properties.

It may also be used as forage for livestock, or as a micronutrient liquid, and a natural anthelminthic and possible adjuvant.

Furthermore, the analysis of the proximate content this plant has shown that its leaves are particularly rich in essential amino acids and antioxidants such as p-carotene, flavonoids.

(Amaglo, Bennett, Locurto, Rosa, Tuco, Gluffrid, Lo curto, Crea, Timpo, and Gowrishankar, 2010). Moringa Oleifera is a promising food source in the tropics because the tree is in full leaf at the end of the dry season when other foods are typically scarce. The plant also has abundant amount of calcium which is considered as one of the important minerals for human growth. While 8 ounces of milk can provide 300 - 400mg, moringa leaves can provide 1000mg. Hence, it can be used as substitute of anemia. Likewise, the high amount of iron present in the plant leaf is a good dietary intake for proper growth of sperm cells and also necessary for the synthesis of DNA and RNA (Farinola, Famuyide, Awe, Adio and Ewolor 2014)

The plant has numerous applications in cooking throughout its regional distribution. Moringa and other plants grown in home gardens found in dooryards and agricultural fields provide rural families with income, food, nutritious vegetables, animal feed and fire wood. This helps the communities to live self - sufficient live. The extract from the plant could be used for water treatment, particularly by people in rural areas where there is limited access to portable water (Farinola, Famuyide, Awe, Adio & Ewolor 2014).The grind leaf powder derived from the dried leaf of moringa oleifera can be added to soup, stew and sauce as a thickner due to its nutritional content.

According to Axe (2024), it is worthy to note that, in this present dispensation, moringa Oleifera serves as a source of income and food to the rural inhabitants and is increasingly be becoming an important source of food security for a number of people. As a result, many people have started nurseries to grow the plant in large quantities for sale and consumption within and outside the country due to its nutritional value. However, people's reasons for planting this valuable tree seem to be for food, its medicinal, nutritional and other functional benefits.

Functional foods are foods that provide health benefits beyond their basic nutrients which include micro and macro nutrients such as vitamins, minerals, carbohydrates, fats, and protein (Levy, 2019). Despite the fact that functional foods provide essential nutrients, they also contain additional, unique and protective compounds that most other foods do not have. These include Omega-3 fatty acids, dietary fibre and antioxidants. Some functional foods are also bred with the intention of improving their nutrient content or appearance. This is the case with some herbs, vegetables, plants, and fruits of which moringa oleifera seeds, leaves and roots is a good source (Axe, 2024).

Marinho, Marina and Mario (2013) stated that scientific progress linking diet and health benefit has promoted attention in nutrition of health benefits and disease prevention. It was further reiterated that the concept of functional food is growing and that the 21st century faces a world in deep transformation with few challenges, longer life expectancy, rising cost of health care, rapid advances in science and technology, changes in lifestyle, concern over the quality of life style and dietary intake.

Since the 1990s, health promoting products have become a trend as people become more conscious of the dietary choices they have on their health. Today, fortified and enriched food products are in high demand because they possess protective phytonutrients, antioxidants and other beneficial compounds of which the miracle plant (moringa oleifera) is a good source. The plant has high nutritive values; every part of the tree is suitable for either nutritional or functional purposes. It was further stated that extracts from the leaves are used to treat malnutrition, argument breast milk in lactating mothers, cure of diabetes, cancers and fortification of commercial product such as soaps, creams, pastries and other cookies. Studies have shown that moringa Oleifera can be used as an anti-neo-prolifera lerative agent, thereby

inhibiting the growth of cancer cell. Soluble and solvent extracts of the leaves have been proven effective as anti-cancer agents.

The nutritional and functional values of moringa Oleifera cannot be over emphasized, Moringa is said to provide 7 times more vitamin c than oranges, 10times more vitamin A than carrots, 17 times more calcium than milk, 9 times more protein than yoghurt, 15 times more potassium than banana and 25 times more iron than spinach. The fact that moringa is easily cultivatable makes it a sustainable remedy for malnutrition. Children deprived of breast milk tend to show symptoms of malnutrition. Lactogo-gues are generally prescribed to lactating mothers to augment milk production. The lactogogue made of phytosterols acts as a precursor for hormones required for reproductive growth. Moringa seed is rich in phytosterols like stigmasterol, sitosterol and kampesterol which are precursors for hormones. Researchers are of the opinion that the compound in moringa leaves increase the oestrogen production, which in turn stimulates the proliferation of the mammary gland ducts to produce milk. It is used to treat malnutrition in children younger than 3 years. Also, about 6 spoonful of leaf powder can meet a woman's daily iron and calcium requirements during pregnancy.

The aforementioned research also reported that Moringa Oleifera have also be incorporated into the fortification of chocolate, and that 20% of Moringa powder was ideal for fortification with cocoa powder for chocolate. This was to develop a protein and mineral rich chocolate. Several such Moringa fortifications are possible and ongoing to ensure intake of adequate amounts of nutrients in children.

Hence, moringa Oleifera has become a household name all over the world and most especially Africa. This is because of its unique importance for various functional, nutritional, medicinal, Agricultural and physical uses. Furthermore, in Nigeria, Moringa Oleifera is called zogalla by the Hausa, konamarade / Moringa by the Fulani, lkwe oyibo by the Igbos,

Eweile by the Yoruba, Moringa by the Edos /Delta, Zogalla / Moringa by the Tiv. Also, in Benin Republic, it is called Gingandjah, paizlava by the Cameroon, in Chad it is called kag n' dongue, shelagda by the Chanian

Moringa Oleifera is a fast growing perennial tree, which can reach a maximum height of 7-12m and a diameter of 20-60cm at chest height. The stem is normally straight, the tree grows with short, straight stem that reaches a height of 1.5-2.0m before it begins branching and it can reach up to 3. 0m. Researcher showed that each tree can produce between 15,000 and 25,000 seeds per year. Also, that all the part of the plant can be used in variety of ways to fortify food for consumption because, the leaves is full of nutrients and vitamins. Over 120 species of tropical and subtropical are edible plants for nutrient content, antioxidant activity and a crop trait indicated that moringa Oleifera is one of the promising crops which could contribute to increased intake of micronutrient and antioxidant.

Antimicrobial activities including the inhibition for the growth of staphylococcus aurous are commonly isolated from food and animal intestine. Flowing from the above research, the plant has some medicinal uses, good for human consumption, animal fodder, water purification, fertilizer, living fence, alley cropping, natural pesticide, fuel wood and growth hormone for plant.

Alhassan et al (2022), posited that moringa Oleifera can be grown in any tropical and subtropical region of the world with a temperature around 25-35 0c. This implies that it requires sandy or loamy soil with a slightly acidic to slightly alkaline PH and a net rainfall of 205-300m. The plant can be cultivated from direct seeding, seedlings and it grows to about 30cm, it can be transplanted, cuttings with 1m length and 4-5cm in diameter. Hence, in commercial cultivation, spacing is important as it helps in plant management and harvest.

The cultivation of Moringa Oleifera in different climate has]slightly different nutritional components. For example, the tree grown in India has slightly different nutritional component than a tree grown in Nigeria. The nutritional differences in the leaves from the ecological location were that, the latter was less nutritious than the former due to the high temperature at the Savanah regions. This means that at high temperature, proteins and enzymes get denatured and this could cause for the difference in nutrient content. It is therefore opined that soil is an important factor that defines the nutrient content and strength of the plant. Hence, fertilizer, poultry manure and organic base fertilizer when applied on the plant can affect the nutrient content of the plant.

However, the overall nutrient attributes of the plant remain same albeit nutrient variability. This makes Moringa Oleifera viable as a potential nutraceutical anywhere in the world as suggested by (Razis, Ibrahim and Kntayya 2014). It is pertinent to note that boiling increases the availability of iron and antioxidant of the plant. Hence, the processed Moringa seed flour can be used to treat malnutrition problems and be preserved for a long time without loss of nutrients. That drying or freezing can be done to store the leaves. This can be done by using economical household appliance like stove to retain a continuous supply of nutrient in the leaves. Therefore, preservation by dehydration improves the shelf life of moringa without change in nutritional value.

The nutritional, functional properties and potentials of components of moringa are too numerous, but to mention a few. For example, the leaves of moringa Oleifera treat asthma, hyperglycemia, Dyslipidemia, flu, heartburns, Syphilis, malaria, pneumonia, diarrhea, Scurvy, headaches, bronchitis, skin disease, ear and eye infections. The leaves may also act as anticancer, antimicrobial, antioxidant, anti-diabetic and anti-atherosclerotic agents.

Meanwhile, Morton (2019), acclaimed that moringa Oleifera helps in treating hyperthyroidism, chrohns disease, anti-herpes, simplex virus, arthritis, rheumatism, gout, cramp, epilepsy and Sexually transmitted diseases. This is because, the seed contains anti-microbial and anti- inflammatory agents. To buttress further, the root bark act as a cardiac Stimulant, anti-Ulcer and anti-inflammatory agent due to the presence of Alkaloids like morphine, moriginine. The alkaloids help the bark to be anti-ulcer, a cardiac stimulant and help to relax the muscles. The flower and the pods act as hypo-cholesterolemic, anti- arthritic agents that are capable of curing urinary problems and cold, it contains calcium, potassium and amino acids. The pods treat liver, diarrhea, joint pains and spleen problem.

The medicinal values of the plant alleviate several complications such as retinopathy, nephropathy and atheroseclerosis hyperglycemia. All the parts of the miracle tree are edible for human consumption. Which also serves as a valuable source of nutrient for all the age groups. In furtherance to this, moringa oleifera has Agricultural value which include; promotion of uniform growth hormone. Also, fertilizer can be produced from the seed cake, the tree also produce viscose resin that are used in the textile industry. While the wood can be used as fuel wood and other uses for cooking because the wood is light.

Additionally, moringa Oleifera contains a very high level of proteins which approximately 1% are active cationic polyelectrolyte with a molecular weight between 7-17 Daltons which can neutralize the colloids in moldy or dirty water since majority of the colloids have a negative electric charge. This protein can therefore be used as a non-toxic natural polypeptide for sedimentary mineral particles and organic in the purification of drinking water, for cleaning vegetables, Oil, or for sedimentary fiber in the juice and beer industries.

Recently, Moringa Oleifera has a lot of functional applications; the seeds are used to extract oil called Ben oil which is rich in oleic oil, tocopherols and sterols. This can withstand oxidative rancidity. The oil can be used as perfume and also for lubrications. The pods can absorb organic pollutants and pesticide. The seeds have wide applicability in averting diseases and can enhance the quality of life in rural communities as it is highly abundant. The seeds can also be used in cosmetics and are source of biodiesels while the seed cakes can be used as manure or fertilizer. The flowers of moringa are used as tea, as sources of nectar used by beekeepers. Moringa is also used as fortification to produce creams, soaps, snacks, bread, butter, crackers, livestock feeds.

The functional applicant of this miracle tree to humans has acted as source of nutritious food that has increased the nutritional wellbeing of the populace in developing countries (particularly in sub- Saharan African). Moringa leaves, seeds and roots have potential to improve nutrition, boost food security, foster rural development, support sustainable land use, improves health status of the people due to its nutritional and functional properties. It may also be used as forage for livestock, or as a micronutrient liquid, and as a natural anthelminthic and possible adjuvant. In many instance Moringa products (leaves, roots and seeds,) serve more than one functions, the most important uses are broadly categorized as food, traditional medicine, source of food fortification and income. Since moringa leaves are vegetable which are rich in vitamins hence are included in the daily diet.

Since Moringa serve as an eco-friendly nutrient, the cultivation of the plant is increasingly becoming an important source of nutrient for a number of people in the rural areas. In Nigeria, the plant is already a popular tree for indigenous agroforestry paragraph. In recent times, Nigeria has witnessed an increase in poverty and malnutrition. This has become a major national issue and these have been entrenched in most national and international development

programmes and policies including Millennium Development Goals. Interventions that will improve the nutritional status should be locally available and inexpensive for the generality of the population. It has been observed that the country has intended to ignore solutions that are locally available, therefore relying more on relatively more expensive imported and unsustainable interventions.

Moringa has potentials to alleviate Malnutrition, related morbidity, mortality among children, pregnant and lactating woman, and malnourished children, also, the plant's amino acids are essential for development Ferinola et al (2014). In furtherance, it was, posited that four nongovernmental organizations in particular –Trees for Life International, Church World Service, Educational Concerns for Hunger Organization and Volunteer Partnerships for West Africa have advocated for use of moringa as natural nutrition for the tropics. There has been glamour for the Oleifera in farming systems.

In this study, two demographic differences in the awareness of the nutritional and functional properties of moringa oleifera seeds, leaves and roots will be considered – age group and gender. Three age groups will be assessed, namely the youths between age range of 18–40 years, middle age between 25-40 years and the elderly that are from 60years and above. Two genders will be considered, namely female and male. Investigating the level of awareness of the nutritional and functional properties of moringa oleifera seeds, leaves and roots is important to inform the targeted moringa-related health intervention strategies to reduce the prevalence of nutritional and non-communicable diseases in Edo State.

However, while a number of studies have been carried out on the origin, morphology and chemistry of Moringa, little or no efforts have been made to critically unearth the nutritional and functional properties of moringa oleifera root, leaf and seed. In spite of the abundant benefits and enormous possibilities presented by the plant species, many people remain

unaware of and /or unwilling to exploit them. For instance, the Moringa leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. This therefore necessitated this study with a view to analyse the nutritional and functional properties of moringa oleifera roots, leaves and seeds in Edo State.

Statement of the Problem

The prevalence of nutritional deficiency diseases and malnutrition appear to be on the increase. In recent times, Nigeria has witnessed an increase in malnutrition and hunger-related causes. This has become a major national issue and these conditions have been entrenched in most National and international development programmes and policies including Millennium Development Goals. The problems and resultants effects of malnutrition are also related to the poor health and low productivity issues. This is hinged on the fact that a nation that suffers the prevalence of malnutrition and nutritional related diseases is subject to be unproductive. It is pertinent to note that the country may have ignored solutions that are locally available thereby relying more on relatively more expensive imported and unsustainable intervention.

Worldwide, it is estimated that seven million people die each from hunger related causes and the vast majority of these death are caused by chronic malnutrition (Fuglie, Service and Eng, 2017). Moringa Oleifera leaves, seeds and roots have numerous nutritional, medicinal and other functional properties to alleviate the menace of malnutrition in the society. Due to moringa rich nutrient profile, it can serve as an excellent resource to prevent malnourishment. The plant can be used as food supplement. It contains more than 90 nutrients and different antioxidants. Despite the globally accord significance nutritional and functional value

attached to moringa consumption, its product processing and functional uses seems to be grossly inadequate.

In spite of the abundant benefits and functional possibilities presented by this plant species, many people remain ignorant and seem unwilling to exploit them. For instance, the moringa leaves can be eaten fresh, cooked or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. This therefore made it imperative to research on the nutritional and functional properties of *Moringa oleifera* root, leave and seed.

Purpose of the Study

The main purpose of the study was to find out the Analysis of Nutritional and Functional Properties of *Moringa oleifera* root, leave and seed in Edo State. Specifically the study will analyze**;**

1. The awareness of the nutritional value of moringa oleifera leaves in Edo State.
2. The awareness of the nutritional value of moringa oleifera roots in Edo State.
3. The awareness of the nutritional value of *Moringa oleifera* seeds extract in Edo State.
4. The Functional Properties of root of *Moringa oleifera functional uses.*
5. The Functional Properties of leave of *Moringa oleifera functional uses*.
6. The Functional Properties of seed of *Moringa oleifera* functional uses
7. The percentage content of moisture , ash crude fat, protein , crude fibre , and carbohydrate extract in moringa oleifera seeds and leaves.
8. The mineral content of moringa oleifera leaf
9. The functional constituents of moringa oleifera leaf extract.

Research Questions

The following research questions will guide the study:

1. What is the level of awareness of the nutritional value of *Moringa oleifera* leaves in Edo State?
2. What is the level of awareness of the nutritional value of *Moringa oleifera* roots in Edo State?
3. What is the level of awareness of the nutritional value of *Moringa oleifera* seeds in Edo State?
4. What are the functional properties of root of *Moringa Oleifera* when utilized?
5. What are the functional properties of leaves of *Moringa Oleifera* when utilized?
6. What are the functional properties of seeds of *Moringa Oleifera* when utilized?
7. What is the percentage content of moisture, ash, crude fibre, protein, crude fat and carbohydrate extract in *moringa oleifer*a seeds and leaves?
8. What is the mineral content of *moringa oleifera* leaf extract?
9. What are the functional constituents of *moringa oleifera* leaf extract?

Hypotheses

1. There is no significant difference in the level of awareness of the nutritional value of Moringa Oleifera leaves, roots and seed extracts between male and female residents of Oredo Local Government Area of Edo State.
2. There is no significant difference in the level of awareness of the functional properties of Moringa Oleifera leaves, roots and seed extracts between male and female residents in Edo State.
3. There is no significance difference in the level of awareness of the nutritional value of Moringa Oleifera leaves, roots and seed extracts in Edo State based on age group.

4. There is no significant difference in the level of awareness of the functional properties of Moringa Oleifera leaves, roots and seed extracts in Edo State based on age group.

Significance of the Study

It is hoped that the study will be of great benefits to Bakers, confectioneries, farmers, geriatrics, Civil and Public servants, entrepreneurs, Home Economist, hospitals, secondary and tertiary institutions, churches and the general public as follows;

The families in the various axis of Oredo Local Government will be aware that moringa has numerous applications in food. The plant grown in home gardens, found in door-yards and Agricultural field provide rural families with food, nutritious vegetable that help families to be nutritionally balance because of the nutritional value.

The edible vegetables are rich in vitamins, hence are included in daily diet.

The research will benefit Bakers, confectionaries will be exposed to benefits of the plant in the baking and confectionary industries because of the benefits of fortifying the processed products with scone, teacakes, pastries, soaps, ointment, creams, amongst other which contribute positively in the food industry and also boost our economy.

To farmers, it is hoped that farmers in our communities will become aware of the economic benefits of this plant which include the use of the plants extract for water treatment, source of livelihood, natural nutrition. This will boost socio-economic development of our communities.

Cultivation of this species is indeed a promising economic proposition that can generate income among a diversity of other purposes in many instances the products [Stem, leaves, bark, seed, flower, root] serve more than one function and sources of income. Moringa oleifera is used as vegetable, seed, oil gum, hedge tree, ornaments, tea and medicinal plant which all serve as source of livelihood. It can be processed for exportation.

The orthodox and traditional health personnel will align with the use of the miracle tree for treatment of conditions ranging from Fever, throat, intestinal, urethral, skin, and venereal diseases. Also, for the management of non-communicable diseases such as ulcer, diabetes, hypertension, and so on.

To entrepreneurs, this group of people will be abreast with the benefits for planting this valuable tree across the country. The plant is an indigenous agroforestry in Nigeria.

The nutritionist, research, secondary and tertiary institutions will become acquainted with the nutritional properties which include micronutrients, vitamins, minerals, antioxidants; these are tools for managing malnutrition, review or research for update and for further nutritional enquiry in schools.

The general public, parents, Civil and public servants, geriatrics will put on notice of other alternative uses of moringa for health, nutritional and economic purpose. They will be exposed to the nutritional economic benefits of Moringa Oleifera in curbing poverty and nutritional related disease such as, anemia, diabetes, blindness, ulcer and others. They can benefit from the consumption of the plant either as using it for vegetable or taking it as a form of tea among other ways of its usage.

Scope and Delimitation of the Study

The study is designed to examine the analysis, awareness and use of the nutritional and functional properties of moringa oleifera seed, root and leaf in Edo State. The study concentrated on the experimental analysis of the nutritional and functional properties of moringa seed, leaf and root for an in-depth knowledge as well its nutritional and functional value to the youths, elders and market women across Communities in Oredo Local Government Area of Edo State.

Definition of Terms

The following are operationally defined

AIZHEIMER DISEASE; A progressive disease that destroys memory and other memory functions

ANTI-CANCER AGENT; Agents that regulate tumor growth prerecession and Survival.

ANTI-MICROBIAL AGENT; Drug used to prevent the pathogenicity of microorganisms.

ANTI-INFLAMMALORY; Causes redness and swelling of an area of the body or tissue

ANTI-OXIDANT; A substance that inhibits oxidation, it protects cells from damage caused by free radicals

APHRODISIAC; Increase sex drive

DOPAMINE; A substance that acts on the area of the brain to give feeling of pleasure, satisfaction and motivation

DROPSY; Malfunction of the digestive power in the liver

DRUMSTICKS; Immature green pods of moringa oleifera can be prepared similarly as green beans

ESCHERICHIA COLI; A coliform bacterium that is commonly found in the lower intestine of warm blooded organisms.

