UNIVERSITY OF PORT HARCOURT

THE POWER OF FOOD

An Inaugural Lecture

By

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DEDICATION

To

Professor Obiozor E. Ayalogu, the academic giant on whose shoulder I stood and watched with surgical accuracy, the intrepid dance steps of the world's finest intellectual masquerades on the world's best academic arenas.

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To Him whose throne is at the centre of the universe, the Mighty Jehovah, who spoke all things into existence and before whom I am less than nothing; to Him alone be glory now and for evermore. Amen!
Thanks for your support and attendance.

PROFESSOR MATTHEW OWHONDA WEGWU
September 26, 2019

ORDER OF PROCEEDINGS

2.45P.M. GUESTS ARE SEATED

3.00P.M. ACADEMIC PROCESSION BEGINS

The procession shall enter the Ebitimi Banigo Auditorium, University Park, and the Congregation shall stand as the procession enters the hall in the following order:

ACADEMIC OFFICER
PROFESSORS
DEANS OF FACULTIES/SCHOOL
DEAN, SCHOOL OF GRADUATE STUDIES
PROVOST, COLLEGE OF HEALTH SCIENCES
LECTURER
REGISTRAR
DEPUTY VICE-CHANCELLOR [ACADEMIC]
DEPUTY VICE-CHANCELLOR [ADMINISTRATION]
VICE CHANCELLOR

After the Vice-Chancellor has ascended the dais, the congregation shall remain standing for the University of Port Harcourt Anthem.
The congregation shall thereafter resume their seats.

THE VICE-CHANCELLOR'S OPENING REMARKS.

The Registrar shall rise, cap, invite the Vice-Chancellor to make his opening remarks and introduce the Lecturer.
The Lecturer shall remain standing during the Introduction.

THE INAUGURAL LECTURE

The Lecturer shall step on the rostrum, cap and deliver his Inaugural Lecture. After the lecture, he shall step towards the Vice-Chancellor, cap and deliver a copy of the Inaugural Lecture to the Vice-Chancellor and resume his seat. The Vice-Chancellor shall present the document to the Registrar.

CLOSING

The Registrar shall rise, cap and invite the Vice-Chancellor to make his Closing Remarks.

THE VICE-CHANCELLOR'S CLOSING REMARKS.

The Vice-Chancellor shall then rise, cap and make his Closing Remarks. The Congregation shall rise for the University of Port Harcourt Anthem and remain standing as the Academic [Honour] Procession retreats in the following order:

VICE CHANCELLOR
DEPUTY VICE-CHANCELLOR [ADMINISTRATION]
DEPUTY VICE-CHANCELLOR [ACADEMIC]
REGISTRAR
LECTURER
PROVOST, COLLEGE OF HEALTH SCIENCES
DEAN, SCHOOL OF GRADUATE STUDIES
DEANS OF FACULTIES/SCHOOL
PROFESSORS
ACADEMIC OFFICER

PROTOCOLS

- The Vice-Chancellor
- Previous Vice-Chancellors
- Deputy Vice-Chancellors (Admin and Academic)
- Previous Deputy Vice-Chancellors
- Members of the Governing Council
- Principal Officers of the University
- Provost, College of Health Sciences
- Dean, Graduate School
- Deans of Faculties
- Heads of Departments
- Distinguished Professors
- Directors of Institutes and Units
- Visiting Academics and Colleagues
- Esteemed Administrative Staff
- Captains of Industries
- Cherished Friends and Guests
- Unique Students of UNIPORT
- Members of the Press
- Distinguished Ladies and Gentlemen.

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THE POWER OF FOOD

1.0 Preamble

It is common knowledge that oxygen, water and food are the basic necessities of life. Available evidence strongly suggests that in five to ten minutes without breathing, an average person may likely develop serious and oftentimes irreversible brain damage. It is also true that the maximum period humans can survive without water is seven days. Interestingly, there are strong indications that on the average, humans can survive without food for 30 to 40 days, provided they are adequately hydrated. Death however, can occur between 45 to 61 days (www.healthline.com).

The utmost desire of humans is to have enough food that would satisfy their hunger. There exists a harmonious, inseparable synergy between food and the physical, psychological, economic, social and intellectual aspects of humans. In the descending order of priority, food is topmost, followed by shelter, and then clothing. Beginning from pre-historic times till date, food has consistently played major roles in the existence and affairs of the human race. For instance, ancient Indians compared food to God as it was believed that in addition to its physiological effects, food has psychological, organoleptic and healing properties. This line of thought went further to attribute the energy derived from food as 'cosmic' energy as it assists man to experience enlightenment (Manay and Shadaksharaswamy, 2010).

Most migrations recorded in history were obviously influenced by the quest for greener pastures. Humans migrate from areas of scarcity to areas of abundance. This, unarguably, informed the convergence of ancient Mediterranean people on the bank of the fertile River Nile. Despite the distortions of history, it is obvious that the various expeditions by sea-faring white adventurers to Africa, Asia and Latin America were actually in search of food, precious stones and spices. It also accounts for the reason Port Harcourt City in Rivers State, a land that is endowed with natural resources, has remained thickly populated from the pre-colonial era till date.

Also, the 'discovery' of Choba River (erroneously named New Calabar River) by her gallant warriors made the migration of the people of Choba from their ancestral home to the present location inevitable. History is replete with wars among nations, tribes, kingdoms, etc. that were triggered by food shortages or fear of starvation in the future by wondering ancestral pre-farming societies. It is obvious that African nations would not have been colonised if our lands were not fertile to produce excess food for its inhabitants and cash crops for expropriation by colonialists; or if the natives were armed with mutually reciprocal weapons of self-defense to resist colonial intrusion and domination. Jungle justice has for decades served as rewards for hungry Nigerians caught stealing food items in public places. Many have also been sent to their early graves by armed bandits, as such individuals attempted to resist the hungry robbers from robbing them of their foods. The traditional and social media are awash with surreal and sizzling tales of missing pots of soup, while the pots were still on fire in some parts of Nigeria—especially in this era when we are all on a roller coaster voyage to the *Next Level* promised by our political leaders! As the picture below shows, hungry and angry people are not known for empathy or rational thinking, as violence and mob action become the primary weapon of choice without a whiff of conscience.

Fig.1.1: A case of Jungle Justice in Nigeria

Great minds have travelled across the globe in search of 'new' foods to feed their ever-growing populations and nutritionists have successfully brought to the limelight, the proximate profile of foods, including their inevitable contributions to healthy living and methods of disease control etc. Interestingly, many scholars have received enviable awards for discoveries that are food- related. Scientists in Southeast Asia responsible for developing the miraculous paddy rice are the toast of their once hungry societies.

The holy Bible talks about the fall of man because he ate the forbidden fruit (food) from the tree of knowledge of *good* and *evil,* while Esau sold his birthright for a plate of food. Very distinguished Ladies and Gentlemen, let me declare at this point that food is the very essence of human existential strivings and the essence of our total being! It is disheartening to note that man's existential lifespan fell from a lofty height of 969 years (Methuselah) to 70 years and this may be due to a thoughtless transition from the consumption of vegetables, grains and nuts (Mediterranean diet), obtained from the vegetable kingdom to the consumption of fleshy foods and dairy products available in the animal kingdom (Genesis 1: 29). The hope that burns within my heart is that someday, the lost Eden will be restored and humans would have unlimited access to the tree of life that bears twelve types of fruits (foods) with their leaves possessing bioactive compounds that would eliminate all forms of diseases within a split second (Rev. 22:2). This is not fantasy; it is a realistic scientifically verifiable truth that is within our grasp—that is if only we do not collectively perish for lack of nutritional knowledge as did Adam and Eve when they stepped out of the luxuriant and bountiful *Garden of Eden*.

There is a growing consensus among scholars that the most successful winning strategy usually employed by countries in times of conflict is food. There are unsubstantiated claims by combatants on both sides of the unfortunate and avoidable Nigeria-Biafra civil war that food was used as a choice weapon of war. Economic blockade is also employed in conflict situations to gain military advantage. The current seizure and counter-seizure of oil tankers by

Iran and her Western adversaries is a clear indication that policymakers and military commanders routinely resort to starving their perceived enemies in times of war.

a 

b 

Fig.1.2 a,b: Impact of economic blockade on innocent children in a war situation

In most local Nigerian homes, food is often used as a reward for obedience and punishment for disobedience as naughty children are sent to bed without food, while the best part of the meal is freely given to the obedient and pliant ones. Food is, indeed, a powerful weapon of choice in the hands of tyrants, community and family heads.

Oftentimes, those who revolt or protest against "constituted authorities", corporate organisations or powerful individuals are denied access to food. It is no longer news that in its attempt to silence the Academic Staff Union of Universities (ASUU) in the Union's crusade for proper funding of the educational sector, successive governments had oftentimes threatened to evoke and actually evoked the uncivilised policy of 'NO WORK, NO PAY' to compel compliance to its approved version on how the critical sector would be administered. On the contrary, however, the struggle becomes fiercest when the Unions are sanctioned with through the withholding of the salaries (purchasing power) of their members. On the part of the government, it is believed that the Unions would yield to pressure and resume work once food is no longer present on the dining tables of their members. You can see the inherent power of food. In Ikwerre villages, daily paid labourers hired as farm hands valued the heavy lunch and dinner provided by the farm owner and eagerly looked forward to the food far more than the pay.

It is interesting to note that the behavioral pattern of an infant is influenced by the extent to which it feels secure in terms of availability of food. A sense of confidence is gained by a growing child when there is evidence that food is available in the household. Hunger creates tension and a state of great uncertainty. Responsible governments and parents are usually confident and secure when they are sure of abundant food items in the storehouse for the upkeep of their citizens and family members, respectively; especially during periods of food scarcity.

Certain kinds of food usually serve as status symbols as the affluent in society would always go for the expensive, oftentimes, nutrient-deficient foods. Such status symbol associated with some select food varieties consumed by the rich have made such high profile foods popular and more preferred to the simple, less expensive, but nutrient-loaded foods that are cheaper and easy to access. Example is the preference for polished white rice to brown rice that protects against *beriberi*, the thiamin-deficiency disease. Rice germ and bran are important sources of thiamin (vitamin B_1) and consumption of

rice whose germ and bran has been eliminated during processing for a prolonged period of time may lead to *beriberi*.

Fig.1.3: Brown (unpolished) Rice and White (polished) Rice.

In most Nigerian cultures, hospitality to a guest is usually expressed through the offer of traditional foods. It is common practice among natives to provide foods to displaced persons arising from war and natural disaster such as famine or flood, etc. Food has served consistently as an emotional outlet to some individuals. Boredom and loneliness are sometimes relieved simply by continuous nibbling of food.

2.0 The Origin of Food

The origin of food as contained in the two opposing but widely accepted *evolutionist* and *creationist* theories is intimately woven into the beginning of life on earth. There is a consensus among evolutionists that all life that currently exists evolved by common descent from one primitive life form – the CYANOBACTERIA. It is further assumed that originally, some 4.5 billion years ago, the atmosphere of planet earth had virtually no free oxygen and cyanobacteria probably, were the first to make free oxygen through the process of photosynthesis. Water is central to the life cycle of cyanobacteria and this unicellular organism make food with the aid of chlorophyll by photosynthesis. In this process of photosynthesis, carbon dioxide is absorbed from the atmosphere and the energy from the sun is used to build it into complex sugar, resulting in the release of oxygen. Thus being photosynthetic, cyanobacteria has the

capacity of utilising the sun's energy, water and carbon dioxide to synthesise carbohydrates, proteins and lipids which are their energy storage components (www.scientificamerican.com)

Creationism theory, however, posits that God created foods such as vegetables, fruits and nuts on the third day of creation, fishes and birds on the fifth day of creation and animals on the sixth day. This account further revealed that humans were the last of God's creation and He permitted mankind to consume the foods He created (Genesis, chapters 1and 2).

A critical analysis of these views of the origin of food would reveal that:

a) Evolutionism presents a world without food prior to the emergence of the first life form— cyanobacteria. Life would have ceased to exist if the sun had not supplied its energy and if this unicellular organism had lacked chlorophyll. Obviously, the prominence of chlorophyll in cyanobacteria and the presence of the sun to supply the energy for photosynthesis is suggestive of a system that did not just evolve but structured by an INTELLIGENT BEING that has defied human scrutiny so far.
b) Creationism presents the picture of a Creator (or Intelligent Designer), who prepared enough food for His creatures prior to their creation.
c) Imagine there was no food when the mighty Dinosaurs, powerful Eagles and great Whales first emerged on the surface of planet earth. These creatures would have made a delicious breakfast meal of our first parents.

Fig1.4: Hungry Eagles, Whales and Dinosaur ready for a breakfast meal.

3.0 What is Food?

Fig.3.1a: Plant Based Foods

Fig.3.1b: Animal/Bird/fish Source Foods

Food is a substance obtained from plant or animal that is taken into the body of organisms to yield energy and nutrients for growth, maintenance of life and repair of tissues. In simple terms, energy is the capacity to do work and the energy in food is chemical energy that the body can convert to electrical, heat or mechanical energy. Nutrients, however, are chemical substances that are present in food that the body can use to provide energy, structural materials, and regulating agents to support growth, repair tissues and maintain life. In general, carbohydrates, lipids, proteins, vitamins, including some

of the minerals that are present in foods and water are nutrients (Whitney and Rolfes, 2002). We have successfully demonstrated in our laboratory research that nutrients in foods may reduce the risks of some non-communicable diseases (Wegwu and Amadi, 2007).

3.1 Nutrients in Foods

There are basically two groups of nutrients: the inorganic and organic nutrients. Inorganic nutrients do not contain carbon and they include minerals and water. Minerals are the simplest of all the nutrients and each mineral is a chemical element with all of its atoms alike. Their identity does not change. A typical example is iron in plantain that remains iron when the plantain is cooked or roasted and eaten, when the iron in the plantain becomes an integral part of the red blood cell, when the red blood cell dies after 120 days and is broken down, and when the iron is lost by excretion from the body.

Minerals are present in the fluids of the body and are known to wield influence in their properties. In important structures as the bones and teeth, some minerals are put together in orderly arrays. While sixteen (16) minerals are known to be essential in the nutrition of humans, the nutritional value of others, including lead, cadmium and mercury are still unknown. Some minerals that are not essential are important as they have been shown to be environmental contaminants that displace the nutrient-minerals from their duty posts in the body, thus disrupting normal body functions. Although indestructible, minerals can be lost during food-refining processes or when they dissolve in water that is discarded during the cooking process.

Water is the next simple, abundant and indispensable nutrient that plays a central role in all life processes. It is a compound that is made of two elements: hydrogen and oxygen. Water supplies the medium for transporting essential materials to body cells and waste products away from the cells.

The organic nutrients include carbohydrates, lipids, proteins and vitamins. They are more complex and contain carbon, an element that is present in all living organisms, in addition to hydrogen and

oxygen. It should be noted that a substance or molecule that contains carbon-carbon (C-C) bonds or carbon-hydrogen (C-H) bonds is organic. This implies that all foods are organic, though some persons, especially farmers would sometimes use the word *organic* to represent foods grown without manufactured fertilizers and pesticides. With the exception of vitamins, the rest are energy-yielding nutrients as they can be used to provide energy in the body.

The energy released from carbohydrates, lipids and proteins usually are measured in calories (small units of energy). They are so tiny that one tomato provides thousands of them. In general, energy is expressed in 1,000-calorie metric units called kilocalories (or commonly referred to as calories). It should be noted that a kilocalorie is not present in foods; rather, it is a measure of the potential energy that is present in foods. It is therefore, technically incorrect to seek kilocalories in yam. It is, however, correct to speak of the energy yam provides.

The quantity of carbohydrates, lipids and proteins present in a food variety determines the amount of energy that a particular food provides consumers. A gram of carbohydrate and protein yields four (4) kilocalories of energy respectively, when completely broken down. Also, when completely broken down, a gram of lipid yields nine (9) kilocalories of energy. Alcohol contributes energy as it yields seven (7) kilocalories of energy per gram when it is metabolised in the body. It is, however, not a nutrient but interferes with the growth, maintenance and repair of the body. The oxidation of alcohol takes preference over those of other nutrients? The reason is that, unlike carbohydrates and fatty acids, the metabolism of alcohol in the liver is not subject to negative controls. Indeed, the absence of feedback inhibition in the metabolism of alcohol is a clear indication that the reactions of alcohol metabolism came into existence not as a pathway that generates energy, but as a detoxification system for the little quantity of alcohol that is usually formed due to bacterial fermentation in the colon.

It is incorrect to describe a food as its predominant nutrient, because most foods contain virtually all the three energy-yielding nutrients, including vitamins, minerals and water. A few foods such as sugar (pure carbohydrate) and oil (mainly pure fat) are exceptions to this rule. The energy-yielding nutrients are used by the body to fuel all its activities. Usually, the bonds between the nutrient's atoms break down when carbohydrates, proteins or lipids are used by the body for energy. Some of the energy released when the bonds break occurs as heat, while some may be used to send electrical impulses through the brain and nerves, to synthesise body compounds, and movement of muscles. Indeed, the energy from foods supports all body activities beginning from moments of rest to vigorous sporting activities. Excess nutrients are rearranged into storage compounds such as body fat and are used between meals or overnight when there are insufficient supplies of fresh energy. Consumption of more energy than is expended would lead to an increase in energy storage and weight gain. Conversely, consumption of less energy than expended would certainly lead to weight loss.

Alcohol can also be converted to body fat and stored when consumed in excess volume. In the United States of America, for instance, alcohol is second only to tobacco on the list of 'DEADLIEST DRUGS'. Two (2) cans of beer would yield 300 calories as two jiggers of 100 proof whiskey and two glasses of dessert wine would yield 250 and 280 calories, respectively. These are empty calories as they cannot provide the nutrients required by the body (Manahan, 1994; Meisenberg and Simmons, 1998, Whitney, 2002; Bivens, 2013; Satyanarayana and Chakrapani, 2015).

3.2 Food and Healthy Living

The popular phrase: 'let your food be your medicine and your medicine be your food,' which is credited to the founder of modern Western medicine, Hippocrates, is often applied to emphasise the relevance of healthy foods in the prevention or cure of diseases. Apart from the nutrients earlier discussed, there are other important

food constituents that are indispensable in the maintenance of health. These would include fibre, antioxidants and phytochemicals.

3.2.1 Dietary Fibre

Fibre constitutes an important part of our food that is inedible and indigestible, but incredibly essential. They go through the bodies when consumed and excreted without being used. Recent findings have shown that fibre may be likened to the king (*Nye Nwe Ali*) of a structured kingdom as, like the king, the fibre also controls most metabolic processes in the body. Two basic types of fibre are identifiable: the soluble and insoluble fibres. In most of the body's digestive and metabolic processes, fibre plays major roles. Some of the incredible and indispensable functions of fibre include:

- Protection against overeating and aiding in weight control—insoluble fibre (those that do not dissolve in water), have the capacity to absorb and hold water between four to six times its own volume, thus creating soft, spongy masses in the stomach, including the small and large intestines. This gives the individual a sense of fullness much faster than with a diet that is deficient in fibre. Acting like soaked-up sponges, the fibre masses fill the intestines more adequately and this, indeed, stimulates the intestines to carry out its activity appropriately. Also, the spongy masses pass along much faster and are eliminated within 24 to 36 hours, unlike low fibre foods that will remain in the gastrointestinal tract for several days as compacted clumps. Most constipations are cured by this action, including relief from problems associated with hemorrhoids and diverticular disease.

