

AN ATLAS OF **MORINGA OLEIFERA**

FOR
**FOOD SECURITY AND
CLIMATE CHANGE ADAPTATION**



LIFEBUILDERS

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The unnamed individuals represent institutions ranging from Lifebuilders, Institute of Agricultural Research and Training, Obafemi Awolowo University, VIDSA Multiventures Limited, Raw Materials Research Development Council, National Centre of Genetic Resources and Biotechnology, Forestry Research Institute of Nigeria, N-power, Federal and State Ministry of Environment, Akinyele LGA, University of Ibadan and Alore Ijaiye Community of Oyo state. Their efforts are greatly appreciated.

Chief (Mrs) Grace Oluwatoye
ED. LIFEBUILDERS

PREFACE

This Atlas/Manual was written to create further awareness about the importance of the *Moringa oleifera* plant, also known as Zogall (Hausa), Okwe olu (Igbo), Ewé ilé (Yoruba), Drumstick or Horseradish tree (English). It is designed as a Policy Advocacy Material to reach high level decision makers responsible for securing food security at household level, and those working on various adaptation programmes for the Climate Change Agenda. The manual contains a detail exposition of the huge potentials of *Moringa oleifera* plant, to motivate its mass cultivation, processing and utilization to meet the needs of the numerous people at the base of the population pyramid globally and particularly in Nigeria.

Moringa oleifera remains one of nature's best gifts to mankind with enormous nutrient density and potentials as raw materials for industries to address household level food security, job and income generation opportunities. It is also a natural carbon sink and it can be used to reclaim degraded land thereby checking deforestation, erosion and land degradation. Its pulp can be used as raw material to produce soft paper; fiber for organic fertilizer; the wood wastes after substrate extraction for the production of medicinal mushrooms and the production of low carbon briquettes to replace fossil fuel currently used by over 67% of rural dwellers for daily cooking needs. The roots of moringa when processed as bio-char are a favoured replacement of current inorganic/chemical fertilizers that are laden with potential hazards to human health. Moringa is also a great resource for water filtration. The extraction of sap from Moringa has been used to produce bio-ethanol, and other typologies of ethanol useful in pharmaceutical and cosmetic industries. The bio ethanol has been processed by Lifebuilders to biogel which is being used for cooking in place of firewood. This achievement has been patented and now ready for commercial production of moringa biogel.

Moringa has been widely published in academic journals and books while the social media is agog with its numerous uses and cultivation. This has opened the eyes of the western worlds to its immense benefit resulting in its global demand to the tune of \$60billion given its classification as a "super food" and its use in their industries to replace the erstwhile inorganic chemicals used in foods and pharmaceuticals.

There is thus a great opportunity for us in this tropical climatic zone where moringa grows naturally to tap into the global multimillion-dollar industry. This manual is a great resource for policy makers in the agricultural, health, water, environmental, finance and national planning sectors for necessary policy shift that can favour humanity.

The above are the reasons the Global Environment Facility Small Grants Programme (GEF SGP) implemented by the United Nations Development Programme (UNDP) is supporting this effort since 2012 and we hope this effort will motivate a national effort to ensure food security, health and environmental wellbeing and national prosperity.

The ATLAS/Manual is presented in a manner to give a quick pictorial appeal of the plant's structure and show its potentials in the various industries listed within the food security and the Climate Change Adaptation value chains. The second section showcases its phytochemical contents in the seed, pods, leaves, stem, fibre, roots, substrates and wood wastes as well as the number of existing and emerging industries that the plant can generate primary and secondary raw materials to address the food security and the climate change issues.

Ibironke Olubamise
National Coordinator
GEF Small Grants Programme

PROFILE OF MORINGA OLEIFERA PLANT

S.O Oluwatoye (Lifebuilders & VMV Ltd.)

The Moringa plant is known to have originated from the southern hills of the Himalayas in North West India and has spread to all countries in the tropical zones of the world where it grows copiously in sandy soils where there is plenty sunshine. It is known to have been used in Northern and South Eastern parts of Nigeria where it was used as fence and fodders for animals (RMRDC 2011). Early reports of its nutrient density and use in the fight of malnutrition was first reported by Fugill who documented its copious use by the World Council of Churches in Senegal in the nineties. It was reported as God's kindness to people living in poor resource settings of the earth. It was helpful to pregnant and nursing mothers to fight anaemia, while adults testified to its use in promoting good sleep while making their animal husbandry project to flourish as the animals thrived well from eating and ruminating on its stems.

Moringa is also called a 'Miracle' tree because of its abundance in nutrients which is useful in food, medicine, economic sectors of human needs. All are parts are useful and recently has been documented also to be a good carbon sink for sequestering numerous tons of carbon dioxide while its stem substrate is useful in the production of useful bio ethanol.

Moringa Leaf: The Moringa leaf has been validated by the American Chemical Society as a cheap and sustainable product for purification of drinking water especially in the rural areas where people depend on water from rivers, streams, and shallow well. It is also reported as useful in the prevention and treatment of malnutrition and some communicable and non-communicable diseases common in developing nations. The fresh leaves of Moringa contains Vitamin C, Calcium, Potassium, Magnesium, iron and proteins. When dried it has these vitamins in higher contents. When compared with other plants it is rated as very nutrient-dense having more than double to even seven times more than their contents in other plant.

The World Health Organization WHO and The Food Agriculture Organization (FAO), two Leading United Nations body concerned with health and food have promoted Moringa leaves for years as an inexpensive health booster for poor countries with high malnutrition rates.

Recent studies and use of moringa have shown that the leaves can be dried and used as tea (dry or fresh). Drinking such tea promotes health and increases breast milk of lactating mothers while helping good and sound sleep.

It is high in magnesium which is used in prevention of eclampsia in pregnant women thereby saving lives from current high levels of maternal mortality resulting from pre eclampsia and other toxemia of pregnancy. The folklore medicine reported its use in the cure of over 300 diseases- worthy of more clinical researches to validate the claims however emerging testimonials from several users of the leaves and the products have convincing evidences of the need for more objective studies.

The leaf has high vitamin A and C, iron and high density lipoprotein (HDL) 'good cholesterol' level with its abundant health benefits in various diseases situations such as diabetes, high blood pressure, cardiovascular disease, stroke etc. The plant has been scientifically proven as an antibacterial agent and as a way of improving glucose tolerance in diabetes.

According to the result of some investigation, Moringa plant has the potential for both water and alcohol based Moringa leaf tinctures to fight a variety of bacterial infection.

The array of antioxidants in the leaf can be explored and used in food supplementation.



Moringa Seed: it is used for water purification as a coagulant as it attracts all the dirty Sediments for easy draining requiring only the seed and sand. This process could clarify water inexpensively and sustainable in the developing world. The result of this technology opens the possibility of providing a simple, locally sustainable process of producing storable drinking water. Moreover, using the technology can save foreign exchange for the country for the impurity and alum and other chemicals needed for water purification on a large scale.

Moringa Stem /Substrates: can also be used for traditional medicine. Equally, its useful in producing pulp for producing soft paper needed in high volumes in the wake of the technologies which print receipts of e commerce. The substrate generated from soft stems of Moringa have been found useful in the production of bio-fuel materials as well as bio ethanol of various typologies when subjected to industrial processing.