FREE RADICALS; Unstable molecules made by the process of oxidation during normal metabolism

GLUCOSINOLOTES: Glycoside and isothiocyanates compounds; These are anti-cancerous agents present in moringa leaf

HORSE RADISH; A spicy root vegetable in mustard family

MEDICINAL VALUE; Rapid healing properties

ATURAL ANTHEMINTHIC; Potency to act against infection caused by parasitic worms

PARASITIC INFECTION; Any illness or conditions caused by parasites living and reproducing in the body

PHYTOCHEMICAL;Is a phytonutrient that is biologically active, naturally occurring substances in plants that have protective or disease preventive properties

PROLIFERATION; Rapid increase in the number or amount of something

PSYCHOSIS; A mental disorder characterized by a disconnection from reality

RNA SYNTHESIS; Ribonucleic acid is a nucleic acid present in a living cell that has structural similarities to DNA

SEROTININ;A chemical substance found mostly in the digestive tract, brain and spinal cord that controls a person's mood

THERAPAUTIC VALUE; A branch of medicine concerned with the treatment of disease and the action of remedial agents

UROLITHIASIS; Kidney stone

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter presented the review of related literature under the following sub-heading:

- Theoretical Framework
- Concept of Moringa Oleifera
- Nutritional and medicinal/analysis of Moringa Oleifera
- Nutritional value of Moringa Oleifera seeds, roots and leaves
- Methods of preserving Moringa Oleifera
- Awareness of the nutritional and functional value of Moringa Oleifera seeds, roots and leaves
- Functional potentials of components of Moringa Oleifera seeds, roots and leaves
- Functional properties of moringa Oliefera seeds, roots and leaves.
- Functional value of Moringa Oleifera seeds, roots and leaves
- Functional Uses of Moringa Oleifera seeds, roots and leaves
- Functional application of Moringa Oleifera seeds, roots and leaves
- Nutritional and Functional Benefits of Moringa Oliefera Seeds, Roors and Leaves
- Functional and Nutritional Trends of Moringa Oleifera Leaves, Seeds and Root
- Moringa Oleifera seeds, roots and leaves incorporation in various food products
- Reasons for the intake of Moringa Oleifera fortified food products (functional foods).
- Side effects of Moringa Oliefera as Miracle Tree
- Review of related literature
- Summary of literature review

Theoretical Frame Work

The theoretical frame work for this study is hinged on "The antibacterial Potency of Moringa Oleifera Leaf Extract on Semau Island, East NUSA Tenggara, Against Escherichia Coli" experimented by Kusmiyati, Ferry, waongsir, Moses Kopong Tokan, Aprisa Adu, Anwar Mallongi and Eryc Zevrily,(2023) .The study was conducted by Kusmiyati et al (2023) to investigate the phytochemical constituent of moringa oleifera leaf extract and determine the inhibition of the extract against Escherichia Coli bacteria. In the study, moringa leaves were collected and quantitative testing was carried out to determine the bioactive components of moringa leaf extract. The well diffusion method was used to test the inhibitory activity of moringa leaf extract against E. coli. The treatments were divided into 10 extract concentrations (10%, 20%, 30%, 40% 50%, 60%, 70%, 80%, 90%, 100%).

At the end of the laboratory experiment, the results showed the presence of flavonoids, phenols, alkaloids, tannins and saponins in moringa oleifera axtract. The extract from the plant had different inhibitory properties against E. Coli bacteria. Moringa extract concentration of 10%, 30% and 20% did not show inhibitory activity against E. Coli while the other concentrations were able to inhibit the growth of E.Coli. The average inhibition zone diameter for each concentration varied at 1.9mm (40%), 6.27mm (50%), 8.53mm (60%), 10.39 mm (70%), 12.80 mm (80%), 14.84 mm (90%) and 19.04 mm (100%). The most effective for inhibiting the growth of E.Coli bacteria was 100%. It was concluded by the researchers that M. Oleifera leaves have the potential as an antibacterial; as well as properties in overcoming various environmental health problems.

This theory is significant in this study because moringa oleifera leaf is one of the variables that the functional and nutritional properties will be critically examined: as a candidate for curing various diseases, as natural medicine for increasing immunity defense against deadly

ailment, as a healthy diet, as food products in human nutrition and its benefits in addressing malnutrition issues in our society.

Concept of Moringa Oleifera

Moringa is a plant that is native to the sub-Himalayan areas of India, Pakistan, Bangladesh, and Afghanistan. It is also grown in tropics. It is a perennial plant, which has been found to possess high economic and cultural values in many countries of the world. According to Afsharypuora, Asgharia, Mohagheghzadehb & Dehshahrib (2010), moringa is a short, slander, deciduous, perennial tree, and almost every part of the tree is of value for food. Moringa news as reported by Sindhu, Mangala and Sherry (2013) revealed that the leaf is a power house of nutritional value and can be eaten like peanut in Mlaya. Also, the thickened root is used as substitute for horse radish while the foliage is eaten as greens, in salads, in vegetable curries, as pickles for seasoning and the root is used for dropsy.

Alhassan, et al. (2022) posited that Moringa Oleifera is a small size tree with approximately 5 to 10 meters height which is cultivated all over the world due to its multiple utilities and wide adoptability and ease of establishment. Every part of moringa is used for certain nutritional or medicinal purpose. Besides being a good source of protein, vitamins, oils, fatty acids, micro and macro mineral elements and various phenolic. He also reported that the miracle tree had anti-inflammatory, anti-microbial, anti-oxidant, anti-cancer, cardiovascular, hepato protective, anti-ulcer, diuretic, anti-uraithiatic and anti-helmic properties. And that these multiple pharmaceutical effects are capitalized as therapeutic remedy for various diseases in traditional medical system. Moringa Oliefera is a multifaceted plant. Most of its parts are edible, and it has the therapeutics values. Its seeds, leaves and roots have relevant nutrients and substances for feeding as reported by Fernandes (2021). Because of this, the leaves have

been widely used as a supplement against malnutrition. The leaves are the most used parts. They can be dried, ground and stored for later use. (Shiriki, 2015).

Mallya et al (2017) reported that moringa has enormous medical potential, which has long been recognized. They further stated that nearly every part of moringa including root, bark, gum, fruit (pods), flowers, seed and seed oil are packed with nutrients that are important to both men and animals. According to Asghari et al (2015), its leaves and seeds are good sources of vitamin C , A, calcium and potassium which support strongly the human immunity against infection. As discussed by (Bashir et al, 2014), Moringa is used for tired blood (anemia), arthritis, rheumatism, asthma, cancer, constipation, diabetes, diarrhea, epilepsy, stomach pain, intestinal ulcers, headache disorders, bacterial, fungal, viral and parasitic infections. He further stated that it is used to reduce swelling, increase sex drive (as an aphrodisiac), prevent pregnancy, boost human immune system and increase breast milk production. Also, that some people use it as a nutritional supplement of tonic. Sometimes, it is applied directly to the skin as a germ-killer or drying agent (astringent). In addition, it is typically for treating pockets of infection (abscesses), athlete's foot, dandruff, gum disease (gingivitis), snake bites, warts and wounds, heart problems, high blood pressure, kidney stones, fluid retention, and thyroid

Nutritional and Medicinal Properties/Analysis of Moringa Oleifera

Nutrition is the processes by which an organism assimilates food and uses it to provide energy and materials for their growth, activities and reproduction.(Lucy and Obidiwe, 2019). It is worthy to note that nutrition is a basic characteristics of life, while food is complex energy rich organic matter which living organisms feed on to obtain nutrients and substances necessary for life. Suffice to note that moringa oleifera also known as miracle tree due to its multipurpose nutritional uses and capacity to cure many diseases has reserved nutrients. The

plant is a slander, deciduous shrub or tree with an ovoid crown that can grow up to 10 metres tall. The leaves are feathering and pale green in colour and are rich source of minerals like calcium, potassium, zinc, magnesium, iron and copper with low calorific value which can be used in the diet of obese person. The leaves also contain all essential amino acids and are rich in proteins. (Janick and Paul,2018). The seeds are dark brown with 2 papery wings. It is resistant to harsh condition. Goswami, Inamdar, Dethe, Gururaj, Jamwal & Bahaskar (2016). Interestingly the various species are Arango, Arbol de lasperlas, Behen, Ben Aile, Ben Nut Tree, Ben Oleifera, Ben Zolive, Caneficier de I' inde, Chinto Borrego, Clarifier Tree, Drumstick Tree, Horsea dish Tree, Indian Horse radish, Jacinto, Kelor Tree, Malunggay.

Oil from moringa seeds is used in foods, perfume, hair care products, ointment cream for body pains, soaps and as machine lubricant. Lalas, Athanasiadia, Tsaknis & Chinou (2012), proved that moringa seeds can be used as natural purifier for water. Also, it is an important food source in some parts of the world because, it can be grown cheaply and easily, and the leaves retain lots of vitamins and minerals when dried. Alsha, Danjuma & Muhammad (2021) revealed that, moringa leave and seed are used in India and Africa in feeding programs to fight malnutrition, the immature green pods (drumsticks) are prepared similarly for green beans, while the seeds are removed from more mature pods and cooked like peas or roasted like nuts. That the leaves are cooked and used like spinach, and they are also dried and powered for use as a condiment. He further said that the seed cake remaining after oil extraction is used as a fertilizer and also to purify well water and to remove salt from sea water. In addition, the miracle tree also contains proteins, vitamins and minerals, while as an anti-oxidant, it seems to help protect cells from damage and boost the immunity against infectious diseases.

Kumar (2016) explained that the benefit of using moringa oleifera in treating different diseases or symptoms of diseases has guaranteed it as a good candidate for curing various diseases. Also, the leaves are applied as poultice to sores, for headaches, and it has purgative properties and can stop bleeding. While the roots are acrid, pungent and are taken to promote digestion, to treat tumors, treat liver and spleen problems and pain of the joints. More so, the leaf tea has an anti-bacterial and anti-inflammatory effect that treats gastric ulcer and other non-communicable diseases such as diabetes, and urinary problems. In fact nutritional analysis of moringa indicates that the leaves and seeds contain wealth of essential and disease preventing nutrients, vitamins as well as group of all essential amino acids to boost the immune system and cure various diseases.

S'a'adu, (2016) opined that moringa tree is one of the most incredible plants ever encountered. This may sound sensationalist, but moringa's nutritional, medicinal and other functional benefits properties have the potential to end or prevent and heal many diseases and maladies that predisposes one to infection. It is truly a miracle plant, and a divine gift for the nourishing and healing of man. The plant has so many uses and special features that are beneficial to mankind. The most incredible thing about the plant is the amount of nutritional and medicinal chemicals and compound found in it. The chart below shows some of the notable nutrients contained in the plant. According to Bashir et al (2014), the nutritional properties of moringa are now so well known, 100grams of dry moringa leaf contain: 10 times the vitamin A of carrots, ½ times the vitamin C of Oranges, 17 times the calcium of milk, 15 times the potassium of bananas, 25 times the Iron still in the nutritional properties of moringa. Bashir et al (2014) pointed out that, "the nutritional properties of moringa leaves and seeds are now known that there seems to be little doubt of the substantial health benefit to be realized by consumption of moringa leaf powder in situation where food insecurity and various diseases are imminent. It is now seen as herbal remedy.

As seen in the chart below, Moringa Oleifera contains vitamin A, vitamin C, calcium, potassium, Iron, and protein in high amounts that are easily digested and assimilated. It is also known to contain 539 compounds which according to traditional African and India medicine is said to prevent 300 diseases and maladies thereby reducing the outbreak.(Leone et al,2015).

Nutrients in Moringa Leaves and Seeds.

Table 1: Vitamin and Mineral Content of Moringa leaves and seeds.

	Fresh leaves	**Dried leaves**	**seeds**
Calories	92cal	205cal	
Carbohydrates	13. 4g	38.2g	0.12g
Fat	1.7g	2.3g	0.03g
Fiber	0.90g	19.2g	0.03g
Protein	6.70g	21.1g	0.19g
Carotene (vita)min A	6.78mg	18.9mg	-
Thiamin (B1)	0.06mg	2.64mg	0.05mg
Riboflavin (B2)	0.05mg	20.5mg	0.06mg
Niacin (B3)	0.8mg	8.2mg	0.02mg
Vitamin C	220mg	17.3mg	0.17mg
Vitamin E	448mg	113mg	4.4mg
Calcium	440mg	2.003mg	4.5mg
Copper	0.07mg	0.57mg	0.5mg
Iron	7.0mg	28.2mg	-
Magnesium	42mg	368mg	8.66mg
Phosphorus	70mg	204mg	75mg
Potassium	259mg	1.324mg	-
Sulphur	137mg	870mg	0.05mg
Zinc	0.16mg	3.29mg	-

All values are in 100mg per plant nutrients.

Table 2: Amino Acid Content of Moringa Leaves

Fresh leaves **Dried leaves**		
Arginine	406.6mg	1.325mg
Histidine	149.8mg	613mg
Isoleucine	299.6mg	8.25mg
Leucine	492.2mg	1.950mg
Lysine	342.4mg	1.325mg
Methionine	117.7mg	350mg
Phenylalanine	310mg	1.388mg
Threonine	117.7mg	1.188mg
Tryptophan	107mg	425mg
Valine	374.5mg	1.063mg

Table 3: Moringa Oleifera: Nutritional Value of leaves and powder.

Analysis of moringa seeds, fresh (raw) leaves and dried leaf powder has shown them to contain the following per 100grams of edible portion.

	Seeds	**Leaves**	**Leaf powder**
Moisture	86.9	10.14	7.5
Ash	26.0	4.56	27.1
Protein (g)	2.5	9.38	27.1
Fat (g)	0.1	7.76	2.3
Carbohydrate (g)	3.7	53.33	38.2
Fiber (g)	4.8	11.23	19.2
Energy(Kcal)		332.68	
Mineral (g)			
Ca (mg)	30.0	440.0	2.003
Mg (mg)	24.0	24.03	68.0
P (mg)	110.0	105.23	204.0
K (mg)	259.0	33.63	1.324
Cu (mg)	3.1	1.1	0.57
Fe (mg)	5.3	9.46	8.2
S (mg)	137.0	139.08	70.0
Na (mg)		289	
Oxalic acid (mg)	10.0	101.0	1.6
Vitamin A-B carotene (mg)	0.11	6.8	16.3
Vitamin A-choline (mg)	423.0	423.0	
Vitamin B1-thiamin (mg)	0.05	0.21	2.64
Vitamin B2-riboflavin (mg)	0.07	0.05	20.5
Vitamin B3-nicotinic acid (mg)	0.2	0.8	8.2
Vitamin C-ascorbic acid (mg)	120.0	220.0	17.3
Vitamin E-tocopherol acetate (mg)	113.0		
Arginine (g/16g N)	3.6	6.0	1.33%
Histidine (g/16g N)	1.1	2.1	0.61%

Lysine (g/16g N)	1.5	4.3	1.32%
Trytophan (g/16g N)	0.8	1.9	0.43%
Phenylanatine (g/16g N)	4.3	6.4	1.39%
Methionine (g/16g N)	1.4	2.0	0.35%
Threonine (g/16g N)	3.9	4.9	1.19%
Leucine (g/16g N)	6.5	9.3	1.95%
Isoleucine (g/16 N)	4.4	6.3	0.83%
Value (g/16g N)	5.4	7.1	1.06%

Source: Moustafa & Mansour (2020): Moringa a natural medicine for increasing immunity defense against deadly ailment. Med Aromat Plants (Los Angeles).

Atli (2015), is of the opinion that many of the above vitamins, minerals and amino acids are very important for a healthy diet. An individual needs sufficient levels of certain vitamins, minerals, proteins and other nutrients for his physical development and wellbeing. A deficiency of any one of these nutrients can lead to health problems. Some of the problems caused by deficient diets are well known: scurvy, caused by lack of vitamin C, night blindness caused by lack of vitamin A, kwashiorkor caused by lack of proteins, anaemia caused by lack of Iron. Many other health problems are caused by lack of vitamins or minerals which are less known, but still essential to a person's body functions.

He further stated that actual need for different vitamins will vary depending on an individual's metabolism, age, sex, occupation and where he/she is living. Therefore, bio-availability of the vitamins and minerals present in moringa leaves will vary. For example, the Iron content of plants absorbed by the body during digestion may be low.

Nutritional and Functional Value of Moringa Oleifera Leaves, Seeds and Roots

Moringa leaves and seed is nutritional power house and provide a great range and amount of essential protein, vitamins and mineral. Atli (2015) opined that every part of the plant is a storehouse of important nutrients and anti-nutrients. The leaves are rich minerals like calcium, potassium, zinc, magnesium, Iron and copper. Vitamins like beta-carotene of vitamin A,

vitamin B such as folic acid, pyridoxine, thiamine, riboflavin, niacin and nicotinic acid, vitamins C, D and E are also present in the plant. Phytochemicals and anti-oxidants quercetin such as tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids and reducing sugar present along with anti-cancerous agents like glucosinolates, isothiocyanates, glycoside compounds and glycerol-1-9-Octade canoate. He further buttressed his opinion that moringa Oleifera leaves have a low calorific value and can be used in the diet of the obese. While the pods are fibrous and are valuable to treat digestive problems and thwart colon cancer. Research shows that fortified noodles had better effect on the mammary glands of rats and improved milk production. The effect of sauteing on noodles improved lactogogum values, because the oil used was rich in sterols.

Moringa Oleifera has also been incorporated into chocolates. Alhassan et al (2022), in his report tested different percentages of moringa in the chocolate fortification, and found that 20% moringa incorporation in cocoa powder was ideal. Studies have shown the potential for developing protein and mineral-rich chocolates. Several such moringa fortifications are possible to ensure intake of adequate amounts of nutrients in children. Laurencia and muthulisi (2020) reported that moringa Oleifera leaf powder (MOLP) has contributed significantly to addressing under nutrition in developing countries.Singh, Jale, Prasad, Sharma & Prasad (2012), remarked that the leaves and seeds are used in preparation of several delicacies in lndian Subcontinent. Hence, the high nutritional value of its edible portion has made the plant more important food source inorder to combact Protein Energy Malnutrition problem in most under developed and developing countries of the world.

Aisha Danjuma et al (2021) posited that the plant has immersed culinary use. This, the author said that, the leaves, seeds and roots are used as food items. Leaves of the moringa can be added as salads, used in preparation of sauces and soups. Also, the cold pressed moringa oil

from the seed is used for cooking and it is appreciated for its shell life. The immature seed pods popularly known as drumstick are used in various dishes. The leaves are great alternative to meat, because of the high protein content, especially for vegetarians. In addition, the plant contains amino acids, aregenine and histidine which are essentials for infants to combat malnutrition. The functional value of all the aforementioned nutrient when added to our daily diet boost the body immune system against free radical caused by oxidative stress, aging, infection and nutritional deficiency diseases.

Methods of Preserving Moringa Oleifera Leaves, Seeds and Roots.

Moringa leaves and seeds can be preserved for long time without loss of nutrients. Drying or freezing can be done to store the leaves. A report by Evison et al (2015) shows that a low temperature oven used to dehydrate the leaves retained more nutrients except vitamin C than freeze dried leaves. Hence, drying can be done using economical household appliance like stove to retain a continuous supply of nutrients in the leaves. Preservation by dehydration improves the shelf life without change in nutritional value. Hence a daily dose of 70g of moringa is suggested by the author to be good and prevents over accumulation of nutrients (Iron intake) which can cause gastrointestinal distress and hemochromatosis.

Functional Potentials of Components of Moringa Oleifera Leaves, Seeds and Roots

i. **Leaves:** The leaves of moringa Oleifera are rich source of vitamins and mineral which exhibits strong antioxidants activity often attributed to the plants vitamins and phenolic compounds such as acquercetin and kaempferol. The leaves can be taken as vegetable and processed in tea, powder and pharmaceutical purpose. Furthermore, juice can be extracted from fresh leaves and act like growth harm one and increase crop yield by 25-35% (Daba, 2016).

Moringa leaves treat asthma, hyperglycemia, dyslipidemia, flu, heart burns, syphilis, malaria, pneumonia, diarrhea, headache, scurvy, skin disease, bronchitis, eye and ear infections. Also reduces blood pressure, cholesterol and act as an anti-diabetic neuro protectant and antiathero-sclerotic agents (Bashir et al, 2014). Williams et al (2013), stated that moringa leaves contain fiber, fat, proteins and minerals like calcium, magnesium, phosphorus, potassium, copper, Iron and sulphur. Vitamins like vitamin A (Beta-carotene), vitamin B-choline, vitamin B-thiamine, riboflavin, nicotinic acid and ascorbic acid. Furthermore, the leaf is said to provide seven (7) times more of vitamin C, than oranges, ten (10) times more vitamin A than carrots, seventeen (17) times more than calcium than milk, nine (9) times more than protein than yoghurt, fifteen (15) times more than potassium than banana and twentt-five (25) times more than Iron than spinach (Gandhi, 2018). Various amino acids like Arginine, Histidine, lysine, Trypsin, Phenolylinine, Thripcine, Leucine, Melconine and valine are present. The phytochemicals present include tannins, sterols, saponins, trepenoids, phenolics, alkaloids while flavonoids like quercitin, isoquercitin, kaemfericitin, isothiocyanates and glycoside compounds are present in the leaves.

According to Nambiar, Guin, Parnami and Daniel (2010), the presence of flavonoids gives the leaves the anti-diabetic and anti-oxidant properties. The isothiocyanates are anti-cancer agents. Flavonoids like quercitin, isoquercitin and others are known for anti-proliferative, anti-cancer agents. The presence of minerals and vitamins help in boosting the immune system and cure a myriad of diseases.

ii. **Seeds of Moringa:** The seed contains potential range of phytochemicals, including antioxidants such as vitamin C, B-Carotene, d and y-tocopherol. The seeds help in treating hyperthyroidism, chrohn's disease, anti-herpes, simplex virus arthritis, rheumatism, gout, cramp, epilepsy and sexually transmitted diseases, can act as anti-microbial and anti-inflammatory agents. The seeds also contain Oleic acid (Ben Oil), anti-biotic called pterygospermin, and fatty acids like linoleic acid, linolenic acid, behenic acid, phytochemicals like tannins, saponin, phenolics compounds, quercetin and kaempferol, phytate, flavonoids, terpernoids and lectins. Vitamins like A, B, C and amino acid are also present in the seeds. The presence of flavonoids gives its anti-inflammatory property. The anti-biotic pterygospermin is responsible for anti-microbial properties (Morton, 2019). The other phytochemicals help in treating various diseases.

iii. **Root Bark:** The root bark of the plant has potential to cure gastric ulcer and gastric mucosal lesions. It also decreases the acidity and increases the PH of gastric juice. Therefore, the root bark acts as a cardiac stimulant, anti-ulcer and anti-inflammatory agent. Alkaloids like morphine and moriginine help the bark to be anti-ulcer and also act as cardiac stimulant that help to relax the muscles (Alhassan et al 2022). Hence, can be used as a source for antiulcer drugs in future.

