BIOGRAPHY OF THE AUTHOR

Prof. (Mrs.) Clara Leyibo Igeleke is a Professor of Phytopathogenic Microbiology in the Department of Biological Sciences, Faculty of Science, Benson Idahosa University, Benin City. She was born into the family of late Chief Edmund Olufusi Okotie and Princess Abigail Tebine Okotie (nêe Emiko) in Warri, Delta State. She attended St. Andrews Primary School, Warri (1960 – 1965). She had her secondary school education at Anglican Girls' Grammar School (A.G.G.S.), Benin City (now Adesuwa Girls Grammar School) from 1966 to 1970 and obtained her West African School Certificate in grade one. While in school she was a Federal Government Scholar. She later proceeded to the University of Benin, Benin City in 1971 for her first degree, and graduated with a B.Sc (Hons) in Microbiology in 1975.

After her National Youth Service in 1976, she joined the services of the Rubber Research Institute of Nigeria, Iyanomo, near Benin City in December, 1976 as a Pupil Research Officer. She was later sent on in-service training to the University of Ibadan, Ibadan where she obtained her M.Sc in Agricultural Biology in 1980. She returned to the Rubber Research Institute of Nigeria, Iyanomo and rose to the position of Chief Research Officer and Head of Department of the Plant Pathology/Microbiology Division (1990 to 1995). She joined the services of the then Christian Faith University, now Benson Idahosa University, as the 1st Substantive Academic Director from 1995 – 1997, and the co-ordinator of the programmes for

Basic and Applied Sciences from 1997 – 2002. When the school was licenced to operate as a University in 2002, she was appointed a Senior Lecturer and the first Acting Dean of the Faculty of Basic and Applied Sciences (2002 – 2003). She also served as the first Head of Department of Basic and Applied Sciences (2002 – 2008).

She was later appointed as the first Dean of Students Affairs in Benson Idahosa University (2003 – 2004).

In Benson Idahosa University, she rose from the position of Senior Lecturer to a Professor in 2012. She is a member of the University Senate from inception up to date and Senate Representative to the University Council from 2014 to date. She has served in various committees of the University both as Chairman and member. Currently she is the Chairman of the University Committee on Spiritual Culture.

Prof. (Mrs.) Igeleke is the recipient of the following awards: Midwestern Government Scholarship Award for bright students of Secondary Schools (1966 – 1970), Bendel State Government Scholarship for High Education (1972 – 1973), Federal Government Scholarship for Higher Education (1973 – 1975). Excellence in Workmanship of the Rotary Club of Benin (1989), University of Benin Alumini Association (2018).

Prof. (Mrs.) Igeleke is a member of several learned societies, viz: American Society of Microbiology (ASM), Society for Applied Microbiology (SFAM), Nigerian Society for Microbiology (NSM), Nigerian Society for Plant Protection (NSPP), Horticultural Society for Women Scientists (NSWS),

National Association of Women Academics (NAWACS), Nigerian Society for Experimental Biology (NISEB) and Organization for Women in Science for the Developing World (OWSD BIU Chapter).

Prof. (Mrs.) Clara Igeleke is a seasoned scholar, researcher and a respected academic she has several publications in reputable National and International academic journals.

She has rendered a lot of services to other bodies outside BIU. She was a Member of the Pioneering Committee on the Development of the Academic Brief for Benson Idahosa University, Benin City (1992 – 1994), Member of the Committee on the Development of the National Agricultural Strategic Plan for Nigeria (1994 – 1996), Member of the Caleb University Actualization Committee, Lagos (June – September, 2007), Member of Itsekiri Education Trust Fund, Warri, Delta State (2012 to date), and Member of the Concerned Iwere people for Higher Education (CIPHEF): promoters of Uniwarri Project Planning and Implementation Committee (2016 to date).

Prof. (Mrs.) Clara Igeleke is a Christian and an ordained minister of the Church of God Mission Int. Inc. She is happily married to Engineer Solomon Abiodun Igeleke and they are blessed with three wonderful children, namely Precious Ofioritse Olohireme, Marvelous, Oritseseundede Olihita and Emmanuel Eyituoye Igeleke, after twenty years of faithfully waiting on the Lord for the fruit of the womb. A testimony that the Almighty God never fails those who put their trust on Him. Glory be to God!!!

THE 8TH INAUGURAL LECTURE

MICROBES; THE GOOD, THE BAD AND THE FASCINATING: MAN THE EFFECTIVE MANAGER

PROFESSOR CLARA LEYIBO IGELEKE
B.Sc Microbiology, University of Benin, 1975
M.Sc. Agricultural Biology, University of Ibadan, Ibadan, 1980
Ph.D Microbiology, University of Benin, 2000.

Professor of Phytopathogenic Microbiology
Inaugural Lecture Series 08
Benson Idahosa University
Benin City, Nigeria

NOVEMBER 26TH, 2019

DEDICATION

This work is dedicated to God Almighty, the author of life, the Alpha and the Omega, the beginning and the end of all things, to Jesus Christ my Saviour and Redeemer and to the Holy Spirit my Director, Enabler, Strengthener and Companion. To Him be all glory and praise forever and ever. Amen.

TABLE OF CONTENTS

5.0 **PART TWO**

PROTOCOLS

The Chancellor
The President
Members of Benson Idahosa University Governing Council
The Vice Chancellor
The Registrar
The University Librarian
The Bursar
Dean, School of Postgraduate Studies
Deans of Faculties and Student Affairs
Director of Campus Life
Professors and Members of Senate
Heads of Departments and Units
Highly respected Academic and Non-Academic Staff
My Lords Spiritual and Temporal
Distinguished Invited Guests
Gentlemen of the Press
Great Students of Benson Idahosa University
Ladies and Gentlemen

I welcome you all to the 8th Inaugural Lecture Series of this great University.

PREAMBLE

I wish to thank God Almighty for the grace given to me today to deliver the 8th Inaugural Lecture Series of this great University. Eight is for completeness and a new beginning. I am also grateful to you all for finding time to honour the invitation to be at this lecture. I feel greatly honoured by your presence.

This is the 1st lecture in the Inaugural Lecture Series of Benson Idahosa University to be delivered by a female Professor. It is therefore with a deep sense of humility and gratitude to God, that I stand on this highly exalted podium to give this lecture. I thank the immediate past Vice Chancellor, Professor Ernest Izevbigie who kept prodding me to give my Inaugural Lecture immediately after Professor Sam Guobadia, the present Vice Chancellor gave his Inaugural Lecture. I earnestly thank them both for the opportunity.

I wish to state that by the special grace of God, I am the first female Professor in Benson Idahosa University and feel highly elated to be the 1st female Professor to deliver her Inaugural Lecture. By the special grace of God, this is also the first Inaugural Lecture Series from the newly established Faculty of Science in Benson Idahosa University, the 1st from the Department of Biological Sciences and the 1st from the Microbiology Unit. To God be all the

glory!!!

Inaugural Lectures are usually given by Professors as a lecture to mark their elevation of status to the professorial cadre in the university. They are lectures meant to;

- Sustain the academic atmosphere and flavours, coming from varied disciplines
- Bring town and gown together under a relaxed but serious academic atmosphere to make some profound statements that are relevant to the society and

Share knowledge and motivation amongst the majority of the audience, young academics and the students who must carry the academic baton on to their generation.

Therefore, it is with a great sense of humility and gratitude to God, that I stand here today to give the 8th Inaugural Lecture of this great University, Benson Idahosa University, titled "Microbes; The Good, the Bad and the Fascinating: Man the Effective Manager".

Mr. Vice Chancellor Sir and my distinguished audience, my lecture this afternoon will be in two parts. The part one will deal with; the good, the bad and the fascinating microorganisms: and the part two will deal with "My exploits as a Phytopathologist and how I effectively managed some phytopathological issues during my academic pursuit.

My erudite V.C., I will kick-start this treatise by quoting from the word of God the creator of all life who said in Genesis 1:26-28, the abridged version:

Vs. 26: And God said, let us make man in our image and let them have dominion over every creeping thing…….

Vs. 27: So God created man in his own image

Vs. 28: And God blessed them and God said unto them "subdue the earth and have dominion over every living thing that moves upon the earth".

The Oxford Advanced Learner's Dictionary defines the word "dominion" as "authority to rule, to control and to manage".

God has given man authority to dominate, control and manage every living thing including microbes, hence my Inaugural Lecture title. Even the seemingly bad microbes can be effectively managed to be beneficial to man.

INTRODUCTION

Microbe is another word for microorganisms, so I shall be using the two words interchangeably.

When we conceptualize microbes, the image that readily comes to mind is “dangerous elements” “disease-causing entities” “no go areas”. However, I want to pause here and ask a pertinent question; “are microbes all BAD? or put in a different form “Are microbes guilty as charged?” Microbes are not all bad, there are a lot of beneficial microbes. Indeed man cannot live without microbes.

We shall now go through the journey of Microbes; the Good, the Bad and the Fascinating: Man the Effective Manager” which is the title of my Inaugural Lecture for today.

EARLY HISTORY OF MICROBES

Before microorganisms were discovered, some investigators suspected their existence and responsibility for disease. Amongst these were, the Roman philosopher, Lucretius (about 98 – 55 B.C.) and the physician, Girolamo Fracastoro (1478 – 1553) who suggested that disease was caused by invisible living creatures. The earliest microscopic observations appear to have

been made between 1625 and 1630 on bees and weevils by the Italian, Francesco Stelluti, using a microscope. In 1665, the first drawing of a microorganism was published in Robert Hooke's Micrographia. However, the first person to publish extensive, accurate observations of microorganisms was the amateur microscopist, Antony Van Leeuwenhoek (1632 – 1723) (Prescott *et al.,* 2008).

WHAT ARE MICROBES

Microbes are life organisms which are too small to be clearly perceived by the unaided human eye. If an object has a diameter of less than 1 millimeter, the human eye cannot perceive it. Therefore organisms with a diameter of 1mm or less are microorganisms and fall into the broad domain of microbiology.

Microorganisms have a wide taxonomic distribution; they include bacteria, fungi, viruses, algae, protozoa. The very existence of this microbial world was unknown to mankind until the invention of microscopes at the beginning of the 17th century. This invention of microscopes opened the biological realm of the very small organisms, to systematic scientific exploration.