- Since the transit time of ingested food is very short, less decomposition of organic material (putrefaction) in the intestines would occur and there will not be enough time for carcinogens and other poisonous end-products of digestion to irritate the walls of the bowel. Also, insulation against damaging food residues is provided by fibre. These actions of fibre may account for the observed very low colon cancer rates among communities with higher fibre intake.

- The rate at which nutrients enter the bloodstream is slowed down by fibre. This is necessary in the control of blood sugar levels and provides consistently the required energy for daily use. Much of the low blood sugar (hypoglycemia) is relieved when blood sugar is stable and it also assists in the control of high blood sugar (hyperglycemia).

- Soluble fibre is known to attach itself to by-products of fat digestion and pulls such products out of the body. In the absence of soluble fibre, the excess by-products of fat digestion will be reabsorbed into the blood stream and this would be a dangerous development to someone with already high levels of the by-products. Soluble fibre is abundant in fruits, oats and beans (Domine, 1997).

- In general, this 'miracle worker' is plentiful in every unrefined plant-based food. Consumption of varieties of whole grains, fruits, vegetables (beans, peas and lentils) would provide varieties of fibre which the body requires. It is important to note that animal foods do not contain any fibre. Persons whose diets are made up of meat, poultry, fish, eggs, dairy products, sugars and other refined foods may have health challenges arising from the absence of fibre in their diets. It is worthy of note that juices are actually vegetables and fruits that have been robbed of their fibre.

3.2.2 Anti-Oxidants

All cells in the body need steady supply of oxygen to derive energy from foods that have undergone the digestive process. This oxygen utilisation for energy generation usually comes at price as it also generates free radicals which are unstable molecules that are known to damage cells. Electrons are usually comfortable and stable when they occur in pairs but oftentimes, one of the electrons may be lost by the molecule. A typical example is a common occurrence during the process of energy production in cells in which one of the electrons of oxygen is usually stripped away. The oxygen atom

which is now a free radical becomes unstable and goes on a search to find another electron to complete the set. In the process, the free radical can destroy the molecule it stole from an electron.

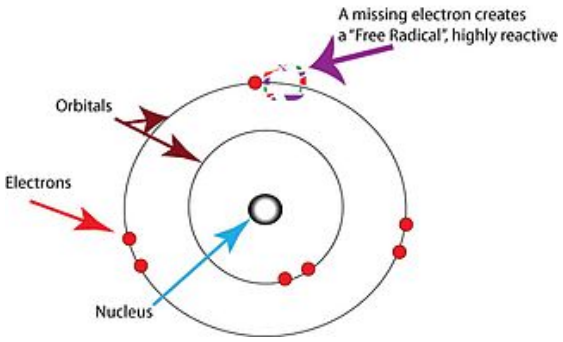


Fig.3.2a: Highly reactive free Radical (Source- Please Click)

In general, free radicals would best be described as highly reactive because they possess unpaired electrons. Like hungry lions, they embark on the search for molecules which they can rob of an electron. In turn, the molecule that was robbed will go in search of an electron to upset its deficiency. This complex process will set off a chain reaction in the body that would lead to the creation of many free radicals. Healthy cells usually produce free radicals but a variety of other factors have been shown to promote the formation of free radicals in the body. Typical examples include radiation (including x-ray), cigarette smoke, alcohol, and pollutants in the environment. When in excess, free radicals can damage deoxyribonucleic acid (DNA) and other genetic materials. Free radical damages are also responsible for a lot of diseases that afflict the body, including cardiovascular (heart) diseases and cancer. They are also responsible for accelerating the ageing process.

In contrast, anti-oxidants are compounds that protect against damages caused by free radicals. They function by 'calming down' free radicals, donating one of their own electrons to it and putting an end to its rampage. By mopping up free radicals, antioxidants prevent damage to cell membranes and other cell structures, including DNA.

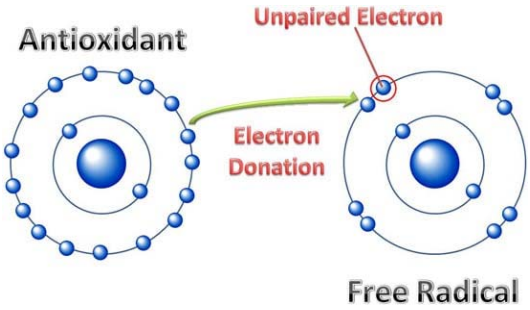


Fig.3.2b: Antioxidants and Free Radicals. (Source – Please Click)

They are abundant in fruits, vegetables, and nuts. Vitamins C and E, selenium, and carotenoids such as lycopene and carotene are anti-oxidants. Most findings have linked diets rich in anti-oxidant to a reduced risk of heart disease and cancer, including other degenerative diseases in our society (Manay and Shadaksharaswamy, 2010).

Fig.3.3: Antioxidant densely loaded foods.

There are millions in our society who, like free radicals, are highly reactive (restive) because they have not successfully met their immediate needs such as food, shelter, clothes, gainful employments etc. If we, like antioxidant would be kind to provide the needs of these teeming populations, the insecurity that we have witnessed in recent times will be a thing of the past and our society will be a better place to live.

3.2.3 Phytochemicals

These are natural chemicals present only in plants and so cannot be obtained in animal products. They have been shown to possess a lot of cancer-protective benefits. The phytochemicals appear to be powerful 'ballistic missile' in the war against degenerative diseases--especially cancer. Presently, several thousands of phytochemicals are known to exist. Tomatoes alone are believed to contain an estimated 10,000 different phytochemicals just as every carrot contains hundreds of these compounds. High plant food consumers are about half as likely to have heart disease, diabetes, cancer and certain lifestyle diseases when compared to consumers of fleshy foods and dairy products that have sadly become the hallmark of urban dwellers.

Available evidence suggests that phytochemicals act either as blocking or suppressing agents. As blocking agents, they work on cancer-causing compounds (carcinogens) by preventing them from affecting the cells of the body. For instance, certain indoles present in cruciferous vegetables such as cabbage, broccoli, etc.
function as blocking agents by increasing colon enzymes that can deactivate some of these carcinogens. Some other phytochemicals block the attachment of bacteria to the cell surface.

Phytochemicals that function as suppressing agents act on the body's own cells, combating malignant changes that either free radicals or carcinogens may have initiated. This class of phytochemicals achieve this feat by slowing down tumor growth through suppression of the ability of cancer cells to multiply.

Also, the phytochemicals can suppress the activity of certain enzymes that are needed for the growth of cancer cells (Ludington and Diel, 2000).

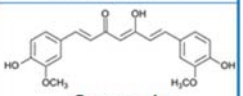
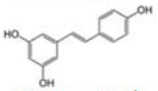
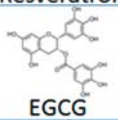
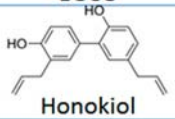
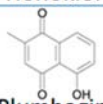
Source	Phytochemical
 Turmeric	 Curcumin
 Grapes	 Resveratrol
 Tea	 EGCG
 *Magnolia*	 Honokiol
 *Pumblago*	 Plumbagin

Fig.3.4: Selected Phytochemicals and their sources.

4.0 Something must kill a Man

Fig.4.1: A glutton engaging in gastronomic self-destruction

In more developed climes, governments and family members insist on the conduct of autopsy to ascertain the cause of death of their citizens and loved ones. This action is considered very necessary to avert future occurrence of similar deaths in the family, especially when it is adjudged to be avoidable. Our tradition, on the contrary, demands that the cause of death of our loved ones, even when they may have died as centenarians, must be explained by the oracle or the seer. Oftentimes, innocent persons are wrongly implicated and visited with unimaginable violence or sanctioned with outright excommunication from the community. The obvious fact is that most diseases and deaths that occur in our communities are traceable to our lifestyle, especially riotous eating habits.

All over the world, people have reasons for eating the way they do, some of which may include:

- Personal preference (oh, the flavor is fantastic!)
- Habit or tradition (these foods are familiar; I grew up eating it)
- Social pressure (they are offered; you just fill it will be wrong to refuse them)
- Availability (they are there and ready to eat)
- Convenience (you don't have enough time to prepare your meal, so, you settle for fast foods)
- Nutritional value (you think they are needed by your body).

While it may appear obvious that *something must kill a man*, it is also true that our aging and dying process may be retarded by consuming foods based on their nutritional value and contributes to a positive lifestyle. It should be noted that a tiny portion of the brain called the hypothalamus is the area that evokes the sensation of hunger and satiety. Destruction of the satiety centre in the central portion of the hypothalamus causes animals to eat voraciously, while the destruction of a centre in the side region of the hypothalamus—the feeding region—would result in the opposite effect, making the animal to become anorexic. It is interesting to note that stimulation of the satiety centre would cause an organism to stop eating as stimulation of the feeding centre would cause the organism to eat (Manay and Shadaksharaswamy, 2010).

5.0 Food and Athlete's Performance Enhancement

One of the energy-yielding nutrients, carbohydrate, is an indispensable exercise fuel. Independently important to performance are blood glucose and muscle glycogen. It has been demonstrated that the utilisation of carbohydrate by working skeletal muscle increases during exercise, while muscle glycogen content is reduced after exercise. This implies that increase in glucose intake by working muscle would complement glycogen breakdown in the provision of fuel during exercise.

Most elite athletes are aware that carbohydrate is a performance-limiting factor. It is also obvious to them that both hypoglycemia (low blood sugar) and depletion of muscle glycogen are major contributory factors in the reduction of performance of athletes, including promotion of fatigue. These elite athletes, including the track and field warrior, Usain Bolt, achieved balance by eating, at least, three or preferably four, and most ideally, five different types of nutrient-dense foods during breakfast, lunch and dinner.

Pre-training or competition fuel has long been demonstrated to prevent hypoglycemia and the associated symptoms of light-headedness, fatigue, blurred vision, and indecisiveness. These symptoms can interfere with athlete's performance. Pre-training fuel also fuels the muscles with carbohydrates that were consumed in advance to be stored as glycogen, including carbohydrate that is consumed within an hour of training or competition, which enters the blood stream and feeds the brain. I am glad to state that members of the University of Port Harcourt Sports Team (*Team UniPort*), are aware of the indispensable role of pre-exercise fuel and usually consume foods with relatively higher glycemic index within an hour of training or competition.

During training, members of *Team UniPort* are encouraged to drink carbohydrate-containing sport drinks, especially during endurance sporting activities.

Fig.5.1: Select members of *Team UniPort* after one of their conquests

The carbohydrate in the sports drink is known to increase the availability of carbohydrate to working muscle fibers, and this can have a profound positive influence on endurance performance. Presently, we are investigating the efficacy of certain local plants in performance enhancement and endurance. Preliminary investigations strongly suggest that the active ingredients of the plants have the capacity to accelerate or improve biochemical or metabolic processes. We are of the view that they achieve this by speeding up the enzymatic process of glycogenesis (synthesis of new glycogen), and glycogenolysis (production of glucose from the stored glycogen); thus, reducing the levels of lactic acid in muscles (which in part, is responsible for fatigue), increasing ATP production, enhancing the utilisation of oxygen by cells, increasing protein synthesis, and stimulating blood production in the bone medulla after bleeding. Our findings also indicate that these plants do not contain steroids and other excitant properties as are common in hard drugs such as cocaine and other doping substances. Our ultimate goal is to produce a UniPort Sport Drink that will be acceptable on the international stage.

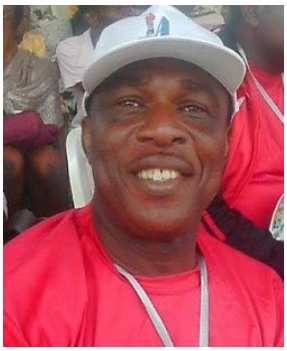
Fig.5.2: *Symphonia globulifera* (Common name: English hog gum tree, common trade name: Chewstick, Ikwerre (Elele) name: agbake); one of the trees that are being investigated for performance-enhancing properties.

It is in our character to ensure that our athletes eat the right kind of foods after a training session. This is to maximise the beneficial biochemical effects of training through adaptation operations and repair of body tissues. It is well understood that the rate of glycogen recovery is rapid after complete or near complete exhaustion and this is partly due to increase in the activity of glycogen synthase. The greater the depletion of glycogen, the greater the activity of glycogen synthase and this is usually in response to loss of glycogen during high intensive training (Wildman and Miller, 2014).

It is heartwarming to report that Professor Ken Anugweje, a renowned professor of Sports Science, has compounded a diet composed of higher and medium glycemic index foods for the quick recovery of athletes after strenuous training sessions. We are eagerly waiting for a time when this magic product would be patented and made available in commercial quantities to athletes everywhere.

5.1 Athlete's Peak Performance in the Eye of the Biochemist

'Peak performance of athletes is reliant on their ability to maximise ATP utilisation and minimise lactic acid production'. This statement was credited to an eminent Biochemist, Professor Ken Anugweje, shortly after the Sydney 2000 summer Olympics where the country won one gold and two silver medals.



Professor Ken Anugweje: An Eminent Biochemist.

We viewed the above statement as one that contained credible biochemical truth that would require further investigation. Our studies were in two parts:

(a) **The Mitochondria and ATP Utilization**.

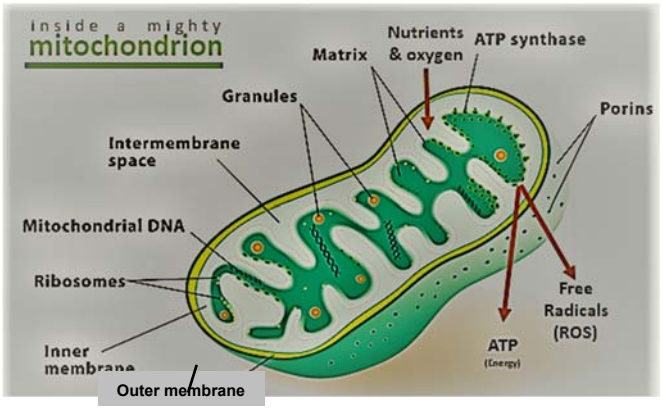


Fig. 5.3: Mitochondrion (Source: https://mitocanada.org/understand)

We know the mitochondria as the power houses of the cell and that they absorb nutrients in foods and break them down to create molecules that are rich in energy for the cells. Most of the reactions involved in cellular respiration occur in the mitochondria, and this explains why the mitochondria are indeed the working organelles that keep the cells full of energy. This implies that the cell's supply of adenosine triphosphate (ATP), a molecule that cells use as a source of energy, is made by the mitochondria. Once inside the internal structure of the mitochondria, glucose is converted into pyruvate and nicotinamide adenine dinucleotide (NADH). They are transported into the central part of the mitochondria where they produce ATP (the energy currency of the cells) in the presence of oxygen. There are tiny fibrils inside the muscle cells that are called Actin and Myosin. Muscles contract when ATP binds them to the myosin fibril. Energy production for the working muscles requires such simple ingredients as glucose, oxygen, calcium, potassium, and magnesium. Calcium is required for the transformation of glucose to pyruvate and NADH, including the interaction of the myosin and actin.

It has been established that the mitochondria of the elite athletes are more in number and larger in size than the non-athletes. Mitochondria in the muscle cells of the skeletal and cardiac (heart) systems of athletes have more folds in the inner membrane and the density of the membrane varies. All these enable the mitochondria to produce about 25% extra energy than the mitochondria of non-athletes.

Since mitochondrion does not operate in an anaerobic environment, it is our belief that athletes who train in Zone II during pre-season periods stand a better chance of developing more mitochondria. The athletes' capacity to exercise ultimately depends on the ability to transform chemical energy into mechanical energy. Carbohydrates and lipids (fats) are the two main substrates used in ATP production, with a little contribution from protein. At low and moderate exercise intensities, ATP synthesis is generated from fats and carbohydrates. At higher exercise intensities, however, ATP generation needs to be faster to maintain muscle contractile requirements. Under such

condition, carbohydrates utilisation is enhanced and becomes the predominant energy substrate as the rate of synthesis of ATP derived from carbohydrate is faster than that from fat (Whitney and Rolfes, 2002).

The skeletal muscle is made up of two types of muscle fibres: type I (slow twitch), and type II (fast twitch) fibres. Slow twitch fibres are recruited at slower speeds while fast twitch fibres are employed at faster speeds. Type I muscle fibres have the greatest density of mitochondria and capacity and are, therefore, efficient at utilising fat to generate energy. Type II muscle fibres have lower mitochondrial density and very high capacity to use glucose and ATP stored in these fibres for the immediate anaerobic energy. The intensity generated during exercise, therefore, implies different muscle fibre recruitment patterns and different metabolic responses. This has been demonstrated to correspond to six training zones. Training Zone I uses fat only as substrate and type I muscle fibre, while Zone II uses both fat and carbohydrates as energy substrates and type 1 fibre. Training Zones III, IV, V use carbohydrates only as energy substrate. Apart from training Zone III that uses types I and II fibres, Zones IV and V use the type II fibres. Training Zone VI uses carbohydrates, ATP and phosphocreatine (PC) as energy substrates and type II b fibres.

The advantages of training in Zone II are enormous as training in this Zone stimulates type I muscle fibres, thus stimulating mitochondrial growth and function which in turn would improve the ability to utilise fat for energy production. This is of greater advantage to athletes because by improving on the utilisation of fat, glycogen utilisation is preserved throughout competition activities. Athlete can then use the preserved glycogen at the end of the race when a lot of competitions require very high exercise intensity and a lot of utilisation of glucose (Wildman and Miller, 2004; Clark, 2014; www.trainingpeak.com).

(b) Minimising Lactate Production.

Lactate is a product of glucose breakdown which is utilised in large amounts by fast twitch muscle fibres. Lactate,

therefore, is produced in fast twitch fibres which, through MCT-4, a specific transporter, export lactate away from these fibres. Lactate, however, needs to be cleared to avoid accumulation. It is at this point that Type I muscle fibres play the key role of lactate clearance. In general, besides fat utilisation as was discussed earlier, type I muscle fibres are as well responsible for lactate clearance. A transporter known as MCT-1 which is in charge of taking up lactate and transporting it to the mitochondria where it is re-used as energy, is abundant in type I muscle fibres (www.trainingpeak.com).

The obvious is that Zone II training enhances mitochondrial density, including MCT-1 transporters. In general, Zone II training improves fat utilisation, preserves glycogen, and increases lactate clearance capacity and is ideal if applied during pre-season training. Athletes must however, progress to higher training zones when preparing for competitions. These are key to the peak performance of athlete. We had earlier reported that certain indigenous plants possess active ingredients that could mask or reduce lactate loads for optimal contraction of muscles.

6.0: The Crux of the Matter

Distinguished Ladies and Gentlemen, we have in the past minutes successfully justified the timeless aphorism that food is life and its powers transcend mere consumption in private or public places. Now that it is glaring that food has the capacity to strengthen or weaken powerful nations, stabilise or destabilise societies, and even cause the hungry to sell their birthrights, such as Esau did in the Book of Genesis (chapter 25:29-34), it would therefore, be necessary to present the current status of the spheres that influence, promote and control food production in our geopolitical space. Our findings on this subject are discussed below:

7.0 The Environment and Food Production

There are basically three spheres of the environment where foods are produced: the *atmosphere*, the *geosphere* and the *hydrosphere*. The

Earth's surface is covered by a thin layer of gases referred to as the atmosphere. A reservoir of gases, the atmosphere is known to moderate the temperature of the earth, absorb energy and dangerous ultraviolet radiation from the sun and transport energy away from the equatorial regions. The geosphere is made of the solid earth which includes the soil that supports most plant life. The water on earth is contained by the hydrosphere. Apart from sea water, the water that usually circulates through environmental cycles and processes occur in the atmosphere, underground in the form of ground water, and as surface water in rivers, lakes, estuaries, streams, reservoirs and ponds (Manahan, 1994). We have for over fifteen years consistently assessed and monitored the pollution status, including the impact of anthropogenic activities on the health of these spheres in parts of the Niger Delta Region of Nigeria. Some of our key findings are presented below.