The Functional Properties of Moringa Seeds, Roots and Leaves

Phytochemicals: These are non-nutritive components present in a plant based diet (Phyto is a Greek word meaning plant) that have protective or disease preventive properties.

They have been associated with protection from and/or treatment of chronic diseases such as heart disease, cancer, hypertension, diabetes and other medical conditions. Foods containing

phytochemicals are often very colorful. But white food such as Onions, garlic, and Olive oil are also high in phytonutrients.

Generally phytochemical have been classified into six major categories based on their chemical structures and characteristics. These categories include carbohydrate, lipids, phenolic, terpenoids, alkaloids and other nitrogen containing compounds [Chidema, 2020]. A range of different phytochemicals such as phenolic, tannins, alkaloids, saponins, flavonoids and steroids are found in moringa seeds, leaves and roots as observed by the author.

Phenolics: This is a class of phytochemical also referred to as phenols. They are associated with antioxidant properties and believed to lower the risk of heart disease and cancer.

Tannins: This is a class of phytochemical found in moringa plant. The organic properties of tannin are proved haemostatic, they are also beneficial when applied on mucosal coating in the mouth and other digestive part of the body. Hence, the reason while the herbs of moringa oliefere is widely used as mouth washes and ulcer medication. They also restrict bare swellings.

Aikaloids: This is a class of phytochemical associated with antioxidant properties which are nitrogen containing naturally occurring compounds. They are found to have antimicrobial properties due to their ability to intercalate with DNA of microorganisms.

Flavonoids: The presence of flavonoids in Moringa Oleifera plant reveals their ability to scavenge free radicals in the body such as hydroxyl, superoxide anions and lipid peroxy oxide radicals. This may be the most important function of flavonoids. They also induce mechanisms that may kill cancer cells and inhibit tumor invasion

Saponins: The phytochemical property presence in Moringa Oleifera plants may be associated with improving the immune system response and inhibiting the growth of cancer

cells. Saponins detected in the miracle tree have shown to be beneficial to lowering of cholesterol. Due to the ability of saponins properties to form froth, soap is being produced locally from it for bathing.

Steriods: Steroids presence in Moringa Oleifera leaves and seeds increase protein synthesis. This promotes growth of muscles and bones. They have great importance in organic drugs due to their relationship with sex hormones compounds. (Bamishaye etal, 2011)

Functional Value of Moringa Oleifera Leaves, Roots and Seeds

Moringa contains an immense wealth of healthy components and phytonutrients. The leaves, seeds, barks, roots, sap and flowers are widely used in the traditional medicine. Also, the leaves and in-matured seeds are used as food products in human nutrition. Due to its extraordinary and unmatched range of medicinal benefits, the plant was named the miracle tree during the food crisis in Africa (Amarson, 2020). In addition, the miracle tree have functional values that deals with cultivation, nutrition, commercial and prominent pharmacological problems used for treating different symptoms of diseases, commercial, Agricultural, nutritive and functional uses.

Aisha Danjuma et al (2021), observed that Moringa Oleifera leaves, seeds and roots are sources of various herbal medicines which is very important in the treatment of conditions ranging from fever, throat, intestinal, urethral, skin, venereal diseases and other non-communicable diseases which include:

i. **Anti-oxidants:** Antioxidants: Moringa plant offers a rich blend of powerful antioxidant such as kaemferol, caffeoylquinic acid, zeatin, quercetin, rutin, chlorogenic acid, and beta-sito sterol. These powerful antioxidants found in moringa

leaves, seeds and roots possess high free radical scavenging capacity and have shown its therapeutic value in curing the damage caused by oxidative stress.

ii. **Edema:** Moringa root **e**xtracts are beneficial in the treatment of edema. Research studies have confirmed that treatment with moringa oleifera root extract, which possesses anti-inflammatory qualities, has been significantly effective in inhibiting the development of edema and also a potent in the treatment of painful conditions such as painful inflammatory symptoms.

iii. **Liver Protection:** Moringa extracts exert a hepatic protective effect on the liver. Research studies have validated the effectiveness of moringa leaves against the liver damage caused by anti-tubercular drugs as well as its stimulating effects in speeding up the recovery process. Moringa leaf helps to restore the levels of glutathione content in the body and prevents radiation induced hepatic lipid peroxidation. This protective effect is attributed to the presence of phytochemicals such as catechism, epicatechin, ferulic acid and vitamin C found in moringa leaf which helps in the management of terminal, ailments.

iv. **Stomach Disorders:** The isothiocyanates present in moringa are effective in the treatment of abdominal disorders such as constipation, gastritis and ulcerative colitis. Studies have shown that moringa extracts can be considered as an effective herbal alternative to a range of commercially available antacids and antihistamines. Aracil and Green (2019) reported that moringa contains anti-bacteria and anti-inflammatory properties, and it exerts inhibitory effects on the growth of various pathogens that predispose a person to abdominal disorders. These pathogens include helicobacter pylori bacteria and coliform bacterial, which can trigger conditions like diarrhea. This anti-bacterial and anti-inflammatory plant has the potential to tackle, regulate

inflammatory response and stimulate the immune system to overcome complications observed.

v. **Diabetes:** Moringa leaf, seeds and roots has the efficacy to cure both Type 1 and Type 2 diabetes. Type 1 diabetes is one where the patient suffers from non-production of insulin, which is a hormone that maintains the blood sugar level at required normal level while Type 2 diabetes is one associated with insulin resistance. Diabetes leads to several complications such as retinopathy, nephropathy and atherosclerosis. Moringa can be used to prevent such ailments. When there is hyper glycemia, the blood glucose reacts with proteins to cause advanced glycated end products (Makker & Becker, 2017).

vi. **Cancer:** This is a common disease and one in seven (7) deaths is attributed due to improper medication. Around 2.4 million cases are prevalent in Nigeria. Cancer treatments like surgery, chemotherapy and radiation are expensive and have side effects. Moringa Oleifera leaf, seeds and roots can be used as an anti-cancer agent as it is natural, reliable and safe at established concentration (Mbikay, 2012)

vii. **Hypertension:** Moringa is effective in maintaining optimal levels of blood pressure in the body. Bioactive components such as isotihocyante and niaziminin present in moringa leaf prevent the thickening of arteries and reduce the development of pulmonary hypertension. But the bioactive properties of moringa leaf and root extract have been recorded to help patients overcome the complications of the disease.

viii. **Obesity:** Moringa leaf helps in combating obesity. Laurencia and Muthulisi (2020) reported that it has nutritional value and low-fat qualities which makes it a good diet for managing obessed patient. The impressive content of vitamin B in moringa leaves aids in digestion and converts the food into energy rather than storing it as fat.

ix. **Asthma:** the benefits of moringa plant extracts also include relief from bronchial asthma and inflammation caused in the airways. According to Divneet Kaur (2019) the anti-viral, anti-inflammatory and immunomodulatory properties of the plant help to reduce the severity of asthmatic attack to various symptoms such as wheezing, cough, dyspnea, tightness of the chest and difficulty in breathing. These properties have the capacity to stimulate the immune system of the victim to overcome complications. He went further to state that moringa extends its protective effects against bronchial constrictions and encourages better lung function and respiration.

x. **Urolithiasis:** Moringa extracts are effective against the formation of stones in the kidney, bladder and uterus. According to research studies, the administration of moringa root exerted anti-urolithiatic activity and resulted in a noteworthy reduction in the urinary oxalate levels. The curative effect of moringa root has also shown a reduction in the formation of stone deposite and aids in regulating endogenous oxalate synthesis. The anti-urolithiatic activity of urinalysis helps in the management of kidney complication.

xi. **Tooth Ache:** The bark or root is boiled with potash to treat tooth ache.

xii. **HIV:** The seeds are grinded and taken orally for management of HIV.The seeds are used for their antibiotic and anti-inflammatory properties to treat arthritis, rheumatism, gout, cramps, sexually transmitted diseases and boils. The seeds are roasted, pounded, mixed with coconut oil and applied to the problem area. Seeds oil can be used for the same ailments (Bashir et al, 2014). Many products such as methylated cream, tube and soaps are sold for these purposes.

xiii. It fights against free radicals: Moringa Oleifera leaves and seeds contain antioxidants called flavonoids, polyphenols and ascorbic acid that fight against free radicals that cause oxidative stress, cell damage and inflammation. Thereby, keeping

the cells of the different organs of the body healthy and functioning in their best. Free radicals are unstable atoms that can damage the cells, causing illness and aging such as grey hair, wrinkles, cancer and other terminal ailments (Kantilata et al 2019).

xiv. **Neurodegenerative Disease**: The effectiveness of moringa has been very valuable in the treatment of neurodegenerative disease. Research studies have shown that the treatment with moringa leaves extracts have potential to alter brain monoamines like norepinephrine, serotonin and dipamine and it even extend its protection against monoaminergic deficiencies related to Alzheimer's disease. Hence, the reason the miracle plant is able to manage the symptom of headache.

According to Grosvenor (2020), moringa is useful for low amount of calcium in the blood serum. It can deliver to the body the calcium needed in a safe way. The abundant amino acid help to prevent against Edema, weight loss, general weakness, muscle soreness, slowness, in healing wounds, headache, severe depression, anxiety, lack of energy and difficulty in sleeping and stomach pain.

Similarly, Bashir et al (2014) emphasized that moringa tree has been used effectively against varying ailments. The leaves rubbed against the temple can relieve headache, to stop bleeding from a shallow cut, apply a poultice of fresh leaves, there is an anti-bacterial and anti-inflammatory effect when applied to wound or insect bite.

xv. **Anti-aging Effects**: Moringa Oleifera leaves and seeds contain antioxidants property called quecetin that has been demonstrated to have possible anti-aging effects.(Enwelim,Joy, 2020).

xvi. **Enhances wound healing**: Moringa has blood clotting properties in its leaves, roots and seeds that benefit wound healing and can reduce clotting time.

xvii. **Supports brain health**: Moringa plays very crucial role to support brain health and boost cognitive power due to its antioxidant and neuro-enhancer activities. It has

shown several preliminary results as a treatment of Alzheimer's disease. The high amount of vitamin C and E help to improve brain function and also normalize the neurotransmitters serotonin, dopamine and noradrenalin in the brain which play a key role in memory, mood, organ function, responses to stimulus such as stress and pleasure, and mental health like depression and psychosis.

Functional Uses of Moringa Oleifera Roots, Leaf and Seeds

Industrial uses: Moringa Oleifera seeds contain between 30-40% Oil and the press-cake obtained as a by-product of the oil extraction process contains a very high level of proteins. Some of these proteins (approximately 1%) are active cationic polyelectrolyte having molecular weight between 7-17 Daltons (Foidi Makkar and Becker, 2010). The cationic polyelectrolyte neutralized the colloids in moody or dirty water since the majority of these colloids have a negative electric charge. The protein can therefore be used as a non-toxic natural polypeptide for sedimentary mineral particles and organics in the purification of drinking water, for cleaning vegetables, oil, or for sedimentary fibers in the juice and beer industries.

According to Alhassan, et al (2022), the properties of the natural polypeptide produced from the seeds of moringa have been known for many centuries in China with the colonization of India by British, the knowledge was effectively dispersed to the rest of the world. It has been employed with particular effectiveness in both Egypt and Sudan for cleaning water from Nile specifically for human consumption. Investigation conducted by Williams et al (2013) revealed that seeds from moringa were used for the final treatment in waste water treatment units. In oxidation lagoons, 80% of the oxygen demand of water is caused by unicellular algae. These algae also contain between 40-60% of the nitrogen and phosphorus found in the pre treated waste water. To avoid eutrophication of rivers or lakes by the release of high loads

of both phosphorus and nitrogen, the seed can be used to coagulate algae and remove it by this treatment. Hence, the seeds are as anti-coagulant. Harvested seeds are dried, shelled and crushed into powdered form and made into paste with the water before mixing with more water. The mixed water is allowed to settle and sieved or used as turbidity which can extensively reduce hardness of water as discussed by Williams et al (2013).

Agricultural Uses: Alhassan, et al (2022) posited that fertilizer can be produced by processing the seeds to extract oil, the cake cannot be eaten as it contains harmful substances. However, it contains high levels of proteins and makes a good fertilizer for use in Agriculture. He further stated that using moringa shoot as a green manure can significantly enrich agricultural activity. The seedlings are ploughed into the soil to a depth of 15cm and then prepared for the desired crop. Moringa has a large tap root and few lateral roots, so it will also add to the nutrients available as it produces many proteins rich leaves. They grow very quickly but do not provide too much shade due to the structure of their leaves. They also very good as reclaiming, marginal land as stated by Alhassann, et al (2022).

In addition, the wood of the plant serves as fuel, wood and other uses, the wood is light, but provides a fairly good fuel for cooking. However, it is not suitable for building, the bark fiber is used in making rope, mats and the wood produce a blue dye, chipping of wood can be used to make a good quality paper, the trees also produce viscose resin that are used in the textile industries (Alhassan et al (2022)

For Human Consumption: Alhassan, (2022), lamented that Moringa Oleifera tree has probably be one of the most under-utilized tropical crops. Leaves of Moringa Oleifera could serve as a valuable source for all age groups. The leaves have a great source of vitamins and mineral when served raw, cooked or dried. Fuglie (2018), reported that 8g serving of dried leaves powder will satisfy a child within age of 13years with 14% of the protein, 40% of the

calcium, 23% of the Iron, and nearly all the vitamins that the child needs in a day. 100g of leaves could provide women with over a third of her daily need of calcium, copper, Sulphur, and vitamin B. The flower can be cooked and mixed with other food or fried in butter. They can also be placed in hot water for five minutes to make a kind of tea for drinking. They are a good source of nectar for honey producing bees. The pods can be eaten from the time they first appear to when they become too woody to snap easily. They are cooked like other green beans and have a similar flavor to asparagus. Also, the root is medicinal and similarly, to horse radish source can be made from the roots when seedling is only 60cm tall. The root bark should be completely removed as it contains harmful substances, the root is grinded up and vinegar salt added. The leaves of moringa oleifera are used for vegetable soups, stews and sauce in most dishes in Nigeria.

As Plant Growth Hormones: Plant hormones also known as phytohormones are chemicals that regulate plant growth (Alhassan, et al, 2022). These researchers further stated that plant hormones determine the formation of flowering, stems, leave, the shedding of leaves and the development and ripening of fruits. A large number of related chemical compounds are synthesized by humans which, are used to regulate the growth of cultivated plants. These man made compounds are called plant growth hormone regulators.

Therefore, the extract obtained from the leaves of moringa in 80% ethanol contains growth enhancing principle called zeatin (i.e. hormone of the cytokine type). The extract is used in the formation of a foliar spray to accelerate the growth of young plant; use of the growth hormone spray will cause the plant to be firmer and more resistant to pest and diseases (Evison et al, 2015).

Maker and Becker (2017), further buttressed that the process for spraying is done by diluting the moringa extract with distilled water for a notable effect such as durability, more vigorous

life span, heavier roots, stems, leaves and bigger fruits. The act increases the yield of plant by 30%. Examples of plants include maize, red pepper, tomatoes, soya, onion, tea, coffee, melon, chili and sorghum.

Medicinal Uses: All parts of this miracle tree can be eaten or utilized as ingredients or as a part of customary home growth drugs. The leaves and pods are commonly eaten in every parts of the world including Nigeria as stated by Alhassan (2022). Moringa tree has been used effectively against vary ailments. The leaves can be rubbed against the temple to relieve headaches. To stop bleeding from a shallow cut, apply a poultice of fresh leaves, there is an antibacterial and anti-inflammatory effect when applied to wound or insect bite. Extracts can be used against bacterial or fungi skin complainants (Alhassan, 2022).

According to Bashir et al (2014), eating moringa as food product is good for those suffering from malnutrition due to the high protein and fiber content. The bark is boiled with potash to treat toothache and the seeds are grinded and eaten orally for HIV management. In furtherance to the above statement, the seeds are used for their antibiotic and anti-inflammatory properties to treat arthritis, rheumatism, gout, cramp, sexually transmitted diseases and boils. The seeds are roasted, pounded, mixed with coconut oil and applied to the problem area. Seeds oil can be used for the same ailments.

Functional Application of Moringa Oleifera Seeds, Leaves and Roots

i. Moringa seeds are used to extract the ben Oil. The Oil is rich in oleic tocopherols, sterols and can withstand oxidative rancidity. The Oil can be used in cooking, as perfumes and also for lubrication. The pods can absorb organic pollutants and pesticides (Atli, 2015).

ii. The flowers of moringa are used to make tea with hypocholesterolemic properties. They taste like mushrooms when fried and are great sources of nectar used by beekeepers (Morton, 2019).

iii. According to Alhassan (2022), the root bark has medicinal values and is used for dyspepsia, eye diseases and heart complaints.

iv. Also the tap root of moringa is used as a spice.

v. Furthermore, the gum from the tree can be used in calicoprinting. The gum and roots also have antibacterial, anti-fungal and anti-inflammatory properties, while the growth hormones from the leaves, called zeatin is an excellent foliar that can increase the crop yield by 25%-30%.

vi. It is important to note that, studies have tried fortifying moringa leaf powder in snacks. The fortification and incorporation of the miracle plant has a significant value to tackle nutrient deficiencies and malnutrition.

vii. Bashir et al, (2014), added that, moringa can be used as a fortificant to produce creams, soaps, methylated cream, butter crackers. When fortified with ipomoea batatas, additional nutrients are added to the snacks. Sensory evaluation proved fortified cream crackers to be widely accepted. Reports attested that Moringa Oleifera leaves can be incorporated in the diet of hens and layers thereby providing excellent protein source which substitute soya bean meal and groundnut cake. Considering the views of several such fortifications, it is opined that such addition can be done to other snacks as well. It is pertinent to note that most snacks are made up of corn meal and several studies have revealed that a little addition of moringa leaf flour to maize flour can add nutritive value to the snack in terms of protein, energy and minerals.

viii. Alhassan (2022), postulated that moringa seeds have coagulant properties that can precipitate organics and mineral particulates out of a solution. For example, chemical

coagulants such as aluminum sulfate (Alum) and ferric sulfate or polymers removes suspended particles in wastes water by neutralizing the electrical charges of particles in water to form flow making particles filterable. However, Moringa Oleifera seed is a natural coagulant that contains a cationic protein that can clarify turbid water. This property of the seed is attracting much research as other coagulants such as alum, activated carbon and ferric chloride are expensive and rare.

In furtherance to the above, the seeds extract has the ability to eliminate heavy metals such as lead, copper, cadmium, chromium and arsenic from water. Report has it that Moringa Oleifera functionalized with magnetic Nano-particles such as Iron oxide is beneficial in surface water treatment by lowering settling time. Also, the seeds extract have anti-microbial properties that inhibit bacterial growth, hence preventing water borne diseases. Therefore, these wide properties of moringa oleifera seeds have wide applicability in averting diseases and can enhance the quality of life in rural communities as it is highly abundant. These seeds are used presently in cosmetics and are sources of biodiesel while the seed cakes can be used as green manure or fertilizer.

Functional and Nutritional Trends of Moringa Oleifera Leaves, Seeds and Root

In recent times, there is awareness about health related issues which make people to be very much interested in taking healthy and nutritious food. For example, food rich in wide range of health benefits intend to prevent or cure various diseases. These kind of foods are called super food. According to zahidul Islam et al (2021), the global moringa products are expected to increase by 9.3% which is USD 7902.9 million by 2025. Moringa products such as oils, capsules, leaf powder, soap, methylated cream and tea are extracted from different parts of the tree. It is also noted that Asia Pacific contributed the largest share of 35.30% of the moringa product market in 2018. Australia, China, India and New Zealand are key countries

which are contributory in the growth. Suffice me to say that presently, moringa products such as soap, methylated cream, herbal drugs and tea are sold or hawked at markets, motor parks and offices in Edo State. The production is mostly consumed locally due to the traditional use of the plant in wellness, skin care, hair care and food

It is worthy to note that moringa derived food and nutraceutical products possess a huge potential which can decelerate the rate of mal-nourishment in Nigeria and other developing nations. Some food products and medicines incorporated with leaf powder and other parts of moringa tree are shown in the table below as postulated by Zahidul, Faruk, Karzi, Rakibu and Razaul (2021).

Table 4: Moringa Seed and Leave Incorporation in Various Food Products

Products Types	**Addition**	**Benefits**
Soup	Alone or with spinach, melon and others as ingredient of soup.	
Moringa panner	Panner with extract of moringa leaves	increase the protein and fiber level into a satisfying amount
Chocolates	Moringa leaf powder as extra protein and fiber agent	
Biscuits and cakes	Leaf powder in replacement of a Percentage of flour	
Bread	Fortified with 5% leaf powder.	
Muffin	12% incorporated of leaf powder.	

Table 5: Moringa Plant Parts and Their Derivatives

Plant parts	Derivable local and industrial products
Leaves	Fresh in bunch to the market
	Dried in jute bags to the market.
	Dried in room temperature for tea.
	Export as fodder.
	Powdered in container for medicine uses.
Bark/roots	Treated to contain fibers for weaving industries.
	Mat, basket and bag production
	Rug/carpet production.
Seeds	Raw in bag for exports
	Fried in paper bags for domestic consumption.
	Canned like green peas for local and international market.
	Milled and prepared into cakes for water purification.
	Grits for animal feed formulation
Oil	Soap
	Cosmetics
	Table or cooking oil.
Roots (horse radish)	Fresh for local market
	Shrewd and confined in far (super market)
	Dried and powdered for medicinal uses.