Moringa Fibre: The soft bark of young Moringa stems have also been used for the production of fibre when dried to serve as raw materials in the souvenir and packaging industries as well as general



1. MORINGA FOR FOOD SECURITY:

The rate picture of malnutrition in Africa is quite depressing with 20-25% of the population nutrient intake falls below minimum dietary requirement. 20-30% of children under 5 are under-weight while 33-45% suffers from vitamin A deficiency (VAD) while another 30-25% have stunted growth (Ojibwa et al., 2013).

The Moringa Oleifera plant is a substantive source of pro vitamins including over 30% of iron requirements needed by majority of Nigerians and indeed Africa who still live below poverty level. Moringa that can be classified as an indigenous vegetable is believed to contain several nutraceuticals such as alanine, beta carotene, flavonoid, isothiocyanate, limonoids etc. many of which are antioxidant that prevent or ameliorate disease symptoms. German and Dillard, 1998, asserted or posited strong association between the nutraceuticals and immunity enhancement and prevention of chronic diseases among humans.

Nutritionally well balanced diet do increase the control of HIV infection and mitigate the health impacts of AIDS, FAO, 2008. Moringa is among the indigenous vegetable reported to have strong nutraceutical potential to provide a good interface between food and nutritional security and HIV and AIDS.

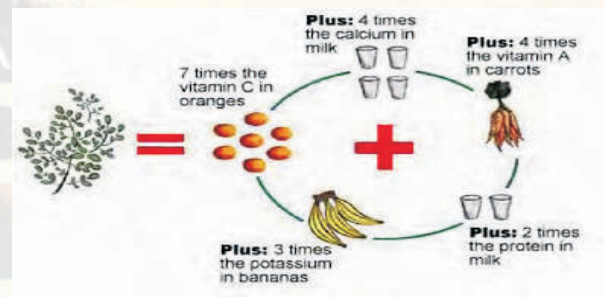
The consumption of Moringa has been demonstrated to improve the health condition of HIV/AIDS patient by increasing the cluster of differentiation 4 (CD4 cells and lowering virus count Hiart and Lindsay, 2005.) Therefore, diversifying diet of people in low resource setting with indigenous vegetable like Moringa is a sustainable way to supply a range of nutrients to the body and combat malnutrition and associated health problems or poor households. Therefore, the cost of creating easy access of these group of people at the base of the pyramid would be a worn-off to the currently high cost of supplementation through drug treatment or through artificial food additives Moringa for Climate Change Adaptation: Evidences now abound that the Moringa plant is a good carbon sink when planted in large quantities. Its different parts are useful in producing renewable energy sources to replace fossil fuel in the global warming activities.



1.2 MORINGA OLEIFERA NUTRITIVE VALUE

Here is a nutritional breakdown of Fresh Moringa Leaves:

- 7 times the Vitamin C of Oranges;
- 4 times the Calcium of Milk;
- 3 times the Potassium of Bananas;
- 2 times the Protein of Yogurt;
- 4 times the Vitamin A of Carrots;
- 3/4 the iron of Spinach.



Dried Moringa leaves is a greater powerhouse of nutrition:

- 1/2 the Vitamin C of Oranges;
- 17 times the Calcium of Milk;
- 15 times the Potassium of Bananas;
- 9 times the Protein of Yogurt;
- 25 times the Vitamin A of Carrots; and
- 20 times the Iron in Spinach.

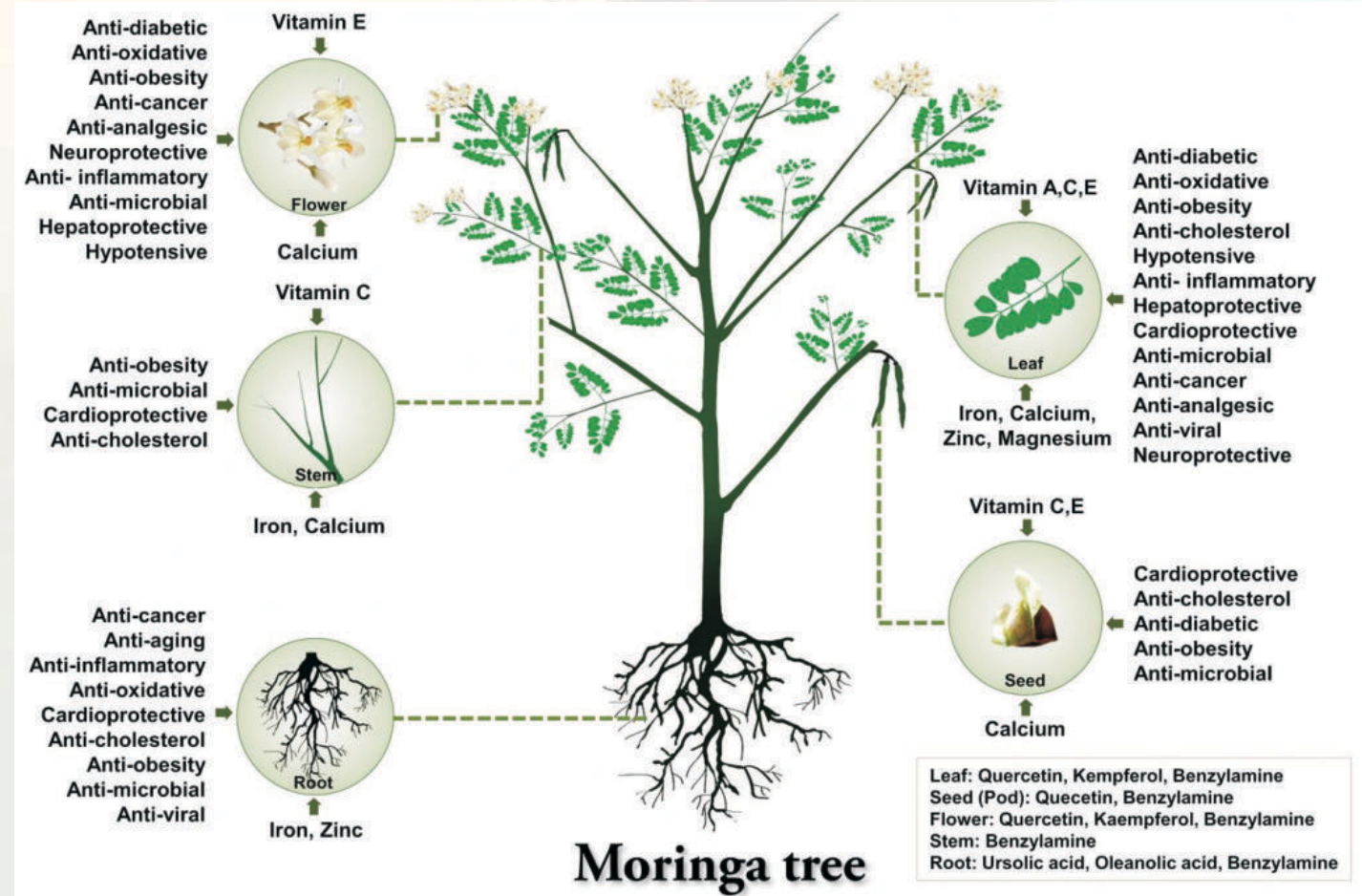


1.3 NUTRIENT CONTENT OF MORINGA PODS, LEAVES AND LEAF POWDER

Content	Pods	Leaves	Leaf powder
Moisture (%)	86.9	75	7.5
Calories	26	92	205
Protein (g)	2.5	6.7	27.1
Fat (g)	0.1	1.7	2.3
Carbohydrate	3.7	13.4	38.2
Fibre	48	0.9	19.2
Minerals	2	2.3	-
Calcium	30	440	2003
Magnesium	24	24	368
Phosphorus	110	70	204
Potassium	259	259	1324
Copper	3.1	1.1	0.57
Zinc	-	-	3.29
Iron	53	7	28.2
Sulphur	137	137	870
Selenium	-	-	0.09
Oxalic acid	10	101	1600
Vitamin A-B carotene	0.11	6.8	18.9