Microorganisms are ubiquitous, meaning that they are found everywhere; in and on humans, animals, plants and inanimate objects. Most parts of human, animal and plant body carry different types of microorganisms. Some of these microorganisms are natural residents of these human, animal or plant parts, living in harmony with the organism. When there is this harmony, the consciousness of their presence is not noticed. However, when there is a disharmony, the microorganisms may revolt and cause disease.

THE SCOPE AND RELEVANCE OF MICROBIOLOGY

Microbiology has both basic and applied aspects. The basic aspects are concerned with the biology of microorganisms themselves and include such fields as bacteriology, virology, mycology, phycology or algology, protozoology, microbial cytology and physiology, microbial genetics and molecular biology, microbial ecology and microbial taxonomy. The applied aspects are concerned with practical problems such as disease, water and wastewater treatment, food spoilage, food production, phytopathology, crop protection and industrial uses of microbes (Fig. 1). It is important to note that the basic and applied aspects of microbiology are intertwined. Basic research is often conducted in applied fields and applications often arise out of basic research.

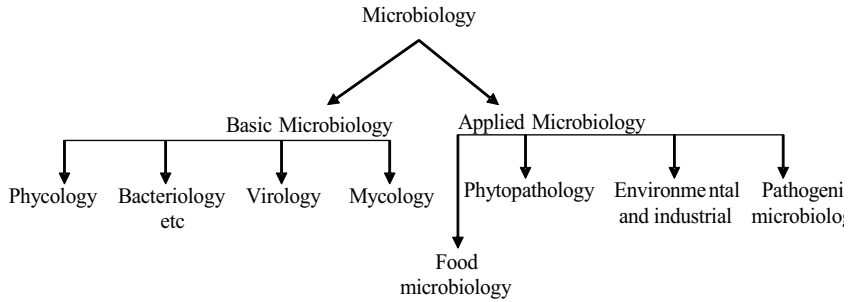


Fig. 1: Branches of Microbiology

THE FIRST PART OF THE LECTURE

THE GOOD MICROBES

Microorganisms have always had enormous impact on the lives of all living organisms, including humans. Only a small percentage of microbes cause diseases, while greater percentage are beneficial to our bodies. Table 1 shows a list of some good microbes that are found in our bodies.

Table 1: Some Good Microbes that are Beneficial to our Bodies

S/N	Part of the body	Microbial species	Type of microbe
1.	Ear (outer)	*Aspergillus*	Fungus
2.	Skin	*Candida*	Fungus
3.	Small intestine	*Clostridium*	Bacterium
4.	Intestines	*Escherichia coli*	Bacterium
5.	Vagina	*Gardnesella*	Bacterium
6.	Stomach	Lactobacillus	Bacterium
7.	Urethra	Mycobacterium	Bacterium
8.	Nose	Staphylococcus aureus	Bacterium
9.	Eye	Staphylococcus *epidermis*	Bacterium
10.	Mouth	Streptococcus salivarius	Bacterium
11.	Large intestine	*Trichomonashominis*	Protozoa

Source: http://www.niaid.nih.gov/publications

These are usually harmless microbes, some of which help keep our bodies functioning normally. If their numbers become unbalanced, however, these microbes may make us sick. Most are bacteria, few fungi and others protozoa.

Few other examples of microbial activities will buttress my point that microbes are beneficial to man.

1. Vital Activities of Microbes

The activities of microbes are responsible for the survival of all living organisms including humans. For example, nitrogen which is an essential part of most important molecules in human bodies, such as nucleic acids and proteins, is the most common gas in the atmosphere, but neither plants nor animals can use nitrogen gas, without certain bacteria that can covert N_2 in air into a chemical form that plants can use, this is what makes life to exist on earth.

Secondly, all animals including humans require oxygen to breathe. On land, plants are important producers of 0_2, but considering all land and aquatic environment, microbes are primarily responsible for continually replenishing the supply of 0_2. (Nester *et al.,* 2004).

APPLICATIONS OF MICROBIOLOGY

In addition to the crucial roles played by microorganisms in maintaining all life on earth, they have also made life more comfortable for humans. Biotechnology (a branch of microbiology) is the application of biology to solve practical problems and produce useful products economically (Prescott *et al.,* 2008).

Microorganisms as Food

Many species of microorganisms are used as food sources or supplements. Examples are fungi, algae and bacteria.

Mushrooms:- Mushrooms which are fungi species are excellent food sources and are used as additives to different diets and menu. Edible mushrooms come in a range of shapes, sizes, textures, colors, flavours, scents and densities.

Plate 1: Some species of mushrooms

Mushrooms contain varying amounts of trace minerals and they represent one of the world's greatest untapped resources of nutritious foods. They are rich in protein, minerals and vitamins and they contain an abundance of the essential amino acid, lysine (Chang, 1980). Mushrooms therefore can be a good supplement to cereals.

Yeast: Yeasts are fungi species which are used for fermentation. Fermented beverages are produced through the process of fermentation, which is a metabolic process by which yeast converts sugar to ethanol.

Fig. 2 shows some examples of fermentation processes:

- Fermentation of fruit juice results in wine. Most wine are made from grapes
- Beer and ale are produced by the fermentation of malted grains
- Distilled beverages are produced by concentrating alcohol by distillation.

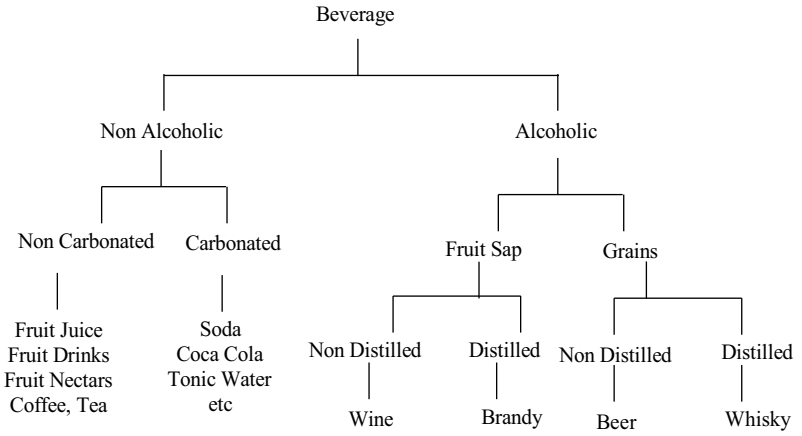


Fig 2: Fermentation of Alcoholic and Non-Alcoholic Beverages

Bread Baking

Bread is the product of baking a mixture of flour, water, salt yeast (a fungus) and other ingredients. The basic process involves mixing of ingredients until the flour is converted into a stiff paste or dough, followed by baking the dough into a loaf.

Algae:-Different species of algae are eaten as food or used as food supplements. Few examples are as follows; Spirulina (*Arthrospira platensis*) is a blue-green microalgae with a long history as a food source. Spirulina is high in protein and other nutrients, finding use as a food supplement and also used for patients with malnutrition.

a: Growing spirulina plant

b: Spirulina found on gardens and ponds

c: Spirulina powder

d: Spirulina processed into tablets

e: Spirulina capsules taken as food supplements

f: Spirulina powder mixed with water and taken as superfood

Plate 2: Spirulina plants processed

Borowitzka (1998) reported that macroalgae have been used as human food for thousands of years in all parts of the world. The commonly consumed macroalgae include the red algae *Porphyra, Asparagopsis taxiformis,* and the kelps.

a: Red algae: Porphyra sp.

b: Red algae sp.

c: Brown algae sp. Seaweed

d: The kelp in the coal mine

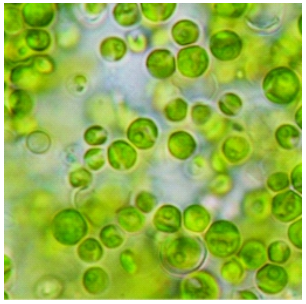
Plate 3: Species of Red and Brown Algae and the Kelps

Source: Google

Several macroalgae are also the source of hydrocolloids such as agar-agar which are widely used in the food industry as stabilizers, thickeners and gelling agents.

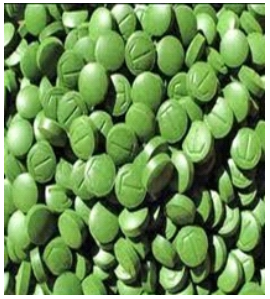
Chlorella is a fresh water algae that is rich in nutrients and can be used as nutritional supplements and medicine.

Chlorella is regarded as a superfood that boosts energy, supports fat loss and helps detox heavy metals like lead and mercury from the body. Studies have shown that chlorella benefits the entire body by supporting healthy hormonal function, promoting cardiovascular health, helping to negate the effects of chemotherapy and radiation, lowering blood pressure and cholescterol, and aiding in the detoxification of our bodies (Cousens, 2007; Manisha and Chaugule 2014).



a: Chlorella sp.

b: Chlorella powder and drink



c: Chlorella tablets

Plate 4: Photograph of Chorella

Bacteria

Some bacteria species are very important in food manufacturing. Lactobacillus species are important in this aspect. Bacterial food cultures are responsible for the aroma, taste and texture of cheese and fermented milk products such as yogurts and dough.

Examples of some bacteria used in the diary industry include:

a. Acidophilus milk which is made with *Lactobacillus acidophilus*
b. Butter, made from pasteurized cream, to which a lactic acid starter has been added
c. Cheese, often made with *Streptococcus and Lactobacillus species*.

Milk Production

Virtually every human culture that has domesticated milk – producing animals such as cows and goats has also developed the technology to ferment milk to produce foods such as yogurt, cheese, buttermilk, etc. Today, the bacteria added to some fermented milk products are touted by nutritionists as protecting against intestinal

infections and bowel cancer – this is the field of probiotics. (Prescott *et al.,* 2008). Probiotics are live bacteria and yeasts that are good for our health, especially our digestive system. We usually think of these as germs that cause diseases. Our bodies are full of bacteria, both good and bad. The good bacteria help our bodies to overcome the bad ones. Probiotics are good and helpful bacteria that help to keep our guts healthy.

Bioremediation: Is the use of microbes to degrade environmental pollutants such as DDT, PCB, TCE (trichloroethylene and many others). These toxic wastes have been detected in soil, waste water and underground water (boreholes). Microbes have also being used to degrade oil, assist in the cleanup of oil spills and treat radioactive wastes rendering them into less toxic or non-toxic substances.