Source: Salami & Nwadike (2020): An Evaluation of the potentials of Moringa Oleifera, A vegetable and Hedgrow plant for Diet Supplements and multi-purpose utilizations. Forestry Research Institute of Nigeria, Upland Forest Research Station (UPR), Gombe, Gombe State, Nigeria.

Moringa Oleifera has very high nutritional, medicinal and other functional values, (Madukwe, 2013). The leaves are consumed locally in Edo State, and other states in the North as vegetable and local salad. It is also used widely as folder for livestock. It has been described as the most reliable vegetable and fodder because of its high nutritional value (Salami, and Nwadike 2020). It is worthy to note that the seeds also contain cationic polyelectrolytes that have proved to be efficient in water treatment as a substitute to Aluminum Sulphate and other flocculent. And this, contain no harmful chemical or pollutants against human health but are biodegradable as claimed by Salami and Nwadike (2020).

The plant species also have high medicinal values through its leaf, stem, root, bark and liquid extracts. Furthermore, several local and industrial products are derivable from its various parts such as leaves, roots, bark and seeds as shown in table. The aforementioned affords the plant a high valued resource capable of alleviating diseases and improving the nutritional standard of the citizenry of Oredo Local Government Area, Edo State.

Table 6: Moringa Plant Parts and their Medicinal Uses as Obtained in Kano State. Source: Salami and Nwadike (2020).

Plant Part	Ailments	Formulation/Administration
Leaves	Gonorrhea	Antibiotic
	Body itching	Anti-histamine
	Eye irritation	Drops
	Renal failure	Diuretic
	Asthma and bronchitis	Cardiac and Circulatory tonic
	High blood pressure	Antihypertensive
	Low libido	Stimulant
	Pile	Purgatives, laxative, Antibiotics
	Skin disease	Anti-biotic, disinfectants
	Malnutrition	Diet supplement
	Diarrhea and vomiting	Dehydration therapy
	Anemia	Hematinic
	Ulcers	Antacid
	Wounds and cuts	Antibiotic
Bark expellant	Loss of appetite, malnutrition	
	Corneal nebulae, ear disease	Diet supplement, worm
	Fever	Drops
	Mouth sore, leprosy	Antifebrile
	Vitamin C deficiency	Antiscorbutic
	Diarrhea.	Antiscorbutic
		Dehydration therapy.
Pods and seeds	Back ache	Analgesic
	Pile	Antibiotic, laxatives
	Malnutrition	Diet supplement
	Skin infection	Ointments.
		Stimulants
Roots	Epilepsy, nervous debility	
	Asthma and bronchitis	Cardiac and respiratory tonic
	Hyst eria, stress and anemia	Stimulant and Hematinic
	Renal failure	Diuretic
	Inflammations	Anti-inflammations
	Pile (hemorrhoids)	Antibiotics, stimulants
	Loss of appetite	Worm expellant, diet supplement
	Ulcers	Antacids.

Nutritional and Functional Benefits of Moringa Oleifera Leaves, Seed and Roots.

Moringa Oleifera leaves, seeds and root have been used for formulations of supplements against malnutrition and as an additive or fortifier of most varied foods. (Leone, Bertoli Lello,Bassoli, Ravasenghi, Borgonovo, Forlani and Battezzati) The use of dried and powdered moringa leaves is relatively common to fortify dairy drinks, increasing the drinks nutritional benefits. Singh et al 2015 reported in a review article that milk products incorporated with Moringa presented good sensory acceptance except the color. The use of dry leaves in curd improved nutritional, micro biological and organoleptic properties. In butter milk, the leaves demonstrated the potential to increase health benefits and sensory attributes. Moringa seed extract is incorporated into cottage cheese to increase yield, protein and mineral content of the product. (Singh et al 2015).

Hekmal et al 2015 elaborated that the fortification of probiotic yogurt with the addition of 0.5% powered Moringa leaves and seed powder enhances the nutrient content and health benefits of the product. It is worthy to note that, the fortification at 10% causes a strong undesirable flavor to the yoghurt. Studies conducted by Shiriki, Igyor and Gernah 2015, stated that the nutritional value of maize, peanuts and soy blends is improved on when fortified with moringa oleifera leaves powder. In this course, the fortification up to 10% increases the protein, fiber, ash and micro nutrients contents of the products. The fortification at 15% promoted a decrease in protein quality. That is, lower intakes of the products due to unpleasant taste of oleifera. The addition of moringa leave powder to snack for the purpose of increased nutritional composition and acceptability improves the mineral content of the products. Although there is color alteration from light brown to dark green which makes the snack more crumble.(zugu, van, kolanisi and siwela, 2020). Thammacrat

and Airougyuwa 2020, showed that there is better stability of total polyphenols as cookies were fortified with morigan oleifere leaves extract.

Table 7: Summary of Nutritional and Functional Benefits Promoted by the Addition of Moringa Oleifera Leaves and Seed in Food

Food product	Additives	Evaluation	Benefits	Negative result

Curd	Moringa Leaves	Chemical, Microbiological and organoleptic properties during storage	Improvement in nutritional, microbiological and organoleptic properties	
Butter Milk	Moringa Leaves	Nutritional value	Protein, ash, iron, calcium and vitamins level increase	
Cottage cheese	Moringa seed extract	Product yield and quality	Increase in yield, protein and mineral content	
Probiotic yoghurt	Moringa leaves	Nutritional value and possible health benefits	Leaves level at 0.5% enhances the nutrient content of the product	1.0% Moriga leaves caused a strong & undesirable flavor to the yoghurt
Maize, Soy and peanuts blends	Moriga leaves	Nutritional value	Protein, fibers,ash and micronutrients level increased, fortification up to 10% resulted in higher protein quality	The fortification at 15% promoted a decreased in protein quality. lowers intake due to unpleasant taste.
Snack	Moringa leaves	Nutritional composition and acceptability	Mineral content improve	Color alternative (from light brown to dark green) fortification
Snack	Moringa leaves	Chemical composition and sensory analysis	Good results in terms of protein, moisture and ash content	makes snack more crumble
Cookies	Moringa leaves extract Microencapsulate	Sensory acceptance	Better stability of total polyphenols there was no decreases to acceptability	
Fresh pasta	moringa leaves extract micro encapsulated	Phenolic bioaccessiblity and digestibility	rabidly digestible starch fractions decrease increased levels of slowly digestible starch	

Source : Singh, singh and Kumar .2015 Drumstick (Moringa Oleifera) Nutri food SU 45(3)423-32 https/doi org/10.1108/NFS-02-2015 0018

Reasons for Intake of Moringa Oleifera Fortified Food Products (Functional Foods)

There is need to supplement dietary intake with functional foods, no matter the healthy life style due to the following reasons:

i. **Filling Nutritional Gap**: About 90% of people do not get the recommended amount of important nutrient from food alone due to strict dieting, poor appetite or changing needs. Fortified food with moringa plant parts is intended to bridge the nutritional gap and maintain proper diet balance that will enhance the nutrient density of the diet.

ii. Nutrient Absorption Declines with age: As one ages, mal-absorption becomes a problem because the body does not have the same capability to breakdown and absorb nutrients as it used to. The production of digestives enzymes which breaks down and absorbs nutrients from food naturally begins to declines the older one gets. There may be increase in medications than when one gets younger. Most modern medications actually depletes essential nutrient. Functional foods from moringa oleifera seeds, roots and leaves may help restore this imbalance.

iii. Avoid Harmful Chemicals: Warning! Pesticides and herbicides used to form food, chemicals found in water supply and external environmental issues like pollution may increase the need for extra vitamins and minerals. These harmful chemicals create free radicals that attack the digestive and immune system. The antioxidants properties in moringa plant help fight against the free radicals.

iv. Exercise increase Nutrient Needs: Athletes require a lot of energy and nutrients to stay in shape. During exercise, the body uses up stored energy and nutrients in the body. It is vital to replenish these essential nutrients, fuel energy levels and promote recovery after an intense workout. Taking moringa leaf tea and power as food is a quick and easy way to get the required calories, instead of eating a big bowl of pasta and chicken or eba and soup.

v. Poor Eating Habits: Erratic eating habits, eating processed junks foods and stress contribute to poor digestion. This may make it difficult for the body to extract all the nutrients needed from food. Although, Moringa fortified food product cannot replace poor diet, it may help prevent the damage poor eating habits cause as well as ulcer and colon cancer.

vi. Prevent Expensive Health Issues: Health providers do encourage the populace to look for disease treatment. Therefore, taking daily functional food, regular exercise and frequent medical checkup are important for preventing costly health issues from arising in future.

vii. Soil Depletion: Modern farming techniques use fertilizers that deplete the soil and rob the plants of essential nutrients. Fertile soil is a crucial agricultural element for absorbing the proper amount of minerals. Moringa plant parts act as organic manure to the soil which may also boost the soil and plant essential nutrient leading to high yield; Onariase Eunice (2021).

Side Effects of Moringa Oleifera as Nutritional Miracle Tree

Cadman B. (2020), postulated that the aforementioned plant has risk factors as stated therein:

I. For pregnant women: Although moringa leaves can solely satisfy the daily Iron and calcium needed, it may possess anti-fertility characteristics in some cases.

II. For thyroid treatment: although the plant leaves aid thyroid function, it may create problem during the treatment with any other thyroid medication.

III. For diabetic medications: although the leaves effectively reduce blood sugar, it may cause too low blood sugar levels in some cases.

IV. For blood pressure medications: although the plant is used in lowering blood pressure. Moringa intake with drugs that reduce blood pressure may result in too low blood pressure.

V. Too much intake of the seeds may lead to nausea as experienced by some people.

Review of Related Empirical Studies

Farinola (2014) carried out a study to examine household perception, awareness and willingness to pay for moringa powder in Oyo State. The objective of the study was to determine consumer's level of perception and awareness of the plant and also describe the plant consumption pattern in Oyo State. Well-structured questionnaires were administered to 150 respondents. A multi- stage random sampling procedure was employed in selecting the respondents. Data were analyzed using descriptive statistics and the logistics regression model.

Analysis of the demographic characteristics of the respondents showed that majority were female (59.0%), and 77.3% were in the age range of 26 to 55years. Economic expenditure and awareness, 52.75% respondents spent between N200 to N1,000 per month on moringa, while 80.6% of the respondents were aware about moringa and these indicated that they consume moringa. Furthermore, 35.5% of those who consumed the plant claimed that they were very satisfied with the benefits derived from it and the majority (85.67%) of the respondents were of the view that moringa can significantly contribute to the health and economic status of individuals. The contingent evaluation result revealed that more than half of the respondents (65. 3%) were willing to pay N 350, while only about 28.7% were willing to pay N 450 for 50g of moringa powder.Logistics regression results revealed that the level of education, age, marital status, price of moringa, level of awareness, occupation and gender were statistically significant factors affecting household willingness to pay for moringa

powder. The study buttressed further that, moringa serves as a source of income to the rural inhabitants and is becoming an important Source of livelihood for a number of people.

Some people have started to grow the plant in their homes for nutritional and functional purposes in some areas in Edo State. They believe that the plant parts may contribute a significant improvement in food security for the community at large. Also, as a result of the adverse effect of some orthodox drugs, the populace prefers organic medicines. This is the reasons some researchers and the tradomedical body are yearning that effort be made at ensuring the plant is made available and accessible. Also, the Government, NGO and cooperate bodies should create awareness for the general public and the World at large. The nutritive, medicinal and functional importance of moringa oleifera seeds, root and leaves cannot be under estimated.

It is worthy to note that moringa can withstand severe drought, mild frost conditions and may widely be cultivated across the world. Also, it is confirmed to have high nutritive value and every part of the tree suitable for nutritional, medicinal and commercial purposes. The leaves are rich in minerals, vitamins and other essential phytochemicals. The extracts from the leaves are said to be used to treat malnutrition, augment breast milk in lactating mothers. While the seeds are used as natural coagulant in water treatment. Some scientific effort has provided insights on the use of the plant as a cure for diabetes, cancer and fortification of food and other products for commercial purposes. Therefore, moringa leaves, flowers, stems, roots, pods, or other plant organs exhibit a wide kind of pharmacological and physiological activities. Hence, it is assumed to be a tree with diverse potentialities that can be consumed as food or process into other forms to be used in different areas.

Offor, Ehiri and Njoku (2014) in Ebonyi State, Nigeria reviewed that our environment contain a wide range of heavy metals with varying concentration ranges depending on the

surrounding geological and natural activities that has occurred. These heavy metals include Fe, Zn, Cr, Cd, Pb, Ni, Mn, Hg. In view of the potential effects of the aforementioned metals on human health, agriculture and environment, proximate nutritional analysis and heavy mental accumulation in dried Moringa Oleifera leaves was investigated by the above stated researchers. They reported that they used standard analytical techniques to ascertain the nutritional and heavy mental content value in dried Moringa leaves that was carried out at Egbooda, Oshiri in Onicha, Ebonyi State.

In the course of the assessment fresh leaves of Moringa Oleifera were plucked and air dried at room temperature and their proximate nutritional content determined. Ash and moisture content were determined with the aid of Association of Official Analytical Chemist (AOAC) method. Fat, crude fiber and protein content were determined using soxhlet fat extraction method, weends method and kjeldahl method respectively. Carbohydrate content was determined with aid of arithmetic different method.

The result showed that the mean nutritional content of the samples were 24.5% protein, 14.8% moisture, 17.3% crude fiber, 4.5% fat, 3.8% Ash, 50.6% carbohydrate. Heavy mental composition was assessed using spectrophotometric and ethylene – diamine tetra acetic acid (EDTA) Titrimetric methods. They further postulated that the result indicated Ca and Cd were not detected in the leaf samples, while the mental content in the leaves are Fe [505mg/L), Zn [85.810.951mg] Cu [1.016mg/l], Mg[386.555mg/L], Mn [79.563mg/L] and Pb [352.013mg/L] In view of the above, the researchers concluded that dried moringa leaves was a good source of important nutrients, thus, the plant might be explored as a viable supplement in both animal and human food. While the variation in the heavy mental content of moringa leaves may be due to climate and edaphic factors, solvents used for the analysis,

the cultivation method used and the age the plant. Hence, the reason the leave is known to serve as a herbal tonic and maintenance of tissues and cell membranes.

Ravensthorpe (2014) reported a research conducted in United States of America on the health benefit of moringa oleifera leaves to the treatment of countless health conditions such as cancer, high blood pressure, diabetics and osteoporosis amongst others. The population of the study was 8.3 percent of the United States. For the study, the researcher fed aqueous extract of moringa leaves to albino rats that were suffering from streptozotocin-induced diabetes.

During the trial period, the researchers monitored the fasting plasma glucose levels of the rats, as well as their levels of glutathione (an antioxidant) found in moringa that contains antidiabetic properties. Specifically, the extracts reduced their fasting plasma glucose levels from 380 percent to 145 percent (that is their blood sugar level were reduced by more than 2.5 times). The extract increased the levels of the important antioxidants, glutathione, from 22 percent to 3 percent, a significant improvement in the management of non-communicable diseases such as diabetes, hypertension and cancer. The experimental findings clearly indicated the potential benefits of using aqueous extract of moringa oleifera leaves as a potent for managing nutritional deficiency and non-communicable disease.

Akpeghagha Ozemoya Theresa (2015), reviewed the level of awareness and usage of moringa oleifera for managing health challenges among medical personnel in Benin City,Edo State. The purpose of the study was to find out the level of the use of moringa oleifera by medical personnel in health institutions for the prevention and management of non-communicable diseases in Benin City metropolis.

The researcher raised seven research questions and adopted descriptive survey research design. A population of 1890 medical personnel from central Hospital and UBTH was used for the study, while a sample of 189 was used with the aid of proportionate sample technique.

179 questionnaire items were retrieved and used for the study representing 94.7%. The questionnaire was titled “Awareness and usage of Moringa Oleifera”. The results revealed that all medical personnel agreed that they are fairly aware of the existence of moringa oleifera for the management of some illnesses in Benin City. All medical personnel agreed that they have fairly used moringa oleifera for the management of patients with cancer, high blood pressure, malnutrition, diabetes, ulcer and anemia. Based on the findings, the researcher recommended that deliberate efforts should be made by management of health workers, general public from time to time to improve on the awareness level of people. Also, the use of moringa oleifera should be introduced in every health institution to prevent the a foretasted non-communicable diseases.

Ojo, Ogunleye and Alimi (2016), conducted a research on factors affecting the profitability of moringa Oleifera production in Oyo state, Nigeria. The objective of this review was to identify the socioeconomic characteristics of moringa Oleifera farmers in Oyo state, evaluate the cost and returns to production of the plant and also determine the factors affecting the profitability of the plant. A multistage technique was employed for this study. The data obtained were analyzed with descriptive statistics , budgetary analysis and multiple regression technique.

Findings from the study showed that about 90% of the respondents were men, thus, making Moringa Oleifera production a male dominant enterprise. The mean age of the farmers was 46.45 year and the average farming experience was 5.1years. Literate farmers were predominant in the study area with the least being secondary education. The mean farm size was 1.77ha putting farmers into the class of small holders. The study further showed that the profitability of the plant production in Oyo State was based on factors which include the level of education/awareness, planting materials, labour, land and rent, and these factors were

statistically significant at 5% level. The profitability ratio gave a benefit cost ratio of 2.77, which showed that Moringa Oleifera production was profitable. Hence the researchers added that the leaves of the plant were very nutritious and are consumed as vegetable in Nigeria. Therefore, the study concluded that Moringa Oleifera farming was profitable and economically efficient in Oyo State. In addition, it was recommended that provision of improved planting materials, access to labour and reduction in land rent could further enhance the profitability of Moringa Oleifera.

A similar research was conducted and reported by Bolarinwa, Aruna and Raja (2019) in Nigeria. They reported that when an individual was malnourished his body goes into a state of starvation which negatively affects the immune system, kidneys, cardiac muscles, liver and gastrointestinal tract. This ailment makes the person to get a serious infection with covid-19. The researchers then postulated that the best approach to prevent and slow down COVID-19 transmission was to introduce the consumption and acceptability of bread fortified with morigan Oleifera leaf powder (MOLP). In the course of experimental research study a standardized bread making recipe was fortified with Moringa Oleifera Leaf Powder. MOLP partially replaced wheat flour at 5% and 10% substitution levels of MOLP in both white and brown bread. The ingredients for experiment were 180-250ml lukewarm water,300mg brown/white bread flour, 10g dry yeast,3.8g salt, 15ml melted butter,15g or 30g MOLP for substitution levels. (This was added after the flour and salt was sifted).The bread was fortified with 0%,5%,10%,15% and 20% moringa Oleiferal leaf powder, the nutritional contents were determined. A sensory evaluation was conducted using a seven point scale to access consumer acceptability for the sensory attributes: - colour, shape, texture, sweetness, flavor, month feel and overall acceptability.

The study results indicated that as moringa Oleifera leaf powder was added to bread, there was a significant increase in protein, ash, fat, fiber, phosphorus, potassium, calcium, iron and vitamin A contents. However, there was no decrease in moisture and carbohydrate. The sensory evaluation results indicated that there was no difference between the control bread and the 5% moringa for the fortified bread. Furthermore, the bread containing 5% moringa Oleifera leaf powder was rated the best for the sensory attribute investigated.

Therefore a food – based intervention such as fortification of bread with MOLP could improve the nutritional contents of bread which is staple food to the populace. This could be used to address this existing nutritional deficiency disease due to the nutritional and antioxidants contents of the product. However, further research involving incorporating MOLP in other popular, but deficient foods need to be conducted to determine the most suitable foods for fortifying with MOLP. This will boost our nutritional status.

Laurencia and Muthuslisi (2020) reported a research conducted in South Africa on the effect of morigan Oleifera leaf powder on physical quality, nutritional composition and consumer acceptability of white and brown bread in the wake of Covid-19 pandemic. Food security and malnutrition were globally experienced in the wake of Covid 19 pandemic. Moderate and severe hunger affected approximately two billion individuals world-wide due to rise in food costs.

Hence indigenous crops such as moringa Oleifera which was known to be nutrient rich with many health beneficial, nutritional, antioxidant and phytochemical properties was used to fortify bread which was a staple food in South Africa. To increase the nutritional composition of bread, moringa Oleifera leaf powder (MOLP) was used as it was rich in proteins and several micronutrients that were deficient in bread. Bread was an affordable source of energy,

therefore was a suitable candidate for supplementation with MOLP so as to curb the increase of Covid-19 infection in South Africa by increasing the nutritional intake of the populace.

Moustafa (2020) reported on using moringa oleifera as a natural remedy for boosting the immune system against non-communicable diseases. Based on the researcher's previous studies and collected literatures, it was revealed that moringa leaves and seeds have sufficient amount of vitamin A, C, calcium and potassium. Historically and recently, moringa Oleifera has been recorded to have a wide range of traditional, nutritional, functional, industrial and medicinal values. It was used on healthcare purposes such as fever, muscle pain and asthma. The researcher suggested that the plant species can be used to support lives and also as a source of improved livelihood in Bodiun and villages in the North Africa and Arabian-Peninsula.

The study of Moustafa indicated that the chemical analysis of moringa oleifera showed the presence of active groups such as flavonoid, isothiocyanate, phytosterol, triterpenoid, glycoside and polyphenol which are antioxidant to boost human immunity for defensing the system. Also, the phytochemical analysis done revealed that the leaves and seeds contain appropriate quantities of vitamin C (83 and 14mg/100mg/DW, vitamin A: 6 .8+ - 0 – And 24.8 _+ 0. Mg /100/ DW, calcium contents: 764.8 and 1164.8mg/100/DW. Calcium 900.2 and 572mg/100g/DW respectfully. This led the researcher to opine that moringa leaves and seeds are good sources of vitamin A, C, Calcium and potassium, and that for sure will strongly support the immune system.