7.1 The State of the Atmosphere

The atmosphere is the source of carbon dioxide for plant photosynthesis and of oxygen for respiration. It also provides nitrogen which nitrogen fixing bacteria (azotobacter) and plants that manufacture ammonia use in the production of chemically-bound nitrogen that is essential for life. It is unfortunate; however, that the atmosphere has become a dumping ground for most pollutant materials, including oxides of sulphur, nitrogen, Aerosol-Can-Freon, etc. These pollutants are known to cause damage to vegetation, decrease the human lifespan and may alter the characteristics of the atmosphere itself (Manahan, 1994).

Gas flaring in the Niger Delta region has remained a common and regular feature and its health implications are obviously heartbreaking: cancer, neurological, reproductive and impairment on faetal and infant developmental stages. Available report suggests that Oil and Gas firms operating in the area are flaring 700 million standard cubic feet of gas everyday which would amount to a loss of ₦868 million per day (*Vanguard* news, 2018).

Results of air quality monitoring of Onne atmosphere in the dry seasons of 1998 and 1999, are shown in Table 7.1. The results strongly suggest marked abundance of gases such as ammonia, oxides of nitrogen, carbon monoxide and sulphur dioxide. Also detected in substantial quantities were total hydrocarbons, suspended particulate matter and heavy metals. It would be observed that these pollutants occurred in the rainy and dry seasons, including the upwind and downwind zones. The obvious implication of the presence of these pollutants in the upwind is that air pollutants generated in Rivers State may have its impact felt in the Northern part of Nigeria rather than the epi-centre (Rivers State). This is true as these pollutants may travel several kilometers away from their source.

Table7.1: Mean concentrations and ranges (in parenthesis) of selected air pollutants in Onne, Rivers State

Parameter	December	January	February	March
NH_3 (µg/m^3)	0.07 ± 0.05^a (0.03 - 0.12)	0.12 ± 0.04^a (0.10- 0.13)	0.07 ± 0.03^a (0.03 - 0.09)	0.10 ± 0.01^a (0.08 - 0.10)
NO_2 (µg/m^3)	8.75 ± 0.73^a (8.11 – 9.39)	8.45 ± 1.10^a (7.49 – 9.41)	2.50 ± 1.45^b (1.25–3.76)	2.82 ± 1.82^b (1.25–4.41)
SPM* (µg/m^3)	516 ± 64.9^a (459 - 572)	766 ± 70.4^b (705 - 827)	26.4 ± 7.05^c (20.3 - 32.5)	289 ± 21.8^d (129 - 450)
CO (mg/m^3)	5.14 ± 0.66^a (4.57– 5.72)	4.58 ± 1.31^a (3.43–5.72)	1.69 ± 0.53^b (1.24- 2.15)	1.05 ± 0.27^b (0.95–1.14)
SO_2 (µg/m^3)	36.3 ± 20.2^a (18.8–53.7)	179 ± 10.9^a (40.29-317)	77.9 ± 37.2^a (45.6-110)	168 ±17.8^b (13.4-322)
THC* (ng/m^3)	44.7 ± 17.2^a (29.8 – 59.6)	17.9 ± 3.45^b (14.9 – 20.9)	11.1 ± 4.26^b (7.44 – 14.9)	8.20 ± 0.86^b (7.44 – 8.94)

Values are means ± STD for 40 samples (n = 40) per month
SPM = Suspended Particulate Matter
THC = Total Hydrocarbon

Means in the same column bearing different superscript letters (a – c) are statistically significant at the 5 percent level (Wegwu and Sule, 2006).

7.1.1 The Reign of Black Soot (Incomplete Combustion)

The people of the Niger Delta Region have in the past 60 years experienced divers kinds of air pollution arising from gas flaring, emission of hydrocarbons, etc. In 2016, however, a more devastating kind of atmospheric pollution has been experienced in this geo-political zone, especially by those living in Rivers State. Rising black soot particles were observed in the air, living its residues on surfaces of vehicles, buildings, and most painfully, in living homes, nostrils, cloths, palms and plants. Composed of carbon, soot is a by-product of incomplete combustion of fossil fuels, including coal, oil, wood, etc. They are extremely tiny particles of about 2.5 micrometers or less. The tiny size of soot, coupled with the toxic nature of its contents, makes it extremely deadly as it can find its way into the lungs and other organs of the human body.

Fig 7.1a

Fig 7.1b

Fig 7.1c

Fig 7.1d

Figures 7.1 a, b, c & d: Black Soot in Port Harcourt City

In 2018, we investigated variations (sunny and cloudy) in the levels of two distinct particulate matters: $PM_{2.5}$ and $PM_{10.}$ As is evidenced in Table 5.2 (a and b), very high levels of these two particulate matters were recorded during sunny and cloudy days in Borokiri and Choba towns, respectfully, and the results obtained far exceeded the World Health Organisation permissible limits. Black carbon (BC) is an important constituent of soot ($PM_{2.5}$) and among soot particles, those from diesel engines contain greater amounts of carcinogenic substances, including polycyclic aromatic hydrocarbons (Ramanathan and Garmichael, 2008).

Table 7.2a: Selected air quality parameters in Port Harcourt, Rivers State, Nigeria (sunny days)

Parameter	Borokiri		Choba		WHO Limit (Annual mean)	WHO (2015) (24 hour mean)	FMENV Limit(Hourly mean)
	Day 1	Day 2	Day 1	Day 2			
Particulate Matter 2.5 ($PM_{2.5}$) ($\mu g/m^3$)	18.43± 0.79	29.86± 6.96	130.14± 7.65	210.9± 6.12	10	25	15
Particulate Matter 10 (PM_{10}) ($\mu g/m^3$)	116.7± 2.06	220.14± 14.76	462.29± 16.88	721.7± 12.5	20	50	50
Ground Level Temperature (GLT) °C	34± 4.69	31.14± 0.9	31.57± 1.90	32.29± 1.38			
Humidity Ground Level (HGL)%	66.47± 4.49	79.00± 6.66	75.7± 9.27	76.29± 5.82			
Wind Speed (WS) at 50m (m^2)	0.5± 0.58	1.03± 0.54	1.76± 0.44	1.73± 0.22			

(Kilani, 2018)

Table7.2b: Selected air quality parameters in Port Harcourt, Rivers State, Nigeria (cloudy days)

Parameter	Choba		Borokiri		WHO Limit (Annual mean)	WHO (2015) (24 hour mean)	FMENV Limit(Hourly mean)
	Day 1	Day 2	Day 1	Day 2			
Particulate Matter 2.5 ($PM_{2.5}$) ($\mu g/m^3$)	3.72 ± 0.79	290.87± 6.96	350.96± 7.65	224.87±6.12	10	25	15
Particulate Matter 10 (PM_{10}) ($\mu g/m^3$)	25.43± 2.06	1307.0±14.76	1709± 16.87	939.5± 12.5	20	50	50
Ground Level Temperature (GLT) ^oC	12.0± 1.40	4.87± 0.81	21.72± 1.90	11.43± 1.38			
Humidity Ground Level (HGL)%	120.74±4.49	266.00± 6.66	515.43± 9.27	208.92±5.90			
Wind Speed (WS) at 50m (m^2)	2.01± 0.58	1.75± 0.54	1.14± 0.44	0.48± 0.48			

(Olorogun, 2018)

7.1.2 Disappearance of Indigenous Bird species

As earlier stated, birds were created on the fifth day and most of these birds have served as food source in most cultures for centuries. The emission of toxic wastes into the atmosphere by humans has rendered it unconducive for the continuous existence of bird species. Large bird populations, including the edible ones, have either migrated to safer, unpolluted atmosphere or have gone into total extinction as a direct result of uncensored human activity. Kindly share with me the agonising letter of **Swallow** (***Eneke,*** *or* ***Asanga*** *in* ***Ikwerre)*** *the bird* as fictionalised in Chinua Achebe's Things *Fall Apart* to Mother Nature:

Dear Mother Nature,

> *You may recall my previously boast that "since humans have learned to shoot without missing, I have learnt to fly without perching." At that time, I had the entire atmosphere to myself as these mischievous humans lacked the capacity to target me in motion far above their reach. As you are aware, they have as well destroyed our beautiful atmosphere, including the home you bequeathed to us–the luxuriant trees. Since these destructive humans could no longer reach me, they resorted to scotch-earth destruction of everything in sight, including the once pristine environment and atmosphere that sustained all forms of life on planet earth. They did not stop there; they also contracted multi-national companies that place profit over people, including flora and fauna to complete the programmed decimation of everything that sustains life forms below and above the earth! These so-called IOCs have recruited willing local collaborators who help them to achieve their programmed decimation of everything in sight and they call it 'development.' The result can better be imaged. As I write this SOS letter to you, my previous boast about flying without perching can no longer hold water, because I cannot even fly again, let alone attempting to perch. My family members who stubbornly continued to "fly without perching" have*

mostly perished from the devastating impact of environmental and atmospheric pollution. The situation has become so intolerable that my species is close to total extinction that I have, therefore, resolved to embark on a long distance flight to a more pristine, brighter and fairer abode, where the inhabitants love and dutifully care for everything you created and bequeathed to them for sustenance. ***Mother Nature****, I guess you may be wondering why I took it upon myself to write this SOS to you, despite the fact that there are uncountable bird species under environmental assault; the answer is not far-fetched. I am the only bird species that you imbued with the installed capacity to fly continuously without perching for a l-o-n-g period of six months. It is a final goodbye to this earth plane where humans pay lip service to environmental and atmospheric stewardship. I can only wish them well and hope that their destructive enterprise would thrive. I'm off!* ***(flap, flap, flap).***

Fig 7.2 ***Eneke the birds in search of a better atmosphere***

7.1.3 Safety Strategy

In 2017, air quality monitoring of Agbura community in Bayelsa State of Nigeria was conducted (see Table7.3). The community is still in its natural state with very minimal industrial activities. It is flanked by thick forests and the pristine Ikoli Creek. Results of particulate matter obtained from there fell below WHO limit (24-

hour mean), while results of most of the gases fell below the detection limit. These findings suggest that the surrounding luxuriant

forest trees may have functioned as ultra-filters of the pollutants. It is, therefore, recommended that rather than destroy trees as it is indiscriminately practiced in our society today, the people resident in polluted environments should be encouraged to embark on tree planting, while appropriate sanctions should be imposed on destroyers of life-saving trees. Vice Chancellor Sir, we are eagerly waiting for the replanting of those trees that made way for the excellent covered walkway on this campus, which is your brilliant welfare initiative for students.

Table 7.3 Air Quality Profile and Meteorological Assessment of Agbuda Community

Sample Points	Temperature (^oC)	Relative Humidity (%)	Wind Speed (m/s)	Wind Direction	Carbon Monoxide (ppm)	SO_2 (ppm)	NO_2 (ppm)	Suspended Particulate ($\mu g/m^3$)	Volatile Org. Compounds (ppm)
AGAQ 1	29.15±0.03^b	80.10±0.04^e	5.57±0.40^e	SW	0.02±0.01^b	ND	ND	16.24±0.14^a	0.03±0.02^a
AGAQ 2	29.25±0.02^c 28.95±0.04^a	78.56±0.03^c	3.25±0.07^c	NE SW	ND ND	ND ND	ND ND	24.17±0.04^c	0.08±0.03^b <0.01±0.00^a
AGAQ 3	29.32±0.01^c 29.13±0.02^b	86.39±0.08^f	1.63±0.13^a	NE SW	ND ND	ND ND	ND ND	19.33±0.19^d	0.03±0.01^a
AGAQ 4	31.12±0.09^d	78.85±0.01^c	4.34±0.16^d	SW	ND ND	ND	ND	23.23±0.04^d	<0.01±0.01^a
AGAQ 5		82.33±0.02^e	2.55±0.26^b					20.36±0.11^c	<0.01±0.00^a
AGAQ X		73.80±0.01^a	2.89±0.04^{bc}					16.13±0.04^a	

Means in the same column with different alphabet are significantly different while means in the same column with the same alphabet are not significantly different. AGAQ (1-5)–Sampling points; AGAQX–Control; ND–Not Detected (Ighariemu, 2018).

7.2 The State of the Geosphere

The foods consumed by humans and animals are mostly provided by plants and these plants grow on the geosphere. The plants also provide biomass for use as renewable materials such as fiber, wood, fuel and raw materials. Non-renewable minerals, ores, fossil fuels, and materials used by modern societies that are industrialised are obtained from the geosphere. In fact, the ultimate sink for disposal of varieties of waste is the geosphere. It is, therefore, important that the health of the geosphere must be jealously monitored and

protected as alterations or modification of this sphere would certainly have profound negative effects on the environment and perhaps, be a subsisting threat to the continuous existence of humans (Manahan, 2013).

Field reconnaissance studies of available lands in parts of Southern Nigeria gave evidence of previously viable, high quality food producing agricultural lands that now display visible symptoms of gradual, but consistent topsoil and soil nutrient-losing lands. Further investigations implicated the following as culprits: deforestation, erosion, irresponsible acquisition of food-producing lands for urban development and establishment of industries, including soil chemical changes arising from systems of cropping, indiscriminate discharge of industrial wastes and crude oil pollutants. Reports of investigations on the characteristics of contaminants of crude oil and industrial effluents showed high trace metal contents (Hg, V, Ni, Cd, Pb, Fe, Zn, Mn, Cu, As, among others), aliphatic and aromatic hydrocarbons (Wegwu, 1999). We have detected in substantial amounts pollutants, including nutrient and non-nutrient heavy metals, hydrocarbons, polycyclic aromatic hydrocarbons and pesticides in soils, industrial effluents and foods grown and consumed in the Niger Delta Region of our country.

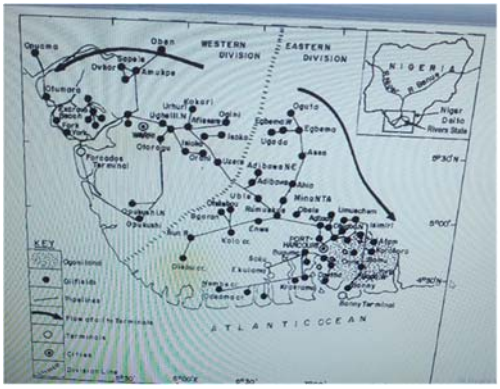


Fig7.3: Shell Petroleum Development Company onshore oilfield map of the Niger Delta of Nigeria. Adapted from the Shell Petroleum Development Company of Nigeria.

The Figure above clearly suggests that the geosphere of the Niger Delta is dotted with oil fields with its attendant oil spills. Available evidence indicates that there exist over 900 oil wells, including 100 flow stations, in the Niger Delta area. This geographical space accommodates over 45,000 km of trunk lines. Unfortunately, oil spills and indiscriminate discharge of industrial wastes are regular features in the oil-producing communities as over 250 oil spills are recorded annually (Wegwu and Omeodu,2010). The implication of this development is that if adequate steps are not taken to address the issue of industrial pollution and food security, the people of the Niger Delta may in the nearest future lack agricultural lands for food production, and suffer unremitting hunger and the inevitable social tension and violence that it breeds.

7.2.1 Impact of Oil Exploration and Exploitation on Agricultural Lands of Oil-Producing Areas of the Niger Delta.

The alarming Figures below are indications of the devastating effects of crude oil pollution on viable agricultural lands in parts of Niger Delta. The inability of oil-producing companies to replace expired pipelines with new ones, as it is practiced in other industrialised climes with stringent regulatory frameworks, is obviously responsible for virtually all the recorded oil spills in the area—the latest being in a sleepy community known as Kom Kom in Afam, Oyigbo Local Government Area of Rivers State, Nigeria.

Fig 7.4: A section of a high pressure oil pipeline in Umuechem Community of Etche Local Government Area of Rivers State, Nigeria, showing a point of crude oil leakage (Wegwu and Omeodu, 2010)

As I deliver this Inaugural Lecture, the National Oil Spills Detection and Response Agency (NOSDRA), announced the detection of a whopping 50 oil spill sites in Rivers State alone. According to NOSDRA, 36 of the spills happened in June, while 12 happened in July, 2019. As is evidenced in the above figure, the burst pipe is traceable to rust and not due to the activities of vandals. In Nigeria, the common causes of crude oil pollution include: flow line/pipeline leaks, overpressure failures/overflow of process equipment components, hose failures on tanker loading systems, failures along pump discharge manifold (vibration effects) and occasional sabotage by community elements agitating for development and employment of inhabitants of the area.

Unfortunately, most agricultural lands in the Niger Delta have either experienced the devastating effects of oil spillage, while the vulnerability of the few remaining lands to similar crude oil pollution remains a living threat to food production.

Fig 7.5: Post crude oil-spilled status of a section of an agricultural land in Rumuekpe community of Emohua Local Government Area of Rivers State, Nigeria (Wegwu and Omeodu, 2010).

The people of Rumuekpe in Rivers State have for centuries enjoyed a robust agro-based economy as their soil was suitable for production of foods consumed by people living in the urban areas. Constant oil spills in the area, however, has completely altered the narrative as the soil can no longer sustain the cultivation and production of food crops, even for subsistent living.

The Figure below is a portion of polluted Omoku land. The spillage occurred in April 2002, and emanated from a high pressure pipeline leakage, spilling several thousand barrels of crude oil into the environment.

Fig 7.6: Superficial patches of spilled oil on soil and vegetation in Omoku old pipeline road (Osam, Ayalogu, Uwakwe, and Wegwu, 2011)

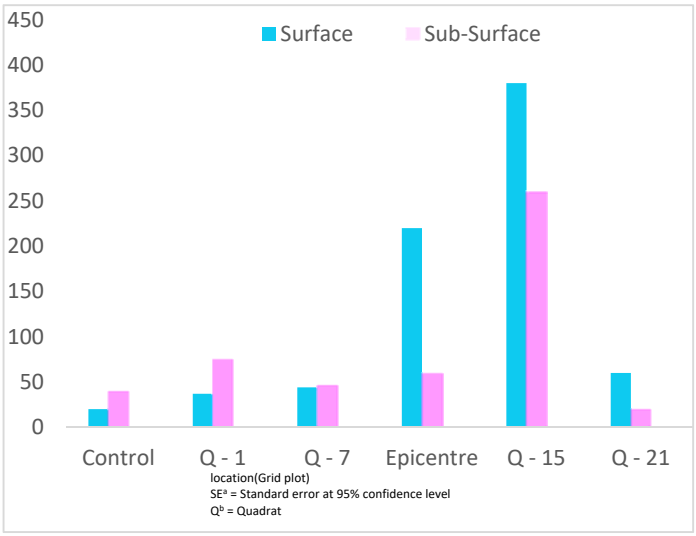


Fig. 7.7 Mean THC (mg/kg) of oil spilled soil at Omoku

The proximate profile of cassava tubers harvested from Omoku soils were assessed and the results are as shown below:

Table 7.4: Percentage proximate composition (±S.E[a]) and calorific value of cassava tuber harvested from oil-spilled and non-oil-spilled soils.