Content	Pods	Leaves	Leaf powder
Vitamin B-choline	423	423	-
Vitamin B1-Thiamine	0.05	0.21	2.64
Vitamin B2-riboflavin	0.07	0.05	20.5
Vitamin B3-nicotinic acid	0.2	0.8	8.2
Vitamin C ascorbic Acid	120	220	17.3
Vitamin E-tocopherol	-	-	112
Arginine	90	402	1325
Histidine	27.5	141	613
Lysine	37.5	288	1325
Tryptophan	20	127	425
Phenylalanine	108	429	1388
Methionine	35	134	350
Threonine	98	328	1188
Leucine	163	623	1950
Isoleucine	110	422	825
Valine	135	476	1065

1.4 Medical Benefits Of Moringa Oleifera



Medicinal Benefits	Parts of Plant
Dental care /Tooth ache	Root, Barks and Gum
Typhoid	Gum
Urinary tract infection	Leaf
Common cold	Flower
HIV-AIDS	Leaf
helminthes	Leaf, flower, and pod
Schistosomes	Seeds
Throat infection	Flower
Thyroid	Leaf
Snakebites	Bark
Arthritis	Seeds
Epilepsy	Roots, bark
Headache	Leaf, bark, root and gum
Joint-pain	Pods
Nutritional benefits	Parts of Plant
Anti-oxidant	Leaf and oil
Iron deficiency	Leaf and seed
Vitamin/mineral deficiency	Leaf and seed
Goiter	Seed
Protein deficiency	Leaf and seed
Energy supplement	Leaf, seed and oil
Anti-nutritional factor	Bark



Adapted from; Jed Fahey, 2005. Trees of Life Journal volume 1 no 5. A review of the medical evidence for its nutritional, therapeutic, and prophylactic Properties

2.0 VARIETIES OF MORINGA SPECIES CONSERVED FOR SUSTAINABLE UTILIZATION

Research And Development At National Centre For Genetic Resources And Biotechnology (NACGRAB), Moor Plantation, Ibadan, And Oyo State, Nigeria.

National Centre for Genetic Resources and Biotechnology (NACGRAB) was established 1987 to conduct research, gather data and disseminate technology information on matters relating to genetic resources conservation, utilization and biotechnological applications. The Centre backed by Decree 33 of 1987 regulates the Seed, Livestock and Fisheries industries through its varieties release committees.

NACGRAB has the mandate to conserve the rich Genetic Resources of the nation, with a view to enhancing agricultural, economic and social development.

Its mission is to ensuring the conservation and sustainable utilization of these rich biodiversity through Research and development.

The Centre continued to sustain her role as the focal point for the conservation and sustainable utilization of both plant and Animal genetic resources in Nigeria.

In the year 2012, significant achievements were made in the areas of germplasm acquisition and collection which is a core aspect of the centre's mandate. The Centre embarked on an extensive germplasm exploration and collection exercise on Moringa seeds which cut across some communities in Kebbi and Oyo State, a total number of 25 accessions of Moringa seeds were collected 12 accessions from Kebbi State and 13 accessions from Oyo State respectively. Each accession was replicated 20 times amounting to a total of 500 Moringa seedlings that was raised in the Field Gene Bank Unit, which is an integral part of the Plant Genetic Resources department in the Centre. The seeds were collected from the farmers' field and local markets in each State.

MORINGA TREE (THE MIRACLE TREE) 2.1

The plant belongs to the family Moringaceae, it is a small tree with a soft white corky trunk and branches bearing a gummy bark. Each tripinnately compound leaf bears several small leaflets.

The flowers are white and the three-winged seeds are scattered by the wind. It is mostly grown just for ornamental purpose; it is however a very useful tree. There are 13 different species of Moringa known globally, but 2 out of the 13 species are common in Africa, *Moringa oleifera* and *Moringa stenopetala*. Both are used in the same way (the flowers, tender leaves and pods are eaten as vegetable. Since the leaves are rich in iron, it is highly recommended for expectant mothers). The dried leaves makes a valuable nutrient supplement according to the annals of the ayurveda, india's old traditional medicines, the



leaves could treat at least 300 diseases ranging from eye infection, cold, bone and teeth diseases, memory loss, immune break down, stunted growth, unhealthy circulatory challenges, inflammations, restlessness, Cancer, Aging, and serves as antioxidant just to mention a few. The Seeds can also be eaten both when immature and matured, it serves as antibiotics and it is useful for making muddy water clear (Water purification).

Moringa oleifera is a small tree originating in Asia (Northern India), the plant requires at least 500 mm annual rainfall and a mean annual temperature above 130c. It grows up to an altitude of about 1000m above sea level.

Moringa stenopetala on the contrary is larger originates from Africa (Majorly in Ethiopia). It grows up to an altitude of 2100m above sea level

Dr. S.E. Aladele

Several research and development activities has been carried out in NACGRAB on the 2 aforementioned Moringa species (*Moringa oleifera* and *Moringa stenopetala*) in the following areas:

SUSTAINABLE AGRICULTURAL PRACTICES AND FOOD SECURITY: Documentation of effective cultivation practices of Moringa both in Nursery and Field sections.

HUMAN HEALTH:

Nutritional analysis of Moringa leaves, production of Moringa leaf and flower powder, application of Moringa seeds in water purification.

PLANT GROWTH ENHANCER: in areas of using the leaf extract as - growth accelerator in young plants, pest and diseases resistant in plants, plant yield (20-35% yield increment) and as organic manure.

LIVESTOCK FODDER SUPPLEMENT: Growth evaluation of selected livestock fed foliages of Moringa at the animal genetic resources unit in the centre.

FUTURE PROSPECT

NACGRAB in recent time has been working assiduously to ensuring the following;

- Characterization and Phytochemical screening of both short and long pod of Moringa seeds,
- Production of Moringa leaf powder on an industrial scale via certification by the appropriate authorities in the country, and
- Scaling up the Moringa germplasm on the FGB to meet both national and international quantitative and qualitative requirement.