As a result of the study, it was recommended that the leaves and seeds of moringa oleifera be used as natural meals for people who were malnourished and were isolated in home and suspected to be infested by any form of disease. This will increase their immunity and protect them from getting worse. However, there is need for more detailed studies about using

moringa seeds, roots and leaves for nutritional purpose as well as treating already infected cases.

Salami and Nwadike (2020), carried out a survey to evaluate the potentials of moringa Oleifera within and outside kano metropolis of Kano state, Nigeria, where it serves as vegetable and hedgerow plant for diet supplement and multipurpose utilizations. Structured interview was used with a total of 100 respondents, randomly spread. Four (4) local government areas (LGAs) were covered. These were: Nassarawa, Ungogo, Taraumi and Dala. The results of the structured interview using the convenience sampling technique showed that moringa is very rich nutritionally, functionally and medicinally. Moringa utilization cuts across various categories of people with 69% usage recorded for male, and 40% for literate users, while students and civil servants had 21% each. Moringa farmers that cultivated simultaneously on farmlands and backyard gardens were however 73%. The analysis of results further indicated that the plant was rated very high as diet supplement in the state, owing to the facts that it is very rich nutritionally, apart from its functional and medicinal values. It was however recommended that the plant nursery propagation be encouraged and community interest in its cultivation should be mobilized.

Fajri (2021) in his research reported that moringa oleifera leaves, seeds and roots are generally believed to have potentials that act as immune booster against infection. The plant parts can be a source of functional food and as immune booster. This is because the plant is cheap, easy to access and provides health benefits enmasse.

Based on the aforementioned generalization, the health functional properties of the plant seeds, leaves and roots exhibit anti-inflammatory, anti-microbial, anti-diabetic, antioxidant, anti-tumor, anti-cancer, anti-hypertensive, anti-asthmatic, anti-urolithiasis, anti-helminthic, anti-fertility, anti-hyperthyroid and anti-Alzheimer properties. Therefore, people with good

body immunity tend to be able to survive infection and attack. It was further opined that some of the components of the plant that played a role in this were kaempferol, pterygospermin, morphine, quercetin and apigenin-7-0-nutinoside. Research showed that, Apigenin which is an anti-oxidant has the highest activity against diseases and infections.

Aisha Danjuma Muhammad et al (2022) assessed a research on the economic relevant of moringa Oleifera to the farmers and marketers in Katsina State. The aim was to assess the inadequate information in terms of the quality of leaves and seeds produced and turnover of moringa in the state. Survey and interview were adopted for data collection from farmers and marketers in the selected local government areas. In the research, twenty four (24) moringa Oleifera farmers and sixty–five (65) moringa Oleifere marketers respectively were randomly sampled within nine (9) local government areas selected from the thirty four (34) local government areas of the state. The study revealed that majority of the moringa farmers and marketers in the study area were aged and receive no assistance from the government. Just as there was difference between farmers' prices and marketers price of moringa, so also was there difference between demands of moringa leaves and seeds in the state, implying that the business is gainful and the leaves are used for nutritional and functional purposes in katsina State. The study therefore recommended that the state government should enlighten the youth on the need of moringa farming and marketing and also provide the needs and assistance to moringa farmers and marketers so as not to eliminate the production and marketing of the product in the near future in Katsina State.

Ezinne Prisca Obinwa etal (2023), assessed a research on the proximate, mineral and functional properties of moringa seed and pearl millet flour blends in Umuahia, Abia State. The goal of the study was to expand the use of composite flour blends based on cereal as a viable strategy of alleviating micronutrient malnutrition, analyzed the nutrient value of the

flour mixes and their functional characteristics. In the course of the study, moringa seeds and millet grains were processed into flour using different processing methods. The different flour were blended to produce composite flour at different ratios 90:10, 80:20, 70:30 and 100: 0 wheat flour (control). Proximate, mineral composition and functional properties of the composite flour blends were determined. Results were analyzed statistically by the analysis of variance. Result from proximate composition of the flour samples shows significant increase ($p<0.05$) in the ash content (0.83% - 1.83%), Fat (1.16% - 12. 66%), protein (2.01% - 5 – 60%) and fiber (0.77% - 183%). Mineral composition of the flour samples revealed that the control had highest sodium potassium and iron content, (38.40% - 46.40%, 165.85% - 181. 29% and 5.31% - 6.53%) respectively while the composite flour had highest magnesium, calcium and zinc, 47.61% - 56.44%, 82.77% magnesium, calcium and zinc 47.61% - 56. 44%, 82. 77% - 92. 62% and 2.69% - 3.59% respectively. Water absorption foam stability, gelatin capacity and swelling index were found maximum in the composite flour blends while oil absorption and foam capacity were maximum in wheat flour. It was concluded that there was need to utilize moringa seeds and pearl millet in diverse form to enhance household menus and improve the nutritional quality of pearl millet flour.

Victoria Thobias, Davis Naboth and Alex Wenaty (2023) investigated the effect of incorporating moringa leaf powder and sardine powder into wheat –based noodle formulation on their nutritional composition. The approach was to offer a practical and affordable solution to address adolescent malnutrition and also provide evidence based recommendations to improve the quality of diet for adolescents in Tanzania. In the study, different formulation were prepared with varying ratios, expressed in percentage (%): WM1 (99.6 wheat:0.4 moringa), WM2 (99.2wheat: 0.8moringa) and WM3(99 wheat:1 moringa):WS1(95wheat:5sardine), WS2 (90 wheat:10 sardine), WS3 (85 wheat: 15sardine) and the control sample (WC) containing 100% wheat was included for comparism.The

nutritional parameters assessed included crude protein, crude fiber, crude fat, ash, carbohydrate and energy content.Mineral composition were also determined, including calcium(Ca), magnesium(Mg), Iron(Fe) and Zinc(Zn). The results demonstrated significant variations in the nutritional compositions of the different formulations compared to the control sample. Results of proximate composition based on dry matter showed that the crude protein values ranged from 11.76-21.40g\100g, crude fire values ranged from 1.89-2.94g\100g, ash content values ranged from 62.31-74.29g\100g and energy values ranged from 358.50-364.53kca\100g.Furthermore, the minerals results showed iron values ranged from 32.55-65.50mg\100mg, calcium values ranged from 7.39-66.61g\100g, magnesium values ranged from 28.86-87.35mg\100g and Zinc values ranged from 2.21-39.25mg\100g. Hence, the researcher postulated that, the results showed that the fortification of noodles with moringa and sardine powder can be a viable approach to enhance nutritional value of noodles. It was concluded that enrichment of noodles paves way to address nutritional deficiencies promoting of the health and wellbeing of consumers in the food industry.

Summary of the Literature Review

The chapter delves into an extensive review of related literature, exploring various facets of Moringa Oleifera leaves, seeds and roots theoretical. It begins by establishing a conceptual framework, laying the foundation for subsequent discussions. The concept of Moringa Oleifera is thoroughly examined, encompassing both its nutritional and functional aspects. The nutritional analysis highlights the diverse components that contribute to its functional benefits.

The focus then shifts to the nutritional value of Moringa Oleifera leaves, seeds and roots emphasizing its significance in promoting well-being. Preservation methods for Moringa Oleifera are explored, providing insights into how it nutritional properties can be retained.

The chapter also addresses the critical aspect of awareness regarding the nutritional and functional value of Moringa Oleifera leaves, seeds and roots shedding light on the importance of wide spread knowledge.

Functional potentials and values associated with different components of Moringa Oleifera are scrutinized, elucidating the various ways in which this plant contributes to human wellbeing. Additionally, the nutritional and functional uses of Moringa Oleifera leaves, seeds and roots are detailed, showcasing its versatility in diverse applications.

The functional application of Moringa Oleifera is discussed, offering a glimpse into how the nutritional and Functional properties are potent and harnessed. Functional and nutritional trends related to moringa oleifera are analyzed, providing valuable insights into its demand and popularity. Furthermore, the chapter explores the incorporation of Moringa Oleifera leaves, seeds and roots into various food products, illustrating its adaptability in the culinary realm.

To substantiate the theoretical framework, a comprehensive review of related empirical studies is undertaken. This synthesis of literature serves as a comprehensive resource, offering a nuanced understanding of the multifaceted aspects of Moringa Oleifera leaves, seeds and roots medicinal properties to its functional significance and awareness dynamics.

In the review of empirical studies, findings were carried out in different parts of the world on moringa oleifera as a natural, medicinal and nutritional benefits for increasing immunity defense against infection and nutrient enrichment(food fortification), none has been found to be carried out on the analysis of the nutritional and functional properties of moringa oleifera seeds, leaves and roots in communities in oredo local government area of Edo State. However, Fajri (2021) study which is the closest explored moringa oleifera as an immune

booster and functional food. But the study does not focus on oredo local government area, Edo State, leaving a gap that this study aims to fill.

CHAPTER THREE

METHODOLOGY

This chapter deals with the method that will be adopted for carrying out the study. It is organized under the following sub headings.

- Design of the Study
- Population of the Study
- Sample and Sampling Technique
- Research Instrumentation
- Validity of the Instrument
- Reliability of the Instrument
- Method of Data Collection
- Method of Data Analysis
- Preparation Process
- Materials and methods used in the analysis of functional and nutritional properties of moringa oleifera leaves and seeds.

Design of the Study:

The study adopted the quasi experimental design to analyze the nutritional and functional properties of moringa oleifera and descriptive survey design was used to collect data on the awareness and utilization of moringa oleifera among the targeted population. The study analyzed the proximate nutritional and functional properties of moringa oleifera leave, root and seed. This design was considered appropriate since it enabled the researcher to collect detailed and factual information from the laboratory and sampled respondent in order to establish awareness and utilization of Moringa Oleifera foods and products for nutritional and

functional purposes. This mixed methods approach ensured a comprehensive understanding of both the scientific properties of moringa oleifera and its practical applications to analyze the nutritional and functional properties of moringa oleifera.

The Population of the Study:

The population of the study was comprised of men, market women and youths in Oredo which was *374,671* as at the (2006) census.

Source: Field Survey, Ministry of Local Government, Community and Chieftaincy Affairs, (2024).

Sampling and Sampling Techniques:

Proportionate sampling techniques was used to select fifty six thousand, one hundred ninety (56,190) population from thirty (30) communities out of the two hundred (200) communities in Oredo Local Government Area. Therefore, the number of the population in each community was 1873 individual. And 10% was purposively selected due to its manageable size. Hence, a total sampling size of 1873 was narrowed down to 180 respondents which equally represented the men, market women and the youths. The size of the population was 80 for market women, 60 for for men and 40 for youths. This ensured that the findings were balanced and applicable across different demographic group.

This is shown in the table below.

Table 8:

S/N	Men	Market women	Youth	**Total**
1.	60	80	40	**180**

Source: Researcher's computation, (2024)

Research Instrumentation:

The instrument that was used for the study was structured questionnaire and interview for literate men, women and youths and illiterate market women in the market. The researcher gave several questions to the respondents. The questionnaire had sections A and section B. Section A was the personal data of the respondents, while section B was questions/statements for the men, market women and the youth. Research question one had items 1-18: Research question two had items 19-24: Research question three had 25-30: Research question four had items 31-36: Research question five had 37-42: Research question six has items 43-48. The response was rated on four point rating scale ranging from fully Aware (FA) = 4, Fairly Aware (FA)= 3, Slightly Aware (SA)= 2 and Not Aware (NA)= 1. While the rating for usage was Very Great Extent (VGE) = 4, Fairly Great Extent (FGE) = 3, Slightly Great Extent (SGE) = 2 and Not Great Extent (NGE)= 1.

Validity of the Instrument

The instrument was validated by the researcher's Supervisor, one expert in Home Economics and two experts from Business Education unit, all from Faculty of Vocational and Technical Education, University of Benin, Benin City. This was to ensure that the items strictly addressed the research questions raised for the study. The item statements were reduced from one hundred and two to forty eights, and the questionnaire items were rephrased. The experts suggested that demographic variables that were not hypothesized be removed. It was also recommended that the rating scale for usage be changed from Very Great Extent (VGE), Fairly Great Extent (FGE), Slightly Great Extent (SGE) and Not Great Extent (NGE) to Very High Extent (VHE), Fairly High Extent (FHE), Slightly High Extent (SHE) and Not High Extent (NHE). These corrections, comments and other observations were incorporated in the final draft of the instrument.

Reliability of the Instrument

To ascertain the reliability of the study, Cronbach alpha statistics was used to test the internal consistency of the items. Copies of the instrument were administered once to 5 youths, 5 older men and 10 market women from Oko community that was not in the study area in Oredo Local Government Area. The data obtained were subject analysis with Statistical Package for Social Sciences (SPSS), and a Cronbach Alpha value of 0.986 was obtained, indicating that the items in the instrument were very highly internally consistent.

Method of Data Collection

The instrument which was the questionnaire was administered directly to the respondents, who were men, market women and youth in the 30 communities captured in the study. A qualified researcher from the Department of Home Economicss Education, University of Benin, Benin City assisted in gathering the data. The questions were administrated by the researcher and retrieved immediately in order to control loss. The exercise was about one month.

Method of Data Analysis:

The data generated from the interview and filled questionnaire was analyzed using mean (X) and standard Deviation (St.D) to answer the research questions while t test was used for testing the hypotheses at a significance level of 0.05. The decision rule was based on if the mean was greater or equal to 2.50. It was regarded as great extent, while the calculated mean less than 2.50 was regarded as slightly great extent. On the bases of hypotheses, a probability value of 0.05 was used, such that when P-value was less than or equal to 0.05 the hypotheses will be rejected, otherwise it will be retained.

Materials and Methods Used in the Analysis of Functional and Nutritional Properties of Moringa Oleifera Leaves and Seeds.

Collection of Plant Materials:

The fresh leaves and dried seeds of Moringa Oleifera were pruned from the trees of Moringa Oleifera at the open field of No 2, 2nd Utagban, off Upper Ekewan Road, Benin City, Edo State,Nigeria. The leaves and seed of moringa oleifera were identified by Professor Akinibosun of the Botany Department, Faculty of Life Sciences, University of Benin, Benin-city, Edo state, Nigeria, with the voucher number, UBH-T2162.

Preparation of the Extracts

Freshly collected leaves and dried seeds of moringa oleifera were dried under the sun for 14 days and milled with a Bench-top milling machine in a milling shed at Oba market,Ring Road, Benin City, into fine powder (1100 g) and soaked in 15 L of methanol and stirred for 3 days. The methanol solution was filtered thrice using several folded clean pieces of cheesecloth during each filtration process to remove debris. The mixture was concentrated using a rotary evaporator set at 600C and Freeze-dried to a constant weight with a freeze drier. The dried extract gave a yield of 31.14% (w/w) and was stored in an air-tight container in a refrigerator at about 4°C until when needed.

Proximate Analysis

Proximate analysis was carried out on the methanol extract of the leaves and seeds of moringa oleifera to ascertain its nutritional composition. Analysis of the sample was carried out using the method of association of official analytical chemists, (AOAC, 1990).

Ash Content

When organic matter is burnt in a furnace for three hours at a temperature of 6000C, the amount of inorganic residue left over is measured as the sample's ash content. The sample's ash content was determined using the AOAC (1990) method, which involved loading 2g of the sample into an empty, pre-weighed crucible (w0), which was then heated in a muffle furnace set to 600°C for three hours. The ash was then allowed to cool in a desiccator before being reweighed (w2). By comparing the weight of the sample before and after ashing, it was possible to determine the weight of the ash.

Percentage ash was obtained by

$$\% \text{ Ash} = \frac{(w1-w2) \times 100}{(W1-w0)}$$

Where: w0=Weight of the empty crucible, g

w1= Weight of crucible + sample, g

w2= Weight of crucible + ashed sample, g

Crude Fibre Determination:

This was done following the AOAC (1990) protocol. A 1 liter conical flask (w0) was filled with 2 g of the samples. The flask was filled with 200 ml of 1.25% H_2SO_4 acid, which was then allowed to boil for 30 minutes while being constantly monitored by cooling fingers and then filtered using a poplin cloth. Using a spatula, the residue was transferred back to the flask, and 200 ml of 1.25% NaOH (produced by dissolving 100g of NaOH pellets in 1 liter of distilled water) was added. The mixture was then allowed to boil for an additional 30 minutes

while being constantly agitated with cooling fingers. A poplin cloth was used to filter the material, and the residue was properly cleaned with hot distilled water before being thoroughly rinsed twice with industrial methylated spirits, acetone, or ethanol. Rinse three times with petroleum ether (BP 40-60 °C) to finish. Heat dry overnight at 105°C in the oven, allow it to drain completely and scrape the residue into a crucible. Once removed, it was chilled in a desiccator. In a muffle furnace, the weighed sample (w1) was ashed for 90 minutes at 550 °C. In the end, it was dried in a desiccator and weighed once more (w2).

The percentage crude fibre was calculated thus;

Where:

% of crude fibre = (w1- w2) X 100

W0 = Weight of sample, g

W1 = Weight of dried sample, g

W2 = weight of ash sample, g

Crude Protein Determination:

For the purpose to determining crude protein, the AOAC (1997) employed was a modified version of the micro-Kjeldahl method.

A small amount of anti-bumping granules was added to a micro-Kjeldahl digestion flask along with three grams of each of the defatted samples that were individually weighed on pre-weighed scales. Each flask received two grams of the catalyst solution (CuSO4: Na2SO4: SO2, 5:1:02 w/w), along with 10 ml of nitrogen-free concentrated H2SO4. The flasks were set up on a heating mantle in a fume cupboard at an angle. After the foaming stopped, the

temperature was raised to 50°C for another 30 minutes, then to full heating (100°C), where it remained until a clear solution was achieved. In order to achieve thorough digestion and nitrogen conversion to ammonium sulphate, simmering was maintained below boiling point for an additional 30 minutes. Samples were transferred quantitatively into 100 mL volumetric flasks after washing and cooling to room temperature once digestion was finished. With distilled water, volumes were adjusted to the proper levels.

A 10 ml pipette was used to transfer 10 ml of the digest filtrate into a 25 ml standard flask. Alkaline phenate (2 ml) was added, and the mixture was agitated to ensure good mixing. After properly shaking, 2ml of sodium hydroochlorite was added, followed by 6ml of sodium potassium tartrate. With the use of a UV/visible spectrophotometer, the solution's absorbance at 630 nm was measured after being diluted with distilled water to the 25 ml mark. The sample and the nitrogen standards were handled in the same manner.

Calculation

%N = Instrument. Reading. X Slope Reciprocal X Color Vol. X Digest Vol.

Weight of Sample X Aliquot Taken X 10000

% Crude Protein = %Nitrogen×6.25

Crude Fat:

AOAC (1973)'s soxhlet extraction method was used to estimate the crude lipid. Prior before weighing the empty 250 ml extraction flask, dry it in the oven at 110°C then let it cool in the desiccator. A porous thimble with a label was filled with cotton wool, and the folded filter paper (w0) containing 2 grams of the sample was placed inside. In the dry 250-ml extraction flask, about 200 ml of petroleum ether was added. Constructed apparatus by inserting the

cover porous thimble into the condenser for 5–6 hours was used for the extraction. The porous thimble was carefully removed, and then the petroleum ether was retrieved and stored it in the top container (tube) for future use. Drying took place in ovens at 1050°F–1100°F for a period of one hour. The weight was taken after cooling in the desiccator. When the petroleum ether was nearly completely gone, the extraction was removed flask from the water bath.

Calculation:

Weight of empty porous thimble =W0

Weight of empty thimble + ground sample = W1

Weight of ground sample = W1- W0

Weight of empty extraction flask =W2

Weight of empty extraction flask + ether = W3

Weight of ether (fat or oil) = W3 - W2

$$\% \text{ Fat} = \frac{W3 - W2}{(W1 - W0) \times 100}$$

Moisture content

This represents the amount of moisture that has evaporated after drying at 105°C in an oven. A pre-weighed (w0) crucible (wl) was filled with one (1) gram of the sample. The crucible containing the weighed sample was kept in a 105°C oven for three hours. After being taken out of the oven, the crucible was placed in a desiccator where it was permitted to cool. The weight was taken after cooling. Repeating the drying, cooling, and weighing steps led to the

achievement of a consistent weight (w2). The percentage of moisture was obtained by the equation;

$$\% \text{ moisture} = \frac{(wl-w2) \times 100}{(W1-w0)}$$

w0= Weight of the empty crucible, g

w1 = weight of sample + empty beaker, g

W2 =weight of dried sample + empty beaker, g

Determination of Soluble Carbohydrate (Nitrogen-Free Extractive)

Test method no.: qal/am/po6

The nitrogen free extractive (N.F.E.), also known as soluble carbohydrate, was obtained as a difference between crude protein and the total of ash, protein, crude fat, and crude fiber rather than being directly assessed.

N.F.E. 100-(%Ash +% crude fibre + % crude fat + crude protein)

N.F.E. is a general term that refers to all starches and sugars, a small amount of hemicellulose, and various amounts of lignin. It does not refer to any specific compound or collection of substances

Preparation Process of Moringa Oleifera Leaf and Seed.

Materials and Method

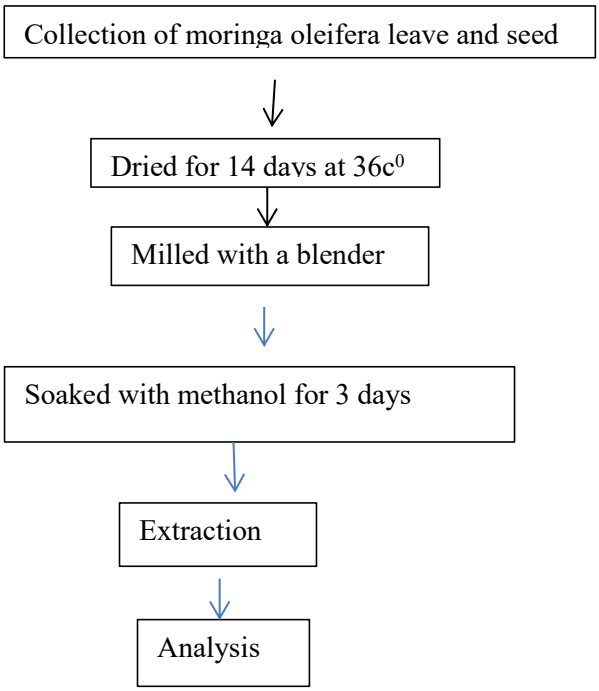

Fig 1: A flow chart diagram showing the preparation of moringa oleifera leaf and seed extraction.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

Research Question 1: What is the percentage content of moisture, ash, crude fibre, protein, crude fat and nitrogen free extract in moringa oleifera seeds and leaves?