	PROXIMATE COMPOSITION (%)	
CONSTITUENT	POLLUTED TUBER	UNPOLLUTED TUBER
Moisture	63.95 ± 3.4(+ 4.91)	60.81 ± 0.26
Ash	0.58 ± 0.10 (+ 13.8)	0.50 ± 0.15
Crude Protein	0.44 ± 0.05 (+ 74.2)	0.74 ± 0.08
Crude liquid	1.20 ± 0.05 (+ 74.2)	0.31 ± 0.07
Crude fibre	1.56 ± 0.12 (+ 9.62)	1.41 ± 0.03
Total carbohydrate	32.27 ± 1.3 (-12.3)	36.23 ± 0.29
Calorific value (Kcal/100g sample)	141.64 (-6.38)	150.67

[a]*S.E: Standard error for the three replicate samples.*
Values in parenthesis indicate % increases (+) or decreases (-) for the samples grown in oil-spilled soils over the control (unpolluted

Post-impact assessment of crude oil spill, four years after recorded incidence at Ubie in Ogba/Egbema/Ndoni Local Government Area in Rivers State showed the recalcitrant nature of crude oil on agricultural lands (figure5.6)

Figure 7.8: A section of spilled site at Ubie, four years after recorded incidence. The total organic carbon and total organic matter of Ubie soil is shown in Table5.5 below:

Table 7.5: pH, Total Organic Carbon (TOC) and Total Organic Matter (TOM) contents of soil samples.

Sample location	Soil depth (cm)	Ph	TOC(%)	TOM(%)
Control	0 - 15	7.96 ± 0.02	1.44 ± 0.02	2.46 ± 0.03
Control	15 - 30	7.91 ± 0.02	1.25 ± 0.01	2.15 ± 0.02
Quadrat 1	0 - 15	7.59 ± 0.00	2.40 ± 0.08	4.13 ± 1.21
Quadrat 1	15 - 30	7.48 ± 0.05	1.68 ± 0.03	2.89 ± 0.06
Quadrat 3	0 - 15	7.10 ± 0.05	1.98 ± 0.08	3.41 ± 0.14
Quadrat 3	15 - 30	7.03 ± 0.03	2.56 ± 0.07	4.40 ± 0.11
Quadrat 5	0 - 15	6.93 ± 0.05	2.25 ± 0.03	3.87 ± 0.05
Quadrat 5	15 - 30	7.00 ± 0.01	1.56 ± 0.07	2.68 ± 0.11
Epicenter	0 - 15	6.92 ± 0.06	1.56 ± 0.03	2.69 ± 0.06
Epicenter	15 - 30	6.57 ± 0.06	2.34 ± 0.03	4.03 ± 0.06
Quadrat 11	0 - 15	6.66 ± 0.07	2.46 ± 0.11	4.23 ± 0.12
Quadrat11	15 - 30	6.69 ± 0.05	2.67 ± 0.03	4.59 ± 0.05
Quadrat 15	0 - 15	6.47 ± 0.06	1.80 ± 0.01	3.10 ± 0.02
Quadrat 15	15 - 30	6.55 ± 0.03	2.21 ± 0.02	3.80 ± 0.03
Quadrat 17	0 - 15	6.61 ± 0.03	3.27 ± 0.03	5.62 ±0.06
Quadrat 17	15 - 30	6.51 ± 0.03	2.52 ± 0.03	4.33 ± 0.03
Quadrat 19	0 - 15	6.57 ± 0.07	2.01 ± 0.05	3.46 ± 0.11
Quadrat 19	15 - 30	6.51 ± 0.03	1.65 ± 0.03	2.84 ± 0.05

7.2.2 Levels of Polutants in Selected Indigenous Foods

Studies on the levels of bio-accumulated trace metals in the African Giant Snail, *Archchatina maginata* collected from six states of the Southern part of Nigeria revealed substantial amounts of nutrient and non-nutrient elements in the tissues of the snail. The findings also showed that snails collected from the highly industrial zones showed non-nutrient trace metal values that approached or even considerably exceeded the critical values.

Figure 7.9: African giant land snail *Archachatina marginata* (Wegwu and Wigwe, 2006)

Table 7.6: ***Metal Concentrations (in Mg/kg of snail flesh;*** **including ranges in parenthesis) of** ***A. marginata*** **collected in different states of Southern Nigeria**

Location [a])	Cd	Pb	Ni	Cu	Fe	Zn
Rivers State:						
Aluu	0.82 (0.80-0.84)	1.00 (0.90-1.40)	4.20 (3.80-4.60)	6.40(6.10-6.60)	21.0 (20.2-21.6)	15.0 (14.9-15.1)
Ogoni	0.66 (0.60-0.68)	1.00 (0.80-1.08)	4.20 (4.00-4.60)	4.20 (4.00-4.40)	16.2 (16.0-16.40)	12.8 (12.5-12.7)
Akpor	0.82 (0.81-0.84)	1.00 (0.90-1.20)	4.40 (4.00-4.60)	5.20 (4.80-5.29)	20.2 (16.0-20.4)	18.6 (15.5-18.7)
Abia State	0.8 (0.60-0.72)	1.00 (0.80-1.09)	4.80 (4.40-5.00)	3.40 (3.10-3.60)	13.6 (13.0-14.0)	10.2 (10.1-10.3)
Bayelsa State						
Odi	1.70 (1.68-1.72)	5.00 (1.00-6.00)	10.2 (9.8-10.4)	3.20 (3.00-3.30)	27.6 (27.4-27.8)	11.7 (11.6-11.8)
Yenagoa	0.76 (0.72-0.78)	0.86 (0.60-1.60)	4.20 (3.60-4.30)	5.20 (5.00-5.24)	12.6 (12.4-12.8)	13.5 (13.4-13.6)
Akwa Ibom State	0.74 (0.70-0.80)	0.94 (0.80-1.00)	4.40 (4.30-4.80)	3.20 (3.00-3.40)	18.2 (12.8-18.6)	13.0 (12.1-13.1)
Cross Rivers State	0.76 (0.70-080)	1.20 (1.00-1.40)	4.40 (4.00-4.46)	5.00 (4.00-5.20)	19.2 (19.0-19.3)	13.1 (12.9-13.3)
Anambra State:						
Nsukka	0.74 (0.71-0.76)	2.20 (2.00-2.23)	4.80 (4.60-5.20)	6.4 (6.10-6.80)	19.0 (18.8-19.1)	20.4 (20.3-20.5)
Onitsha	0.82 (0.80-0.84)	2.00 (1.00-2.20)	6.00 (5.00-6.40)	5.20 (4.80-5.40)	15.4 (15.3-15.6)	16.6 (16.4-16.7)
Edo State	0.74 (0.72-0.76)	1.00 (0.90-1.40)	4.20 (4.00-4.40)	9.60 (8.60-9.80)	34.8 (34.6-3.2)	12.2 (12.1-12.3)
Ondo State	0.6 (0.60-0.68)	1.00 (0.90-1.40)	3.40 (4.00-4.40)	3.20 (3.00-3.40)	12.6 (12.4-12.8)	11.3 (11.2-11.4)
Total Mean	**0.83**	**1.52**	**4.93**	**5.02**	**12.6 (12.4-12.8)**	**14.0**

[a]) Per location, 80 samples were collected, and the values averaged.

The levels of nutrient and non-nutrient elements in selected seeds and edible vegetables were investigated. Results of our findings are shown in Tables 7.6. The levels of Cd and Pb obtained in Owerri samples were below those of Rivers State. The marked variation in the heavy metal levels in samples from these two zones were attributed to oil spills that is a common feature in Rivers State.

Fig. 7.10: *Veronia amygdalina* (Eligbo-Bitter Leaf)

Fig. 7.12: *Talinum triangulare* (Water Leaf)

Fig. 7.11: *Gnetum africanum* (Okazi)

Fig. 7.13: *Ocimum gratissimum* Mgbedengi-Scent Leaf)

Fig. 7.14: *Brachystegia Nigeria* (*Mkpuruachi*)

Fig. 7.15: *Citrulus vulgaris* schrad (Egusi)

Fig. 7.16: *Irvingia gabonensis* (Agboli)

Fig. 7.17: *Piper guineese* (Azise)

Table 7.7: Mean trace metal concentrations [ng/g dry weight of selected edible vegetables from an oil-producing (OP) and a non- oil-Producing (NOP) State of Nigeria. Values are means ± STD (n = 40)

	Veronia amygdalina		*Gnetum africanum*		*Talinum triangulare*		*Ocimum gratissimum*		*Piper guineese*		WHO Limit
Trace Metal	**OP**	**NOP**	**OP**	**NOP**	**OP**	**NOP**	**OP**	**NOP**	**OP**	**NOP**	
Pb	1.15±0.14 (d) [a)]	BDL[b)]	0.44±0.03 (c)	BDL	1.01±0.69 (d)	0.09±0.01 (b)	0.82±0.04 (d)	0.10±0.01 (c)	0.23±0.01 (c)	0.11±0.01 (c)	2.0
Cd	0.15±0.02 (c)	BDL	0.11±0.01 (c)	BDL	0.68±0.06 (d)	BDL	0.22±0.03 (c)	BDL	0.09±0.11 (b)	BDL	2.0
Fe	23.1±0.11 (c)	10.6±0.04 (b)	79.1±0.12 (d)	33.4±0.22 (e)	15.1±0.13 (c)	22.0±0.44 (c)	19.9±0.08 (c)	5.67±0.23 (b)	35.0±0.15 (e)	10.5±0.09 (b)	-
Mn	255.0±1.23 (c)	304.0± 2.14 (f)	509.0±3.32 (h)	148.0±2.05 (c)	189.0±2.21 (d)	98.1±1.59 (b)	473.0±2.13 (g)	234.0±1.9 (c)	319.0±1.48 (f)	513.0±3.02 (i)	-
Ni	6.11±0.01 (c)	8.01±0.21 (d)	4.11±0.15 (c)	1.33±0.01 (b)	12.1±0.32 (e)	4.40±0.09 (c)	6.69±0.02 (c)	10.4±0.41 (d)	9.23±2.10 (d)	4.39±1.15 (c)	-
Zn	6.15±0.02 (d)	2.32±0.02 (b)	10.3±0.02 (e)	14.1±0.11 (f)	9.11±0.03 (e)	3.28±0.10 (c)	9.98±0.04 (e)	15.9±0.01 (f)	13.2±0.05 (f)	21.4±0.19 (g)	1000.0
Cu	3.31±0.01 (d)	1.10±0.02 (c)	2.35±0.01 (c)	0.	7.54±0.03 (e)	2.11±0.08 (c)	4.62±0.02 (d)	1.10±0.01 (c)	1.58±0.05 (c)	0.38±0.02 (b)	30.0

a) Means with different letters in parentheses within the same row differ significantly by Duncan's multiple range test ($p \leq 0.05$) BDL: Below the detection limit (< 0.01 μg /g dry weight).

Table 7.8: ***Mean Trace Metal Concentrations [ng/g dry weight] of selected seeds from an oil-Producing (OP) and a Non Oil-Producing (NOP) State of Nigeria.*** **Values are means ± STD (n = 40).**

Trace metal	*Brachystegia Nigeria*		*Citrulus vulgaris* schrad		*Irvingia gabonensis*		WHO Limit [15]
	OP	**NOP**	**OP**	**NOP**	**OP**	**NOP**	
Pb	0.23±0.01 (c) [a])	BDL[b])	0.14±0.03 (b)	BDL	0.20±0.13 (c)	BDL	2.0
Cd	0.14±0.02 (b)	BDL	0.10±0.02 (b)	BL	0.11±0.04 (b)	BDL	2.0
Fe	19.3±0.03 (b)	21.1±0.02 (b)	24.2±0.10 (c)	22.4±0.20 (b)	26.2±0.40 (c)	21.8±0.30 (b)	-
Mn	71.6±0.25 (c)	239.0±0.36 (e)	62.9±0.02 (c)	22.6±0.20 (b)	902.0±0.20 (f)	231.0±0.30 (d)	-
Ni	145.0±0.30 (d)	90.3±0.30 (b)	175.0±0.02 (d)	153.0±0.10 (c)	161.0±0.31 (c)	199.0±0.30 (d)	-
Zn	2.43 ±0.30 (d)	0.50±0.03 (b)	5.27±0.05 (e)	1.12±0.03 (c)	2.77±0.31 (d)	1.77±0.10 (c)	1000.0
Cu	11.2±0.30 (b)	11.5±0.03 (b)	11.7±0.11 (b)	12.5±0.22 (b)	16.8±0.40 (c)	12.9±0.30 (b)	30.0

[a]) Means with different letters in parentheses within the same row differ significantly by Duncan's multiple range test ($p \leq 0.05$). [b]) BDL: Below the detection limit (< 0.01 μg /g dry weight).

The levels of total petroleum hydrocarbons in the soil, bitter leaf, water leaf, cocoyam and cassava obtained from the oil-rich Gokana in Ogoni land was compared with those of Umuchichi, a non-oil producing community in Abia State. Our findings showed high levels of total petroleum hydrocarbons in samples from Gokana (Table 7.9)

Fig. 7.18: *Manihot esculenta* (*Odogara*)

Fig. 7.19: *Colocasia esculenta* (*Edee*)

Fig. 7.20: *Veronia amygdalina* (Eligbo-Bitter Leaf)

Fig. 7.21: *Talinum triangulare* (Waterleaf)

Table 7.9: Mean concentration of total petroleum hydrocarbons (mg/kg dry weight) of soil, selected leaves and root crops in Umuchichi and Gokana.

Sampling site	Cassava	Soil	Bitter leaf	Water leaf	Cocoyam
Umuchichi	0.01	BDL*	0.58± 0.04	0.49±0.02	0.14±0.01
Gokana	2.17±0.06	3830±19.6	11.3±0.07	9.67±0.08	3.99±0.09

* Below detection limit of 0.001mg/kg (Source: Nwosu, Wegwu and Nwaichi, 2014)

We also recorded substantial amounts of polycyclic aromatic hydrocarbons, including heavy metals in soil, vegetables (Bitterleaf and Waterleaf) and root crops (Cocoyam and Cassava) from the oil

rich Gokana Local Government Area of Rivers State. Very low levels of the pollutants were obtained from Umuchichi samples.

7.2.2 The Menace of Gully Erosion

Gully erosion in Nigeria is indeed an age-long environmental crisis that is responsible for the degradation of valuable agricultural lands, loss of lives and property. Typical example of disaster arising from gully erosion is that found in Isuikwuato of Abia State as shown in the figures below.

a

b

c.

Figures 7.22a, b and c: Impact of gully erosion in Isuikwuato LGA of Abia State

7.2.3 Majoring in the Minor: The bane of Nigeria's geosphere.

7.2.3a Majoring in Minor:The bane of Nigeria's Geosphere

Our ancestors were so wise that they consistently ensured that food availability was topmost on their priority lists. These ancients erected structures on lands identified as non-productive (*Ali mgbaraja*), while the vast productive lands (*Ali wiri)* were set aside for agricultural purposes. It was clear to them that their survival was largely dependent on food availability and this informed their wise and incontrovertible decision to settle and build houses on non-fertile soils, while the greater fertile part of their lands were reserved for farming activities. Interestingly, this practice is visible in structured, western societies where only non-useable, barren lands are permitted by law for citing of industries, institutions and construction of residential, housing estates. This noble practice by our ancestors and the more developed Western countries stemmed from their in-depth understanding that the continuous existence of life is strictly dependent on food availability and that any form of developmental activity that would directly or indirect impact negatively on food production was unsustainable.

a 

b 

c

d

Figures 7.23 a, b, c, d: Agricultural grass lands. (Areas generally viewed as non-developed, especially by the ruling class).

It is disheartening that Nigerians, including the elite class view areas that are void of magnificent structures as non-developed and would freely support the permanent destruction of such productive lands with the siting of industries, institutions and estates that render the locals jobless, hungry and restive (figures7.23 a, b, c, d).

Fig 7.24: A housing estate built on fertile agricultural land (Source: dailytimes.ng)

Figure7.25 below was a section of Choba forest that for over 300 years housed 30 fish ponds. This part of the forest (*Igbogo Iru*) seasonally provided different species of fish for members of the community and other residents. *Iru* was a natural habitat for rare wildlife species and thus, game hunting was a common practice. The siting of a humongous Centre of Excellence by the University of Port Harcourt Administration at *Iru*, brought those fishing and hunting activities to an abrupt end. It will be highly appreciated if qualified members of the thirty Choba families that were divested of their ancient source of livelihood in that location would be employed to work in the Centre as a token compensation for their unquantifiable loss.

Fig 7.25: A section of *Igbogo* (forest) Choba, previously designated by the University Management as Conservation Centre, now housing the University of Port Harcourt Centre of Excellence.

Figure 7.26: University of Port Harcourt Centre of Excellence

7.2.3b Indiscriminate Estate Development on Arable Lands

Another tasteless commercial venture that may threaten the livelihood of Ikwerre farming communities is the new phenomenon of massive development of mega estates by property developers, who have taken Rivers State by storm. Dangling paltry monetary incentives before indigent farmers, these rapacious land speculators have serially divested these Ikwerre communities of their title to ancestral lands bequeathed to them in the days of yore. Aluu, Iguruta, Omagwa, Ipo, Ozuaha, Omademe, Omanwa and Isiokpo; Igbo Etche and Oyigbo, are frontline communities currently selling their ancestral lands on a massive scale to these estate developers which have besieged the print and electric media, including billboards and social media with advertisements of new estates where plots of land can be purchased. These phantom estates go by some funny-sounding names meant to attract buyers. One of such estate developers has recently encroached massively on surveyed land belonging to the University of Port Harcourt! It should, of course, be noted that all the choice lands being advertised for sale (usually 'near' or 'behind' the Port Harcourt International Airport, Omagwa), are fertile farmlands that previously produced agricultural yields for the indigenous communities. One wonders what would become of these farmers once they are finally dispossessed of their farmlands; not to talk of those of us waiting in the urban areas for agricultural products from the hinterland.

It is unfortunate that rather than build good roads, provide potable water, schools, hospitals, electricity and other social amenities in rural, farming communities, the ruling elites in Nigeria would prefer attracting projects on those productive lands that oftentimes are abandoned as "white elephant projects." The country is littered with various abandoned projects, including government-funded housing estates on previously fertile lands for agriculture. This indeed is MAJORING IN THE MINOR as ignorantly, the 'stomach infrastructure' is deemphasised and food insecurity is embraced by the ruling class with open arms.

It is common knowledge that in Rivers State of Nigeria, over 50 thousand hectares of arable agricultural lands have been sacrificed on the altar of residential homes within the last fifteen years.

Oftentimes, the farmers are forced to sell their lands when it is rumored that government may acquire the lands for projects that are usually no well-thought through before they are rolled out with pomp and ceremony. There are, however, emerging evidence that such rumors were peddled by the rich with the intent of acquiring such lands at very low costs. This was responsible for the indiscriminate sale of the vast agricultural lands stretching from Ozuoba to Mgbuoba, Alakahia to Rumuosi and down to Rumuokoro; including other kingdoms and clans in Rivers State. It is obvious that all the choice lands that have been designated for the development of *Greater Port Harcourt City* were previously arable agricultural lands held by the local inhabitants.

The consequence of this unsustainable development is that the failure of successive governments to provide meaningful employment for the youths who have not only lost their farmlands, but have also lost their hunting fields, have been transformed into human hunters (kidnappers), militants and armed bandits. In parts of the State where farm lands are still intact, farmers in such localities have been forced to abandon their farms arising from the nefarious activities of 'armed bandits' and 'herdsmen', including cult gangs battling each other for supremacy. Examples include the yam farming communities of Ibaa, Odegwu and a host of other communities in Ikwerre, Etche, Khana, Gokana, Eleme, Ahoada, Ogba/Egbema/Ndoni Local Government Areas of Rivers State, where human heads are violently harvested with pride on a regular basis. Shockingly, this ugly trend is evident in virtually all the six geo-political zones of Nigeria today without any sign of concrete action to change the ugly narrative.