Useful Products from Microbes

Microbes can synthesize a wide variety of different products in the course of their metabolism, many of which have great commercial value.

Few examples are enumerated below;

i. Antibiotics used for treating diseases. Examples, penicillin, streptomycin, etc.
ii. Amino acids used as dietary supplements
iii. Cellulose used in stereo head-sets
iv. Ethanol used for various purposes
I. Bioinsecticides used for killing insects (insect poisonous chemicals). These are environmental friendly
ii. Hydroxybutyric acid used in the manufacture of disposable diapers and plastics

Genomics is the science of sequencing DNA (the unit building blocks of all living cells). Genomics gives insight into the unique characteristics of all living organisms, including humans. This has greatly improved on modern day technology.

THE BAD MICROBES

So far in this lecture, I have highlighted a few aspects of good microbes. The list is inexhaustable.

Mr. V.C. Sir and my great audience, we shall now take a peep at some sinister aspect of microbes. Two major areas will be considered in this lecture, and these are:

i. Diseases, which will include nosocomial infections (hospital acquired)
ii. Bioterrorism (use of microbes to intentionally cause death in a population)

Diseases

Microorganisms infect all living organisms ranging from humans, animals to plants resulting in diseases. Infection can occur in or on the different parts of living organisms and by different classes of microorganisms. However, I wish to remind us here that only a small percentage of microorganisms are responsible for diseases.

Human Diseases

Many human diseases are caused by bacteria. Some of the causal agents are airborne involving the respiratory system. Examples include tuberculosis, pneumonia, diphtheria, pertussis, some systemic diseases like meningitis and rheumatic fever. Other causal agents infect through direct contact involving the skin, mucous membrane or underlying tissues. Examples include leprosy, tenanus, gas gangrene, gonorrhea, syphilis, bacterial vaginosis and many others.

Some bacterial diseases can be acquired directly from animals, referred to as zoonotic diseases such as anthrax, ebola,

brucellosis, etc.

Humans also contact food-borne and water-borne diseases such as cholera, E.coli infections, Staphylococcal food poisoning, Salmonellosis, etc.

Nosocomial Infections

Nosocomial infections result from pathogens that develop within a hospital facility and are acquired by patients while still in the hospital. Besides harming patients, nosocomial infections can affect nurses, doctors, visitors, sales people and anyone who has contact with the hospital. Most nosocomial infections become apparent while patients are still hospitalized, while others may occur after patients have been discharged.

About 10% of all hospital patients acquire some type of nosocomial infection. About 40 million people are admitted to hospitals annually, which results in about 2 to 4 million people developing an infection they did not have upon entering the hospital (Prescott *et al.,* 2008). Thus nosocomial infections represent a significant proportion of all infectious diseases acquired by humans.

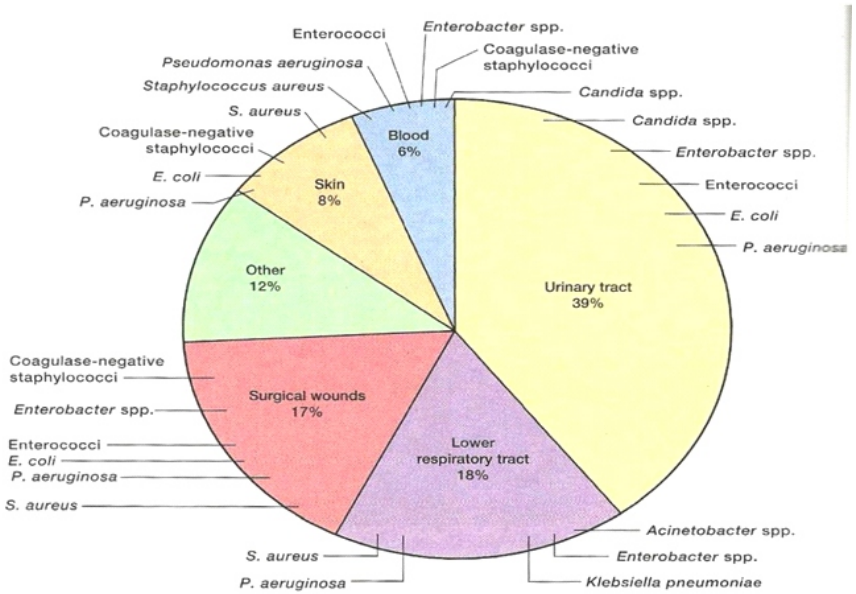


Fig. 3: Relative frequency of occurrence of different types of Nosocomial infections by body site.

BIOTERRORISM

Bioterrorism is the intentional or threatened use of microbes or their toxins to produce death or disease in humans, animals and plants. The modern use of biological agents is a reality.

Bioterrorism agents are separated into three categories by the Centre for Disease Control (CDC), depending on their ease of transmission and severity of effect. (Table 2)

Table 2: Pathogens and Toxins defined by CDC as agents for bioterrorism

Category	Definition	Examples
A: Highest Risk	• Easily transmitted from person to person • High death rates (mortality) • Could cause public panic • Require special public health preparedness response	Anthrax Botulism Pneumonic plague Smallpox Tularemia Ebola Viral hemorrhagic Fevers
Category B: Next Highest Risk	• Moderately easy to spread • Moderate illness rates (morbidity) • Low death rates (mortality) • Response would require specific enhancements of existing laboratory capacity and enhanced disease monitoring	Brucellosis Q. fever Typhus Food and water borne pathogens
Category C: Third Highest Risk – Emerging Pathogens that could be engineered for mass dissemination	• Easily available and spread • Potential for high illness (morbidity) and death (mortality) rate and major health impact	Hantavirus Yellow fever Multidrug-resistant Mycobacterium Tuberculosis

Source: http://emergency.cdc.gov.agent/agentlist -category.asp Accessed 5/9/18

The list of biological agents that could pose great public health risk in the event of a bioterrorist attack includes viruses, bacteria, fungi, parasites and toxins. Biological agents can be chosen as a means of localized attack, known as biocrime or for mass destruction known as bioterrorism. They are mostly invisible, odorless, tasteless and difficult to detect.

Among weapons of mass destruction, biological weapons can be more destructive than chemical weapons, including nerve

gas. They can be as devastating as a nuclear explosion. For example, a few kilograms of anthrax could kill as many people as a Hiroshima size nuclear bomb. The cheering news, however, is that in 1925, The Geneva Protocol signed an International Law prohibiting the use of biological weapons as weapon of destruction.

THE FASCINATING MICROBES

There are fascinating microorganisms amongst all microbial species. We shall now take a look at some few examples.

FASCINATING BACTERIA SPECIES

Bacteria are fascinating microbes. As tiny as they are they can communicate with each other and coordinate their actions. Some can survive in extreme environmental conditions which would kill humans, some can produce light and some can detect and respond to magnetic fields. Some species are predators that attack other bacteria species.

Some bacteria live in extreme environments and are known as extremophiles. Such extreme environments include those with very high or very low temperatures, those with high pressure, salinity, acidity, alkalinity, high radiation level or those with no oxygen.

Some examples of extremophiles;

i) **Halophilic** bacteria live in salty environments. *Salinibacter ruber* is a rod-shaped, orange-red bacterium that grows best when it is living in ponds containing 20 to 30% salt (seawater contains only about 3.5% salt by weight). Some halophilic bacteria survive very well in water that is almost saturated with salt, such as the Dead Sea, Salt Lakes and natural brines.

ii) **Thermophilic** bacteria live in hot environments. Hyperthemophilic bacteria live in extremely hot temperatures ranging from 140^0 – 180^0F. Bacteria living around hydro-thermal vents in oceans require a temperature of at least 194^0F in order to survive. A hydrothermal vent is a crack in the Earth's surface from which geothermally heated water emerges. Some archaeons survive around deep water vents at a temperature greater than 100^0C (212^0F). In 2013, scientists discovered a bacterium called *Planococcus*

i) *halocryophilus* living in permafrost in the High Artic. The bacterium reproduces at -15^0C and is able to survive at a temperature of -25^0C. *Deinococcus radiodurans* (known as the world's toughest bacterium can survive cold, acid, dehydration, vaccum and radiation a thousand times stronger than a human can withstand.

ii) **Bioluminescent** bacteria are found in sea water, in sediments on the ocean bottom, on the bodies of dead and decaying marine animals and inside ocean creatures. Some marine animals have specialized light organs which contain bioluminescent bacteria

iii) **Quorum Sensing:-** Quorum sensing is cell to cell communication in bacteria. Bacteria communicate with one another using chemical signal molecules. As in higher organisms, the information supplied by these molecules is critical for synchronizing the activities of large groups of cells.

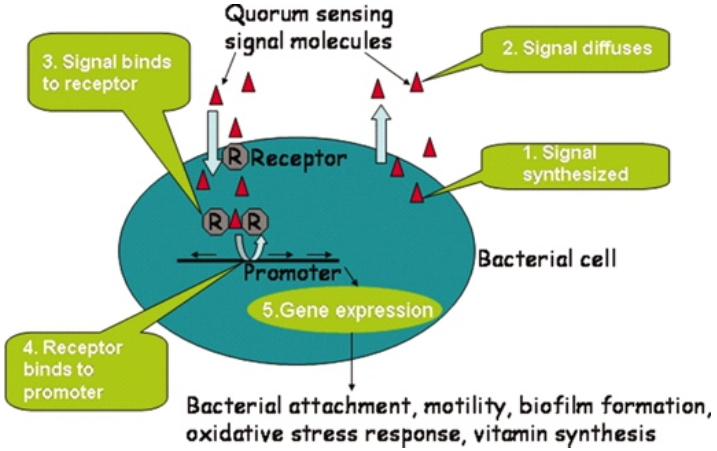
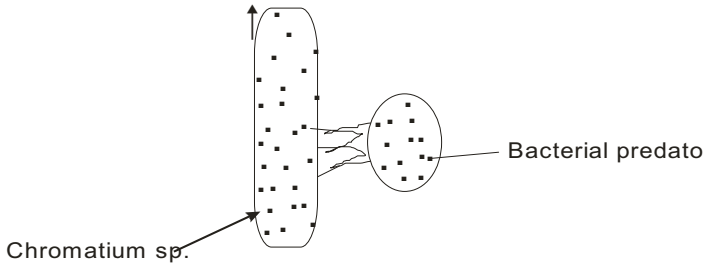


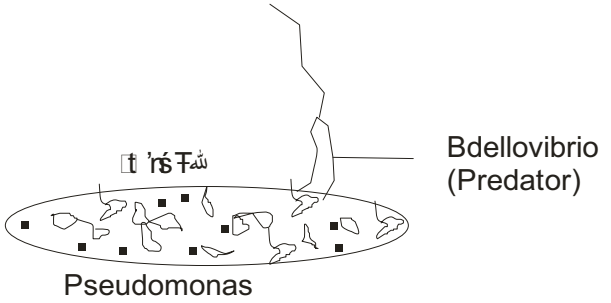
Fig. 4: Novel bacterial "language" discovered

i) **Predatory Bacteria:** Predatory bacteria attack and kill other bacteria. These type of bacteria are widespread in aquatic habitats and in soil. Two examples are described below;

a. *Vampirococcus* lives in freshwater lakes with high sulphur content. It attaches to a much larger purple bacterium called *Chromatium* and absorbs the liquid from its prey, killing it's prey. A process similar to the blood sucking vampires, hence its name.



a. *Bdellovibrio bacteriovorus* attaches to another bacterium and then enters its prey instead of staying on the outside. It produces enzymes to digest the outer covering of its prey and drills its way into the prey. It reproduces inside its prey and then destroys it.