Moringa stenopetala



Moringa oleifera

3.0 GROWING MORINGA OLEIFERA FOR MASS CULTIVATION & ROLE OF EXTENSION

Dr. O.O. Olugbire – Forestry Research Institute of Nigeria

Moringa oleifera is a multipurpose tropical tree, mainly used for food with other numerous industrial, medicinal and agricultural uses, including animal feeding. Moringa history dates back to 150 B.C. when ancient kings and queens used the leaves and fruit in their diet to maintain mental alertness and healthy skin (Jahn, 1996). History had it that Maurian warriors of India who defeated "Alexander" the Great were fed with juice extracted from the leaves of Moringa and these was believed to add to the soldiers extra energy and relieve them of the stress and pain incurred during war (Jahn, 1996). Research later revealed that these small leaves and fruits contain high amount of nutritional contents (Makkar et al., 1997). Besides being widely known and used for its health benefits and high nutritional value, Moringa has a fast-growing ability and it is drought-tolerant. This traditional plant was rediscovered in the 1990s and its cultivation has since become increasingly popular in Asia and Africa, where it is among the most economically valuable crops. It has been dubbed the "miracle tree" or "tree of life" by the media.



3.1 METHODS OF CULTIVATION



Large scale production of Moringa oleifera trees requires the development of nursery procedure involving the use of seeds or vegetative propagation.

Seed propagation

Traditionally tropical trees, such as Moringa oleifera, are propagated and conserved

by seed either by establishing plantations or by incorporating them within the traditional farming systems as inter planting, live fence or fetish groves. Seed collection is organized from such established tree plantations or farm. Establishment of tree nurseries is undertaken on suitable sites with the support of requisite tools and equipment.

Vegetative propagation

Techniques adopted under this strategy include:

- Stem cutting using materials of different sizes with two or more nodes.
- Large stakes referred to as truncheons.
- Apical pruning at about 1.5m height to induce dwarfing of tree.

The above propagation techniques can easily be embarked upon on a large scale at state, local government and community levels to ensure adequate seedling production and spread in most available planting sites, thus ensuring adequate planting stock and established tree population of the species.

Concept of Agroforestry

This is particularly suitable for low input conditions and fragile environment. It places emphasis on the use of indigenous multipurpose trees and shrubs.

3.2 ROLE OF EXTENSION IN MORINGA MASS CULTIVATION

Agricultural extension is the application of scientific research and innovation to agricultural practices through farmer education. The field of 'extension' now encompasses a wider range of communication and learning activities organized for people by educators from different disciplines. The role of extension with regard to moringa cultivation and mass production cannot be overemphasized and such responsibilities range from extension planning through training to



demonstration that encompasses all the stages of production, processing, value addition and marketing. All of these efforts are to ensure proper dissemination of knowledge, adoption of new technologies and improve wellbeing and livelihood of the people as well as their socialization and civilization which primarily depends on what they eat and their standard of living. Hunger and poverty related issues have continued to occupy a prominent position on the front burner of economic discussion in the world, and developing nations are faced with a number of challenges regarding nutrition, health and standard of living. Lack of economic power for minimum standards of living among

the poverty stricken people of the rural communities and the quest for survival makes them rely on natural products and utilize them in all aspects of their life. Although Moringa oleifera has been identified as a source of food, medicine and income globally, but in Nigeria, inadequate knowledge about its distribution, growth performance, appropriate silvicultural management practices, genetic improvement, germplasm conservation and the best provenances/strains that maximize its production have limited the prospect of utilizing this valuable multipurpose tree species in many places in Nigeria. During one of the routine visit by extension officers from Forestry Research Institute of Nigeria to Agricultural Development Programme Farmer's Field School, Ibadan, a farmer shared his experience about usage of natural herbs from leaves and bark of popular Neem tree (*Azadiractaindica*) also known as "Dongoyaro" in Yoruba for malaria treatment

and combination of cotton leaf, mango tree bark to control blood pressure among many other cited examples of natural herbal treatment. Despite the fact that this traditional knowledge is renowned and proven to be effective, as well as strong tool to combat poverty and improve health status, moringa oleifera still face challenges in it terms of mass cultivation which extension is playing pivotal role to solve. Some of the common issues with cultivation of moringa as a tree crop are land tenure system of the country which limits effective cultivation due to life span of the plant, poor marketing channel and market uncertainty after processing or value addition. Low levels of awareness of the inherent benefits of the plants have challenged the level of its cultivation and inadequate knowledge about its cultivation and uses

In some countries, like India and Kenya, extension has played major roles in creating more awareness on the benefits of this "miracle tree" to farmers and even encouraged them to plant as boundary or in between arable crops as agroforestry practice so as to ensure mass cultivation of moringa, in these countries, land use and acquisition reforms has been reviewed through suggestions and policy advise from extension officers which in turn ease burden on famers as well as the impact of extension on agricultural cooperative society whereby farmers' group are registered as finance group so as to receive support from governmental and non-governmental organization in securing land for suitable use. Nigeria as a country can learn from these countries by supporting the extension system to promote mass cultivation of moringa for income generation, food and nutrition security among the farming communities.

In conclusion, extension plays key role in mass cultivation of moringa oleifera by providing knowledge through education (sensitization on its benefits, how to cultivate and nurture, harvesting, processing and marketing), promote adoption, assist farmers in harnessing enormous opportunities in the production and usage of moringa. This is expected to make the product available for all, reduce poverty among the rural people and improve the economic situation of our nation.

4.0

MORINGA DEMYSTIFIED

All doubts and myths surrounding the use of Moringa leaf and tree were demystified at a lecture recently held at the Federal University of Technology, Akure. The lecture organized by the University's Centre for Research and Development (CERAD) with the topic "Uses and Potentials of Moringa Products for Health Improvement and Wealth Creation" was delivered by a former staff of the University and the National Secretary, Moringa Development Association of Nigeria (MDAN), John Tolani.

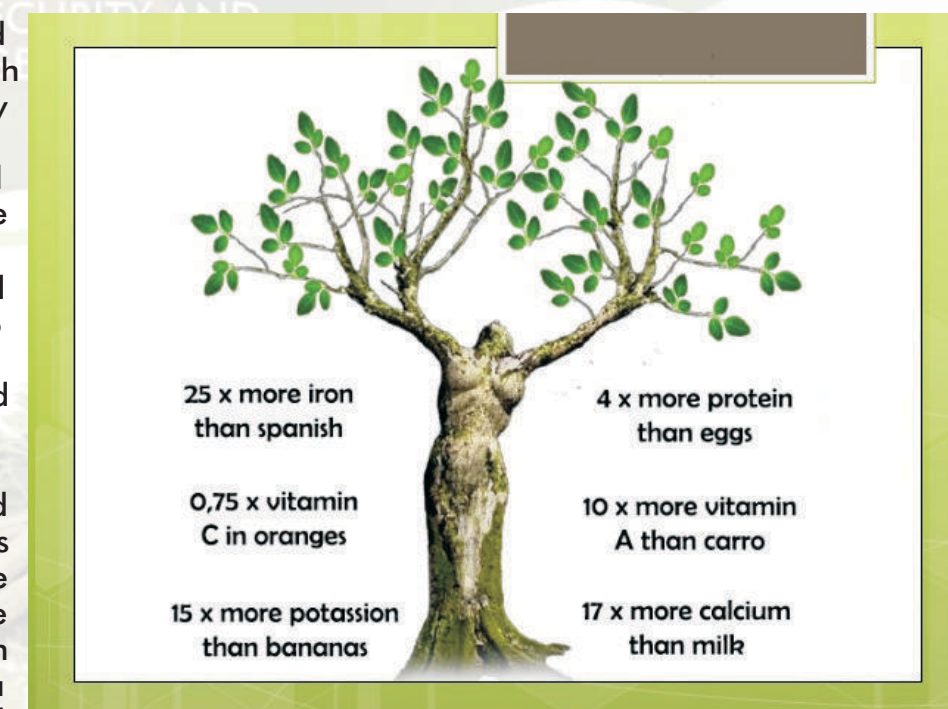
Tolani who spoke extensively about the many benefits of Moringa also touched on some of the possible side effects of the wonder tree. Said "the unusual endowment of the Moringa tree places it at an exceptionally vantage position to help the human body in fighting and neutralizing the two causes of disease; and thereby restores the body to good health. This is because when consumed, Moringa provides an unusual concentration and combination of nutrients which meet the Recommended Daily Allowance (RDA) for the body to thrive healthily and eliminate toxins from the body".