Fig 7.27: Armed bandits (Source: saharareporters.com)

We live in a country where the relationship between availability of agricultural lands and population growth is asymmetrical in character, because while agricultural lands are diminishing in geometrical proportion, the country records a population growth rate of 2.6 percent per year (Okonjo-Iweala, 2018). The obvious implication is that hunger will inevitably be our companion in no distant time. If urgent steps are not taken to curb this menace, we will painfully and helplessly, arrive at a stage in which the living will envy the dead as food unavailability could lead to unpleasant consequences that have not previously been contemplated, including the possibility of food wars and cannibalism!

Figures 7.28: A famine stricken family (Source: Wikipedia.org)

7.2.4 Strategies for Remedying the Geosphere

a) Phytoremediation of polluted soils.

Our in-depth understanding of the biochemical reactions that occur in the rhizosphere, including the complex plant and microbial exudates that are common features of the sphere strengthened our resolve to identify some wild-type plants that have the capacity of bio-concentrating and bio- degrading of pollutants. We are excited to report that certain wild type indigenous plants successfully biodegraded soil pollutants, including recalcitrant hydrocarbons. Some of these plants that showed efficiency in the recovery of polluted agricultural lands are shown below.

Fig 7.29a: Yellow Flame Tree (*Peltophorum pterocarpum*)

Fig 7.29b: Rattle weed (*Crotalaria retusa*) (Source: Osam, Wegwu and Ayalogu 2011).

Fig 7.29c*: Mucuna pruriens* Wegwu and Onyeike,2009)

Fig. 7.29d: *Vigna subterranean. .* (Source: Nwaichi, (Source Nwaichi and Wegwu, 2010)

b) Remediation by Enhanced Natural Attenuation (RENA) technique (Wegwu, Uwakwe and Anabi, 2010).

This technique promises to be highly efficient in the recovery of crude oil polluted lands. In less than 11 days of the application of RENA, over 98% of the polluted soils were recovered as shown below:

Figure 7.30a: Crude oil spillage site

Figure 7.30b: Windrows constructed at polluted site

Table7.10a Effects of RENA on Total Petroleum Hydrocarbon (TPH) Contents of polluted soil (mg/kg)

Component	Site I			Site II			Site III		
	PS	RS	C	PS	RS	C	PS	RS	C
C_8	a	a	a	a	a	a	a	a	a
C_9	20.3±10.7	a	a	11.9±2.06	a	a	17.4±0.15	a	a
C_{10}	a	a	a	a	a	a	a	a	a
C_{11}	a	a	a	6.70±4.50	a	a	a	a	a
C_{12}	11.4±5.42	a	a	43.9±25.6	a	a	14.4±6.86	a	a
C_{13}	18.4±6.43	a	a	12.4±7.81	a	a	13.1±3.64	3.09±3.56	a
C_{14}	46.8±42.5	a	0.15±0.27	22.9±9.81	a	a	9.09±0.86	a	a
C_{15}	34.6±30.4	a	a	24.8±4.87	a	a	18.0±2.30	4.77±2.55	a
C_{16}	22.0±3.07	a	a	18.8±3.45	a	a	11.5±1.57	a	a
C_{17}	a	8.50±3.40	a	0.98±0.06	a	a	a	a	a
PRISTANE	1.05±1.01	a	a	409±23.8	20.3±10.7	a	198±8.65	a	a
C_{18}	1.57±1.31	a	a	537±27.6	25.8±13.7	a	203±8.67	a	a
PHYTANE	521±148	a	a	95.8±34.5	13.5±12.6	a	89.9±10.8	a	a
C_{19}	506±13.4	a	a	180±33.2	16.9±11.8	a	12.7±2.67	a	a
C_{20}	208±35.7	a	0.16±0.25	45.9±32.7	a	a	18.9±2.37	a	a
C_{21}	54.0±9.08	a	a	23.4±4.50	a	a	18.3±2.65	a	a
C_{22}	73.3±5.85	a	a	35.7±43.2	10.8±6.25	5.23±3.45	39.8±11.90	a	a
C_{23}	457±4.87	a	a	106±15.6	a	a	122±20.5	11.8±15.6	a

PS- Polluted soil; RS- Remediated soil; C- control.
Values are means ± S.E. for 4 replicates (n=4)
a = below detection limit (0.0001 mg/kg)

Table 7.10b Effects of RENA on Total Petroleum Hydrocarbon (TPH) Contents of polluted soil (mg/kg) Continues

Component	Site I			Site II			Site III		
	PS	RS	C	PS	RS	C	PS	RS	C
C_{24}	5.03±2.07	a	a	a	a	a	a	a	a
C_{25}	769±45.9	a	a	110±15.6	a	3.89±6.79	89.2±6.75	a	a
C_{26}	49.8±32.8	a	a	23.6±17.2	2.55±0.86	a	36.8±2.46	9.08±5.67	a
C_{27}	56.0±24.2	a	a	34.8±18.9	8.56±3.23	a	27.6±1.32	9.78±4.89	a
C_{28}	23.6±3.24	a	a	24.9±16.6	a	a	26.6±1.32	a	a
C_{29}	675±32.8	a	a	254±12.9	a	a	126±2.39	a	a
C_{30}	965±54.9	a	a	206±31.5	7.50±3.56	a	134±4.58	a	a
C_{31}	2376±896	a	a	907±54.3	a	a	201±2.85	9.67±4.98	a
C_{32}	1578±953	8.25±10.6	a	205±45.2	a	a	175±34.7	13.9±8.54	a
C_{33}	2098±767	5.25±9.73	a	136±23.5	a	a	108±38.2	a	a
C_{34}	785±467	a	a	86.0±56.2	a	a	87.5±30.7	6.89±4.98	a
C_{35}	362±34.6	a	a	110±65.8	18.7±8.80	4.78±2.78	116±34.4	12.7±5.76	1.33 ±0.56
C_{36}	77.8±46.9	a	a	67.3±12.8	a	a	55.4±23.8	8.75±3.23	a
C_{37}	60.7±32.9	12.8±3.30	a	13.7±11.3	a	a	24.8±8.89	6.77±1.86	a
C_{38}	35.8±4.98	a	a	12.5±16.7	a	a	18.9±23.7	6.75±1.87	0.98 ±0.35
C_{39}	57.5±34.0	a	a	38.4±22.5	11.6±5.71	a	23.6±18.6	a	a
C_{40}	a	a	a	9.31±0.21	2.94±0.72	a	3.98±0.87	a	a
TOTAL	**14,569±400**	**139±108**	**0.37±0.52**	**3,713**	**139**	**45.2**	**2,156±28.2**	**103±71.6**	**2.20 ±7.81**

PS- Polluted soil; RS- Remediated soil; C- control.
Values are means ± S.E. for 4 replicates (n=4)
a = below detection limit (0.0001 mg/kg)

Table 7.11

Table 2: Effects of RENA Method on the Polycyclic Aromatic Hydrocarbon (PAH) (mg/kg) Contents of Soils

Component	Site I			Site II			Site III		
	PS	RS	C	PS	R S	C	PS	RS	C
Naphthalene	0.30±0.06	a	a	0.23±0.04	a	a	a	a	a
Acenaphthylene	4.53±2.72	a	a	0.29±0.19	a		a	a	a
Acenaphthene	17.2±8.22	a	a	4.67±3.90	a	a	3.60±2.37	a	a
Flourene	2.08±1.86	a	a	0.91±0.05	0.54±0.20	a	0.77±0.47	a	a
Phenanthrene	2.11±1.90	a	a	3.53±2.57	1.28±1.05	a	0.21±0.16	a	a
Anthracene	1.36±0.47	a	a	0.52±0.09	0.26±0.11	a	0.39±0.22	a	a
Flouranthene	0.87±0.45	a	a	0.66±0.14	0.30±0.15	a	a	a	a
Pyrene	0.22±0.16	a	a	0.66±0.42	a	a	0.35±0.60	a	a
Benzo(a)Anthracene	0.86±0.19	a	a	a	a	a	a	a	a
Chrysene	a	a	a	0.48±0.08	a	a	a	a	a
Benzo(b)flouranthene	a	a	a	a	a	a	a	a	a
Benzo (k) flouranthene	a	a	a	a	a	a	0.52±0.89	a	a
Benzo(a)pyrene	5.38±1.20	a	a	a	a	a	a	a	a
Indeno(1,2,3)pyrene	0 a	a	a		a		a	a	a
Dibenzo(a,h)									

Table 7.12:

Table 3 Mean Concentrations of Heavy Metals (mg/kg) in Polluted, Remediated and Control Soil Samples

Heavy Metals	Site I			Site II			Site III		
	PS	RS	C	PS	RS	C	PS	RS	C
Pb	80.0±21.3	61.0±59.9	26.9±14.4	69.3±25.7		16.6	86.6±13.5	62.5±6.31	9.62±3.10
As	a	a	a	a	a	a	a	a	a
Ba	15.1±3.13	14.6±3.39	12.5±3.32	17.2±4.88	8.75±5.32	4.50±3.07	13.0±3.83	12.7±3.12	6.09±4.44
Cd	7.88±4.53	3.28±5.24	2.47±3.45	15.4±22.9	9.80±5.24	5.70±3.10	17.6±2.38	12.4±2.43	1.63±2.38
Ni	87.7±103	85.7±66.7	56.7±33.0	116±94.8	77.0±10.3	20.6±12.7	96.5±9.40	10.2±88.5	22.9±4.72
Zn	65.3±5.00	54.3±40.5	31.5±13.1	90.4±24.1	59.7±18.6	39.2±16.7	25.0±14.9	7.60±33.5	4.70±3.16
Cr	1.66±3.71	2.08±3.59	a	12.5±13.8	6.25±3.67	4.18±1.23	12.5±13.8	2.08±3.59	a

PS- Polluted soil; RS- Remediated soil; C- control.
Values are means ± S.E. for 4 replicates (n=4)
a = below detection limit (0.0001 mg/kg)

c). Maximising available lands: Lessons from Rwanda and Benue State

Most agricultural lands in the Niger Delta are under threat of being rendered infertile and this may be traced to indiscriminate discharge of pollutants, use of pesticides and other chemicals that are harmful to farmlands, degradation due to gully erosion and construction of estates under the guise of development. This implies that in no distant time, precisely before the end of the next decade or thereabout, the people of the Niger Delta may depend on food supplies from the northern parts of Nigeria or die of hunger. To avert this avoidable, but impending doomsday scenario, it is my considered view that all available lands should be engaged in food production. In other words, rather than beautify our surroundings with flowers and interlocking stones to announce our 'arrival', such valuable spaces should be populated with economic trees and vegetables. The indigenous people of Benue State and Rwanda have interestingly perfected the act of maximising their few available lands, including the frontages of their homes, for use in food production. The figures below are houses from Orokam in Ogbadibo Local Government Area of Benue State and those of Rwanda. This practice of maximizing land for food production by the Benues and Rwandans serve as strong lessons for the people of Niger Delta who have shown delight in the sale of their valuable lands to the wealthy for estate development.

a.

b.

c.

d

Fig 7.31 a - e: Maximising available agricultural lands: the indigenous people of Benue State

Sites from Rwanda (inhabitat.com)

iv

Fig 7.32 i – vi: Farming in Rwandan homes

vi

d) Niger Delta: A Land of Great Delight

Some have travelled to distant places in search of lands 'flowing with milk and honey'. There are strong indications, however, that this land may truly be likened to the Biblical Canaan Land that is 'flowing with milk and honey'. We have observed that apart from the abundant mineral deposits, our lands are some of the highly fertile soils on planet earth. With very little effort, food crops can be cultivated to feed the teeming population. As is shown below, seeds of fruits eaten and thrown away have the capacity of germinating, developing to maturity and bearing fruits for human consumption. Such fertile lands are not common in Nigeria and other parts of the world.

Fig 7.33: Seeds of Water Melon that were thrown away at the frontage of Dr U.J. Nwogu's residential home, germinated and produced fruits without any farm input.

7.3 State of the Hydrosphere

Water is an indispensable part of living systems. In the past five decades, it was common practice among the natives of the Niger Delta to rush to the river with their baskets, scoop the water, and rush back home with enough fish catch for their lunch or dinner. Hunger was alien to the people inhabiting this region as during low

tides, the natives would harvest enough periwinkles, oysters, shrimps and lots of other shellfish for domestic and commercial purposes. This was possible because the rivers, lakes, estuaries and other water bodies were still in their pristine state. Those were the days when the rivers served as dependable sources of potable water supply, recreational activities such as swimming, boating and artisanal fishing. It is still fresh in my memory that back in the 1970s, children were banned from visiting the river during quiet moments of the day when adults have all gone to their farms. This was due to the fear of the likely appearance of two most dreaded sea creatures: the river goddess (Aquatic Spirit, locally known as *Owumini*) and Sea Elephant (*Enimini*). It was a common belief among the people of Choba and other neighbouring communities that mermaids would, with delight, abduct any human that crosses its part while the sea elephant would cease its prey with its broad palm and sail away to an unknown destination.

It is widely known that the destination for virtually all pollutants is water. In other words, water serves as the ultimate receptor or sink for atmospheric and land pollutants. Two sources of water pollution are known: the point and non-point sources. A point source is a specific, identifiable source where pollution originates. Typical examples include a drain or pipe through which industrial effluents or wastes are usually discharged to the river. Atmospheric depositions and runoffs in general, constitute the non-point source.
Under natural condition, the distribution of hazardous substances is relatively constant due to natural biological processes that initiate and affect their production (synthesis) and degradation. In other words, the synthesised toxicant would pose no serious threat to the health of the water bodies, including the aquatic *flora* and *flora* as the rate of its synthesis is in equilibrium with the amounts degraded. When used, however, in industrial processes, the toxicant may re-enter the environment and alter or disrupt the natural action of living things to such an extent that the maintenance of the balance or equilibrium between synthesis and degradation would be altered (Wegwu, 1999). Alteration of the natural status of the water bodies arising from crude oil pollution and indiscriminate discharge of toxic

industrial wastes into the aquatic milieu of the Delta Region began to manifest in the early 1980s, when most of the natural features were observed to have drastically decreased in population or gone into extinction. In fact, the fear of *Enimini* or mermaids is now history as either they have migrated to distant waters or gone into extinction as they could no longer survive the harsh, hazardous industrial wastes that are constantly dumped into the receiving water body. The obvious fact is that majority of indigenous fishes no longer exist, except the recalcitrant few, including catfish that have shown admirable capacity to survive extreme conditions. This would account for the regular availability of catfish for sale within the vicinity of Choba Bridge till date.

Fig 7.34: Sea Elephant (Elephant Seal). Source: www.alamy.com

Fig- 7.35: Aquatic Spirit (Mermaid), caught in camera. (Source www.youtube.com)

We have detected in substantial amounts of environmental pollutants, including non-nutrient and nutrient trace elements, polycyclic aromatic and aliphatic hydrocarbons in surface water, sediments, aquatic *fauna* and *flora* in Choba River (New Calabar River), Alakiri River, lakes and estuaries in the Niger Delta Region. Radionuclides such as polonium 210, a poisonous substance that was reportedly responsible for the death of Palestinian leader, Yasser Arafat, has been detected in some of the waters and fishes of the Niger Delta. Results of a few of our findings are shown below:

Table 2: PAH concentrations (µg/kg wet wt.) in *Tilapia queneesis* from the study areas (Kaa, B-Dere and Bodo City).Value are mean ±S.E.M for three replicates, (n=3).

PAH COMPOUND	KAA (CONTROL)	B-DERE	BODO CITY
Naphthalene	0.11 ± 0.00^{a}	BDL^{a}	BDL^{a}
Acenaphthylene	0.32 ± 0.01^{a}	14.1 ± 0.56^{b}	BDL^{a}
Acenaphthene	0.03 ± 0.00^{a}	6.54 ± 0.26^{b}	BDL^{a}
Fluorene	0.02 ± 0.00^{a}	6.29 ± 0.25^{b}	0.30 ± 0.00^{a}
Anthracene	0.01 ± 0.00^{a}	0.13 ± 0.01^{a}	0.73 ± 0.01^{a}
Phenanthrene	0.01 ± 0.00^{a}	0.4 [illegible]	0.03 ± 0.00^{a}
Fluoranthene	0.04 ± 0.00^{a}	0.6	0.13 ± 0.00^{a}
Pyrene	0.10 ± 0.02^{a}	2.71 ± 0.11^{b}	0.05 ± 0.00^{a}
Benz[a]anthracene	BDL^{a}	7.58 ± 0.30^{b}	0.05 ± 0.00^{a}
Chrysene	0.04 ± 0.17^{a}	0.51 ± 0.02^{a}	0.03 ± 0.00^{a}
Benzo[b]Fluoranthene	15.9 ± 0.31^{a}	40.6 ± 1.61^{b}	120 ± 1.18^{c}
Benzo[k]Fluoranthene	0.01 ± 0.00^{a}	0.15 ± 0.07^{a}	0.04 ± 0.00^{a}
Benzo[a]Pyrene	0.01 ± 0.00^{a}	3.51 ± 0.10^{b}	0.03 ± 0.00^{a}
Indenol[1,2,3-cd] Pyrene	0.84 ± 0.16^{a}	BDL^{a}	0.66 ± 0.01^{a}
Dibenz[a, h]anthracene	0.28 ± 0.00^{a}	0.20 ± 0.12^{a}	0.001 ± 0.00^{a}
Benzo[g, h,1]perylene	0.001 ± 0.00^{a}	1.34 ± 0.13^{b}	0.03 ± 0.01^{a}
Total PAHs	17.7 ± 0.65^{a}	84.7 ± 3.57^{b}	121 ± 1.21^{c}
PEC	0.003	0.006	0.012
LMW-PAH/HMW-PAH ratio	0.03	0.48	0.01
BaA/(BaA + Chry) ratio	0.15	0.87	0.48

Values with different superscript letters (a,b,c) in the same column are significantly different at the 0.05 level ($P \leq 0.05$). BDL implies below detection limits of 0.0001 µg/kg wet wt.).