The methanol extract of the leaves and seeds of moringa oleifera was analyzed for the nutritional and functional contents, and the results obtained are presented in Table 1.

Table 9: Proximate Analysis of Methanol Extract of Moringa Oleifera Leaves and Seeds

	Moisture Content %	Ash Content %	Crude fibre Content %	Protein Content %	Crude fat Content %	NFE Content %
Leaves	6.1 ± 1.79	9.25 ± 0.06	10.11 ± 0.27	27.61 ± 1.91	2.5 ± 1.21	47.09 ± 0.06
Seeds	71.1± 0.67	24.1± 0.12	9.24 ± 0.83	3.6± 0.15	15.1 ± 1.34	3.4± 0.97

Data is represented in mean ± S.E.M triplicates. MC = moisture content, AC = ash content, NFE = nitrogen free extract.

Analysis of the leaf extract samples showed that carbohydrate content was high (47.09 ± 0.06%), second to protein (27.61 ± 1.91%), third to crude fibre (10.11 ± 0.27%), ash, moisture and crude fat content were obtained. Moringa oleifera leaves are rich in all primary nutrients. In table 9, the percentage of protein (27.61%) is high, bearing in mind that the leaf extract is a sustainable remedy for malnutrition in children and lactating mothers. Crude fat of 2.5% support the opinion that moringa oleifera contains lactogogue made of phytosterols that act as a precursor for hormones required for reproductive growth. NFE (Carbohydrate) gave the highest amount of 47.09% which makes the plant a good source of food to man and animals. The moisture content of 6.1% suggests a very good shelf life of the leaf if properly stored. The percentage of AC (9.25%) showed the presents of mineral and vitamins in the plant that may boost health benefit and disease prevention. While the crude fibre content of

10.11% of moringa oleifera leaf extract is an indication that the plant is a very good source of dietary fibre to aid the digestive system.

From the analysis of moringa oleifera seed extract , the values of the measured parameters of the moringa seed extract were significantly different from each other. Analysis of the sample showed that moisture content was high (71.1 ± 0.67%) second to ash content (24.1± 0.12%), third crude fat content (15.1 ± 1.34%). crude fibre content, protein content and nitrogen free extract (carbohydrate) content were also obtained as shown in the afore-stated table.

Research Question 2: What is the mineral content of Moringa Oleifera Leaf Extract?

Table 10: Mineral Analysis of Methanol Leaf Extract of Moringa Oleifera

Parameters	**Concentration mg/100g**
Calcium (Ca)	641.2±1.20
Copper (Cu)	6.28±0.03
Magnesium (Mg)	186.15±0.28
Iron (Fe)	18.14±0.6
Zinc (Zn))	3.82±0.01
Phosphorus (P)	71.1±0.01
Potassium (K)	261.1±01
Sulphur (S)	135.12±06

Results are expressed as means ± SEM of triplicate replication

Mineral analysis of Moringa Oleifera leaf extract in Table 10 showed that moringa oleifera leaves are among the richest plant-based foods in Calcium (641.2mg/100). They also contain significant amount of Cupper (6.28mg/100), Magnesium (186.15mg/100), Iron (18.14mg/100), Zinc (3.82mg/100), Phosphorus (71.1mg/100) Potassium (261.1mg/100) and Sulphur (135.12mg/100). The calcium content of 641mg/100 is much greater than that of milk or dairy products. While the potassium content of 261.2mg/100 is much greater than that

of banana likewise the Iron content of 18.14mg/100 is still much greater in nutritional properties.

Research Question 3: What are the functional constituents of Moringa Oleifera Leaf Extract?

Table 11: Functional Constituents of Methanolic Leaf Extracts of Moringa Oleifera Leaf

Sample	Moringa oleifera leaf Powder
Alkaloids	+
Tannins	+
Phenolics	+
Saponins	+
Flavonoids	+
Steriods	+
Phtobatanin	-
Tripertenes	-

+ Detected, - Not detected

The analysis of functional properties of the methanol extracts of moringa oleifera leaf extract in Table 11 revealed that the leaves contain Phenolic, Tannins, Alkaloids, Saponins, Flavonoids, Steriod and does not contain Phylobatanin and Tripertenes. These non-nutritive plant chemicals are phytochemicals that have protective or disease properties which have been suggested to have potential therapeutic use.

Research Question 4: What is the level of awareness of the nutritional value of Moringa oleifera leaves in Edo State?

Table 12: Mean and Standard Deviation of the Level of Awareness of the Nutritional Value of Moringa Oleifera Leaves in Edo State

Awareness Statements	Mean	Standard Deviation	Decision
High protein content	3.17	1.049	High
High carbohydrate content	2.70	1.056	High
High vitamin content	3.13	1.024	High
High mineral content	2.85	1.029	High
High moisture content	2.95	1.032	High

High phytochemical properties	2.72	1.144	High

The awareness of the nutritional properties of *Moringa oleifera* leaves among Edo State residents is significantly high across all measured attributes. The highest awareness is related to protein (Mean = 3.17) and vitamin content (Mean = 3.13), suggesting a good understanding of the leaf's essential nutrients. While the phytochemical awareness is the Snutritional properties are known. This suggests successful dissemination of information lowest (Mean = 2.72), it still exceeds the threshold of 2.50, indicating that even less common regarding the benefits of *Moringa* leaves, potentially through community health programs or traditional knowledge.

Research Question 5: What is the level of awareness of the nutritional value of Moringa oleifera roots in Edo State?

Table 13: Mean and Standard Deviation of the Level of Awareness of the Nutritional Value of Moringa Oleifera Roots in Edo State

Awareness Statements	Mean	Standard Deviation	Decision
High protein content	3.05	1.074	High
High carbohydrate content	2.72	1.138	High
High vitamin content	3.00	1.053	High
High mineral content	2.89	1.124	High
High moisture content	2.69	1.084	High

The respondents demonstrated a high level of awareness of the nutritional benefits of *Moringa oleifera* roots, with particular emphasis on protein (Mean = 3.05) and vitamin content (Mean = 3.00). The carbohydrate content awareness (Mean = 2.72) suggests moderate familiarity with the energy-providing aspects of the roots. Although the moisture content awareness is on the lower side (Mean = 2.69), it still qualifies as a high awareness level. This overall trend indicates that the roots are perceived as nutritious, though perhaps less widely promoted compared to the leaves.

Research Question 6: What is the level of awareness of the nutritional value of Moringa oleifera seeds in Edo State?

Table 14: Mean and Standard Deviation of the Level of Awareness of the Nutritional Value of Moringa Oleifera Seeds in Edo State

Awareness Statements	Mean	Standard Deviation	Decision
High fat content	2.67	1.165	High
High protein content	2.79	1.105	High
High vitamin content	2.97	1.042	High
High carbohydrate content	2.65	1.039	High
High moisture content	2.69	1.065	High

There is a high level of awareness of the nutritional content of *Moringa oleifera* seeds, particularly regarding vitamins (Mean = 2.97) and proteins (Mean = 2.79). Awareness of fat content (Mean = 2.67) and carbohydrates (Mean = 2.65) is slightly lower but still within the high awareness range. This indicates that residents recognize *Moringa* seeds as a source of essential nutrients, though possibly not as prominently as the leaves and roots. The slightly lower means suggest that further educational efforts could focus on the less well-known nutritional attributes of *Moringa* seeds.

Research Question 7: What are the functional properties of root of Moringa Oleifera when utilized?

Table 15: Mean and Standard Deviation of the Functional Properties of Moringa Oleifera Roots

Functional Property	Mean	Standard Deviation	Decision
Restrains harmful bacteria	3.08	0.997	High
Combats ulcer	2.73	1.069	High
Anti-bacterial, anti-fungal, anti-inflammatory properties	2.92	1.050	High

Used as spice	2.70	1.089	High
Used as a dietary supplement	2.84	1.097	High
Used in stimulants and haematinics	2.70	1.089	High

Awareness of the functional properties of *Moringa oleifera* roots is high across all parameters, with the strongest awareness surrounding its antibacterial properties (Mean = 3.08) and use in disease combat (Mean = 2.92). The moderate awareness of its culinary use as a spice (Mean = 2.70) and its role in preventing anaemia (Mean = 2.70) indicates a broader, albeit slightly less emphasized, understanding of its diverse applications. This suggests that *Moringa* roots are both recognized for medicinal and culinary purposes, though their functional versatility might benefit from further public education.

Research Question 8: What are the functional properties of leaves of Moringa Oleifera when utilized?

Table 16: Mean and Standard Deviation of the Functional Properties of Moringa Oleifera Leaves

Functional Property	Mean	Standard Deviation	Decision
Used to promote lactation	2.93	1.063	High
Used to manage terminal ailments	2.87	0.961	High
Used as tea	3.13	1.022	High
Used in stew, soup, and sauce	2.92	1.030	High
Used to lower blood sugar levels	3.10	0.964	High
Provides a solution to malnutrition	2.86	1.066	High

Awareness of the functional uses of *Moringa oleifera* leaves is uniformly high, with the most common applications being as tea (Mean = 3.13) and for lowering blood sugar levels (Mean = 3.10). The recognition of *Moringa* leaves as a nutritional supplement to combat malnutrition (Mean = 2.86) reflects an understanding of their importance in public health contexts. This widespread awareness suggests that *Moringa* leaves are a well-integrated part of local diets and health practices in Edo State.

Research Question 9: What are the functional properties of seeds of Moringa Oleifera when utilized?

Table 17: Mean and Standard Deviation of the Functional Properties of Moringa Oleifera Seeds

Functional Property	Mean	Standard Deviation	Decision
Used to manage infections	2.98	1.043	High
Seed oil is recommended for cooking	2.93	0.963	High
Used to fortify methylated spirit	2.80	1.103	High
Used in soap, cream, and detergent production	2.84	1.109	High
Dried seeds used for domestic consumption	2.86	1.103	High
Used as a dietary supplement	2.91	1.006	High

There is a high level of awareness of the diverse functional applications of *Moringa oleifera* seeds, particularly for managing infections (Mean = 2.98) and as a cooking oil (Mean = 2.93). The recognition of *Moringa* seeds in both nutritional and non-nutritional roles (e.g., soap and detergent fortification) reflects a comprehensive understanding of their versatile benefits. This broad awareness indicates a potential for further leveraging *Moringa* seeds in both food security and industrial applications.

Research Hypothesis 1: There is no significant difference in the level of awareness of the nutritional value of Moringa oleifera leaves, roots, and seed extracts between male and female residents of Oredo Local Government Area of Edo State.

Table 18: Independent Samples t-test for Nutritional Awareness Based on Gender

Variable	Gender	N	Mean	Std. Deviation	t-value	p-value	Decision
Nutritional Awareness of Leaves	Male	67	2.74	0.535	-2.477	0.014	Reject Null
	Female	82	2.94	0.480			
Nutritional Awareness of Roots	Male	67	3.03	1.047	1.230	0.221	Retain Null
	Female	82	2.83	0.901			
Nutritional Awareness of Seeds	Male	67	2.81	0.834	0.970	0.334	Retain Null
	Female	82	2.67	0.826			

There is a significant difference in the level of awareness of the nutritional value of *Moringa oleifera* leaves between male and female respondents (p = 0.014), with females having higher awareness. However, no significant differences were observed in the awareness of the nutritional value of *Moringa* roots (p = 0.221) and seeds (p = 0.334) between genders. This suggests that while gender influences awareness of *Moringa* leaves, it does not significantly affect the awareness of roots and seeds.

Research Hypothesis 2: There is no significant difference in the level of awareness of the functional properties of Moringa oleifera leaves, roots, and seed extracts between male and female residents in Edo State.

Table 19: Independent Samples t-test for Functional Awareness Based on Gender

Variable	Gender	N	Mean	Std. Deviation	t-value	p-value	Decision
Functional Awareness of Leaves	Male	67	3.10	0.735	1.857	0.065	Retain Null
	Female	82	2.86	0.841			
Functional Awareness of Roots	Male	67	2.92	0.873	1.187	0.237	Retain Null
	Female	82	2.75	0.885			
Functional Awareness of Seeds	Male	67	2.92	0.820	0.447	0.656	Retain Null
	Female	82	2.86	0.840			

There are no significant differences in the level of awareness of the functional properties of *Moringa oleifera* leaves ($p = 0.065$), roots ($p = 0.237$), or seeds ($p = 0.656$) between male and female respondents. While the p-value for functional awareness of leaves is close to the significance threshold, it remains statistically non-significant. This suggests that gender does not significantly influence the perception of *Moringa*'s functional uses.

Research Hypothesis 3: There is no significant difference in the level of awareness of the nutritional value of Moringa oleifera leaves, roots, and seed extracts in Edo State based on age group.

Table 20: ANOVA for Nutritional Awareness Based on Age Group

Variable	Sum of Squares	Df	Mean Square	F-value	p-value	Decision
Nutritional Awareness of Leaves	Between Groups: 6.635	7	0.948	**4.118**	**0.000**	**Reject Null**
	Within Groups: 32.451	141	0.230			
	Total: 39.086	148				
Nutritional Awareness of Roots	Between Groups: 8.238	7	1.177	1.263	0.273	Retain Null
	Within Groups: 131.381	141	0.932			
	Total: 139.619	148				
Nutritional Awareness of Seeds	Between Groups: 4.491	7	0.642	0.930	0.486	Retain Null
	Within Groups: 97.313	141	0.690			
	Total: 101.804	148				

The analysis revealed a significant difference in the level of awareness of the nutritional value of *Moringa oleifera* leaves across different age groups ($p = 0.000$), suggesting that age plays a role in shaping awareness levels about *Moringa* leaves. However, there were no significant differences for roots ($p = 0.273$) and seeds ($p = 0.486$). This implies that educational interventions or exposure related to *Moringa* leaves may be more prevalent or effective in certain age groups, while awareness of roots and seeds remains relatively uniform across ages.Since the ANOVA test revealed a significant difference in the awareness of the nutritional value of *Moringa oleifera* leaves ($p = 0.000$), a post hoc analysis (LSD test) was conducted to identify the specific age groups where these differences lie.

Table 21; Post Hoc (LSD) Results for Nutritional Awareness of *Moringa oleifera* Leaves

Age Groups Compared	Mean Difference (I - J)	Std. Error	p-value	95% Confidence Interval	Decision
15-20 yrs vs. 33-38 yrs	-0.486	0.193	**0.013**	-0.866 to -0.105	**Significant**
15-20 yrs vs. 39-44 yrs	-0.518	0.186	**0.006**	-0.885 to -0.151	**Significant**
15-20 yrs vs. 45-49 yrs	-0.749	0.180	**0.000**	-1.106 to -0.392	**Significant**
15-20 yrs vs. 50-55 yrs	-0.737	0.205	**0.000**	-1.143 to -0.332	**Significant**
15-20 yrs vs. 56+ yrs	-0.823	0.233	**0.001**	-1.284 to -0.362	**Significant**
21-26 yrs vs. 45-49 yrs	-0.412	0.162	**0.012**	-0.732 to -0.093	**Significant**
21-26 yrs vs. 50-55 yrs	-0.401	0.189	**0.035**	-0.774 to -0.028	**Significant**
21-26 yrs vs. 56+ yrs	-0.486	0.219	**0.028**	-0.919 to -0.053	**Significant**
27-32 yrs vs. 45-49 yrs	-0.385	0.124	**0.002**	-0.631 to -0.139	**Significant**
27-32 yrs vs. 50-55 yrs	-0.373	0.158	**0.020**	-0.686 to -0.061	**Significant**
27-32 yrs vs. 56+ yrs	-0.459	0.193	**0.019**	-0.841 to -0.077	**Significant**

Younger respondents (15-20 years) have significantly lower awareness of the nutritional value of *Moringa oleifera* leaves compared to older age groups (33 years and above). The largest differences are observed when comparing the 15-20 age group with those aged 45 and above, indicating that awareness increases significantly with age. Respondents aged 21-26 years also display lower awareness compared to those aged 45 and above, though the differences are less pronounced than for the 15-20 age group. The age groups from 27-32 years also showed significant differences in awareness when compared to older groups (45 years and above), highlighting a gradual increase in awareness with age. The results suggest

that older adults (45 years and above) have higher awareness of the nutritional value of *Moringa* leaves, likely due to traditional knowledge, health concerns, or more exposure to *Moringa*'s health benefits over time.

Research Hypothesis 4: There is no significant difference in the level of awareness of the functional properties of Moringa oleifera leaves, roots, and seed extracts in Edo State based on age group.

Table 22: ANOVA for Functional Awareness Based on Age Group

Variable	Sum of Squares	df	Mean Square	F-value	p-value	Decision
Functional Awareness of Leaves (Func_L)	Between Groups: 3.730	7	0.533	0.822	0.571	Retain Null
	Within Groups: 91.451	141	0.649			
	Total: 95.181	148				
Functional Awareness of Roots (Func_R)	Between Groups: 4.452	7	0.636	0.813	0.578	Retain Null
	Within Groups: 110.345	141	0.783			
	Total: 114.796	148				
Functional Awareness of Seeds (Func_S)	Between Groups: 4.518	7	0.645	0.937	0.480	Retain Null
	Within Groups: 97.114	141	0.689			
	Total: 101.632	148				

The ANOVA results indicate no significant differences in the awareness of the functional properties of *Moringa oleifera* leaves ($p = 0.571$), roots ($p = 0.578$), and seeds ($p = 0.480$) across different age groups. This suggests that awareness of *Moringa*'s functional uses is consistent irrespective of age, implying that information on its uses is equally accessible or valued across various age demographics.

Discussion of Findings

The nutritional composition of any food substance can be estimated using proximate analysis. The proximate analysis technique helps in understanding the fundamental characteristics and properties of moringa oleifera leaves, seeds and roots which can be valuable in nutrition and functional utilization. The results obtained from the analysis of the nutritional and functional properties of moringa oleifera leaf and seed showed that the methanol leaf extracts had moisture content of 6.1± 1.79% while the Seed extract had a moisture Content of 71.1 ± 0.67% as indicated in Table 9. However, other reports have it that 7.5% moisture content was obtained from moringa oleifera leaf extract and 86.9% obtained from the seed extract.Moisture or water is a universal solvent, it dissolves other substances, carries nutrients and other materials throughout the body, making it possible for every organ to perform its function effectively. This explains why plants are stored in dried form including moringa oleifera leaves, seeds and roots. Food moisture content provides important formation on food preservation and storage. The methanol leaf extract moisture content result revealed that the moisture content is lower than that of the moisture content of the seed extract. Hence, the leaf extract with low moisture content will have a longer shelf life than that of the seed extract with high moisture content since high moisture content encourages microbial growth while low MC hinders the growth of micro-organisms. Ash content of methanol leaf and seed extract is the measurement of the mineral element present. The ash content in the methanol leaf extract was 9.25 ± 0.06% (table 9) while the ash content obtained from the seed extract was 24.1± 0.12% as shown in table 9. Mineral elements are essential for metabolic activities in order to maintain balance. They are distinct from one another. The presence of minerals and vitamins in moringa oleifera leaf and seed extract help to boost the body immune system against free radicals caused by oxidative stress, aging, infection and nutritional deficiency diseases (Aisha Danjuma et al, 2021). Dietary ash has proved helpful in establishing and

maintaining acid alkaline balance of the blood system as well as in controlling hyperglycaemia condition. The ash content in the methanol leaf and seed extract ensures that the plant act as anti-microbial and anti-inflammatory agents (Morton, 2019). The presence of fibre in human diets is known to ease the passage of waste in the colon, thus making it an effective anti-constipation agent. The values obtained for the crude fibre content from the study was 10.11 ± 0.27% for the methanol leaf extract as shown in table 9, while the seed extract was 9.25 ± 0.83% from the value obtained from the same table. Results from other researchers in the literature revealed, crude fibre content for leaf extract: 19.2% while the value obtained for seed was 4.8%. The investigation have shown that moringa oleifera root, seed and leaf extract can be considered as an effective herbal alternative to a range of commercially available antacids and anti-histamines (Makker and Becker, 2017). The result from Table 1 indicated that methanol leaf extract of moringa oleifera has a value of 27.61 ±1.91% protein content ,while the seed extract had a value of 3.6 ± 0.15% protein content (table 9). The presence of protein in the leaf and seed of the plant helps to curb kwashiorkor and Protein Energy Malnutrition caused by lack of protein in diets (Atli, 2015). Protein diet affects growth by regulating the body system that primarily composes organs, red muscles and white muscle. Proteins are needed for buildup of body tissues, repair and replace of worn out tissues of the system. The leaves are great alternative to meat, because of the high protein content, especially vegetarian, malnourished children and lactating mothers. (Aisha Danjuma et al, 2021). This suggests that the plant leaf, seed and root can be used as protein supplement and food fortification. According to Ibukunoluwa et al (2015), lipids are crucial for giving the body its maximum amount of energy, assisting in the movement of fat-soluble vitamins, insulating and protecting internal tissue and supporting critical cellular functions. The methanol moringa oleifera leaf extract revealed 2.5 ± 1.21% Crude fat (lipid) content, as shown in table 9. , while the seed extract showed 15.1 ± 1.34% crude fat (lipid) content,