Some researchers are investigating the possibility of using predatory bacteria to destroy bacteria that are harmful to humans. It is very possible that there are amazing abilities of bacteria still to be discovered and some of these abilities may improve human lives.

FASCINATING FUNGI

Fungi are abundant worldwide, performing various essential roles which include the decomposition of organic matter and nutrient recycling and exchange. They have long been used as a direct source of food, such as mushrooms and truffles, as a leavening agent for bread and in fermentation of various food products such as wine, beer and soy source (Wikipedia).

Below are photographs of some fascinating fungi;

Plate 5: Blue Milk Mushroom (*Lactarius indigo*)

Source: Dan Molter

Lactarius indigo, commonly known as indigo milk cap or the blue milk mushroom, is a species of agaric fungus in the family Russulaceae. It is an edible mushroom, widely distributed and sold in many rural markets.

Plate 6: Bitter Oyster (*Panellus stipticus*)

Source: Ylem

Panellus stipticus is commonly known as the bitter oyster. It grows in groups or dense overlapping clusters on the logs or trunks of deciduous trees. It is one of several dozen species that is bioluminescent (that is; produces light in darkness). The luminescence is localized to the edges of the gills and the junction of the gills with the stem and cap (Wikipedia.org).

1. Golden Jelly Fungus (*Tremella mesenterica*), commonly known as yellow brain, or witches' butter. Although considered bland and flavourless, it is edible. It produces carbohydrates with various biological activities.

Plate 7: Golden Jelly Fungus (*Tremella*

Source: Dan Molter

2. Coral Fungi (*Clavulinopsis coralline rosacea*) is in the Agaricales. They are commonly known as coral fungi due to

their resemblance to aquatic coral. Other common names are sphagetti mushroom or finger fungi.

Plate 8: Coral Fungi (*Clavulinopsis coralline rosacea*)

Source: Susan Spann

3. Fly Agaric (*Amanita muscaria*) is commonly known as the fly agaric or fly amanita. It is a poisonous and phycho-psychoactive fungus. It is noted for its hallucinogenic properties.

Plate 9: Fly Agaric (*Amanita muscaria*)

Source: Harrison

4. Ceasars Mushroom (*Amanita caesarea*) is a highly regarded edible mushroom in the genus Amanita. Organic acids can be

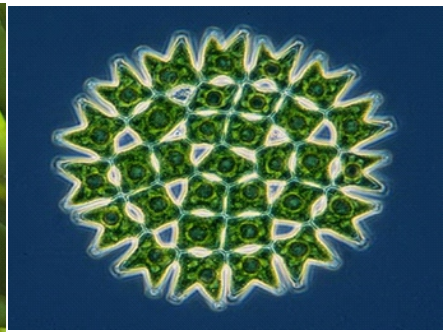
Plate 10: Ceasars Mushroom (*Amanita caesarea*)

Source: Dan Molter

Fascinating Algae

When many of us think about algae, an image of the gross scum floating in fish tanks and ponds often come to our mind. But algae does not exist to be a pollutant. In fact, they do the exact opposite. Algae are amongst important organisms on our planet earth.

a: Halimeda Incressata Marine



b: Pediastrum, the little star in the pond

Plate 11: Halimeda Incressata Marine Macroalgae

Several wastewater treatment facilities use algae to reduce the need for dangerous chemicals and some power plants also use algae to lower emissions of carbon dioxide. In some parts of the Indian Ocean, the sea surface lights up at night with such intense brightness that one can read a newspaper. *Dinoflagellata,* tiny sea algae is responsible for such lights.

Plate 12: Dinophyta sp.

Fascinating Protozoa

Protozoa are single-celled eukaryotes that commonly show characteristics associated with animals, notably mobility and heterotrophy.

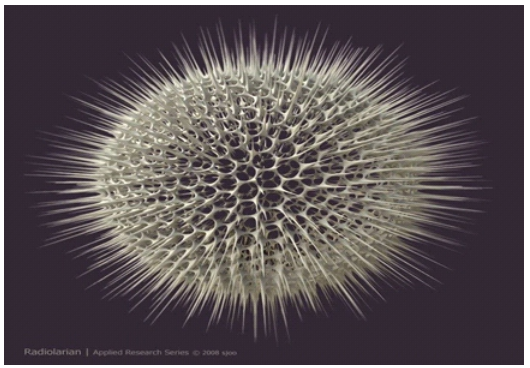


Plate 13: *Radiolaria sp.*

Plate 14: Tardigrades: The vicious, fascinating world of soil protozoan

Source: en.wikipedia.org

MY ACADEMIC PURSUIT AND HOW I BECAME A PHYTOPATHOGENIC MICROBIOLOGIST

My academic journey started, when after graduating from the University of Benin, Benin City with a B.Sc Microbiology, I was employed as a Pupil Research Officer at the Rubber Research Institute of Nigeria, Iyanomo, Benin City. I was deployed to the Microbiology/Plant Pathology Division.

At the Institute's Library, I read about rubber as a crop and the associated pathological problems. That was where I developed interest in Phytopathology.

Shortly after, I was on in-service training for my Master's degree at the University of Ibadan, (UI) Ibadan, and was admitted into the Agricultural Biology Department. On completion of my Masters programme, I quickly returned to Benin City to the waiting arms of my beloved husband, Engineer Solomon Igeleke who waited patiently for me to complete my Masters degree, having left him for UI barely a month after our marriage.

On my return to Benin City, I enrolled at the University of Benin for my Ph.D degree programme. Being an aluminus, I was glad to return to the warm tutelage of my academic father and mentor, Prof. D.K.G. Ayanru.

MY JOURNEY AS A PHYTOPATHOLOGIST

Phytopathology is the scientific study of plant diseases caused by pathogens and environmental conditions, diagnosing and managing of plant diseases and strategizing effective, integrated disease control measures. (Wikipedia; Igeleke; 2018).

The interests of Phytopathologists are varied amongst which are:

i. Health and economic productivity of growing plants

ii. Evaluation and strategic resolution of plant diseases

iii. Healthy and sufficient food production leading to a healthy nation

iv. The sustainability of crop production leading to the sustainability of any country amongst others.

Achieving food security is pivotal to national development, because it serves as boost to other sectors of the Nation's economy (Akinwumi, 2018).

As a Phytopathologists, my research interests have been in three areas;

1. Phytopathology of rubber (*Hevea brasiliensis*), an economically important cash crop of Nigeria
2. Phytopathology of plantain (*Musa parasidiaca L.*) a staple food in Nigeria

3. Antimicrobial activities of some medicinal plants against some pathogenically important microorganisms (phytomedicine)

Phytopathology of Rubber

My first interest in this area was on the abnormal leaf fall of rubber. In Okhuoya *et al.,* (1984), we researched on the fungi species associated with the abnormal leaf fall and pod rot diseases of rubber (*Hevea brasiliensis*). In rubber plantations during the rainy season, rubber leaves fall from tress in large numbers defoliating the leaves drastically and reducing the economic yield of the latex (Igeleke 1980). Pozhamkandath *et al*., (2005) reported on crop loss measured in terms of latex and timber output as a result of abnormal leaf fall of rubber in India. The report indicated that the cumulative loss was

annually estimated at about 20% which was significant. Further studies isolated and identified the pathogenic organisms implicated in the abnormal leaf fall disease in Nigeria. Two organisms, *Phytophthora palmivora and Drechslera hevea* were implicated (Okhuoya *et al.,* 1984, Omorusi *et al.,* 2015). *P. palmivora* has been implicated with leaf and pod diseases in

Malaysia and Ceylon (Perries 1969 and Rao, 1975). An observation of great importance was the consistent association of *D. hevea*, the causal agent of bird's eye leaf spot, with pod rot in Nigeria. Leaves of rubber infected by this fungus may form a source of inoculum for pod infection. Infection of flowers or fruits by pathogens causes precocious abscission of young pedicels or peduncles in many plants including rubber (Hosin *et al.,* 1981). The significance of this study was that it was the first time *P. palmivora* was being identified as the causal organism of abnormal leaf fall and pod rot of rubber in Nigeria (RRIN Annual Report, 1980). Analysis of some factors affecting seed production and availability in rubber indicated biotic factors such as infection of developing fruits (Odetola *et al.,* 1986).

Pod infection translates to seed infection, if not treated. (Kuruvilla Jacob, 2015). Rubber seeds have been reported to have potential use as a source of industrial oil as well as a protein supplement for use in livestock diets (Igeleke and Omorusi, 2007; Aigbodion, 1991; Nair *et al.,* 1981). Also rubber seed oil have the potential for industrial use in the manufacture of alkyd resins for the paint industry (Aigbodion, 1991; Nair *et al.,* 1981) and in the formulation of livestock feed, printing ink, glazing putty, dermal fat-

liquor, liquid soap and hair shampoo (RRIN, 1989). The rubber seed oil, especially when refined, has been shown to have promise as a linoleic acid-rich vegetable oil (Gandhi *et al.,* 1990). The cake or meal derived from rubber seed after oil extraction (RRIN, 1985) and the undefatted rubber seed are potentially useable for livestock feeds and diet. These findings would necessitate large scale collection and storage of rubber seeds (Igeleke and Omorusi, 2007).