He however warned that the root bark is known to be toxic for human consumption. He also said feedbacks from a few users have indicated diarrhea, hypotension and mouth and throat sores as possible side effects. He warned that people should be wary of the source when buying processed Moringa products because of adulteration and contamination.

On the benefits of Moringa products, the guest lecturer said "Moringa is so versatile that most of its parts can be converted into useful products that have traditionally been known to cure about 300 diseases. It is also useful for animals and other plants. The leaves, stems, pods, seeds and roots have been applied to cure or relive diverse human and animal/livestock ailments".

Speaking on wealth creation potential of Moringa products, Tolani confirmed that Moringa is a powerful tool in the hands of whoever wants to create businesses and has high return on investment. According to him, "if the best agronomic, processing and marketing practices are adopted, the input-output ratio is substantial. This implies that an investment of N1 will yield N3.5 and this is achievable within 18 to 24 months in case of leaf powder and tea production".

Speaking on the medicinal and nutritional values of Moringa, Professor Daramola said "Moringa is one of the plants which researches have revealed have high nutritional and medicinal contents. This has made it a household plant. Despite this, it is clear that less than 5% of the Nigerian populace knows this wonderful plant. Thus, this justifies this lecture organized by CERAD and handled by an expert and former FUTA staff, **Mr. John Tolani**".



4.1 MORINGA OLEIFERA FOR PREGNANT WOMEN



Recommended nutrient intakes (RNI) for women in the first trimester of pregnancy and percentage nutrient intake from 100g of food.

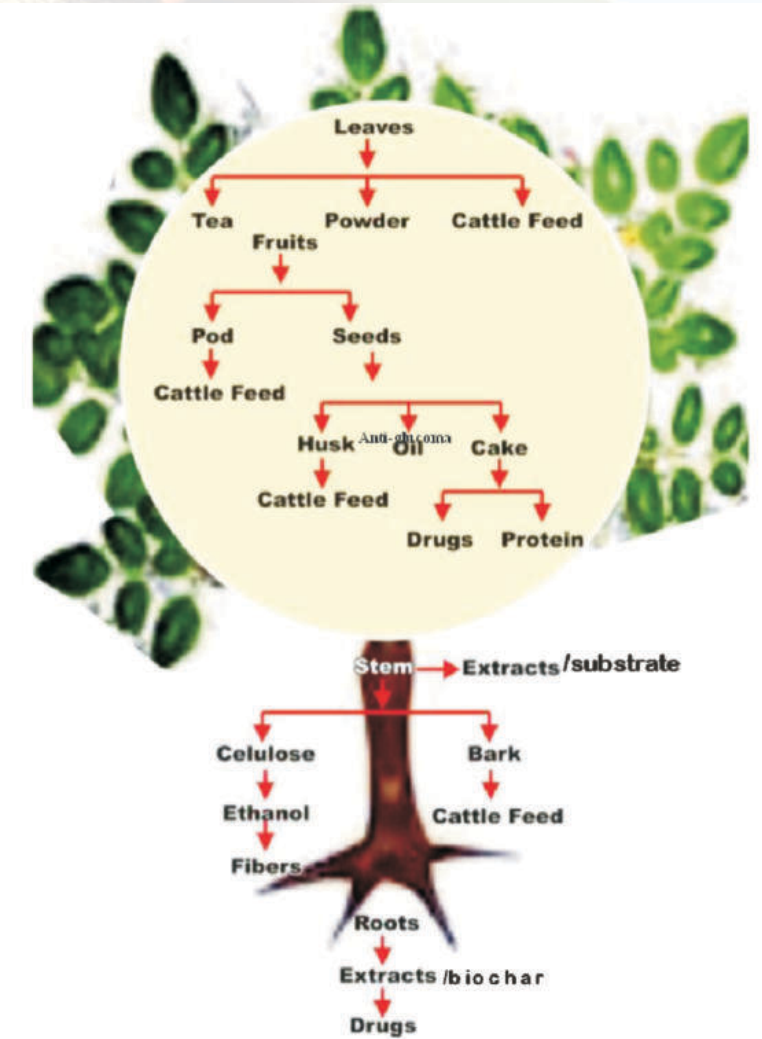
	Protein	Vitamin A	Iron	Folate	zinc	calcium	Vitamin E
RNI for pregnant mothers (1st trimester)	60g	800µg	30mg	600µg DFED	11 mg	1000mg	7.5 mg α-TE
Percentage of RNI from 100g food							
Rice	0	0	1	2	4	0	0
Cassava (root)	2	0	1	5	3	2	0
Millet	6	0	2	14	8	0	0
Meat (chicken)	37	0	3	1	14	1	3
Mungbean	40	2	22	104	24	13	7
Vegetable soybean	18	2	13	28	30	4	78
Cabbage	3	1	1	10	2	4	2
Tomatoes	2	18	1	3	2	1	7
Slippery cabbage	6	106	5	30-177	11	18	58
Moringa leaves	7	146	11	49	5	10	65
Amaranth	9	160	6	31	6	32	17
Jute mallow	10	198	12	21	0	36	36

- A: RNI data source: FAO/WHO 2004, RNI for population of pregnant women first trimester and diet of low iron and zinc bioavailability
- B: Nutrient Data Source. AVRDC nutritional laboratory and USDA nutrient database, 2010
- C: RE: Retinal Equivalent 1µg RE=6µg β-carotene á= 12 µg á- carotene
- D: DFE: Dietary Folate Equivalent 1µg DEF =0.6µg of folic acid supplement
- E:

5.0 MORINGA OLEIFERA FOR FOOD SECURITY - Grace Oluwatoye

Moringa has been used for several ages as food items, because of its medicinal properties and health benefits. It is very rich in healthy antioxidants and bioactive plant compounds. So far, scientists have only investigated a fraction of the many reputed health benefits.

Various households use its leaves and flowers as vegetables added to soup and flour to produce delicacies ranging from omelet, bread, chin-chin, biscuits, spices and fortifiers for Pap, Cassava, plantain, yam and wheat flour in various proportions.