(table 9). The analytical finding is in support of Morton 2019 report that moringa oleifera plant contains saponin, oleic acid (ben oil), fatty acids like linoleic, linolenic and behenic acids that can act as anti-microbial and anti-inflammatory agent. Plants contain carbohydrate in the form of nitrogen-free extract. Carbohydrates are one of the most important components in many foods. Carbohydrates maybe present as isolated molecules or they may be physically associated or chemically bound to other molecules. Individual molecules can be classified according to the number of monomers that they contain as monosaccharides, oligosaccharides or polysaccharides which may be covalently linked by glycosidic bonds. Molecules in which the carbohydrates are covalently attached to proteins are known as glycoprotein, whereas those in which the carbohydrates are covalently attached to lipids are known as glycolipids. Moringa oleifera leaf extract in methanol has a high value of 47.09 ± 0.06% (Table 9), and 3.4 ± 0.97% value from the seed extract as indicated in table 9. The value differs from Moustafa and Mansour (2020) findings, wherein the analytical value of moringa oleifera leaf extract was 38.2% and the seed extract was 3.7%. The presence of carbohydroate indicates that the plant is a reliable source of energy to man and livestock. Variations in the nutritional make-up of the moringa oleifera leaf and seed analyzed in this study and that of other similar researches in the literature review of this study could be attributed to the differences in make-up of the varying generic climatic and soil factors

Mineral elements are essential for organisms' metabolic activities in order to maintain balance, their importance cannot be overstated. Unlike other nutrients like carbohydrates, protein, fats and vitamins, these minerals are distinct from one another (Zoroddu et al, 2019). The mineral composition/analysis of moringa oleifera extract as shown in table 10 reveals that the leaf is rich in some minerals. Calcium (641.2mg/100g) plays a key role in blood clotting, in the development and stability of cell wall, muscle contraction, presentation of membrane permeability and structure. It also plays a crucial role in hormonal and nervous

coordination as well as metabolic processes in some enzymes (Felhi et al, 2016). Calcium, phosphorus and magnesium in the blood must be balanced, therefore, the closer a food composition come to that balance, the better for the body. Reduced root growth, death of terminal buds and distorted leaves are the effects of calcium deficiency in plants (Felhi et al, 2016). Calcium is directly involved in heartbeat and control of arterial pressure. The plant extract richness in calcium in addition to detected phyto-compound may have a beneficial effect on cardiovascular health. Studies have shown that lack of calcium causes nervousness, the leaf extract being very rich in calcium can also achieve the function of the nervous system. The presence of copper (6.23mg/100g) in moringa oleifera leaf extract indicate that moringa oleifera may be used as anti-microbial agent and wound dressing due to its ability to prevent infections, boost immunity and promote healing. It may also act as anti-cancer agent, anti-ageing effect as well as skin repair potentials (Mbikay, 2012). Magnesium (186.1mg/100g), which is present in significant concentration in the leaf extract function as a cofactor for enzyme that catalyze several metabolic pathways. The magnesium content plays a role in constipation relief, antacid agent, and effective maintenance of optimal levels of blood pressure (Laurencia and Muthulisi, 2020). The Iron content value was 18.14mg/100g. Iron is required for blood hemoglobin formation (Ogungbele and Onoge, 2014). The Zinc content of the leaf extract was 3.82mg/100g. Zinc aids the growth and repair of tissues, boosts immune system and plays a vital role in sperm survival. World Health Organization recommends zinc intake of 15 and 10mg/day for adults and children respectfully (Ogungbele and Onoge, 2014). The value of phosphorus (71.1mg/100g) in the plant extract indicated its efficacy in bone and teeth treatment. Potassium is needed to keep osmotic balance of the body fluid, the PH of the body, regulate muscle and nerve irritability, control glucose absorption and enhance proper retention of protein during growth (Ogungbenle and Onoge, 2014). About 261mg/100g potassium content was obtained from the leaf extract. The value have shown that moringa

oleifera plant can be used to prevent diabetics, odema, fight against free radicals, treat arthritis, cramps, gout and obesity. From the leaf extract, about 135.12mg/100g sulphur was obtained. This assures the plant's efficacy for detoxification and protein synthesis.

The analysis of the functional and nutritional properties of moringa oleifera leaf extract in table 11 revealed the presence of some functional constituents/properties of phytochemicals, some of which have been suggested to have potential therapeutic use. The analysis determines the biologically active non-nutritive compounds that contribute to the flavor, colour and other plant parts. Examples of these are alkaloids, tannins, phenolic, steroids, saphonins and flavonoids. The functional screening of the methanolic leaf extract of moringa oleifera in Table 11 showed that the leaf contain alkaloids, tannins, phenolics, saponins, flavonoids and steroids and does not contain phylobatanin and tripertenes. The findings in this study agree with earlier study which stated that moringa oleifera extract is associated with functional properties which may be used as food supplement and the treatment of chronic diseases such as heart disease, cancer, hypertension, diabetics and other medical conditions (Alhassan et al, 2023). Alkaloids were widely distributed in the plant fulfilling many functions. They are nitrogen containing naturally occurring compound, commonly found to have anti-microbial properties due to their ability to intercalate with DNA of the micro-organisms (kasslo et al, 2010). This could be responsible for their much acclaimed medicinal values, though the exact mode of action is poorly understood.The presence of tannins in the leaves also agreed with the work of Alhassan et al, (2022) who also discovered traces of tannin in the leaves grown in Uganda. Tannins can also be effective in curbing hemorrhages as well as restrict bare swellings. Tannins are proved haemostatic, beneficial when applied on mucosal coating in mouth. Therefore, they are herbs possessing plant used as mouth washes, eye washes, snuff and even as virginal douches and also treat rectal disorders. The findings agreed with the report of the Alhassan, et al (2022), that moringa

oleifera plant has functional purposes that make it a herbs widely used as ulcer medication. Long term or excessive use of herbs/vegetables that contain high concentration of tannins is not recommended. Phenolic was present in the methanolic extract of the leaf. Phenols are strong anti-oxidants, anaesthetics which prevent oxidative damage to biomolecules such as DNA, lipids and proteins which play a role in chronic diseases such as cancer and cardiovascular disease (Alhassan, et al 2022). The anti-oxidants properties in moringa oleifera plant help fight against free radical in the body system. However, phenol is considered toxic and corrosive, requiring careful handling and safety measures in industrial and laboratory settings. It contains skin irritant. Saponins were also detected in moringa oleifera leaf extract and they have been shown to possess both beneficial (cholesterol lowering) and deleterious (cytotoxic, permeabilization of the intestine) properties. The presence of saponins in moringa oleifera plant ensures that the plant has beneficial effects on blood cholesterol levels, cancer, bone health and stimulation of the immune system. Also, due to its ability to form froth, soap is being produced locally from it for bathing. The presence of flavonoids has shown the plant anti-fungal activity in vitro. The potent anti-oxidant activity of flavonoids reveals their ability to scavenge hydroxyl radicals, superoxide anions and lipid peroxy radicals; this may be the most important function of flavonoids. The phytochemical properties of flavonoids in moringa oleifera plant may be responsible for the medicinal qualities accorded the leaves. They induce mechanisms that may kill cancer cells and inhibit tumor invasion (Banaishaiye et al, 2011). Steroids were detected in moringa oleifera leaf extract. This is of great importance as they are of interest in pharmacy due to their relationship with compounds such as sex hormones. Steroids increase protein synthesis, promote growth of muscles and bones. They reduce the recovery time needed between training session and enable athletes to train more intensively for longer periods (Bamaishaiy et al, 2011). In general, the presence of these phytochemicals in moringa oleifera plant could

account for the much touted medicinal properties in the management of various disease conditions such as atherosclerosis, arthritis, diabetes, nausea, asthma, skin antiseptic, diarrhea, dysentery, colitis and cancer.

The study revealed that awareness of the nutritional value of *Moringa oleifera* leaves among residents of Edo State is significantly high across all measured attributes. The highest awareness was recorded for protein and vitamin content, suggesting a strong recognition of the essential nutrients provided by the leaves. Awareness of phytochemical properties was relatively lower but still above the threshold for high awareness. This widespread knowledge implies successful information dissemination through community health initiatives, traditional medicine practices, and local dietary habits. This aligns with the findings of Akpeghagha.O. Theresa (2015), who reported that increased awareness of *Moringa oleifera* is often linked to extensive health campaigns and indigenous knowledge transmission.

The findings indicated that residents of Edo State demonstrated a high level of awareness regarding the nutritional value of *Moringa oleifera* roots, with the most recognized attributes being protein and vitamin content. Awareness of carbohydrate content was moderate, suggesting a lesser emphasis on the root's energy-providing benefits. Although awareness of moisture content was the lowest among the attributes, it still met the criteria for high awareness. This trend suggests that while *Moringa* roots are acknowledged for their nutritional benefits, they may not be as widely promoted as the leaves. This observation is consistent with Shiriki (2015), who noted that the nutritional properties of *Moringa* roots are often overlooked in favor of its leaves due to differences in traditional usage patterns.

Awareness of the nutritional content of *Moringa oleifera* seeds was also high, with the most recognized attributes being vitamin and protein content. Awareness of fat and carbohydrate content was slightly lower but still within the high-awareness range. This suggests that

Moringa seeds are recognized as a valuable nutritional resource, though they may not be as prominently discussed as the leaves and roots. The findings indicate that further educational efforts could focus on enhancing knowledge about the specific nutritional benefits of *Moringa* seeds. This finding aligns with Cadman (2020), who emphasized that *Moringa* seeds are often underutilized in many communities despite their rich oil content and nutritional potential.

The functional properties of *Moringa oleifera* roots were well recognized, with the strongest awareness relating to their antibacterial effects and disease-fighting properties. Awareness of the root's culinary use as a spice and its role in preventing anemia was slightly lower but still significant. These findings suggest that *Moringa* roots are perceived as both medicinal and dietary components, although their functional versatility might benefit from further public education. This is in agreement with Morton (2019), who reported that *Moringa* roots contain bioactive compounds that contribute to their antimicrobial and therapeutic properties.

The study found that awareness of the functional uses of *Moringa oleifera* leaves was uniformly high, with the most common applications being as tea and for lowering blood sugar levels. The recognition of *Moringa* leaves as a nutritional supplement for combating malnutrition further underscores their importance in public health. The widespread awareness of these uses suggests that *Moringa* leaves are well integrated into local dietary and health practices. This is supported by Akpeghagha (2015), who found that *Moringa oleifera* leaves are widely used in traditional medicine for managing diabetes and improving nutritional intake.

The results indicated a high level of awareness regarding the functional applications of *Moringa oleifera* seeds, particularly in managing infections and as cooking oil. The recognition of *Moringa* seeds in both nutritional and non-nutritional roles, such as soap and

detergent production, reflects an understanding of their diverse benefits. This suggests potential opportunities for further leveraging *Moringa* seeds in food security and industrial applications. This aligns with the work of Adele Gautier etal (2022), who highlighted the economic and health benefits of *Moringa* seed oil in both household and industrial settings.

The study found a significant difference in the level of awareness of the nutritional value of *Moringa oleifera* leaves between male and female respondents, with females exhibiting higher awareness. However, no significant differences were observed in the awareness of the nutritional value of *Moringa* roots and seeds between genders. This suggests that while gender influences awareness of *Moringa* leaves, it does not significantly affect knowledge about the nutritional value of the roots and seeds. This agrees with Aisha Danjuma (2021), who noted that women tend to have greater awareness of nutritional and medicinal plants due to their role in household food preparation and healthcare.

The findings indicated no significant differences in the level of awareness of the functional properties of *Moringa oleifera* leaves, roots, or seeds between male and female respondents. While the p-value for functional awareness of leaves was close to the significance threshold, it remained statistically non-significant. This suggests that gender does not significantly influence perceptions of *Moringa's* functional uses. This is in line with Akpeghagha (2015), who found that both men and women generally recognize the health benefits of *Moringa* products, though their usage may differ based on cultural roles.The results revealed a significant difference in the level of awareness of the nutritional value of *Moringa oleifera* leaves across different age groups, suggesting that age plays a role in shaping awareness levels. However, no significant differences were found for *Moringa* roots and seeds. The post hoc analysis further showed that younger respondents (15–20 years) had significantly lower awareness of *Moringa* leaves' nutritional value compared to older age groups. These findings imply that educational interventions targeting younger populations could enhance awareness

of *Moringa's* nutritional benefits. This finding supports the work of Ojo T.O.et al (2016), who observed that older individuals are more familiar with traditional plants and their nutritional values due to generational knowledge transfer.

The analysis showed no significant differences in the awareness of the functional properties of *Moringa oleifera* leaves, roots, or seeds across different age groups. This suggests that information on *Moringa's* functional uses is consistently available and valued across various age demographics, indicating that awareness efforts have reached a broad audience. This corresponds with the findings of Aisha Danjuma Muhammed et al (2022), who noted that functional knowledge of *Moringa* is widely shared across age groups, particularly in communities with strong traditional medicine practices.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter summarized, concluded, recommended and had suggestions for further research.

Summary

The dissertation, titled Analysis of Nutritional and Functional Properties of Moringa Oleifera Root, Leaf, and Seed in Edo State, investigates the nutritional composition, functional benefits, and level of public awareness regarding moringa oleifera in Edo State. Moringa is a highly versatile plant rich in proteins, essential amino acids, vitamins, minerals, and phytochemicals. Many people have died of some chronic illness as a result of high cost of buying orthodox drugs .Moringa leaves, seeds and roots have proved to be effective to: manage infections, to promote lactation, use as tea, use as dietary supplement, use as stew, soup, sauce, lower blood sugar level, curb malnutrition, manage terminal ailments, cook,fortify foods, cream, soap and detergents and used domestic and livestock feeds. Despite its numerous benefits—including its role in combating malnutrition, boosting immunity, and serving as an industrial raw material—its utilization in Edo State remains low.

The study analyzed the proximate composition (moisture, ash, protein, fat, fiber, and carbohydrate) and mineral content of moringa seeds and leaves. It also assessed demographic variations in awareness, particularly across gender and age groups. The research employed laboratory analysis, surveys, and statistical methods to evaluate the nutritional value and functional applications of moringa. The findings indicate that moringa is a highly nutritious and medicinal plant with significant economic potential. However, there is limited public awareness and utilization, necessitating increased advocacy and commercialization efforts.

Recommendations

Based on the study's findings, the following recommendations were made:

1. Public Awareness Campaigns: Government agencies, NGOs, and health organizations should intensify awareness programs on the nutritional and medicinal benefits of moringa.

2. Incorporation into National Nutrition Programs: Moringa should be included in government-led food security and malnutrition intervention initiatives.

3. Encouragement of Commercial Cultivation: Farmers should be incentivized to grow moringa on a larger scale, with government support in the form of subsidies, training, and market access.

4. Promotion of Moringa-Based Products: Entrepreneurs should explore moringa fortification in foods, supplements, cosmetics, and pharmaceuticals.

5. Scientific Research and Innovation: Universities and research institutions should conduct further studies on moringa's potential applications in medicine, food processing, and industrial uses.

6. Integration into Agricultural Policies: Policymakers should include moringa as a strategic crop for poverty alleviation, rural development, and economic diversification.

7. Education and Training: Schools and community programs should incorporate moringa cultivation and utilization into their curricula to ensure widespread knowledge of its benefits.

8. Community Development Officers / inspectors and other adversary services can play a big role in meeting the challenges oand assiting farmers harness the enormous opportunities in the production and usage of moringa oleifera.

Conclusion

Moringa oleifera is a highly nutritious and functionally valuable plant with immense potential in health, agriculture, and industry. However, its benefits remain underutilized due to low awareness and inadequate commercialization. This study highlights the need for strategic interventions to promote the cultivation, consumption, and processing of moringa in Edo State and beyond. By increasing public knowledge and integrating moringa into health and agricultural policies, it can significantly contribute to food security, economic growth, and improved public health. If properly harnessed, moringa could serve as a sustainable solution to malnutrition and non-communicable diseases, providing both nutritional and economic benefits to communities.

Suggestions for further research

The following are suggestions for further research:

1. The study should be replicated in other states in Nigeria to create room for wider coverage.

REFERENCES

Abdull Razis A. F., Ibrahim M.D., and Kntayyaa, S.B. (2014). Health benefits of Moringa Oleifera. *Asian pacific journal of cancer prevention; 15 (20).8571-85 76.*

Adele Cautier, Carla Margarida and Isabel Sousa (2022). Moringaoleifera seeds characterization uses as food linking landscape. Environmental. Agriculture and food. Higher Institutes of agronomy. Universidade de Lisbia,Tapadada Aguda,1349-017 Lisbo Portugal.

Aisha Danjuma Muhammed, Muhammad Buhari and Ibrahim Adam Tahir (2021). Assessment of Economic relevance of Moringa Oleifera to its Farmers and Marketers in Katsina State. *African Scholar Journal of Management Science and Entrepreneurship. Vol. 20.No. 7*. African Scholar Publications@gmail. Com.

Aisha Danjuma Muhammad, Muhammad Buhari, Ibrahim Adam Tahir (2021). Assessment of Economic Relevance of Moriga Oleifera to its farmers and marketers in Katsina State. *Vol. 20.7 african scholar publications and Research International*.

Afsharypuora S, Asgharia G, Mohagheghzadehb A and Dehshahrib S. volatile constituents of the seed kernel and leaf of moringa peregrine (Forssk). Fiori, Agricolt. Cultivated in chabahar (Iran). *Iranian .J. Pharm Sci. 2010: 6: 141-144*

Alhassan Y.J., Sanchi I.D., Dorh I.E., Sunday J.A. (2022). Review of the Nutritive, Nutritional and General Economic Potentials Moringa Oleifera*. Cross Current Int. J. Agri Vet sci. 2663-2454* (print) and open Access. 10. 36344/cc ijavs. Jan-Feb. 2022. Vol. 4 (1-8).

Akpekhagha. O. Theresa (2015). Assesment of the Level of awareness and usage of moringa oleifera for managing health challages among medical personnel in Benin City. Masters degree project work 111.

Amaglo NK., Bennett RN., Lo Curto RB, Rosa EAS, Lo Turcov, Gluffrid A, Lo Curto A, Crea F, and Timpo GM (2010). Profiling selected phytochemicals and nutrients in different tissues of the multipurpose tree Moringa Oleifera L. *grown in Ghana. Food Chem. 122: 1047-1054.*

Amarsan, A. (2015). Six –based health benefit of Moringa Oleifera. Authority Nutrition.50,372-375.

AOAC (Association of Official Analytical Chemists) (1990). Official Methods of Analysis. Washington D.C.

AOAC (Association of Official Analytical Chemists) (1997). Official Methods of Analysis. Washington D.C.

AOAC (Association of Official Analytical Chemists) (1973). Official Methods of Analysis. Washington D.C.

Asghari G, Palizban A and Bakhshaei B. Quantitative analysis of the nutritional components of leaves and seeds of the Persian Morigna peregrins. (Forssk). Fiori. *Pharmacognosy Res. 2015:7:242-248.*

Atti Amarsan (2015). Six Science based health benefits of Moringa Oleifera. Authority Nutition 50.372-375.

Axe (2024). News letter on save ancient nutrition. Bone Broth Diet. The 21 day plan to transform your health and body with the ancient super food.

Bamishaiye, E.I., Olayemi, F.F; Awagu, E.F. and Bamishaiye, O,M 92011). Proximate and Phytochemical compound of Moringa Oleifera leaves at three stages of maturation. Advance Journal of Food Science and Technology 3 (4): 233-237, 2011.

Bashir, K.A, Bawa , J.A and Mohammed, I (2014).Efficacy of leaf extract of drumstick tree (Moringa Oleifera Lam.) on the growth of Local tomato (Lycopersicon esculentum). *Journal of Pharmacy and Biological Science, 9 (4-), 74-79*.

Bolarinwa I.F, Aruna T.E and Raji, A.O. Nutritive value and acceptability of bread fortified with moringa seed powder. J. Sandi Soc. *Agric. Sci. 2019, 18, 195-200 (Cross Ref).*

Cadman B: What makes moringa good for you "medicine/News today'. 2020.

Daba, M (2016): Miracle tree; "A review on multipurpose of Moringa Oleifera and its implication for climate change mitigation". Earth Science climate change.

Enwelim Joy (2019): Lecture notes: Antioxidant and free radicals in foods. Advances in Food Technology, University of Benin, Benin City. 5-7.

Ezinne Prisca Obinwa, Patricia Etuna Mbah, & Umeh-Idika Adaku Sandra (2023): proximate, mineral and functional properties of moringa seeds and pearl millet flour blends. Nigeria Journal of Home Economics Professional Association, Vol. 11, Number 8, March, 2023, 49-56

Fabiane Hodas, Maria Rosa T, Zorenon and Poula G. Milan. 2021. Moringa Oleifera potential as a functional food and natural food additive: a biochemical approach. Health Sciences. An Acad Bras Science (2021) 93 (suppl4): e2021o571 doi10.1590/000-3765202120210571.

Farinola L.A, Famiuyide O.O, Awe F., Adi O.A.F., Ewolor, A.S (2014): households' perception, awareness and willingness to pay for Moringa Oleifera Lam powder in Oyo State. *Journal of Agricultural and Crop Research Vol. 2(6), 94-103, June 2014.*

Felhi, S; Baccouch, N; Ben Salah, H; Smaoui, S; Allouche, N; Aharsallah, N, and Kadiri, A (2016). Nutritional Constituents, phytochemical profiles, in vitro antioxidant and antimicrobial properties, and gas chromatography-mass spectrometry analysis of various solvent extracts from grape seeds (vitis vinifera L.).