Estimates of rubber seed production from 200,000 ha of rubber plantations in Nigeria is about 20,000 tonnes per annual (Nwokolo, 1986). This quantity of seeds is largely wasted, as only a fraction is utilized in growing rootstock for budding, (RRIN, 1989).

Igeleke and Ekpebor (1986) evaluated fungal species associated with the deterioration of rubber seeds during storage. Predominant fungal species isolated were *Aspergillus, Collectotrichum, Helminthosporium, Penicillium, Fusarium and Rhizopus* as shown in table 3.

Table 3: Fungi Species Isolated from Rubber Seeds at the Rubber Research Institute of Nigeria (RRIN)

Fungal spp. Isolated	No of colonies per clone				
	Tjiri 16	RRIM 600	RRIM 605	PR 107	TOTAL
Helminthoporium sp	15	19	25	18	77
Collectotrichum sp	4	9	18	12	43
Penicillium	7	1	6	3	16
Aspergillus flavus	14	23	5	21	63
Aspergillus niger	2	-	2	3	07
Aspergillus funigatus	-	9	-	8	17
Aspergillus glaucus	-	2	-	-	02
Botrydipodia	2	1	7	-	10
Fusarium	8	3	-	5	16
Rhizopus	2	1	-	6	09
Geotrichum	1	-	-	-	01
Marasmiums	2	-	2	-	02
Papulospora	1	-	-	-	01

These species are known to be common moulds invading stored agricultural products such as groundnuts (Bhattacharya *et al.,* 2004; Franciete dos Santos *et al.,* 2016), cocoa (Oyeniran and Adeniji, 1975), palm produce (Kuku and Broadbent, 1977) maize (Suleiman *et al.,* 2014), peas and white beans (Mills and Woods, 1994). The effect of moulds on stored agricultural products include discolouration in cocoa beans and palm kernels, destruction of

viability in maize grains, spoilage of flavour in cocoa, palm oil and garri, biochemical changes in palm oil and kernel, weight losses in maize and yam, caking of maize and production of mycotoxins in groundnuts. Fungal invasion of agricultural products in storage is attributed to the presence of excess moisture, pre-storage damage to the products and lapses in processing methods (Igeleke and Ekpebor, 1986; Oyeniran, 1978; McDonald and Harkeness, 1963; Kuku and Broadbent, 1977; Oyeniran and Adeniji, 1975).

For prolonged storage of rubber seeds, the critical moisture content for deterioration – free rubber seed storage is 7%, obtained by drying seeds at a temperature of 70^{0}C for 24/hrs (Igeleke 1990). (Table 4).

Table 4: Efficiency of Drying Whole Seeds and Kernels at various Temperatures

	Whole seeds				Kernels			
Drying Temp. (^{0}C)	Duration of drying (hrs.)	% MC* before drying	% MC after drying	% MC Reduction	Duration of drying drying	%MC* before drying	% MC after drying	% MC Reduction
Control	-	15.36	15.36	-	-	18.49	18.49	-
40*	24a**	16.98	9.34a	44.99a	24	17.34	8.89a	48.73a
50*	20a	14.87	8.62a	42.03a	21	17.65	7.94a	55.01a
60	16b	15.24	7.94a	47.90a	14	18.14	7.16a	60.53a
70	14b	15.75	5.85b	52.85b	13	17.94	4.24b	76.36b
80	10c	14.92	3.94b	73.59b	9	16.88	2.00c	88.15b
90	8c	16.14	2.78c	82.77c	7	17.24	1.29c	92.51c
100	4d	14.86	1.54c	90.29c	6	17.48	1.16c	93.36c

* Percentage moisture content of Seeds/Kernels
** Means followed by a common letter in a column do not differ At the 5% level using Duncan's multiple range test.

The optimum drying temperature for a deterioration – free storage of rubber seeds was investigated for two consecutive years – 1986 and 1987 (Igeleke, 1990).

Shelled and unshelled rubber seeds were subjected to seven temperature regimes (40-100^{0}C). Optimum drying temperature for seeds showing up to 50% initial mouldiness was about 70^{0}C while fresh seeds, virtually free from moulds could be adequately dried at temperatures between 50 and 70^{0}C. Seeds dried to a moisture

content level of below 7%, bagged in transparent polyethylene bags and stored at a temperature of 20± 2^0C over a 12 – month period showed minimal mouldiness. Undried seeds and seeds dried to a moisture content level above 10% (at 40^0C) showed 80 to 100% mouldiness over the same storage period.

Other rubber maladies studied were the tapping panel dryness (Olapade and Igeleke, 1989). It was observed that some rubber tress may suddenly stop producing latex, while in some other cases, only part of the tapping cut dries up. It was asserted that this phenomenon of bark dryness is the first obvious symptom of brown blast disease (Fay, 1988). A survey of rubber plantations within some experimental farms of RRIN was conducted from February to May 1989. A total of ten clones whose plantation ages ranged from 22 – 27 years were investigated. The results are shown in Table 5.

Table 5: Severity of Tapping Panel Dryness in Ten Clones Planted at the Rubber Research Institute of Nigeria (RRIN)

Clone	Types of Dryness		Mean* % Dryness	Yield
	+ CD	PD		kg/ha/yr
PB 28/59	41.15a	16.88de	58.03abc	2197.1
RRIM 707	28.71ab	48.14ab	76.85a	1346.6
RRIM 600	22.36abc	3.43e	25.79de	2480.6
Tjir	23.88	58.07ab	81.94a	1134.0
1 x 16	Abcs			
RRIM 513	15.19	46.74ab	61.93ab	1346.6
Harbel -1	11.71	40.72abc	52.43bcd	1913.6
GT 1	11.66	27.45cd	39.11e	2409.7
	def			
Iyanomo	9.78	23.93cd	33.71d	1275.7
Clones	def			
RRIM 607	5.78ef	40.55bc	46.33cd	1063.1
RRIM 605	1.42F	57.78a	59.20bcd	1346.6

+

CD - complete dryness

PB - partial dryness

TD - total dryness

* Means followed by the same letter in each column are not significantly different at 5% level Duncan's New Multiple Range Test

The ten clones investigated at RRIN showed the tapping panel dryness (TPD) syndrome but with varying degrees ranging from partial dryness (PD) to complete dryness (CD) and with severity ranging from 25 – 82%. Correlating the yield of the clones with severity of TPD, it was observed that the low yielding clones like Tjir 1x16 (1134 kg/ha/yr) had the highest severity of 81.94% compared to a high yielding clone RRIM 600 (2,480 kg/ha/yr) which had the least total dryness value of 25.79%. Reports from other rubber estates in Nigeria indicated that TPD is prevalent.

Further studies carried out on rubber pathologies included the bacteriological evaluation and preservation of *Hevea brasiliensis* field latex (Omorusi *et al.,* 2011), status of the mycorrhizal spore numbers and root colonization of *Hevea* seedlings as affected by seasonal variations in RRIN plantations (Omorusi, *et al.,* 2012) and the in-vitro microbial control of pathogenic *Sclerotium rolfsii* (Bosah *et al.,* 2010).

Phytopathology of Plantain (*Musa paradisiacal L.)* – A Staple Food in Nigeria

While at the Rubber Research Institute of Nigeria (RRIN), I went on an in-service training at the University of Benin for my doctoral programme, where I again got closer to my academic father

and mentor, Prof. D.K.G. Ayanru. Under him I researched on the pathologies of plantain (*Musa paradisiacal L.*). Our first studies was on the fruit-tip rot or cigar-end rot disease of plantain in Edo and Delta States of Nigeria.

The incidence and severity of fruit-tip rot disease (FTRD) on mature fingers and bunches of the false horn plantain (*Musa paradisiacal L.*) were surveyed in a farm-stead and main markets of 13 towns in Delta and Edo States of Nigeria from January to December in 1998 and 1999. The surveys showed that incidence of FTRD ranged from 44% in Ora to 100% in Mosogar. (Table 6).

Table 6: Severity and Incidence of Fruit-Tip Rot Symptoms on Market Plantain Fingers in 1998 in 13 Towns in Delta and Edo States.

Town	No of fingers/ bunch	Disease severity category (DSC)[a]					Disease incidence
		1	2	3	4	5	(%)
				Delta			
Mosogar	39[b]	0	10	13	16	0	100.00
Sapele	34	0	1	9	24	0	100.00
Ughelli	49	12	15	11	10	1	73.47
Warri	23	2	0	5	15	1	91.30
Total	145	14	26	38	65	2	
Mean[b]	36.3	3.5	6.5	9.5	16.3	0.5	19.19
				Edo			
Afuze	34	6	6	7	14	1	82.35
Auchi	48	20	11	7	9	1	58.33
Benin	33	1	5	4	22	1	96.97
Ehor	17	1	10	5	9	2	94.12
Ekpoma	30	2	5	1	16	6	93.33
Ewu	21	23	0	2	15	1	85.71
Ibillo	18	7	2	2	7	0	61.11
Iruekpen	26	0	2	2	17	5	100.000
Ora	18	10	1	3	4	0	44.44
Total	245	50	32	33	113	17	
Mean[b]	27.2	5.6	3.6	3.7	12.6	1.9	79.60

- [a]DSC are: 1 = healthy (no symptoms), 2 = mild symptoms, 3 = average 4 = severe and 5 = prematurely ripe.

[b]Mean of 10 bunches

Of all assessed large fingers in both Edo and Delta States, 83% had varying degrees of infection. The peaks of symptom development were recorded in March in both years.

Symptoms of the disease of plantain fruits were characterized by localized darkening of the peel at the bossom end of

fruit fingers; the area was bordered by a narrow black band between infected and healthy peel tissue. A wider tip of the finger becomes progressively chlorotic and covered with grey powdery spores. These gave the fruit finger tip an ash-grey appearance, usually associated with cigar-end rot as shown in Plate 15A.

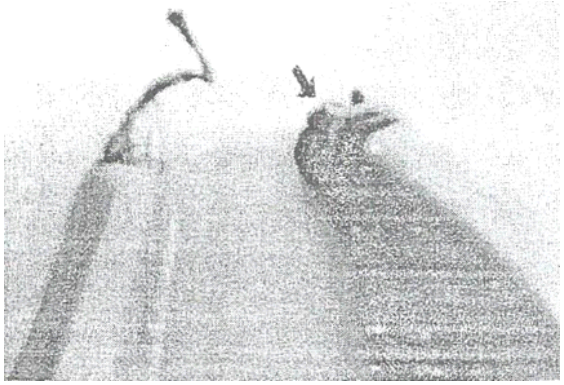


Plate 15A: Disease affected (arrow) and healthy unripe plantain fingers

The severe infection led to premature ripening (Plate 15B).