MORINGA OLEIFERA AS FOOD PRODUCTS



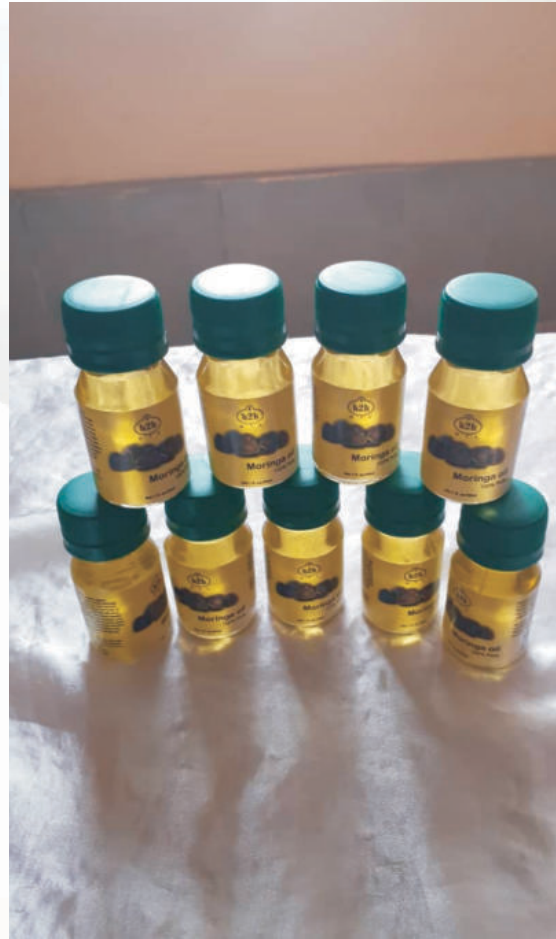
MORINGA BREAD



MORINGA CHIN-CHIN



MORINGA EGG OMELETTE



MORINGA OIL



MORINGA TEA



MORINGA PLANTAIN FLOUR



MORINGA POWDER



MORINGA MUSHROOM



MORINGA DRINK

MORINGA OLEIFERA AS COSMETIC



MORINGA BAR SOAP



MORINGA LIP-BALM



MORINGA BODY GEL



MORINGA BODY OIL



MORINGA BATH SOAP



MORINGA HAND GEL



MORINGA BODY CREAM

6.0 MORINGA OLEIFERA FOR RENEWABLE ENERGY AND CLIMATE CHANGE ADAPTATION

Human activity is increasing the concentrations of greenhouse gases in the atmosphere. Some of the gases include, carbon dioxide (CO₂), methane, nitrous oxide and fluorinated gases. Carbon dioxide is the greenhouse gas most commonly produced by human activities and it is responsible for 64% of man-made global warming. Burning coal, oil and gas produces carbon dioxide and nitrous oxide. It has therefore become highly imperative to seek for alternative energy source. Renewable energy can be a very important alternative. This energy is obtained from processing wastes with minimal emission of some of the gases. Moringa oleifera is an important shrub being processed into various useful by products. Several wastes are generated after Moringa oleifera processing. When the leaves are being processed for human and livestock use, the stem is left to waste. The waste is now being processed into Biogel (Domestic cooking gel)