Foidi N, Makkar, H.P.S. and Becker, K (2010): The potential of Moringa Oleifera for Agriculture and Industries uses. *Dar Es Salaam Journal of Science, 25-45*.

Fuglie L J, Service CW, Eng NY (USA), Development AA for A , Eng D (Senegal); The miracle tree: Moringa Oleifera , natural nutrition for the tropic; 1999. http//agris.Fao.org/agris-search/search do?

Gandhi K, etal (2018). Status and utilization of Moringa Oleifera Lam. A review, *African Crop Science Journal 26 137-156.*

Ghazali H and AS M. Moringa (Moringa Oleifera seed Oil): composition, *Nutritional Aspect and Health Attributes" (2011).*

Goswami SK, Inamdar MN, Dethe SM, Gururaj GM, Jamnal R, and Bhaskar A. Erectogenic and Aphrodisiac Property of Moringa Oleifera: involvement of soluble epoxide hydrolase enzyme phytother Res. 2016;30. 1119-1127.

Govender L, and Siwela M (2010). The effect of Moringa Oleifera leaf powder on the physical quality, nutritional composition and consumer acceptability of white and brown breads. *Foods, 9(12); 1910.*

Gowrishankar R, Kumar M, Menon V, Divi SM, Sarannon M, Magudapathy P, Panigrahi BK, Nair KU, Ven kataramaniah K, (2010). Trace element studies on Tinospora Cordifolia (menispermaceae) ocimmum sanctium (lamiaceae), moringa oleifera (moringaceae), and phyllanthus nururi (Euphorbiaceae) using PIXE. *BIOL. Trace elem. Res. 133:257 363.*

Ibykunolluwa, M.R; Olusi, T.A. and Dada, E.O. (20150. Assessment of chemical composition of three antimalarial plants from Akure, Southwestern Nigeria: A prelimianary study. African Journal of Plant Science. 9 (8). 313-319.

Hekmat S, Morgan K, Sottani M and Gough R. 2015. Sensory evaluation of locally ground fruit purees and insulin fiber on probiotic yogurt in Mwanza, Tanzania and the microbial analysis of probiotic yogurt fortified with moringa oleifera. *J Health popul Nutri 33(1): 60-67.*

Janick J and Paul R. The Encyclipedia of Fruits and Nuts. Walling Ford, *United Kingdom: Cab. Publishing (2018).*

jullian Levy, CHHC. 2019, march 21: Functional foods benefits and how to add them to your diet.draxe.com. *Nutrition journal.*

Kumar. S. (2021). Effect of fortification of pasta natural immune booster Moringa Oleifera leaves powder (MOLP) on cooking quality and sensory analysis. sustainability. *Agri, food and Environmental Research, 9(3):408-424.*

Kusmiyati, Ferry W.F Waangsir, Moses Kopong Tokan, Aspris A. Adu, Anwar Mallongi and Eryc Zevrily Haba Bunga: 2023. The antibacterial Potency of Moringa Oleifera leaf extract on Semau Island, East Nusa Tenggara, Against Escherichia Coli. Miami/vll,n.10/ 10-13/eo591/2023. *Journal of law and sustainable development*.

Kantilate Thapa et al. Moringa Oleifera: A Review Article on Nutritional Properties and its Prospect in the context of Nepal. *ACTA Scientific Agriculture Vol 3. Agriculture and Forestry University, Rampur Chitwan, Nepal. October 2019.*

Leone A, Spada A, Battezzati A, Schiraldi A, Aristil J, and Bertoli S (2015). Cultivation, Genetic, Ethnopharmarmacology, Phytochemistry and Pharmacology of Moringa Oleifera leaves: *An overview.int J mol sci. 16(6). 12791-853https://doi.org/10.3390/ijms 160612791.*

Leone A, Bertoli S, Di Lello S, Bassoli A, Ravsenghi S, Borgonovo G,Forlani F and Battezzati A. 2018. Effect of Moringa Oleifera leave powder on post pradial blood glucose response: in vivo study on Saharawi people living in refugee camps. *Nutrients 10(10): 1-14.https://doi.org/10.3390//ijms 160818923.*

Lalas S, Gortzio; Athanasiadis V, Tsaknis J, and Chinou I: Determination of Antimicrobial Activity and Resistance to Oxidation Moringa Peregrine Seed Oil Molecules. 2012: 17: 2330-2334.

Laurencia Govender and Muthulisi Siwela. The effect of Moringa Oleifera leaf powder on the physical quality, Nutritional composition and consumer Acceptability of White and Brown Breads. Dietetics and Human Nutrition. School of Agricultural, Earth and Environmental Science, University of Kwazulu-Natal, Private Bag X01 Scottsville 3209, Pietermaritzburg 3201, South Africa: Foods 2020, 9, 1910; doi: 103390/Food 9121910.

Madukwe E.U (2013): Nutrient Composition and Sensory Evaluation of Dry Moringa Oleifera Acqueous Extract (PDF). *International Journal of Basic and Applied Sciences IJBAS-IJENS.*

Makker, H.P.S. and Becker, K. (2017). Nutrient and quality factor in different morphological parts of the moringa oleifera tree. *Journal of Agricultural Science Cambridge, 12.*

Mbikay, M. (2012). Therapeutic potential of Moringa Oleifera leaves in chronic hyperglycemia and dyslipidemia; *A Review Front Pharmacology, 24.*

Mallya R, Chatterjee P.K, Vinodini N.A, Chatterjee P and Mithra P, Moringa Oleifera leaf extract: Beneficial effect on cadmium induce toxicities. A review. J Clin. Diagn Res. 2017: 11: CEO I-CE04.

Merriam-Webster (2024);Female/male .merriam Webster.com Dictionary, https//www. Accessed 19,July,2024.

Morton J.F (2019). The Horse radish tree Moringa Ptercygcos Perma (Moringa ceae). *A book to Arid Land. Economic Botany, 18-33.*

Moustafa A. Abdelraouf and Mansour R. Samira (2020): Moringa peregrine a natural medicine for increasing immunity defense against the COVID-19. Medicine and Aromatic plant Department of Botany Faculty of Science, Suez Canal University, Ismaila, Eygpt. Review article. Open access freely available online. Isssn 2067-0412 vol. 9; ISS.5 No: 358.

Nambiar S, Guin P, Parnami S, and Daniel M (2010). Impact of antioxidants from drumstick leaves on the lipids profile of hyperlipidemics. *Journal of Herb Medical Toxicology. 165-172.*

Offor I.F, Ehiri R.C, Njoku CN (2014). Proximate Nutritional Analysis and Heavy Metal Composition of Dried Moringa OLeifera Leaves from Oshiri Onicha L.G.A; Ebonyi State, Nigeria. Journal of Environmental Sciences. *Toxicology and Food Technology, Vol. 8, Issue I Vcr. I (Jan. 2014) 57-62.* WWW.iosrjournals.org.

Ogungbenle, H, and Onoge, F. (2014). Nutritional Composition and functional properties of raw, defatted and protein concentrate of sesame (sesamium indicum) flour. European Journal of Biotechnology and Bioscience, 2 (4): 37-43.

Ojo T.O, Ogunleye A.S and Alimi T. (2016): Factors affecting the profitability of moringa oleifera production in Oyo State, Nigeria. Departmeet of Agricultural Economics, Obafemi Awolowo University, Ile-Ife, Osun State. *Ife Journal of Agriculture, 2016, Vol. 28, No 1.*

Onariase Eunice I. (2019): lecture notes. Food supplements. Advances in Food Technology, University of Benin, Benin City, 17

Popoola Jacob O. and Olawole.O. Obembe : Local Knowledge, use pattern and geographical distribution of Moringa Oleifera lam (moringaceae) in Nigeria. *Journal of Ethnopharmacology, 2 October 2013. 150 (2013) 682-691.* *WWW.elsevier.com/locate/jep.*

Sa'adu H (2016). Medicinal Plants towards Entrepreneurial Development for Effective Socio-Economic Change Being a paper Presented in the 4th National Conference, Titled "change"Organized by School of Secondary Education (Voc. and Tech. Education). Federal College of Education, Katsina, Held on Monday 1st –Friday 5th August, 2016.

Salami A.O (2014). Pre-germination Treatment of some Indigenous Sudan Savannah Tree. Species in Nigeria. A Dissertation Report for M.Sc Award. Department of Geography, Faculty of Earth and Environmental Sciences, Bayero University, Kano.

Salami A. O and Nwadike C. (2020): An Evaluation of the Potentials of Moringa Oleifera lam, A vegetable and Hedgerow Plant for Diet Supplements and multipurpose utilizations. *Journal of Plant Studies Vol. 9. No. 1: February 27, 2020. URL: http//doi.org/10.55 39/JPs, 19 nlp59.*

Shiriki D, Igyor M.A, and Gernah Di (2015). Nutritional evaluation of complementary food formulation from maize, soyabean and peanut fortified with Moringa Oleifera leaf Powder. *Food Nutri. Sci. 6 (5) 494-500 https//doi.org/10.4236/Fns. 2015.65051.*

Singh Y, Jale R, Prasad K.K, Sharma R.K, Prasad K. (2012): Moringa Oleifera; A miracle Tree, Proceedings, International Seminar on Renewable Energy for institutions and Communities in Urban and Rural settings, *Manav Institute, Jeva, India, 73-81.*

Singh T.P, Singh P and Kumar P, (2015). Drumstick (Moringa Oleifera) as food additive in livestock product. *Nutri. Food Sci. 45 (3): 423-432, https//doi.org/10.1108/NFS-02-2015-0018.*

Stohs SJ, Hartman MJ. Review of the Safety and efficacy of Moringa Oleifera. *Phytother Res. 2015. 29(6): 796-804.*

Thammarat K and Airouyuwa J.O (2020). Storage stability, gastrointestinal release and sensory properties of cookies incorporated with protein-based moringa oleifera leaf extract micro capsule. *Chiang MaiUnivJ Nat Sci 19(1): 139-154. https://doi.org//10.12982/CMUJNS.2020.0009.*

Ukaegbu Chidimma H. (2019): Lecture notes. Functional Foods, Food stabilizers and stimulating beverages. Advances in Food Technology, University of Benin, Benin City. 10-12.

Victoria Thobias Mpalanzi, Davis Naboth Chauls & Alex Wenaty (2023). Proximate and Mineral Composition of Noodles Incorporated With Moringa and Sardine Powders. Journal of Agricultural Science & Food Technology. Vol.9(30, 22-33. November 2023. ISSN; 2465-7522 research paper https;//doi.org/10.36630/jasft23011.

Williams O.A, Ajayi C.A, Famuyide O.O, Adebayo O. Economic potentials of moringa oleifera as a commercial tree species and its suitability for forest management intervention in Taungya farming system. *Agro Search. 2013:13(3): 242-255.*

Zahidill Islam, S.M. Rashadul Islam, Faruk Hossen, Kazi Mahtab-ul-Islam, m.d. Rakibu Hasan and Rezaul Karim (2021). Moringa Oleifera is a prominent source of nutrients with potential Health Benefits. *Banladesh Council of Scientific and Industrial Research, Dhaka, 1205 Bangladesh.*

International Journal of Food Science, vol 2021, Article ID 6627265, 11 https/doi.org/10.1155/2021/march.

Zungu N, Van Onselen A, Kolanisi U and Siwela M (2020). Assessing the nutritional, composition and consumer acceptability of moringa oleifera leaf powder (MOLP)-based snacks for improving food and nutrition security of children S. *Afri J Bot 129.283-290. http://doi.org/10.1016/J. Sajb.2019.07.048.*

APPENDIX A

RESEARCH INSTRUMENT

Department of Vocational
And Technical Education,
Faculty of Education,
University of Benin,
P.M.B. 1154, Benin City,
Edo State,
March 11th 2024.

Dear Sir/Ma,

LETTER TO RESPONDENTS

I am a postgraduate student from the Department of Vocational and Technical Education, University of Benin, Benin City, currently carrying out research on Analysis of Nutritional and Functional Properties of Moringa Oleifera root, leaves and seeds in Oredo Local Government Area, Edo State.

Please, be rest assured that every information given will be strictly treated as confidential. I request your assistance by way of objectively responding to the attached questionnaire, to enable me gather the necessary information for the study. The research is purely academic basis as a partial fulfillment of the requirements for the award of a Master's Degree in Home Economics.

Your co-operation is highly appreciated. Thank you.

Yours faithfully,

Onariase Eunice Iguadala.
(Researcher)

APPENDIX B

QUESTION ON THE ANALYSIS OF NUTRITIONAL AND FUNCTIONAL PROPERTIES OF MORINGA OLEIFERA LEAVES, SEEDS AND ROOTS

SECTION A: (PERSONAL- DATA)

Gender: Male ( ) Female ( )

Age Group: 15-20 ( ), 21-26 ( ), 27-32 ( ), 33-38 ( ), 39-44 ( ), 45-49 ( ),50-55( ),56 and above ( )

Community Member Status: Man ( ) Market Woman ( ) Youth ( )

SECTION B:

Instruction: Please read the following item carefully and tick ( ) the appropriate column that best describe your view about each statement.

Key Rating Scale for Awareness:	Rating Scale for Usage
4- Fully Aware (FA)	4- Very High Extent (VHE)
3- Fairly Aware (FA)	3- Fairly High Extent (FHE)
2- Slightly Aware (SA)	2- Slightly High Extend (SHE)
1- Not Aware (NA)	1- Not High Extent (NHE)

STATEMENT SECTION B

S/N	Awareness of Nutritional Properties of Moringa Oleifera Leaf	FA	FA	SA	NA
1	I am aware of the high protein content of moringa leaf extract				
2	I am aware of the high carbohydrate content of Moringa oleifera leaf extract				
3	I am aware of the high vitamin content of Moringa oleifera leaf extract				
4	I am aware of the high content of mineral of Moringa oleifera				
5	I am aware of the high moisture content of Moringa oleifera leaf				
6	I am aware of the high phytochemical properties of moringa oleifera leaf extract				
	Awareness of Nutritional Properties of Moringa Oleifera Roots				
7	I am aware of the high protein content of moringa oleifera root extract.				
8	I am aware of the high carbohydrate content of moringa oleifera root extract				
9	I am aware of the high vitamins content of moringa oleifera root extract				
10	I am aware of the high vitamins content of moringa oleifera root extract				
11	I am aware of the high mineral content of moringa oleifera root extract				
12	I am aware of the high moisture content of moringa oleifera roots				
	Awareness of Nutritional Properties of Moringa Oleifera Seeds Extract				
13	I am aware of the high content of fat in moringa oleifera seed extracts				
14	I am aware of the high content of protein in Moringa Oleifera Seed extract.				
15	I am aware of the high content of vitamins in Moringa Oleifera seed extract.				
16	I am aware of the high content of carbohydrate in Moringa Oleifera seed extract.				
17	I am aware of the moisture content of Moringa Oleifera seed extract				
18	I am aware of the moisture content of Moringa Oleifera seed extract				
19	I am aware of moringa oleifera leaves, seeds and roots containing histidine essential for infants to combat malnutrition.				
20	I am aware that the leaves, seeds and roots of moringa oleifera plant are edible				

21	I am aware of moringa oleifera leave usage as alternative to meat because of the high protein content in vegetarian diet.				
22	I am aware of moringa seeds containing vitamins A and C for the treatment of malnutrition.				
23	I am aware of moringa seeds containing vitamins A and C for the treatment of malnutrition.				
24	I am aware of moringa oleifera leaves, seeds and roots antioxidants properties that combat free radicals in the body.				
	Awareness of the functional value of moringa leaves				
25	I am aware of the usage of moringa leave powder for food fortification.				
26	I am aware of the use of moringa leaves for the management of malnutrition..				
27	I am aware that moringa leaves, seeds and roots are used as Supplements.				
28	I am aware that the leaves are rich in zinc, magnesium, Iron, copper and low caloric value used in the diet of obese.				
29	I am aware moringa leaves, contain amino-acids essential for infants to combat malnutrition.				
30	I am aware that moringa leaf extract promotes lactation that can correct balance of vitamins.				
	Functional Properties of Moringa Leaves.To What Extent	**VHE**	**FHE**	**SHE**	**NHE**
31	Are moringa leaves used to promote lactation				
32	Are moringa leaves extract used to manage terminal ailments				
33	Are moringa leaves used as tea for drink				
34	Are moringa leaves used for stew, soup sauce to all age group.				
35	Is moringa leaf tea is used for lowering blood sugar level.				
36	Moringa leave provides a sustainable solution for malnutrition				
	Functional Properties of Moringa Seeds, To what Extent				
37	Do you recommend Moringa seeds extract used to manage infection.				
38	Do you consider Moringa seed oil extract as healthy for cooking and recommend its use by a lot of persons.				
39	Should Moringa seed extract be used to fortify methylated spirit and made commercially available.				
40	Do you know that Saponin compound from moringa seed extract used to fortify soap, body cream, and detergent and sold in the market.				
41	Do you use Moringa seeds which are dried in paper bags used for domestic consumption				
42	Do you use Moringa seeds as diet supplement to prevent malnutrition.				
	Functional Properties of Moringa Roots				
43	Moringa roots are used to restrain the development of harmful bacteria in the body system.				
44	Moringa roots extracts combined with fruit nod help fight to ulcer.				
45	Anti-bacterial, anti-fungal and anti-inflammatory properties in moringa roots used to combat diseases and ailments in the body.				
46	Moringa tap root used as spice.				
47	Moringa root used to fortify dietary supplement to prevent loss of appetite.				
48	Moringa root used to fortify stimulant and haematinic to prevent stress and anaemia.				

APPENDIX C

RELIABILITY TEST

Reliability

Scale: ALL VARIABLES

```
RELIABILITY

  /VARIABLES=Item1_1 Item2_1 Item3_1 Item4_1 Item5_1 Item6_1 Item7_1 Item8_1
Item9_1 Item10_1 Item11_1 Item12_1 Item13_1 Item14_1 Item15_1 Item16_1
Item17_1 Item18_1 Item19_1 Item20_1 Item21_1 Item22_1 Item23_1 Item24_1
Item25_1 Item26_1 Item27_1 Item28_1

Item29_1 Item30_1 Item31_1 Item32_1 Item33_1 Item34_1 Item35_1 Item36_1
Item37_1 Item38_1 Item39_1 Item40_1 Item41_1 Item42_1 Item43_1 Item44_1
Item45_1 Item46_1 Item47_1 Item48_1

  /SCALE('ALL VARIABLES') ALL

  /MODEL=ALPHA

  /SUMMARY=TOTAL.
```

Case Processing Summary

		N	%
Cases	Valid	20	100.0
	Excluded[a]	0	.0
	Total	20	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.986	48

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
SMEAN(Item1)	123.1005	2098.938	.935	.985
SMEAN(Item2)	123.4005	2126.018	.759	.986
SMEAN(Item3)	122.8005	2112.150	.833	.986
SMEAN(Item4)	122.8005	2118.202	.780	.986
SMEAN(Item5)	123.1564	2137.509	.682	.986
SMEAN(Item6)	123.1255	2135.089	.675	.986
SMEAN(Item7)	123.1005	2111.537	.854	.986
SMEAN(Item8)	123.5980	2144.634	.760	.986
SMEAN(Item9)	122.9005	2112.879	.901	.985
SMEAN(Item10)	122.8505	2132.043	.698	.986
SMEAN(Item11)	122.7580	2120.670	.798	.986
SMEAN(Item12)	123.3505	2140.493	.596	.986
SMEAN(Item13)	123.4505	2113.892	.767	.986
SMEAN(Item14)	123.2005	2103.464	.923	.985
SMEAN(Item15)	123.0005	2102.615	.882	.985
SMEAN(Item16)	123.4005	2121.080	.840	.986
SMEAN(Item17)	123.3505	2112.686	.792	.986
SMEAN(Item18)	123.2505	2116.255	.734	.986
SMEAN(Item19)	123.4005	2100.954	.869	.986
SMEAN(Item20)	122.6505	2151.047	.498	.986
SMEAN(Item21)	123.3005	2101.558	.832	.986
SMEAN(Item22)	123.0005	2099.195	.912	.985
SMEAN(Item23)	123.1005	2108.135	.802	.986
SMEAN(Item24)	122.8630	2109.521	.819	.986
SMEAN(Item25)	122.9005	2101.744	.804	.986
SMEAN(Item26)	123.0505	2090.130	.902	.985
SMEAN(Item27)	122.4505	2141.358	.678	.986
SMEAN(Item28)	123.0005	2101.807	.889	.985
SMEAN(Item29)	123.2305	2119.791	.810	.986
SMEAN(Item30)	123.2830	2093.230	.877	.986
SMEAN(Item31)	123.0005	2108.381	.833	.986
SMEAN(Item32)	122.8505	2141.261	.569	.986
SMEAN(Item33)	122.3505	2141.429	.697	.986
SMEAN(Item34)	123.0505	2149.672	.480	.986
SMEAN(Item35)	122.5505	2141.588	.609	.986
SMEAN(Item36)	122.8584	2130.670	.685	.986
SMEAN(Item37)	123.2005	2135.278	.596	.986
SMEAN(Item38)	122.8505	2120.657	.702	.986
SMEAN(Item39)	123.1216	2143.376	.570	.986
SMEAN(Item40)	123.2268	2157.933	.456	.986
SMEAN(Item41)	123.4005	2126.567	.754	.986
SMEAN(Item42)	123.3847	2119.104	.719	.986
SMEAN(Item43)	123.0339	2104.425	.899	.985
SMEAN(Item44)	123.3505	2099.214	.879	.986
SMEAN(Item45)	123.3321	2103.043	.849	.986
SMEAN(Item46)	123.0163	2106.065	.854	.986
SMEAN(Item47)	123.0689	2103.205	.874	.986
SMEAN(Item48)	123.4505	2109.069	.861	.986

Note: The items are very highly internally consistent.