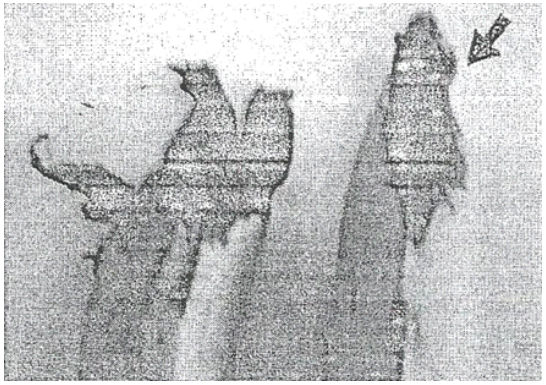


Plate 15B: Ripe plantain finger with blossom end rot (arrow)

The undersized fingers at the caudal end of bunches were also infected (Igeleke and Ayanru, 2004).

More than 44% and 46% of all assessed plantain fingers in Delta and Edo States were rated to have severe symptoms of scale 4. In all the surveyed towns, 4.8% of fingers were prematurely ripe as a result of severe fruit-tip rot disease (FTRD), while 16.4% of the fingers were FTRD symptom-free. Similarly, results of the survey carried out at the farmstead in Benin City showed disease incidence ranging from 86.89% to 100%. (Table 7).

Table 7: Severity and Incidence of Fruit-Tip Rot Disease Symptoms on Large and Undersize Plantain Fingers in a Farmstead in Benin City

No of fingers/ bunch	Disease severity category (DSC) [a]					Disease incidence
	1	2	3	4	5	(%)
Large Fingers						
61[b]	8	6	10	34	3	86.89
40	2	6	12	18	2	92.00
38	1	7	8	20	2	97.37
21	0	4	2	14	1	100.00
27	0	1	1	20	5	100.00
33	0	5	6	18	4	100.00
25	0	1	5	17	2	100.00
24	1	2	2	17	2	95.80
25	2	1	2	18	2	92.00
18	0	1	2	13	2	100.00
Total	14	34	50	189	25	
Mean[b]	1.4	3.4	5.0	18.9	2.5	96.71
Undersize fingers						
16	1	5	3	7	0	93.75
13	0	2	3	8	0	100.00
7	0	1	0	6	0	100.00
10	2	0	1	5	1	80.00
9	0	0	1	6	2	100.00
10	1	0	2	6	1	90.00
Total	4	8	11	38	4	
Mean[b]	0.67	1.33	1.83	6.33	0.67	93.96

[a]DSC are: 1 = healthy (no symptoms), 2 = mild symptoms, 3 = average
4 = severe and 5 = prematurely ripe.
[b]Mean of 10 bunches

More than 60, 16 and 10% of the assessed plantain fingers were in scales 4, 3 and 2 respectively, while over 7% of the fingers were in scale 5.

It was observed that bird pests, especially robins (*Plesiosistagra cuculatus),* weaver birds (*Quelea quelea*) and bulbul (*Pycnonotus barbatus*) frequented plantain bunches with prematurely ripen fruits. The birds scratched and created wounds on other healthy fingers, which accelerated further ripening and rots on the fruits. The peaks of symptom development were recorded in March in both years. FTRD was rare during the rains and early part of the dry season (May – December). Of the eight species of fungi found associated with the disease, *Verticillium theobromae* was the most frequently isolated.

With this observation, the growth and sporulation of *V. theobromae* isolated from plantain fruit tips was studied for its cultural and morphological characteristics on potato dextrose agar (PDA) and six formulated plantain extract media consisting of plantain green leaf (PGL), pseudostem green fruit peel (PGFP), green fruit pulp (GFP), ripe fruit peel (RFP) and ripe fruit pulp agar (RFPA) media. (Plate 16).

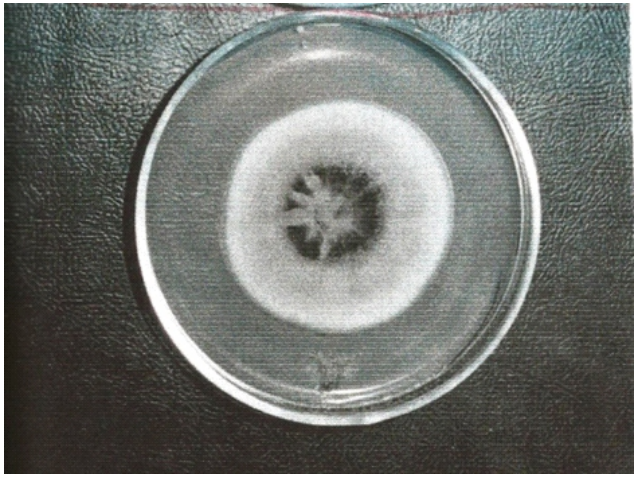


Plate 16: Colony of *V. theobromae* on PDA at 14 – day

The isolate was cultured under continuous light and darkness regimes and its colonies were evaluated for growth and sporulation. Growth and conidial production were studied at temperatures ranging from 10 – 45^{0}C. Both PDA and the six formulated media supported linear growth and sporulation, with plantain leaf and ripe fruit peal extract agar supporting significantly more than PDA ($P \leq 0.01$). Green fruit peel extract agar was the best medium for sporulation, inducing the production of 6.68×10^4 conidia / mm^2 medium surface area. A minimum temperature of 15^{0}C and an optimum of 25^{0}C were required for growth, while 35^{0}C supported the heaviest sporulation. Continuous darkness enhanced growth and sporulation more significantly than light ($P \leq 0.01$) (Fig. 4, 5 and 6).

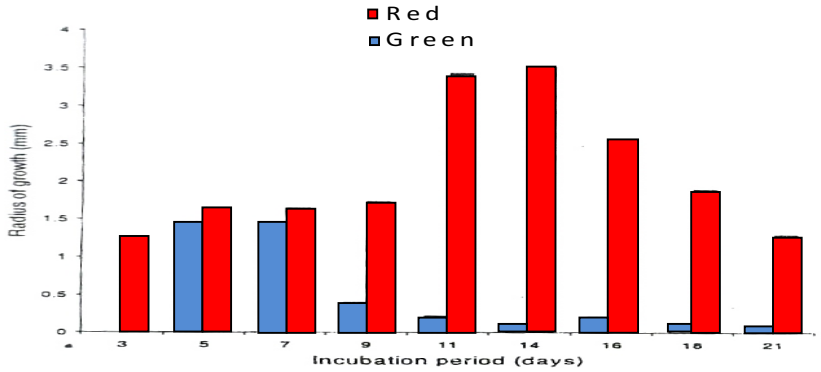


Fig. 4: Comparative growth increases of *Verticillium theobromae* incubated at 30±2^{0}C under light and darkness on PDA

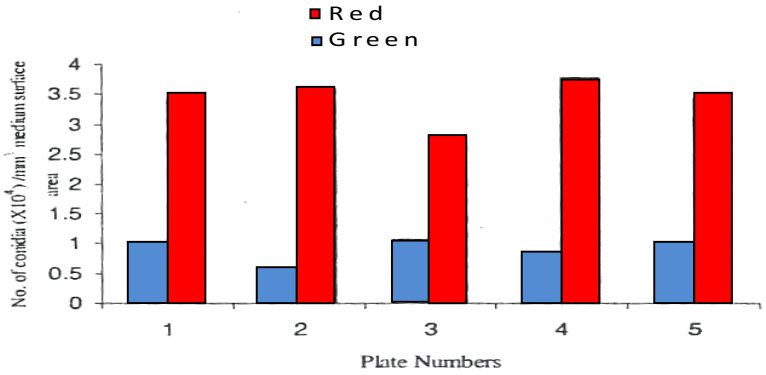


Fig. 5: Comparative sporulation of *Verticillium theobromae* incubated continuously in light or darkness for 14 days PDA at room temperature

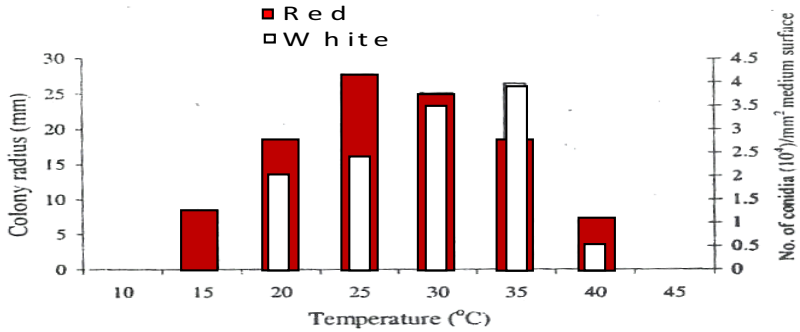


Fig. 6: Comparison of growth (colony radius) and sporulation of *Verticillium theobromae* in darkness on PDA at varied temperature regimes on the 14th day of incubation

These findings are useful information that would facilitate the cultivation of *Verticillium theobromae* and stimulate more research on cigar end rot of plantain.

Verticillium wilt is a wilt disease of over 350 species of eudicot plants with many economically important plants being susceptible (David Guest, 2016). Such plants include tomatoes, potatoes, cotton, oilseed, eggplants, peppers and ornamentals. Igeleke and Ayanru (2006a) also researched on the elemental contents of plants, which play major roles in the susceptibility or resistance of plant varieties to pathogenic microorganisms. Mineral imbalance is one of several factors that pre-dispose plants

to infection by microorganisms. Plants with varied mineral status react differently to pathogens. While some diseases are severe on weakened and under – nourished plants, others are most destructive when plants are growing vigorously (Walker, 1957). The elements necessary for normal growth and development of many plants include N, P, K, Ca, Mg, Fe, Zn, Mn and boron. Each of these elements play a significant role in the physiology and metabolism of the plant. Deficiency or excess of any may be reflected as disease disorder or influence disease development (Delvin, 1967). Igeleke and Ayanru (2006a) researched on the concentrations of mineral elements in two test plantain cultivars with regards to cigar-end rot disease (CERD) incidence. Fresh tissues of the two test cultivars, P100-F (susceptible) and P200 I (resistant) to CERD were analyzed for eight mineral elements, namely, calcium, iron, magnesium, nitrogen, phosphorus, potassium, sodium and zinc. Tissues investigated were mature lamina, bracts (flowers), immature fruit peel and pulp (4 – 7 day old), mature (2 month old) fruit peel and pulp and ripe peel and pulp.