Table 7.14: Table 2. Heavy metals content of fish samples analyzed (mg/Kg)

Metal	Control	*O. niloticus*	*P. koelreuteri*	*M. undulatus*	*C. auratus*	*L. felcipinis*
Pb	BDL	3.01±0.01^{b}	3.82±0.11^{b}	3.71±0.02^{b}	3.79±0.02^{b}	3.05±0.04^{b}
Cd	BDL	0.62±0.02^{b}	0.48±0.01^{b}	0.52±0.06^{b}	3.82±0.06^{b}	3.07±0.03^{b}
Fe	4.34±0.01^{a}	9.52±0.04^{a}	189.87±0.04^{b}	152.61±0.26^{b}	77.87±0.03^{b}	178.45±0.05^{b}
Cu	0.89±0.04^{a}	2.46±0.06^{b}	2.92±0.03^{b}	3.14±0.05^{b}	2.14±0.02^{b}	1.76±0.02^{a}
Zn	3.01±0.18^{a}	38.48±0.02^{b}	35.46±0.04^{b}	36.76±0.03^{b}	29.36±0.03^{b}	29.35±0.03^{b}
Mn	BDL	17.25±0.02^{b}	10.15±0.03^{b}	8.63±0.03^{b}	8.04±0.05^{b}	10
Cr	BDL	3.60±0.02^{b}	4.75±0.02^{b}	3.29±0.01^{b}	3.95±0.05^{b}	3.39±0.02^{b}

Values are presented as mean ± S.D of triplicate determination; Values with different superscript letters differs significantly (P = .05) from the control group; BDL-Below Detectable Limits

Table 7.15: Table 3. Heavy metal content of water and sediment samples

Metal	Water (mg/L)	Sediment (mg/Kg)
Pb	BDL	0.61±0.04
Cd	BDL	0.15±0.04
Fe	8.68±0.01^{a}	347.15±1.05^{b}
Cu	BDL	1.36±0.03
Zn	0.10±0.02^{a}	5.46±0.02^{b}
Mn	0.11±0.00^{a}	6.28±0.01^{b}
Cr	BDL	3.52±0.03

Values are presented as mean ± S.D of triplicate determinations. Values with different superscript alphabets differ significantly (P=.05). BDL-Below Detectable Limit

(Source : Amechi, Wegwu, Omeodu and Feleagha, 2018)

Table 7.16: Mean concentration of TPH distribution in *C. pallidus* (mean ± S.E.M, µg.kg^{-1} wet wt.) collected from Kaa, B-Dere and Bodo City

TPH components	Kaa	B- Dere	Bodo City
C-8	BDL	BDL	BDL
C-9	BDL	BDL	BDL
C-10	0.16 ±0.00	BDL	BDL
C-11	0.001±0.00^a	0.14±0.00^b	0.19±0.00^c
C-12	0.003±0.00^a	0.32±0.00^b	0.05±0.00^c
C-13	0.16 ±0.00^a	1.11±0.15^b	0.06±0.00^a
C-14	0.32 ± 0.00^a	5.96±0.08^b	0.57± 0.01^c
C-15	0.04±0.00^a	3.19±0.04^b	2.26±0.03^c
C-16	0.02±0.00^a	3.93±0.04^b	2.28±0.03^c
C-17	0.05±0.00^a	3.94±0.05^b	2.06 0.03^c
Pristine	0.08±0.00^a	26.5±0.37^b	4.67±0.06^c
C-18	0.14±0.00^a	7.87±0.11^b	1.77±0.02^c
Phytane	0.26 ±0.00^a	3.97±0.05^b	4.24±0.06^c
C-19	0.75 ±0.01^a	12.7±0.18^b	14.3±0.19^c
C-20	21.7 ±0.19^a	94.2±1.30^b	389±5.35^c
C-21	0.56 ±0.01^a	11.6±0.16^b	12.3±0.17^c
C-22	6.44± 0.06^a	19.9±0.28^b	166 ±2.28^c
C-23	0.46 ±0.00^a	4.68±0.07^b	18.3±0.25^c
C-24	2.24±0.02^a	17.1±0.24^b	6.34±0.09^c
C-25	1.39±0.01^a	7.26±0.10^b	12.0±0.17^c
C-26	0.69±0.01^a	26.6±0.00^b	15.5±0.21^c
C-27	2.55±0.02^a	23.9±0.11^b	15.3±0.21^c
C-28	0.81±0.01^a	26.4±0.37^b	6.83±0.09^c
C-29	0.65±0.01^a	197±0.27^b	7.33±0.10^c
C-30	0.98±0.01^a	36.4±0.50^b	23.5±0.32^c
C-31	0.58±0.01^a	33.5±0.46^b	38.6±0.53^c
C-32	4.28±0.04^a	76.9±1.06^b	58.6±20.7^c
C-33	2.58±0.02^a	17.3±0.23^b	45.8±0.63^c
C-34	4.08±0.04^a	20.1±0.28^b	41.9±0.58^c
C-35	9.19±0.08^a	41.5±0.57^b	36.5±0.50^c
C-36	2.82±0.03^a	30.3± 0.42^b	27.5±0.38^c
C-37	1.95±0.02^a	52.8±0.70^b	44.9±0.62^c
C-38	1.81±0.02^a	20.0±0.02^b	31.3±0.43^c
C-39	3.90±0.04^a	54.5±0.75^b	89.5±1.23^c
C-40	1.19±0.01^a	42.6±0.59^b	96.9±1.33^c

Results with different superscript letters (a, b, c) across the row are significantly different at p<0.05 level. BDL implies below detection limits of 0.0001 µg.kg^{-1} wet wt.)

Table 7.17: Mean concentration of TPH distribution in *P. notialis* (mean ± S.E.M, µg.kg^{-1} wet wt.) collected from Kaa, B-Dere and Bodo City

TPH components	Kaa	B-Dere	Bodo City
C-8	BDL	BDL	BDL
C-9	BDL	BDL	0.79±0.01
C-10	0.01±0.00^a	BDL	0.05±0.00^c
C-11	0.002±0.00^a	0.01±0.0^a	0.55±0.01^c
C-12	0.001±0.00^a	0.01±0.00^a	13.9±0.12^b
C-13	0.06±0.00^a	0.02±0.00^b	0.12±0.00^b
C-14	0.02±0.00^a	0.04±0.00^b	0.64±0.01^c
C-15	0.05±0.00^a	0.12±0.00^b	0.35±0.00^c
C-16	0.25±0.00^a	0.24±0.01^a	1.98±0.02^b
C-17	0.09±0.00^a	0.24±0.01^b	BDL
Pristine	0.06±0.00^a	0.24±0.01^b	BDL
C-18	5.20±0.07^a	0.43±0.01^b	10.2±0.09^c
Phytane	0.04±0.01^a	1.00±0.03^b	15.1±0.13^c
C-19	5.58±0.07^a	0.60±0.02^b	10.7±0.09^c
C-20	5.29±0.07^a	7.76±0.22^b	15.6±0.29^c
C-21	3.29±0.04^a	1.369±0.04^b	8.82±0.08^c
C-22	7.41±0.10^a	20.0±0.57^b	67.5±0.59^c
C-23	0.57±0.01^a	0.70±0.02^a	8.91±0.78^b
C-24	1.81±0.02^a	2.83±0.08^a	104±0.91^b
C-25	0.86±0.01^a	1.49±0.04^b	9.41±0.08^c
C-26	0.29±0.00^a	3.30±0.09^b	8.30±0.07^c
C-27	1.97±0.03^a	2.16±0.06^b	2.49±0.02^c
C-28	0.66±0.01^a	1.05±0.03^b	2.39±0.02^c
C-29	1.37±0.02^a	6.38±0.18^b	7.27±0.06^c
C-30	1.24±0.02^a	3.29±0.09^b	0.42±0.00^c
C-31	1.02±0.01^a	4.89±0.14^b	0.24±0.00^c
C-32	1.43±0.02^a	272±7.70^b	718±6.28^c
C-33	0.77±0.01^a	3.01±0.09^b	3.48±0.03^c
C-34	0.62±0.01^a	3.87±0.10^b	6.92±0.06^c
C-35	2.56±0.03^a	2.62±0.07^a	0.29±0.00^b
C-36	1.23±0.02^a	7.06±0.20^b	1.49±0.29^a
C-37	1.45±0.02^a	4.41±0.13^b	2.23±0.20^c
C-38	1.49± 0.01^a	2.55±0.07^a	1.81±0.74^a
C-39	1.99± 0.023^a	5.13±0.15^b	1.83±1.51^a
C-40	2.14±0.00^a	6.13±0.17^b	4.73±0.00^c

Results with different superscript letters (a, b, c) across the row are significantly different at p<0.05 level. BDL implies below detection limits of 0.0001 µg.kg^{-1} wet wt.)

Table 7.18: Comparison of Mean Trace Metal Concentrations (in ranges) in Effluents, Sediments and Aquatic Fauna in Alakiri Flow Station.

Matrix	Hg	Pb	Cd	Cr	Cu	Zn	Fe
Effluent	N.D – 0.65	ND-1.14	ND-0.03	ND-0.24	ND-0.53		
0.02 – 2.22	0.04 – 58.9						
Saver Pit.(Mg/L)							
Water (Mg/L)	ND-0.012	ND-0.94	0.5- 0.05	ND-0.13	ND-0.54		
0.009-0.35	0.03 – 0.99						
Sediments (Mg/Kg)	0.11- 0.68	0.75- 60.8	ND-15.1	0.51- 4.10	3.42 – 20.3		
14.3- 55.1	1.28-7.73						
Fauna (Mg/Kg)	ND-0.19	ND-7.14	ND-2.00	ND-8.88	0.17- 99.7		
ND-458	9.74-3,101.3						

ND= Not Detected

Data Collected in the Months of September to December 1997 and January to March 1998 (Wegwu, 1999).

7.3.1: Bioavailability of Toxicants in Shell Fish and Fin Fish

Table 7.19: Comparison of Mean Trace Metal Levels (in ranges) in Shell and Fin Fish in Alakiri River

Fish Type	Hg	Pb	Cd	Cr	Cu	Zn	Fe
Shell Fish (Mg/Kg)		ND-0.19	0.11-7.14	0.06-2.00	0.03 – 8.88	0.96-99.69	10.1-1980
19.9-3,10							
FinFish (Mg/Kg)		ND- 0.03	ND-1.74	ND-0.15	ND-4.31	0.17- 14.64	5.13-35.1
12.0-43.4							

ND= Not Detected

Data Collected in the Months of September to December 1997 and January to March 1998 (Wegwu, 1999).

a:crab

b: Oyster

C: Periwinkle

d: Shrimp

Fig. 7.36 a,b,c,d: Selected Filter Feeders (Shell Fish).

In the Table above, we compared the ability of shellfish and finfish to bio-accumulate trace metals and our findings during the seven-month investigation showed that shellfish has the capacity of bio concentrating toxic trace elements far above those of the finfish. This observation was attributed to the mode of feeding of shellfish as they are filter feeders. Pollutants are transferred across membranes in the gills of fish. This is a more important route for uptake than transfer of pollutants from ingested material in their gut (Harrison and Roy, 1982). Shellfishes extract the nutrients they need

by filtering and processing large quantities of particulate matter in water. Oftentimes, they inhabit the surface of sediments and can extract trace metals from particles of sediments ingested. This implies that the bio availability of trace metals in fish is dependent on their contact with the particles. The above findings strongly suggest that the shellfishes, including oyster, periwinkles, shrimps, clams etc were not designed for consumption by humans but to play the role of natural water purifiers. It would be recalled that God had commanded the Israelites to abstain from the consumption of aquatic organisms that lack scales and fins (Leviticus: 11 and Deuteronomy 14). The justification for this directive to the Israelites is obvious in this study (Table 7.19).

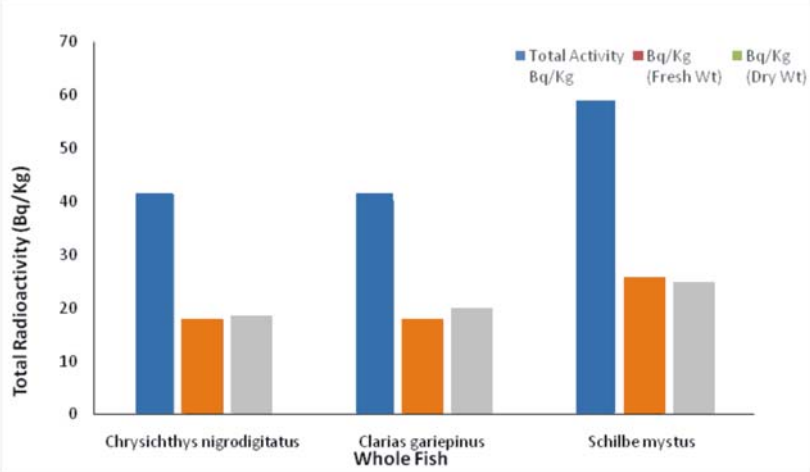


Figure 7.37: Total Polonium -210 activity in *Chrysichthys nigrodigitatus*, *Clarias gariepinus, Schilbe mystus*

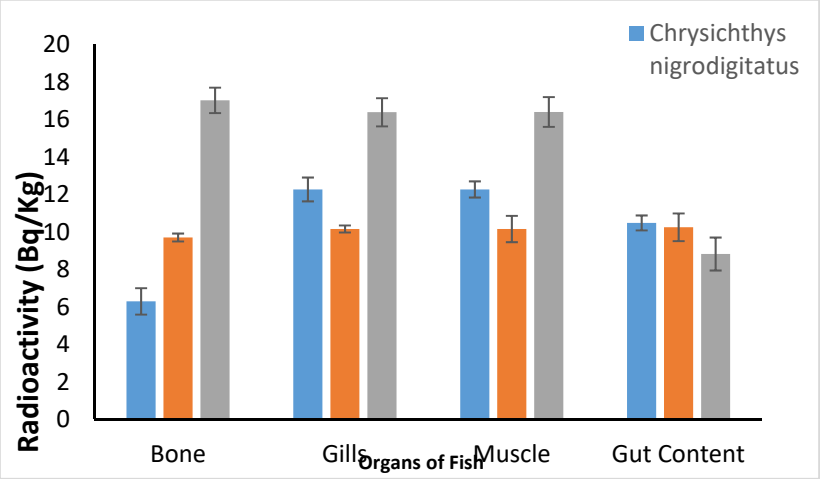


Figure 7.38: Total Polonium -210 levels in various organs of fishes

7.3.2 The Deceptive Nature of Acceptable Limits

Reports of the occurrence of trace metals in shell and fin fishes, water and sediments in the Niger Delta area indicate that for most metals, their concentrations in the aquatic compartments fell far below the acceptable limits of both national and international regulatory agencies (Kakulu and Osibanjo, 1991; Ibok, Udensen, and Udoidiong, 1989; GESAMP, 1991; FEPA, 1991; Wegwu , 1999; Horsfall Jr and Spiff, 2002). However, artisanal and pelagic fishermen have consistently recorded low catch of fish in the last two decades of intense industrial activities in the region. The reported low catch of fish, including the gradual but consistent disappearance of most indigenous fish species, did not corroborate the reported low levels of pollutants, especially trace metals. To unravel this puzzle, we resolved to ascertain the effects of the reported low metal levels on fertilization of fish, fish hatch, development from larvae to fry, including fry rearing. The experimentally determined physico-chemical parameters of dilution water employed in this study is shown below

Table 7.20: Physicochemical Characteristics of Employed Dilution Water

Parameter	Value
pH	6.30-6.70
Temp. [°]	27.0-29.0
Dissolved O_2 [mg/l]	11.0-15.0
Total hardness ($CaCO_3$) [mg/l]	18.0-21.0
Heavy-metal concentration (mg/l)[a])	BDL[b])

[a]) Hg. Cd, Cr, Cu, Zn, Fe. [b]) Below detection limit, i.e., < 1 µg/l.

Next, we determined the concentrations of dissolved trace metals at four sampling sites of the New Calabar River (fig 7.39). As is obvious in the Table below, the concentrations of the dissolved metals in the New Calabar River investigated were very low and for most metals, the levels obtained in water samples fell far below FEPA limits. Also, the levels of these metals in the muscles of selected fish species from the New Calabar River was established as shown in Table 7.20

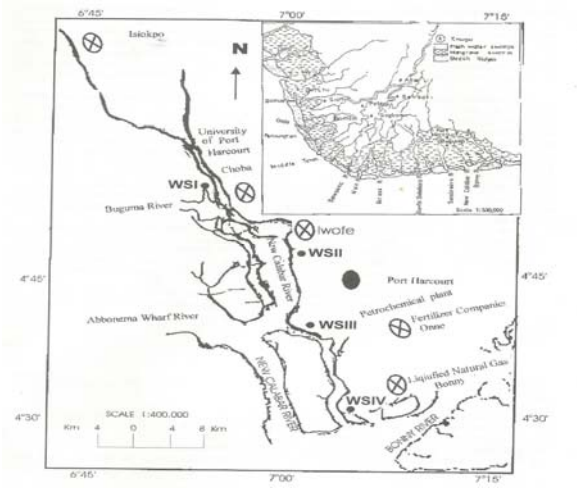


Fig 7.39: Map of the lower reaches of the New Calabar River in the Niger Delta of Nigeria (Adapted from Horsfall and Spiff;2002).

Table:7.21 Mean concentrations (mg/l) of disolved heavy metals in the new Calabar River.

Location[a])	Hg	Pb	Cd	Cu	Cr	Fe	Zn
WSI	BDL	0.44	0.23	2.21	0.06	10.6	5.56
WSII	BDL	1.08	0.81	1.10	0.02	7.76	3.86
WSIII	0.01	1.14	0.53	1.45	0.05	14.4	8.89
WSIV	0.01	0.75	0.66	3.45	0.07	15.2	8.05
Mean	0.01	0.85	0.56	2.08	0.05	12.0	6.59
FEPA Limit	0.05	<1	<1	<1	<1	20	<1

Table: 7.22: Mean Trace-Metal Concentration (in μ g/g wet weight) in the Muscles of Fish from the Calabar River. Values are means $\pm$ STD for five replicates (n=5).

Species	Hg	Pb	Cd	Cr	Cu	Zn	Fe
Oreochromis niloticus	BDL[a])	1.73 ± 0.14^{b})	0.12 ± 0.01^{b})	4.28 ± 0.02^{b})	2.43 ± 0.01^{b})	7.78 ± 0.21^{b})	11.5 ± 2.10^{b})
Liza gradis-quamis	BDL	0.21 ± 0.20^{c})	0.16 ± 0.04^{b})	0.08 ± 0.03^{b})	1.14 ± 0.02^{b})	5.15 ± 0.15^{b})	6.15 ± 1.80^{b})
Penaeus notialis	BDL	054 ± 0.31^{c})	0.10 ± 0.02^{b})	0.55 ± 0.01^{d})	5.01 ± 0.06^{d})	9.02 ± 0.40^{d})	8.33 ± 3.24^{d})
Clarias gariepinus	BDL	1.04 ± 0.01^{b})	0.15 ± 0.10^{b})	0.84 ± 0.01^{d})	6.02 ± 0.11^{c})	2.04 ± 0.22^{c})	8.14 ± 1.45^{c})
WHO Limit [20]	0.5	2.0	2.0	-	30	1000	-

[a]) Below detection limit (< 1 µg/l). [b])–[c]) Values with different superscripts in the same row are significantly different at the 0.05 level ($p \leq 0.05$).

Well-developed eggs of mature *Clarias gariepinus* were selected based on the method of ovarian biopsy of the oocytes (Delince, Campbell, Janssen, and kutty, 1987). Maturation of oocyte and ovulation was enhanced with the hormonal agent, Ovaprim. On expiration of the latency period, the eggs were stripped mechanically into plastic bowls. Spermatozoa (milt) from male C. gariepinus were

procured by surgically extracting milt from its sac and introducing them into 0.9% saline solution. Fertilization was carried out artificially, and the fertilized eggs were introduced into holding tanks containing dilution water spiked with a predetermined concentration of metal. Hatching took place 18-24hrs after fertilization. On complete re-absorption of yolk (72hrs after hatching, when larvae had developed into fry), fry rearing and water quality was ensured with the aid of 40% crude protein, by monitoring the pH, DO and temperature.