MORINGA STEM CRUSH



MORINGA BRIQUETTE STOVE



MORINGA BRIQUETTE



MORINGA FIBER



CLIMATE CHANGE MORINGA SEEDS



MORINGA BIO-GEL



MORINGA BIO-GEL STOVE



MORINGA POWDER



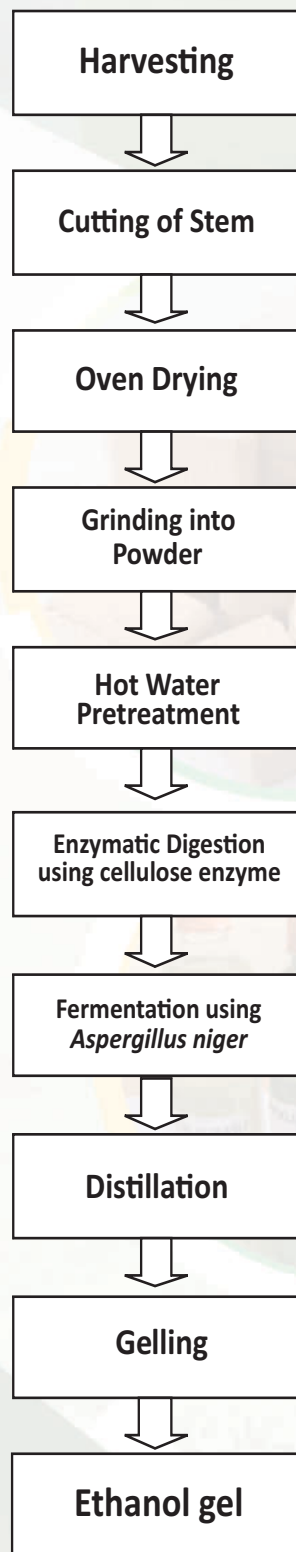
MORINGA OIL

6.1

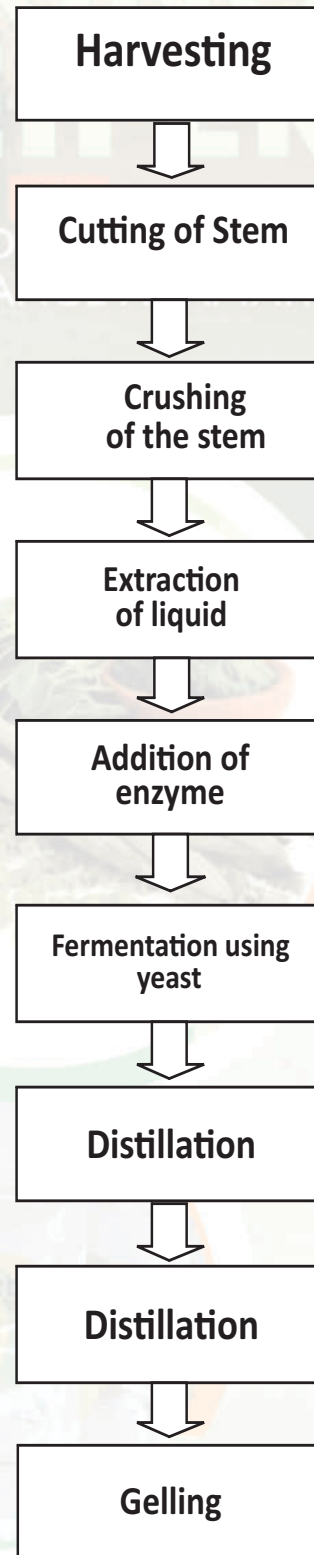
BIOGEL PRODUCTION

BIOGEL PRODUCTION DOCUMENT FOR CHART

Flow chart of Solid-Phase Fermentation

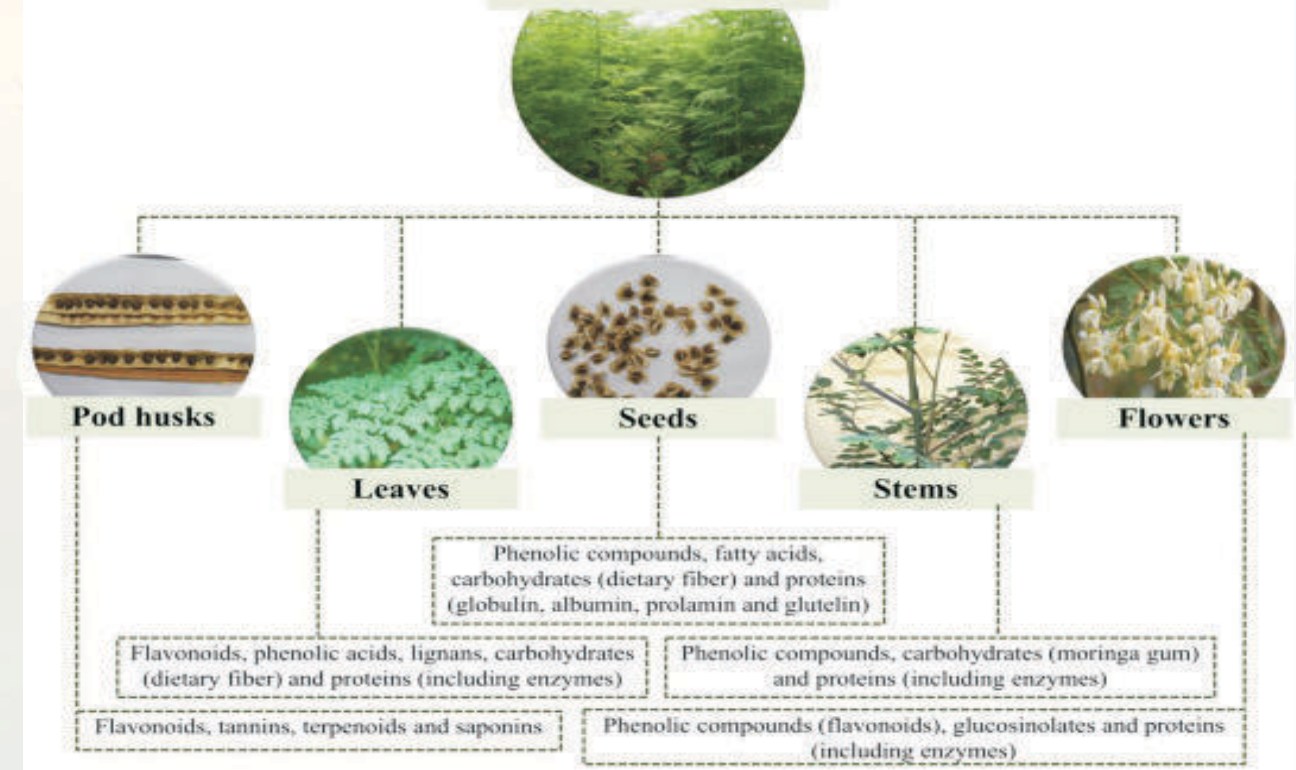


Flow chart of Liquid-phase



MORINGA OLEIFERA FOR FOOD CLIMATE CHANGE

Plants of Moringa



Nutrient Chart



Some antioxidants present in Moringa

Alanine	Delta 7-Avenasterol	Prolamine
Alpha-Carotene	Glutathione	Proline
Arginine	Histidine	Quercetin
Beta-Carotene	Indole Acetic Acid	Rutin
Beta-Sitosterol	Indoleacetonitrile	Selenium
Caffeoylquinic Acid	Kaempferal	Threonine
Campesterol	Leucine	Tryptophan
Carotenoids	Lutein	Xanthins
Chlorophyll	Methionine	Xanthophyll
Chromium	Myristic Acid	Zeatin
Delta 5-Avenasterol	Palmitic Acid	Zeaxanthin

Vitamins

Vitamin A (Carotene)
Vitamin B1 (Thiamin)
Vitamin B2 (Riboflavin)
Vitamin B3 (Niacin)
Vitamin B6 (Pyridoxine)
Vitamin B7 (Biotin)
Vitamin C
Vitamin D
Vitamin E
Vitamin K

Minerals

Alpha-Carotene	Proline
Arginine	Quercetin
Beta-Carotene	Rutin
Beta-Sitosterol	Selenium
Caffeoylquinic Acid	Threonine
Campesterol	Tryptophan
Glutathione	Indoleacetonitrile
Histidine	Kaempferal
Indole Acetic Acid	Leucine

Essential Amino Acids

Phenylalanine	Tryptophan	Isoleucine	Lysine
Threonine	Valine	Leucine	Methionine

Non-essential Amino Acids

Alanine	Aspartic Acid	Glutamine	Histidine	Serine
Arginine	Cystine	Glycine	Proline	Tyrosine

7.0

Moringa Oleifera As A Secondary Raw Material For Sustainable Industrial Growth Of Nigeria

INTRODUCTION

The applications of moringa oleifera as a source of secondary raw materials in the overall industrial growth of the nation cannot be overemphasized. Right from its primary to secondary form, moringa is widely recognized for the nutritional, health and industrial benefits derivable from different parts of the plant: the leaves, seeds and the roots. In the recent past, there is an overwhelming awareness of the multiple use of moringa for both domestic and industrial purposes. Therefore, it is pertinent to discuss the multi-sectoral applications of moringa in the health (pharmaceutical), oil and gas (biofuel), automobile and heavy equipment (lubricants) and food (natural food supplement) industries.

7.1 SECONDARY APPLICATION OF MORINGA IN HEALTH SECTOR

Moringa contains many healthful compounds such as Vitamin A, Vitamin B (thiamine), Vitamin B2 (riboflavin), Vitamin B3 (niacin), Vitamin C (ascorbic acid), calcium, potassium, iron, magnesium phosphorous and zinc. These compounds are extracted from Moringa plant and added as ingredient in the manufacture of essential medications of the treatment of certain ailments and diseases.

Treatment of Edema: Edema is a painful condition, where fluid builds up in specific tissues in the body. The anti-inflammatory properties of moringa may be effective in preventing edema from developing.

Protecting the Liver: Moringa appears to protect the liver against damage caused by anti-tubercular drugs and can quicken its repair process.

Preventing and treating of cancer: Moringa extracts contain properties that might help prevent cancer developing in the body. It contains niazimicin, which is a compound that suppresses the development of cancer cells.

Moringa is also applicable in the treatment of bacterial diseases, stomach complaints, cardiovascular damage, diabetes and asthma.