The results revealed variations in the concentrations of mineral elements in the tissues of the test plantain cultivars studied. Concentrations of Ca, Na and Zn in bracts and immature peel and concentrations of Mg and Fe-^{2} in bracts alone of the susceptible cultivar (P100- F) were significantly higher ($P \leq 0.01$) than those of the resistant cultivar, P200 I (Table 8 and Fig. 7).

Table 8: Comparative Concentrations of Ca, Na and Zn in Tissues of the Two Test Plantain Cultivars

Plantain tissue	Plantain cultivar P100-F	P200-I	Difference (%)[a]
Calcium (%)			
Bract	0.151[b]	0.077	+49.00**
Lamina	0.330	0.418	-26.67**
Peel (47 dayold)	0.520	0.482	+7.31*
Pulp (47 day old)	0.180	0.400	-122.22**
Sodium (%)			
Bract	0.265	0.210	+20.75**
Lamina	0.320	0.387	-20.94**
Peel (47 day old)	0.629	0.490	+22.10**
Pulp (47 day old)	0.120	0.140	+7.41*
Zinc (%)			
Bract	0.490	0.032	+93.47**
Lamina	0.033	0.046	-39.39*
Peel (47 day old)	0.063	0.032	+49.21**
Pulp (47 day old)	0.028	0.030	-7.14ns

[a]Difference (%) = P100-F – P200-I x 100; /P100-F differences with * or ** are, significant at the 5 or 1% probability levels respectively, [ns] Not significant,
[b]Means of 3 replications

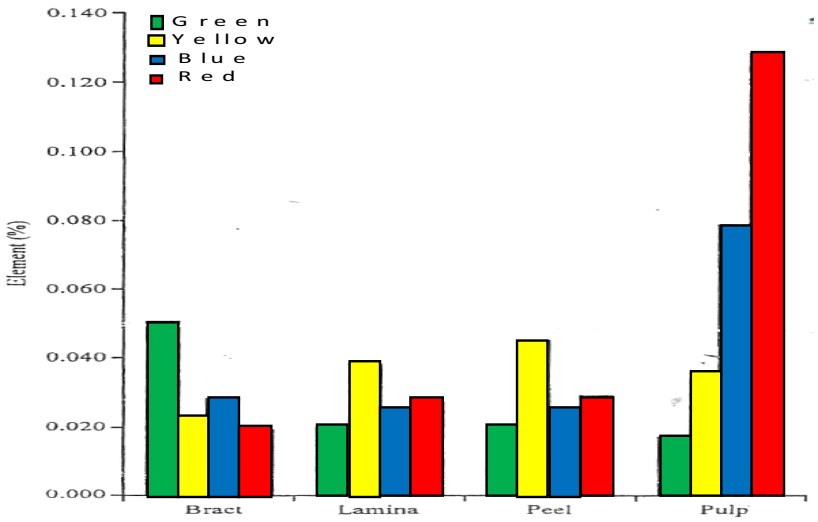


Fig. 7: Comparative concentrations of magnesium and iron in tissues of the two test plantain cultivars

The highest Ca and Na content were in peels, while bracts had the highest Zn content. Zinc content in bracts of P200-I were significantly lower ($P \leq 0.01$) by 93.47% compared to values in P100-F. Concentrations of P and K were significantly lower ($P \leq 0.01$) in all analyzed tissues of the susceptible (P100-F) as compared with those of the resistant cultivar (Fig. 8), using the t-test statistical

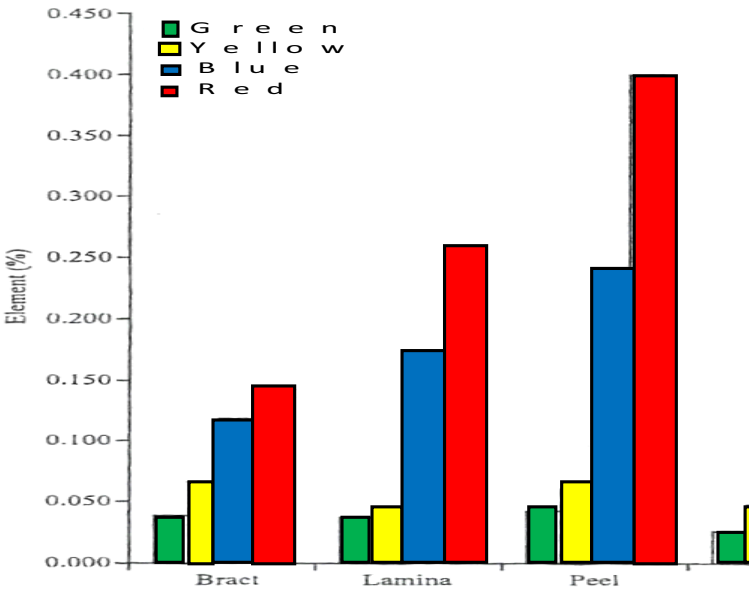


Fig. 8: Comparative concentrations of phosphorus and potassium in tissues of the two test plantain cultivars

Concentration of all eight elements were significantly lower ($P \leq 0.05$ or 0.01) in the immature pulp as compared with the mature pulp. (Table 8).

Table 8: Comparative Element Concentrations in Tissues of the Susceptible Plantain Cultivar (P100-F) of Different Maturity Categories (Immature and Mature)

Elements (%)	Plantain tissue		
	Immature	Mature	Difference (%)[a]
Peel(%)			
Calcium	0.520[b]	0.660	-26.92**
Iron	0.024	0.024	0.0
Magnesium	0.020	0.063	-215.00**
Nitrogen	0.017	0.019	-11.76ns
Phosphorus	0.045	0.045	0.00
Potassium	0.238	0.800	-236.13**
Sodium	0.629	0.570	+9.38**
Zinc	0.63	0.049	+22.22
Pulp (%)			
Calcium	0.180	0.824	-357.78**
Iron	0.079	0.154	-94.94**
Magnesium	0.017	0.090	-429.41**
Nitrogen	0.120	0.200	-66.67**
Phosphorus	0.024	0.047	-95.83**
Potassium	0.138	0.225	-63.04**
Sodium	0.270	0.385	-42.59**
Zinc	0.028	0.034	-21.43*

[a]Difference (%) = Immature – Mature/Immature x 100 differences with * or ** are, significant at the 5 or 1% probability levels, respectively; [ns] Not significant, [b]Means of 3 replications

Augmented concentrations of Ca, Na and Zn in bract and immature peel and Mg and Fe^{2+} in the bract of the susceptible (P100-F) as compared with the resistant cultivar (P200-I) observed in this

study is of significance. Mineral elements play important roles in the physiology and metabolism of plants (McNew, 1953; Walker, 1957; Okorie *et al*., 2015). Deficiency or excess of any may be reflected as disease disorder or influence disease development (Delvin, 1967).

Concentrations of P and K diminished in all the tissues of the susceptible (P100-F) cultivar analyzed as compared with the resistant. Potassium is essential as an activator for enzymes involved in the synthesis of certain peptide bonds, regulating chemical reactions in plant cells. Phosphorus, on the other hand, is a constituent of nucleic acids, phospholipids, the coenzymes NAD, NADP and ATP (Delvin, 1967). The highest concentrations of these two elements are known to occur in the meristematic regions of actively growing plants (Nason and McElroy, 1963), where they are involved in the synthesis of nucleo-proteins. Deficiency of these elements may therefore affect such varied and important processes as respiration, transpiration, photosynthesis and chlorophyll development, thereby increasing the severity of many plant diseases. Deficiency, under most circumstances, implies thinner cell walls in epidermal tissues, reduced production of amino acids and slower growth of meristematic tissue that could retard replacement of diseased tissues (Delvin, 1967).

The relevance of metabolites to susceptibility or resistance of host plants to disease incidence and severity is also worth mentioning. Igeleke and Ayanru (2006b) reported diminished concentrations of carbohydrate, crude protein and nitrogen in tissues of susceptible as compared to the resistant varieties of plantain cultivars. (Table 9).

Table 9: Carbohydrate, Protein and Nitrogen Contents of Tissues of P100-F and P200-I Plantain Cultivars

Plantain tissue	Plantain cultivar		
	P100-F	P200-I	Difference (%)[a]
	Carbohydrate (%)		
Bract	0.29[b]	0.349	-20.34**
Lamina	0.298	0.319	-7.05**
Peel (4-7 day old)	0.306	0.334	-9.15**
Pulp (4-7 day old)	0.370	0.540	-5.04**
	Nitrogen (%)		
Bract	0.018	0.025	-38.89*
Lamina	0.13	0.016	-23.07*
Peel (4-7 day old)	0.017	0.020	-17.65*
Pulp (4-7 day old)	0.120	0.140	-16.67**
	Protein (%)		
Bract	0.113	0.156	-38.05**
Lamina	0.081	0.156	-23.46**
Peel (4-7 day old)	0.106	0.125	-17.92**
Pulp (4-7 day old)	0.750	0.875	-16.67**

[a]Difference (%) = P100-F-P200-I/P100-F x 100; differences with * or ** are significant at the 5 or 1% probability levels, respectively; [b]Means of 3 replications[c] Protein (%) = Nitrogen (%) x 6.25

For the control of the fruit tip rot disease Igeleke and Ayanru (2007) evaluated three fungicides, viz; calixin (tridomorph), benomyl and dithane M-45. This was done on the growth and conidial germination of *Verticillium theobromae in – vitro*. The report indicated that calixin (tridomorph), which is a systemic fungicide, was most effective in inhibiting mycelia growth at a low concentration with an $L.D_{50}$ of 0.14mg mL^{-1} and an $L.D_{50}$ of 21.78mg mL^{-1} against conidial germination as compared with dithane M-45 ($L.D_{50}$ 86.39mg mL^{-1}) and benomyl ($L.D_{50}$ 275.50mg mL^{-1}) (Tables 10, 11, 12 and Fig. 9).