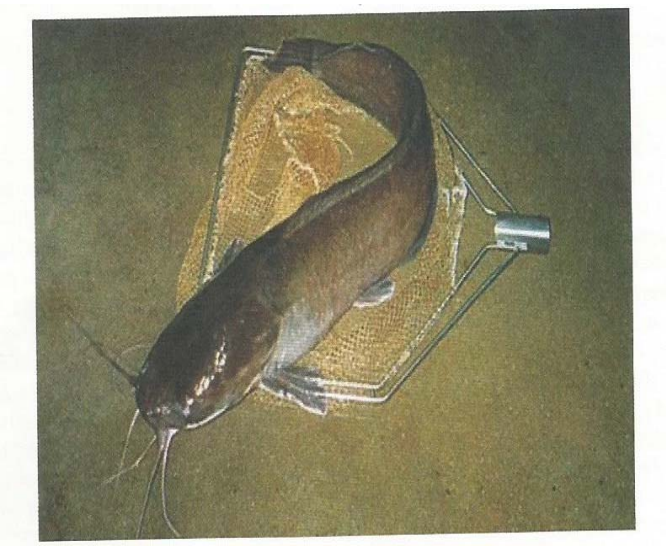


Fig 7.40: Freshly Caught Clarias Gariepinus

Table: 7.23

Table: 7.23

race Metals in Water on Egg Hatch and Fish-Fry Rearing. Selected data only; the number of dead fish after 72 and 192 h were also noted, but not included here. *R1* and *R2* refer to two different replicates.

Metal	Concentration [mg/l]	No. of incubated eggs		No. of hatched eggs		No. of test fish dead[a])						Mortality [%]	
		0 h		24 h		48 h		144 h		216 h		216 h	
		R1	*R2*	*R1*	*R2*	*R1*	*R2*	*R1*	*R2*	*R1*	*R2*	*R1*	*R2*
Hg	0.01	100	108	41	62	70	59	100	108	100	108	100	100
Pb	0.85	115	104	93	89	30	28	71	78	113	98	98	94
Cd	0.56	130	125	80	74	70	61	102	115	130	125	100	100
Zn	0.90	150	120	139	98	25	30	64	55	74	67	49	41
Cu	0.90	103	98	71	76	50	28	103	98	103	98	100	100
Fe	12.0	99	87	85	79	20	13	37	42	55	50	56	64
Cr	0.05	150	94	137	90	20	9	59	42	84	59	56	63
Control	-	91	130	91	130	-	3	5	6	5	6	6	5

[a]) Including unhatched eggs.

Results in the Table above strongly suggest that the occurrence of trace metals even at every low levels in a river system has a direct negative impact on fish hatch, larvae, and fish-fry rearing. Hence, aquatic regions polluted by trace metals, even at very low concentrations, may not be suitable as nursery and schooling grounds for fish breeding. The obvious is that the persistent discharge of industrial wastes into the aquatic milieu in the Niger Delta region is directly responsible for the disappearance and extinction of marine organisms in our rivers, lakes, estuaries etc. The greatest crime that has been committed against aquatic life in the Niger Delta region is traceable to the official acceptance of limits that are unrealistic, foreign and unsuitable for fish breeding. It is disheartening that multi-national oil companies in the region have for the past decades, discharged their effluents and other industrial wastes into the receiving water bodies in the region unchallenged. How can these destroyers of our natural aquatic environment be challenged in the court when they are operating within the limits set

by the country's regulatory bodies? The painful truth is that virtually all the standards that are set by the regulatory bodies in Nigeria were adopted from those of other countries, including Europe and US, with markedly different environmental conditions. The adopted limits can only be useful when they are adapted to suit our local conditions.

Alarmingly, the findings in the hydrosphere show anthropogenic heavy metal enrichment of the aquatic milieu, abundant concentrations of total hydrocarbons and carcinogenic polycyclic aromatic hydrocarbons, and radionuclides in water, sediments, fauna and flora. The gradual but consistent disappearance of indigenous fish species in our rivers, lakes, estuaries, etc. are strong indications that the water bodies in the Niger Delta region are gradually, but steadily approaching the status of the lifeless Dead Sea as the pollutants have impacted and are impacting negatively on the eggs, larvae, nursery and schooling grounds of fin and shellfish, including sea animals and other creatures.

7.3.3 Remediation Strategies

While it may be highly challenging to creatively control the discharge or influx of pollution-laden runoffs into the receiving water bodies, it was our belief that point-source pollutants could be denied access to the aquatic milieu by eliminating all hazardous materials contained in the waste. Our first success story was the use of thioglycolic acid modified oil-palm fibre to isolate trace metals, including iron, zinc and magnesium from polluted water samples (Akaninwor, Wegwu and Iba , 2007). This study showed that the modified fibre was efficient in sorption of trace metals from solutions, especially, in a mild acidic medium. The implication of this finding is that this technique may be appropriate in the removal of toxic heavy metals from refinery and industrial effluents prior to their discharge into the rivers and other water bodies.

Figure 7. 41: Oil-Palm Fibers (*Ruvu*)

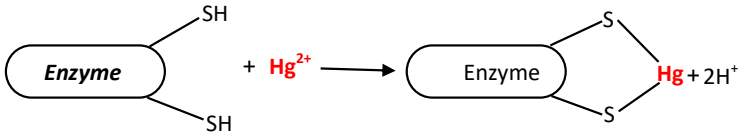
Similarly, bio-sorption of metals such as cadmium, chromium and lead in solution, using the leaf, stem and root of water hyacinth (*Eichhornia crassipes*) was achieved after treatment with 1M thioglycolic acid. The acid modified root, stem and leaves of water hyacinth were highly efficient in the bio-sorption of metals in aqueous solution (Enyi, Wegwu, Uwakwe, 2015). This implies that *Eichhornia crassipes*, a pernicious, invasive plant species, could be effectively applied in the purification of domestic and industrial waste waters, including urban and continental runoffs.

Figure 7.42: Water Hyacinth (*Eichhornia crassipes*) Harvested from Choba River

8.0 Biochemical Implications of Some of The Pollutants Detected In Foods.

a) **Trace metals**:
i) Mercury—the first awareness of the risk in mercury exposure was in the early 50s in Minamata Bay, Japan. The inhabitants of this community suffered from a strange neurological disease that attained epidemic proportion by 1956. This mysterious disease that affected the peripheral nerve system, hearing, cerebellum, including vision impairment, claimed over one hundred and eleven lives, leaving survivors incapacitated to various degrees. Study groups from Kumamoto University that investigated the cause of the mysterious disease observed that there was a relationship between consumption of fish caught in Minamata Bay and the occurrence of disease. The study groups later published a report on the disease expressing agreement that methyl mercury was the culprit that caused the epidemic in the community. The sources of the mercury were effluents from acetaldehyde plant in which mercury was used as a catalyst. Exposure of fish in the Minamata Bay to the mercury-rich effluent, which were drained into the Bay, led to absorption, and bio-concentration of the toxic agent in the tissues of fish and shell fish (Wegwu, 1999).

It is believed that virtually every toxic action of mercurial would be attributed to its interaction with sulfhydryl (-SH) groups (thiols) to form a complex referred to as mercaptide. Proteins contain –SH groups and are thus the primary target for mercurial interaction and consequent toxicological effects.



Attachment of mercury to cell membranes would inhibit active transport of glucose across the membrane. This obstruction would cause an increase in the permeability of membrane to potassium. Absence of sugar in the brain cells due to this inhibition may result

in deficiency of energy in the cell while an increase in potassium permeability has a negative effect upon the transmission of brain nerve impulses. This may account for the reason babies born to mothers suffering from methyl mercury poisoning usually suffer irreversible damage to the central nervous system, mental retardation and convulsions. Methyl mercury poisoning is also known to cause segregation of chromosomes, breakage of chromosomes in cells, and inhibition of cell division (Manahan, 1994).

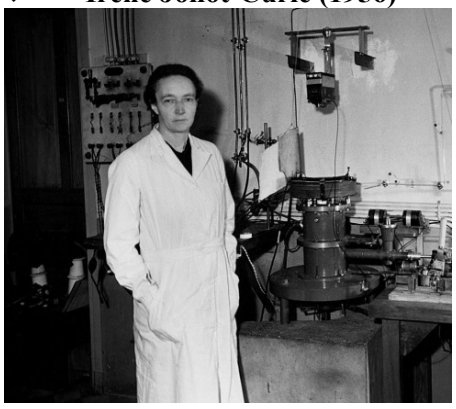
ii) Lead—the interference of lead with the biosynthesis of haem remains the best documented effects of lead on blood. The points of interference include the (a) inhibition of delta aminolaevulinic acid dehydratase, an enzyme that catalyze the conversion of delta aminolaevulinic acid to porphobilinogen, and (b) inhibition of ferrochelatase, an enzyme that is indispensable in the insertion of iron into protoporphyrin to yield haem(US-EPA, 1977). Lead ions also inhibit the activities of acetylcholinesterase, alkaline phosphatase, adenosine triphosphatase, carbonic anhydrase and cytochrome oxidase.

iii) Cadmium--- Metals are present in the structure of a number of enzymes. The activity of such enzymes are oftentimes inhibited when substitution of one of these metals by another metal ion with the same charge and similar size occur. An example is zinc, a metalloenzyme component. Cadmium, directly below zinc in the periodic table, substitutes for zinc. The activity of the cadmium-containing enzyme is impaired despite the chemical similarities of Zn^{2+} and Cd^{2+}. Cadmium inhibits adenosine triphosphatase, alcohol dehydrogenase, amylase, carbonic anhydrase, peptidase activity in carboxypeptidase, and aspartate aminotransferase (Bert and David, 1972). Acute cadmium poisoning would result in high blood pressure, kidney damage, destruction of testicular tissue and red blood cells. The malady commonly known as “Itai Itai,” which is translated as “Ouch Ouch” by the Japanese, is caused by cadmium. This condition manifests in bone fracture and causes intense pain (Bryce-Smith, 1977)

iv) Arsenic—Arsenic (iii) (in the form of arsenate) reacts with sulfhydryl groups on the enzyme to form a stable five-member ring structure. The activity of the affected enzymes is therefore destroyed. Enzymes that produce cellular energy in the citric acid cycle are among those whose activities are destroyed by arsenic. The first step in this cycle, which involves the generation of ATP through the oxidation of pyruvic acid to yield carbon dioxide and acetyl-CoA in the mitochondria by pyruvate dehydrogenase, is inhibited by arsenic (iii) (Moore and Moore, 1976).
Arsenic also interferes with some biochemical reactions involving phosphorus as it is chemically similar to this element. This occurs in the biochemical generation of ATP (Lee, 1977).

v) Polonium-210—This poisonous radionuclide is known to disrupt cell structures and functions, damage DNA, and eventual death of organism. Available evidence strongly suggests that polonium-210 was responsible for the death of Irène Joliot-Curie, Professor Dror Sadeh**,** Alexander Valterovich Litvinenko, a former Russian spy, etc.

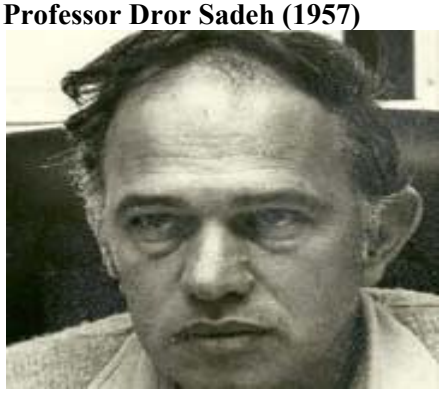
❖ **Irène Joliot-Curie (1956)**



a

She was exposed to Polonium in **1946** and later died in **1956.**
(https://www.medicalnewstoday.com/articles/58088.php)

❖ **Professor Dror Sadeh (1957)**



b

He died after miniature amount of Polonium was suspected to have touched his hands (https://twistedphysics.typepad.com/cocktail_party_physics/page/57/)

Alexander Valterovich Litvinenko (2006)

c

He was killed with traces of Polonium poisoning.
(https://en.wikipedia.org/wiki/Alexander_Litvinenko)

Figs 8.1 a,b,c: Polonium-210.

b) **The Hydrocarbons**---It is common knowledge that the hydrocarbons are toxic in humans. Polycyclic aromatic hydrocarbons, such as 3,4 benzo (a)pyrene, 7,12-

dimethylbenzathracene, and 20-methylcholanthrene are carcinogenic (Thorsteinsson and Thordanson, 1986). Our findings that hydrocarbons are toxic to the liver cells strengthened our resolve to identify some indigenous plants with hepato-protective active ingredients (Wegwu, 1999). We are glad to report that aqueous extracts of selected seeds, nuts and leaves of certain native plants possess hepato-protective powers. Below are examples of such seeds, nuts and plants:

Figure 8.2: *Cassia alata* (Wegwu, Ayalogu and Sule, 2005).

Figure 8.3a Garlic

Figure 8.3b Ginger

Figure 8.3c Chemical structure of Vitamin E
(Fig 8.3: a, b, c: Patrick- Iwuanyanwu, Wegwu and Ayalogu, 2007)

Figure 8.4: Garcinia kola (Wegwu and Didia, 2007).

Figure 8.5: Acanthus montanus (Wegwu and Patrick-Iwuanyanwu, 2008)

Figure 8.6a

Figure 8.6 b

Figure 8.6 c

Figure 6.5 a, b, c: Africa Locust Beans (*Parkia clappertoniana)* (Patrick-Iwuanyanwu, Okiyi and Wegwu, 2010)

Figure 8.7: Negro pepper (Xylopia aethiopica) (Patrick-Iwuanyanwu, Okiyi and Wegwu, 2010)

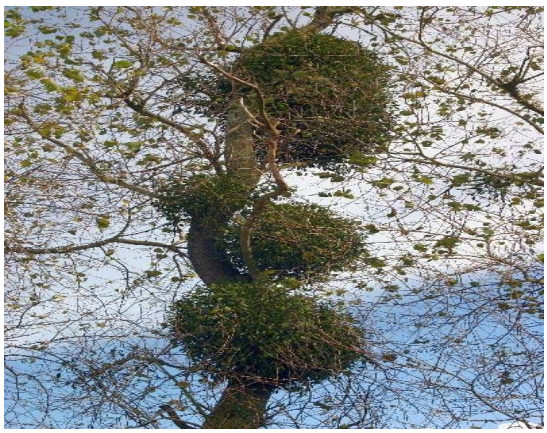


Figure 8.8: African mistletoe (*Tapinanthus bangwensis*) (Patrick-Iwuanyanwu, Onyeike and Wegwu, 2011).

9.0 Sustainable Diet

A major global challenge is obviously how to feed and nourish a population that is ever growing, while balancing what our planet can provide as well as what it can conveniently absorb. It is no longer a hidden truth that the conventional food system poses a credible threat to our health and overall well-being with remarkable increase

in atmospheric and water pollution, exposure of humans to toxic or hazardous substances, soil erosion, antibiotic-resistant bacteria, climate change- induced greenhouse gas emissions, and oftentimes, loss of biodiversity. We are aware that most diets of affluence are contributory to a range of avoidable health problems, including diabetes, obesity, and cardiovascular disease. Other associated health problems include dementia, cognitive decline, other neurodegenerative disorders, and cancer. It is therefore important that the wide-reaching environmental, social and health impacts of industrial agriculture be critically analysed. Our position is that a diet that is sustainable should use available resources without exhausting or completely destroying them, so that the resources would be sustained in the long term. This includes operating within what the planet can conveniently sustain in terms of provision of resources and waste absorption and emission of greenhouse gas.

In recent times, there has been a growing body of research on sustainable diets which according to the Food and Agricultural Organisation (FAO) are "those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimising natural and human resources" (Burlingame and Dennis, 2010). A major contributor to severe environmental crisis such as loss of biodiversity and climate change is the food value chain. It is envisaged that this contribution would increase in view of the global shift in the food consumption pattern in favour of the Western preference for high animal products. Globally, livestock contributes about 14.5% to 18% of human-induced greenhouse gas emissions. On the average, just one cow dung releases about 120kg of methane, a greenhouse gas, annually.

9.1 Bene Willy Abbey Professorial Chair of Nutrition and Environmental Biochemistry (Professor M.O. Wegwu, Chair Occupant)

The University of Port Harcourt administration graciously endowed this Chair in 2015 with my humble self as Chair Occupant. I am glad to report with every sense of modesty that we have recorded landmark successes in our research, most of which have been published in high impact journals (Nkpaa, Amadi, and Wegwu, 2017; Onyegeme-Okerenta, Nwosu and Wegwu, 2017; Alozie, Wegwu, Amadi, Amadi, Njoku, 2018;.Nkpaa, Amadi, Adedara, Wegwu, Farombi, 2018; Nkpaa, Adedara, Amadi, Wegwu, Frombi, 2018; Kpaa, Awogbindin, Amadi, Abolaji, Adedara, Wegwu, Farombi, 2018; Wopara, Uwakwe, Wegwu, 2019; Nkpaa, Amadi, Wegwu, Farombi, 2019). In 2018, we published a book entitled: *Selected Biochemical Research Reports*, in honour of Professor Bene Willie Abbey, an accomplished scholar and uncommon mentor in Biochemical Research. We have focused our research effort on Environmental Nutrition which examines the interrelationships between our food choices, our environment and our total health and wellbeing. Members of our research team are drawn from various fields, including agriculturists, microbiologists, physiologists, chemists, biochemists, engineers, environmentalists, zoologists and botanists.

I am glad to announce that we have commenced researches that are structured to identify diets that are sustainable in our environment. We have successfully produced water hyacinth-source organic manure augmented with: (a) cow dung and kitchen waste, and (b) poultry manure and kitchen waste. Similarly, we have produced soil-nutrient packed organic manure with orange waste. Our ultimate goal is to produce organic fertilisers in commercial quantities, using water hyacinth, domestic and agricultural wastes. It is our belief that the introduction of organic fertilizers to the farming communities would certainly enhance production of high quality, healthy foods that will not impact negatively on the soil, and would not also contribute to global warming.

Fig 9.1a: Water hyacinth

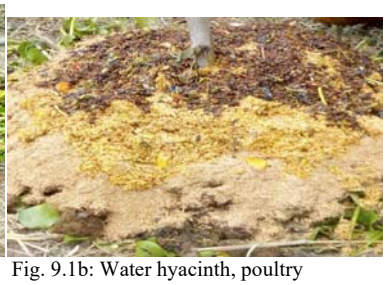


Fig. 9.1b: Water hyacinth, poultry manure, domestic waste

Fig. 9.1c: Water hyacinth, cow dung, domestic waste

Fig. 9.1d: Soil nutrient-dense organic manure

Fig. 9.1e: Decaying of materials

Fig.9.1A, B, C, D, E: Stages of production of water hyacinth source of organic manure

9.2: Proposal for The Establishment of a Centre for Environmental Nutrition, Healthy Lifestyle and Disease Control.

Available evidence strongly suggests that most deaths in the Nigerian space, in recent times, are traceable to cancer, diabetes, chronic respiratory disease, and cardiovascular disease. We are deeply convinced that these are avoidable and preventable conditions that could be achieved through the adoption of healthy lifestyle, including the cultivation of sustainable diets and consumption of healthy foods. When established, research in the Centre shall focus on identifying important dietary factors and lifestyle for the prevention of chronic disease in our society. Also, the Centre shall regularly organise effective health education programmes with the aim of improving diet quality and adoption of healthy lifestyle in our communities. The Centre shall pioneer new knowledge and develop innovative, interdisciplinary, translational and interventional research with the objective of reducing the risk, morbidity and mortality associated with unhealthy diet and lifestyle.
Vice Chancellor Sir, your kind approval of the establishment of this life-saving Centre in our Unique UniPort is most respectfully solicited.

10.0 Conclusion

Vice-Chancellor Sir, it would be deduced from the foregoing that food is indeed powerful as there is no life without food. As posited by Hippocrates, we will add years to our lives and vibrant life to our years if we "let our food be our medicine and our medicine our food". It is however disheartening that the three spheres of environment that support the production of food, especially in the Niger Delta Area, have undergone marked degradation in recent years, arising from anthropogenic activities. We are of the view that the natural resources of the Niger Delta may wink out of existence if the current trend persists.