7.2 MORINGA AS A SECONDARY RAW MATERIAL IN OIL AND GAS SECTOR

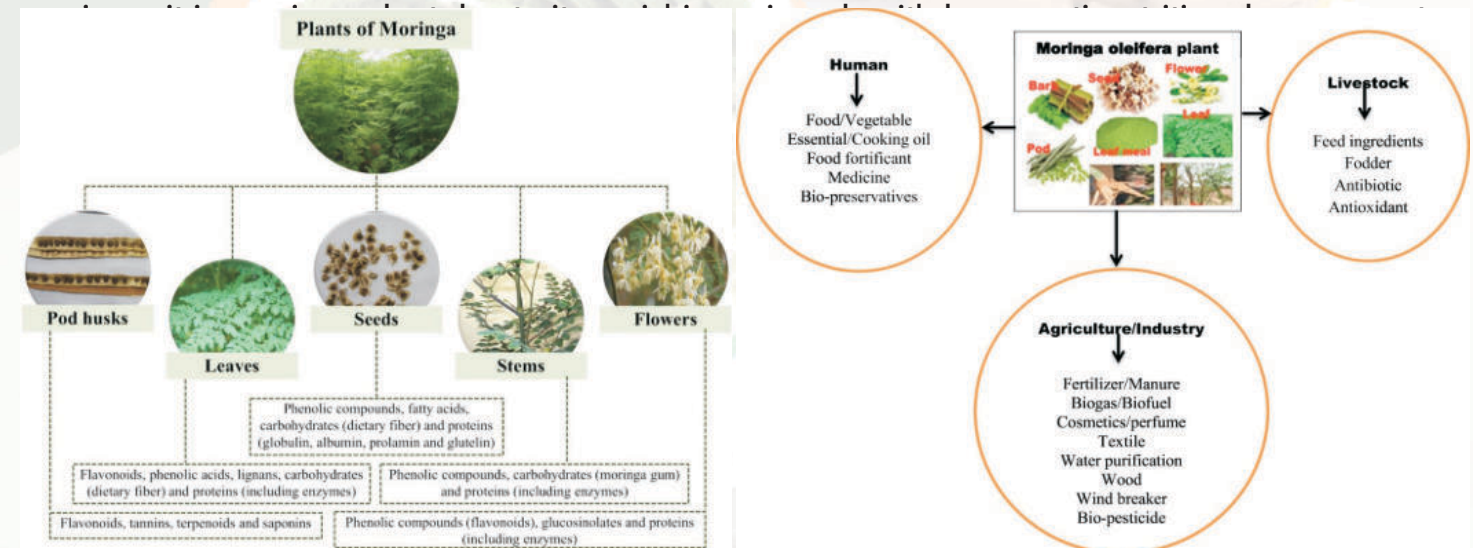
The rapid depletion of fossil fuels and the threat of on climate has influenced researchers to seek alternative energy sources. Consequently, at different oil and gas fora, the properties, extraction methods and potential applications of moringa oleifera seed oil-based biofuel, as a viable alternative to petroleum-derived fuel, have been discussed. Numerous clean energy, green fuels and sustainable technologies have been investigated and proposed for the establishment of future green energy economy.

Therefore, moringa oleifera oil seed is a promising feedstock for biofuel production. For instance, B5 indicates a blend with 5% biodiesel and 95% diesel fuel, in consequence, B100 indicates pure biodiesel. Biofuel from moringa has lower rate of emission compared to distillates from petroleum (crude oil), because it emits little or no greenhouse gases and combustion in ignition engine. Fuel from moringa is safe to handle, because of relatively high flashpoint. Furthermore, biofuel extracted from moringa has a low-soot emission, as it contains little or no sulphur as well as carcinogenic polyaromatic components. In addition, biofuel has higher lubricating properties than petrol-diesel. Thus, it has very promising maintenance potentials to industries that use biofuel as lubricant and fuel. Also, biofuel is degradable and non-toxic. It has low

to petroleum-based fuel. Overall, the use of biofuel will allow a balance to be sought between agriculture, economic development and the environment.

7.3 APPLICATION OF MORINGA AS SECONDARY RAW MATERIALS IN FEED SUPPLEMENT IN POULTRY DIETS

The wide application of in-feed antibiotic in poultry production has created public health hazards. A driving force for the interest of using natural herbs is to establish the antibiotics alternative in poultry production. The effects of moringa and its extracts on chicken performance and health status have sustained the production performance and improved their health status. Moringa leaves are rich in amino acid content. Lysine, Leucin, Isoleucin, Tyrosine, Proline, Glycine and Tryptophan; which are contents of amino acid, abound in moringa. They are of high nutritional values when included in poultry feed. However, moringa contains different anti-nutritional factors, such as tannins, phytates and cyanide, which may affect normal digestion and metabolism of nutrient in animals. These anti-nutritional substances can be neutralized by different feed processing techniques; including chopping, soaking, heat-steaming and fermentation with beneficial organism. Considering the health benefit effects of



CALL TO ACTION MAXIMIZING:
THE BENEFITS OF MORINGA OLEIFERA FOR NATIONAL DEVELOPMENT.
OUR COLLECTIVE RESPONSIBILITIES FOR ITS UPTAKE/UTILIZATION

4. 17 FMENV/12TH NCE/PRI/CCRE/17

INFORMATION MEMO ON MORINGA PRODUCTS PROMOTION FOR CLIMATE CHANGE MITIGATION, WEALTH CREATION AND SUSTAINABLE LIVELIHOOD IN RURAL NIGERIAN COMMUNITIES.

Source : NGO (LIFEBUILDERS)

Purpose : The purpose of this memo is to inform Council on the Importance of Moringa products promotion for climate change mitigation, wealth creation and sustainable livelihood in rural Nigerian communities.

This project explored the production of Moringa bio-gel as alternative to firewood and kerosene for cooking in rural communities addressed fossil fuel cooking habits, environmental pollution, and exposure to health risk.

Prayers

- I. Government should protect and regulate local industries producing Moringa Bio-gel products (Moringa tea, powder, soap, oil, and bio-gel) from foreign competitors who import less quality and sub standard Moringa products which is competing with our local industries and reducing job creation opportunities
- II. Government should support the expansion and scaling up (commercialization) of Moringa tea, powder, oil for easy affordability for Nigerians, especially the rural dwellers and the poor masses as daily household beverages
- III. Government should subsidize production of Moringa bio-gel to replace fossil fuel (firewood, coal, kerosene) used by over 60% of the Nigerian household to reduce climate change effect on environment and protect the health of Nigerians from respiratory infection caused by fossil fuel cooking

Recommendation Council to note the effort of the local organization like LIFEBUILDERS working in the development of biofuel alternatives and urge MDAs, federal, state and private sectors to upscale such initiative.

Adopted

CONCLUSION

Moringa oleifera is in great abundance in Nigeria given its ability to grow virtually in all the thirty-six states of the federation. Given its enormous socio-economic importance in the critical sectors of Food Security and Renewable Energy, the cultivation and processing of Moringa oleifera as a raw material base for several food, pharmaceuticals and industrial sector should be explored. Promoting massive cultivation to generate several metric tons of Moringa stem to produce substrate for the production of Bio-gel or bioethanol from which additional ethanol typologies could be generated for numerous industrial use will create enormous wealth as jobs for small holding farmers while simultaneously sequestering several million tones of carbon thereby safeguarding our environment. Furthermore, the utilization of all the parts of the plants from leaves to root offer amazing opportunities along the value chain to save the country enormous foreign exchange spending. Moreover , its nutritional benefits as an immune boosters, vitamin supplier will definitely improve the health status of not only pregnant and nursing mothers but help people living with chronic illnesses whose dependence on expensive drugs could be curtailed to increase the life expectancy of the vulnerable groups whose current health index status depict Nigeria as an under- developed nation.

A sincere call to action for Government to support efforts to achieve the commercialization opportunities for job creation, sustainable livelihood and environmental conservation cannot be over-emphasized. Other nations such as India, China, Senegal, Malaysia have benefitted from this plants. The Moringa oleifera green gold potentials is overdue for exploration. More research is also highly desirable to generate more benefit of this gift of nature.

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