We can, through collective efforts, avert the impending extinction of this our land of great delight and one of the credible measures is to encourage our leaders to desist from agitating for Resource Control; as it is not the solution to a zone that is helplessly at the end of its existence. I rather recommend that the leadership and the peoples of the region should demand Resource Sustenance and Conservation by adopting a civilized, non-violent approach as this, in my opinion, remains the most acceptable and unswerving strategy to obviate the impending extinction of our resources and arable, food producing agricultural lands.

I thank you all for your attention.

REFERENCES

Akaninwor, J. O., Wegwu, M. O., and Iba, I. U. (2007). Removal of iron, zinc and magnesium from polluted water samples using thioglycolic modified oil-palm fibre. *African Journal of Biochemistry Research*, *1*(2), 011-013.

Amechi, P. A. C., Wegwu, M. O., Omeodu, S. I., and Felagha, I. (2018). Evaluation of Heavy Metals in Fish, Water and Sediment of the New Calabar River. *Asian Journal of Research in Biochemistry*, 1-7.

Bivens, T. (2013) from plant to plate. Life and Health network china. Pp. 11 – 279

Bryce-Smith, D. (1977). Heavy Metals as contaminants of the human environment Peter Grokes ed. Publ. educational techniques subject group. The chemical society, London. 21-23

Chidi, A. S., Mattew, W. O., Benjamin, A. A., Peter, A. U., and Uche, N. C. (2018). The Modulatory Activity of Justicia carnea in Plasmodium Infected Mice. *Trends Journal of Sciences Research*, *3*(4), 151-160.

Clark, N. (2014). Sport Nutrition Guide book. 5th ed. U.S.A

Domine, A. (1997). Organic and Whole foods: Naturally delicious cusine konemann publ. Germany. PP14-446.

Enyi, C. N. (2015). Phytochemistry, nutritional and adsorptive potentials of water hyacinth. Ph.D. Thesis, University of Port Harcourt.*The sciences of the Total Environment*.141:217-221.

Horsfall, M. Jr; Ogban, F.E; and Spiff, A.I(1994) . Petroleum hydrocarbon pollution: the distribution in sediments and water of the New Calabar River, Port harcourt, Nigeria.

Horsfall, M., and Spiff, A. I. (2002). Distribution and partitioning of trace metals in sediments of the lower reaches of the New Calabar River, Port Harcourt, Nigeria. *Environmental Monitoring and Assessment*, *78*(3), 309-326.

https://mitochondria.org/understand

Ibok, U. J., Udosen, E. D., and Udoidiong, O. M. (1989). Heavy metals in fishes from some streams in Ikot Ekpene area of Nigeria. *Nig. J. Tech. Res*, *1*, 61-68.

Ighariemu, V. (2018). Studies on air quality profile and selected pollutants in fishes, water and sediments in Ikoli Creek, Bayelsa State. M.Sc. Dissertation, University of Port Harcourt, Nigeria.

Iwuagwu, O. (2012). FOOD SHORTAGES, SURVIVAL STRATEGIES AND THE IGBO OF SOUTHEASTERN NIGERIA DURING THE NIGERIA CIVIL WAR. *Journal of International Social Research*, *5*(22).

Kakulu, S. E., and Osibanjot, O. (1992). Pollution studies of Nigerian rivers: trace metal levels of surface waters in the Niger delta area. *International Journal of Environmental Studies*, *41*(3-4), 287-292.

Kilani, M. (2018). Air quality monitoring of selected areas in Rivers State, Nigeria. B.Sc. Project, University of Port Harcourt, Nigeria.

Ludingtom, A. and Diehl, H. (2000). Health power: Health by choice not chance. Review and Harvard publ. Assotuation U.S.A. pp. 32-210

Manahan, S. E. (1994). Environmental chemistry. Sixth ed. Lewis publishers U.S.A 619 – 643

Manay, N. S; and Shadaksharaswamy (2010). Foods: facts and principles. 3rd ed. New age International (P) limited. New Delhi: pp 1-10

Meisenberg, G., and Simmons, W. H. (2016). *Principles of Medical Biochemistry E-Book*. Elsevier Health Sciences.

MILLER, B., and WILDMAN, R. (2004). Sports and fitness nutrition. *USA: Thompson Learning. Nes, BM, Janszky, I., Wisloff, U. Stoylen, A. and T. Karslen.(2012). Agepredicted maximal heart rate in healthy subjects: HUNT Fitness Study. Scand Journal Medicine Science Sports. doi*, *10*, 20-31.

Moore, W. J. and Moore, E. A. (1976): Environmental Chemistry. Academic Press. London. Pp. 360-368

Mustafa, M. G., Hacker, A. D., Ospital, J. J., Hussain, M. Z., and Lee, S. D. (1977). Biochemical effects of environmental oxidant pollutants in animal lungs. *Biochemical effects of environmental pollutants*, 59-96.

Nigeria. Federal Environmental Protection Agency. (1991). *Guidelines and standards for environmental pollution control in Nigeria*. Federal Environmental Protection Agency (FEPA).

Nkpaa, K. W., Adedara, I. A., Amadi, B. A., Wegwu, M. O., and Farombi, E. O. (2019). Ethanol via Regulation of NF-κB/p53 Signaling Pathway Increases Manganese-Induced Inflammation and Apoptosis in Hypothalamus of Rats. *Biological trace element research*, *190*(1), 101-108.

Nkpaa, K. W., Amadi, B. A., Adedara, I. A., Wegwu, M. O., and Farombi, E. O. (2018). Ethanol exacerbates manganese–induced functional alterations along the hypothalamic-pituitary-gonadal axis of male rats. *Neuroscience letters*, *684*, 47-54.

Nkpaa, K. W., Amadi, B. A., Wegwu, M. O., and Farombi, E. O. (2019). Ethanol increases manganese—Induced spatial learning and memory deficits via oxidative/nitrosative stress induced p53 dependent/independent hippocampal apoptosis. *Toxicology*, *418*, 51-61.

Nkpaa, K. W., Awogbindin, I. O., Amadi, B. A., Abolaji, A. O., Adedara, I. A., Wegwu, M. O., and Farombi, E. O. (2018). Ethanol exacerbates manganese-induced neurobehavioral deficits, striatal oxidative stress, and apoptosis via regulation of p53, caspase-3, and bax/bcl-2 ratio-dependent pathway. *Biological trace element research*, 1-14.

Nkpaa, K. W; Amadi, B. A and Wegwu, M. O. (2017) Trace elements levels in drinking water from Gokana, Ogoniland, Rivers State, Nigeria. International journal of Hydrology. 1 (2): 1-3

Nwaichi, E. O., Wegwu, M. O., and Onyeike, E. N. (2009). Phytoextracting cadmium and copper using Mucuna pruriens. *African Journal of Plant Science*, *3*(12), 277-282.

Nwaichi, O. E., and Wegwu, O. M. (2010). Phytoextraction of cadmium from petroleum contaminated soil by Vigna subterranean. *Archives of Applied Science Research*, *2*(2), 14-23.

Nwosu, U. L. (2014). Evaluation of some pollutants in soil and selected vegetables and tubers in Ogoni-land

Okonjo-Iweala, N. (2018). *Fighting corruption is dangerous: The story behind the headlines*. MIT Press.

Olorogua, G. (2018). Estimation of the levels of particulate Matter in Port Harcourt city, Nigeria. B.Sc Project, University of Port Harcourt, Nigeria.

Onyegeme-Okerenta, B. M., Nwosu, T., and Wegwu, M. O. (2017). Proximate and phytochemical composition of leaf extract of Senna alata (L) Roxb. *Journal of Pharmacognosy and Phytochemistry*, *6*(2), 320-326.

Opara, K. (2019). Production of Water hyacinth source organic manure augmented with poultry waste. B.Sc. Project, University of Port Harcourt, Nigeria.

Osam, M. U., Wegwu, M. O., and Ayalogu, E. O. (2011). Physicochemical and biological assessment of the efficacy of some wild-type legumes in the remediation of crude-oil contaminated soils. *Archives of Applied Science Research*, *3*(3), 470-480.

Osam, M. U., Wegwu, M. O., and Uwakwe, A. A. (2011). The Omoku old pipeline oil spill: Total hydrocarbon content of affected soils and the impact on the nutritive value of food crops. *Archives of Applied Science Research*, *3*(3), 514-521.

Patrick-Iwuanyanwu, K. C., and Wegwu, M. O. (2008). Prevention of carbon tetrachloride (CCl4)-induced liver damage in rats by Acanthus montanus. *Asian J. Biochem*, *3*(4), 213.

Patrick-Iwuanyanwu, K. C., Onyeike, E. N., and Wegwu, M. O. (2010). Hepatoprotective effects of methanolic extract and fractions of African mistletoe Tapinanthus bangwensis (Engl. and K. Krause) from Nigeria. *EXCLI journal*, *9*, 187.

Patrick-Iwuanyanwu, K. C., Wegwu, M. O., and Ayalogu, E. O. (2007). Prevention of CCI4-induced liver damage by ginger, garlic and vitamin E. *Pak J Biol Sci [Internet]*, *10*(4), 617-21.

Patrick-Iwuanyanwu, K. C., Wegwu, M. O., and Okiyi, J. K. (2010). Hepatoprotective effects of African locust bean (Parkia clappertoniana) and negro pepper (Xylopia aethiopica) in

CCl4-induced liver damage in wistar albino rats. *Int J Pharmacol*, *6*, 744-9.

Ramanathan, V., and Carmichael, G. (2008). Global and regional climate changes due to black carbon. *Nature geoscience*, *1*(4), 221.

Ramanathan, V., and Carmichael, G. (2008). Global and regional climate changes due to black carbon. *Nature geoscience*, *1*(4), 221.

Satyanarayana, U. and Chakrapani, U. (2015) Biochemistry 4th ed. Reed elseviers india private limited Thompson press India limited. India

Thorsteunson, T. and Thordanssan, T. … (1968) Polycyclic Aromatic Hydrocarbons in sninged meat cancer ball. 21:390

Ubajakwe, C. O. (2019). Production of Water hyacinth source organic manure augmented with Cow dung . B.Sc. Project, University of Port Harcourt, Nigeria.

USEPA (United States Environmental Protection Agency), (1977). Air quality criteria for Lead. EPA. Rep. EPA. 60018-77-017.

Vallee, B. L., and Ulmer, D. D. (1972). Biochemical effects of mercury, cadmium, and lead. *Annual review of biochemistry*, *41*(1), 91-128.

Vanguard News, 2018.

Wegwu, M. O. and Sule, O. J. (2006). Measurement of gases, Suspended matter and metals in an industrial urban area of Nigeria. JNES, 3(1and2); 126-133

Wegwu, M. O., and Akaninwor, J. O. (2006). Assessment of Heavy-Metal Profile of the New Calabar River and Its Impact on Juvenile Clarias gariepinus. *Chemistry and biodiversity*, *3*(1), 79-87.

Wegwu, M. O., and Didia, B. C. (2007). Hepatoprotective effects of Garcinia kola seed against hepatotoxicity induced by carbon tetrachloride in rats. *Biokemistri*, *19*(1).

Wegwu, M. O., and Omeodu, S. I. (2010). Trace metal contents of selected seeds and vegetables from oil producing areas of Nigeria. *Chemistry and biodiversity*, *7*(7), 1737-1744.

Wegwu, M. O., and Wigwe, I. A. (2006). Trace-Metal Contamination of the African Giant Land Snail Archachatina

marginata from Southern Nigeria. *Chemistry and biodiversity*, *3*(1), 88-93.

Wegwu, M. O., Ayalogu, E. O., and Sule, O. J. (2005). Anti-oxidant protective effects of Cassia alata in rats exposed to carbon tetrachloride. *Journal of Applied Sciences and Environmental Management*, *9*(3), 77-80.

Wegwu, M. O., Uwakwe, A. A., and Anabi, M. A. (2010). Efficacy of enhanced natural attenuation (land farming) technique in the remediation of crude oil-polluted agricultural land. *Arch Appl Sci Res*, *2*(2), 431-442.

WEGWU, O. (1999). Seasonal variations of pollutants in some areas of the Niger Delta and their toxicity on some aquatic fauna.

Whitney, E. N., and Rolfes, S. R. (2002). Understanding nutrition 9th Edition. *USA. RR Donnelley/Willard*.

Wopara, I; Uwakwe, A. A; Wegwu, M. O. (2019). Effect of combined root extract of sphenocentrum jollyanum and Baphia nitida on some lipid profile indices in male wistar Albino rats. International journal of research and scientific innovation 6(4): 2321-2705

PROFESSOR MATTHEW OWHONDA WEGWU
BSc. (*Hons*), M.Sc, Ph.D (*UniPort*), *MSOT FIPMD, JP*

Professor Matthew Owhonda Wegwu was born in 1968 into the family of Chief and Mrs *Akaruknuga* Wegwu of Choba, Akpor Kingdom in present-day Obio/Akpor Local Government Area of Rivers State. His educational career commenced at State School, Choba, from where he obtained the First School Leaving Certificate (FSLC) in 1978.

Fired by his success at the primary level of education, the young Matthew enrolled into the famous Akpor Grammar School Ozuoba, located at the ancestral headquarters of Akpor kingdom, where he obtained the West African School Certificate (WASC). From then on, Matthew set his eyes on ascending the educational ladder to the pinnacle of his career. Professor Wegwu has not looked back since then and the harvest has been bountiful on all fronts.

Professor Matthew Wegwu is one hundred percent local content, having obtained all his degrees—Bachelor of Science (BSc.), Master of Science (MSc.) and Doctor of Philosophy (PhD) from the University of Port Harcourt—popularly known as Unique UniPort. The University literally came to Professor Wegwu's doorstep in the then sleepy Choba community, thus, making it easier for him and

many of his kinsmen and women to obtain higher education in the neighbourhood, without having to worry about the high cost of travelling outside Rivers State to receive quality higher education. In scientific term, Professor Wegwu can rightly be described as an "endemic species" in the University of Port Harcourt located in his home town.

Following his graduation in the Faculty of Science, Professor Wegwu joined the Department of Biochemistry, Faculty of Science, as Lecturer II in 1999. He has given the University a very distinguished service without blemish in different capacities. Some of the positions he held included Associate Dean of Student Affairs (2006–2008), Dean, Student Affairs (2008-2012), Director of Special Projects in the Office of the Vice Chancellor (2012-2016), and Head of the Department of Biochemistry (2013-2015).

Professor Wegwu currently serves as the pioneer Chairman of the Sports Complex Management Committee and pioneer Chairman of the Academic Board of the University of Port Harcourt Sports Institute. In these capacities, Professor Wegwu has played and continues to play critical service roles in sports development in the University. His valued partnership with the enigmatic Director of the University's Sports Institute, Professor Ken Anugweje, Professor Wegwu has produced six NUGA and four WAUG championships for the University of Port Harcourt—dating back to 2004, when UniPort hosted and won the—NUGA games in style. Along with Professor Anugweje, Professor Wegwu has taken the all conquering *Team UniPort* athletes through a scientifically verifiable diet-based training that has made the University the number one sporting destination in Nigeria, Africa and beyond.

A committed Unionist and fighter for good causes, Professor Matthew Wegwu was a Member of the National Political Committee of the Academic Staff Union of Universities (ASUU) from 2006 to 2010. Between 2005 and 2010, Professor Wegwu served as Internal Auditor of the University of Port Harcourt Branch of ASUU, where he left a glittering record of service.

A truly detribalised Nigerian in word and in deed and a dedicated Member of the *Seventh Day Adventists*, Professor Wegwu treats every woman, man and child as a queen or king, without compromising the principles he deeply believes in and propagates, either in the line of duty or in his personal life. Professor Wegwu is known to have entirely sponsored the education of indigent students who are unable to realise their dream of attaining quality tertiary education. Professor Wegwu's uncommon philanthropy touches relations, students, acquaintances and total strangers alike without discrimination in pursuit of his firm belief that everybody deserves a chance, irrespective of their circumstance of birth or social status.

Professor Wegwu is endowed with the rare gift of finding creative solutions to seemingly impossible problems. It would be recalled for instance, that it was in his tenure as Acting Dean of Student Affairs that the once dreaded students' fortress known as *Aluta House* at the University Park, which instilled fear in successive University administrations ceased to exist without raising tension on campus—all thanks to his strategic thinking and managerial acumen.

Also, the dismantling and final disappearance of "personal self-contained flats"—known as *cubicles* in the hostels happened during Professor Wegwu's eventful tenure. These positive developments happened without the usual violent *Aluta* agitations that characterised previous half-hearted efforts aimed at evacuating the heavily armed and fortified *Aluta House,* occupied by urban notorious terrorists, who masqueraded as "students" of the University of Port Harcourt at the time. Everybody had warned Professor Wegwu that the fortress could not be evacuated without dire consequences; but he accomplished the seemingly daunting task with panache.

On the academic front, *Owhor Dikne* (as today's Inaugural Lecturer is fondly called by his kinsmen and admirers in Akpor Kingdom), has over 85 publications on his bookshelf and still counting. Majority of his publications are in high-impact peer-reviewed

international journals. Professor Wegwu is a very productive academic in the field and the harvest has been bountiful indeed! Till date, he has successfully supervised and graduated 14 PhD candidates and 35 MSc students. Professor is a Member of the American Society of Toxicology (ASOT), the Internal Auditor of the Nigerian Society of Biochemistry and Molecular Biology (NSBMB).

This is in addition to hundreds of undergraduate students who have successfully passed through his academic supervision and direct mentorship. Some of Professor Wegwu's PhD supervisees are currently being assessed for promotion to the rank of Associate Professor. His admirable academic leadership and mentorship are well-acknowledged in and outside the University of Port Harcourt. Candidates assigned to Professor Wegwu can be sure of diligent supervision and quality dissertations and theses.

He is not all a straight-jacketed academic; Professor Wegwu is an accomplished Song Writer, Music Director and currently Associate Education Director of the Eastern Nigeria Union Conference of the *Seventh Day Adventists*. Professor Wegwu is married to Dr (Mrs) Blessing Wegwu and the marriage is blessed with children.

Let me announce to this distinguished audience that that bundle of little joy who drew his first breath at birth in the Wegwu household in 1968; that little toddler who defied gravity and took his first uncertain footsteps around his father's compound; that young lad who explored his immediate environment with the force of energy and commenced his foundational education in the local primary school and attended secondary school two communities away from where we are seated today; that intellectually curious young man who enrolled into the Department of Biochemistry in the Faculty of Science as an undergraduate to increase his knowledge; that determined scholar who attained the pinnacle of his intellectual ambition when he obtained the doctoral degree in record time and joined the academy as a Lecturer II in 1999; that curious and persistent academic and avid researcher who announced his arrival with several quality publications and rose through the ranks to become a Nutritionist, Toxicologist and Environmental Biochemist; yes that full-blown academic is standing before all of us this

afternoon to tell us what he has been professing in the hallowed corridors of the academia as a Professor in the University of Port Harcourt, and his future research focus.

Distinguished Ladies and Gentlemen, I present to you, an accomplished Nutritionist; a seasoned Toxicologist; a practising Environmental Biochemist; a true grassroots man with known political label; an Educationist and Family Man, PROFESSOR MATTHEW OWHONDA WEGWU, to deliver the 163rd Inaugural Lecture of the University of Port Harcourt entitled: *THE POWER OF FOOD.*

Ndowa E. S. Lale
Vice Chancellor