Table 10: Percentage Inhibition of Colony Growth of *Verticillium theobromae* on PDA amended with Benomyl and Calixin

Fungicide	Concentration (µg mL^{-1})	Mean colony radius (mm) diameter	Colony growth as % of control	Inhibition of growth as % reduction control
Control	0.0	56.6	100.0	0.0
Benomyl	10	10.7	18.9	81.1
	50	0.0	0.0	100.0
Calixin	10	0.0	0.0	100.0
	50	0.0	0.0	100.0

Table 11: Inhibition of Germination of *Verticillium* theobromae on Water Agar amended with benomyl, calixin and dithane M-45 after 18 hours of incubation

Fungicide concent ($\mu g\ ml^{-1}$)	Germination	Inhibition (%)
Control		
0.0	100.0a	0.0a
Benomyl		
50.0	100.0a	0.0a
100.0	90.6b	9.4b
500.0	39.0b	61.0c
1000.0	13.3d	86.7d
Calixin		
1.0	100.0a	0.0a
10.0	80.0b	20.0b
50.0	44.3c	55.7c
100.0	12.39	87.7
500.0	0.0e	100.0
Dithane-M45		
10.0	100.0a	0.0a
50.0	86.0b	14.0b
100.0	49.0c	51.0c
500.0	0.0d	100.0d

+Mean of three replications; means in a column not followed by the same letter are significantly different at ($P \leq 0.01$)

Table 12: Probit Analysis Table of the Effect of Benomyl, Calixin and dithane M-45 on colony growth reduction (%) of Verticillium Theobromae after 14 days of incubation

Fungicide +	Degree of freedom	Slob (b)	Intercept (a)	Calculated chi -square	Tabular chi -square	Log ED_{50}	Variance of log	LD_{50} ($\mu g\ mL^{-1}$)
Growth (Colony Diameter) Reduction								
Benomyl	7	1.7095	4.4948	100.1623 **	18.475	0.2955	6.7022 -0.004 e	0.975
Calixin	7	14.2296	4.2043	66.7040 **	18.475	0.0559	2.3338 -0.005 e	0.137
Dithane M -45	6	0.7315	2.6693	26.6256 **	16.812	3.1862	2.4454 -0.002 e	535.171
Conidial germination reduction								
Benomyl	5	2.5706	-1.6186	2.2460 ns	11.070	2.5747	1.0962 -0.003 e	275.5
Calixin	5	2.0204	1.9649	7.5877 ns	11.070	1.5022	1.6606 -0.003 e	21.78
Dithane M -45	5	3.9575	-2.8520	0.4226 ns	11.070	1.9841	7.1524 -0.004 e	86.39

**- Significant at $p<0.01$; ns – Not Significant, + Concentration used were 1.0, 10, 50, 500 and 1000,

Source: Finney (1964, 1971)

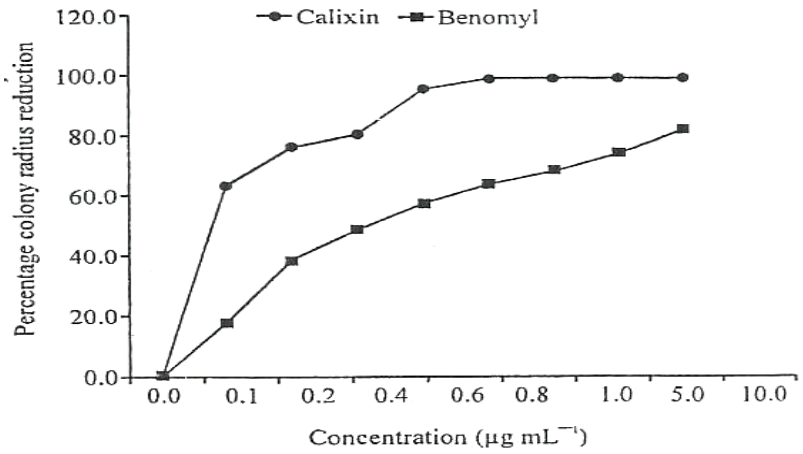


Fig. 9: Mean Percentage reduction in colony radius of *V. theobromae* on PDA media amended with varied low concentrations of benomyl and calixin

ANTIMICROBIAL ACTIVITIES OF SOME MEDICINAL PLANTS AGAINST SOME PATHOGENICALLY IMPORTANT MICROORGANISMS (PHYTOMEDICINE)

Several published reports have shown the effectiveness of traditional herbs against microorganisms (Shajahan and Ramesh, 2004; Obafemi *et al.,* 2006). Medicinal plants contain physiologically active principles which, over the years, have been exploited in traditional medical practice for the treatment of various ailments (Adebanjo *et al.,* 1985; MacDonald Idu, 2009).

As a result, plants are one of the bedrocks of modern medicine. The screening of plant extracts and natural products for antimicrobial activity has shown that higher plants represent a potential source of new, anti-infective agents, as well as serving drug discovery from natural products for primary lead compounds.

Antimicrobial activities and the phytochemistry of some medicinal plants were investigated. Plants investigated included *Khaya senegalensis* roots, *Senna alata* flowers, garlic, neem leaf and some other medicinal plants.

Khaya senegalensis is commonly known as African mahogany. It is a species of plant in the *Meliaceae* family and it is found in many African countries including Nigeria.

Idu and Igeleke (2012) investigated the crude extract of *Khaya senegalensis* roots for antimicrobial activities and it was found to inhibit the growth of *Pseudomonas aeruginosa, Staphylococcus aureus, Bacillus subtilis, Escherichia coli* and *Candida albican.* It did not however inhibit the growth of *Penicillium notatum* and *Asperigillus niger*. The minimum inhibitory concentration (MIC) ranged from 6.0mg/ml to 14.0mg/ml, while the minimum bacteriocidal concentration (MBC) ranged from 8.0mg/ml to 20.0mg/ml. (Tables 13 and 14)

Table 13: Minimum Inhibitory Concentration (MIC) of *Khaya senegalensis*

Test Isolates	Ethanol Extract (mg/ml)	Aqueous Extract (mg/ml)
Pseudomonas aeruginosa	6.0	8.0
Staphylococcus aureus	14.0	0.0
Bacillus subtilis	13.0	0.0
Escherichia coli	8.0	14.0
Candida albicans	0.0	0.0
Penicillium no tatum	0.0	0.0
Aspergillus niger	0.0	0.0

Table 14: Minimum Bactericidal and Fungicidal Concentrations of *Khaya senegalensis* root extracts

Test Isolates	Ethanol Extract (mg/ml)	Aqueous Extract (mg/ml)
Pseudomonas aeruginosa	8.0	20.0
Staphylococcus aureus	10.0	0.0
Bacillus subtilis	15.0	0.0
Escherichia coli	10.0	15.0
Candida albicans	0.0	0.0
Penicillium notatum	0.0	0.0
Aspergillus niger	0.0	0.0

Preliminary phytochemical analysis of the root extracts showed the presence of alkaloids, tannins, sapronins, phylates and oxalates. The quantitative phytochemical analysis showed a high quantity of tannins (7.12mg / 100mg), phylate (4.75mg / 100mg) and alkaloid (3.36mg / 100mg). (Table 15)

Table 15: Preliminary Quantitative Phytochemical Analysis of *Khaya senegalensis* root extracts

Parameters	Root Extract
Alkaloids	+
Tannins	+
Flavonoids	-
Saponins	+
Glycosides	-
Phytates	+
Oxalates	+

Key

+ = Present

- = Absent

The proximate nutritive values also showed a high presence of potassium (52.57mg/kg), sodium (34.45mg/kg), calcium (18.43mg/kg) and magnesium (24mg/kg). Other elements observed were zinc (12.8mg/kg), iron (7.95mg/kg) manganese (5.7mg/kg), lead (2.03mg/kg) and chromium (1.42mg/kg). (Table 16)

Table 16: Proximate Nutritive Values (mg/kg) of *Khaya senegalensis* root extracts

Parameters	Extract
Potassium	52.57
Sodium	34.54
Calcium	18.43
Magnesium	24.84
Zinc	12.86
Iron	7.95
Manganese	5.79
Lead	2.03
Chromium	1.42

The sensitivity of these organisms to *K. senegalensis* root extract is an indication that it can be potentially useful for the treatment of their pathologies.

Idu *et al.,* (2007) also carried out studies on the phytochemistry of the extracts of *Senna alata* flowers for its antimicrobial properties. Extracts tested at a final concentration of 500µg mL^{-1} produced *in–vitro* antimicrobial activities in assays against clinical isolates of *Staphylococcus aureus, Candida albicans, Escherichia coli, Proteus vulgaris, Pseudomonas aeruginosa and Bacillus subtilis*. The zones of inhibitions produced by the extracts in agar diffusion assay against the test microorganisms ranged from 4 to 10mm, while the gentamycin antibiotic control, produced zones that measured 5mm. as shown in table 17.

Table 17: Punch Hole Method showing Inhibition zone (diameters mm) Produced by Flower Extracts of *Senna alata*

Organism	MF	CF	PF	WF	Gentamycin	H_20
B. subtilis	8	-	-	4	5	-
E. coli	10	-	-	-	5	-
Standard *E. coli J62K* $_{12}$	10	-	-	8	5	-
P. vulgaris	5	-	-	-	5	-
P. aureginosa	5	-	-	-	5	-
S. aureus	4	-	-	-	5	-
C. albicans	-	-	-	-	-	-

- No zone., MF = Method flower extract., CF = Choroform flower extract., PF = Petroleum ether flower extract., WF = Water flower extract

Preliminary phytochemical analysis of the plant extracts showed the presence of phenols, tannins, anthraquinoes, saponins and flavonoids. (Table 18)

Table 18: Summary of the Phytochemical Analysis Result

Compound	Flower
Volatile oil	+
Glycoside	+
Alkaloid	+
Saponins	+
Tannins	+
Flavonoid	+
Anthraquinones	+

Other antimicrobial activities of plants investigated included *Stachytarpheta* cayennensis (Igeleke *et al.,* 2012), *Ipomoea involucrate* (Idu *et al.,* 2007), garlic and neem leaf (Irorere and Igeleke, 2012). In each of these investigations, various levels of antimicrobial activities were exhibited by the plant extracts against pathogenically important microorganisms.

RECENT RESEARCHES

Recent researches have focused on the effects of benomyl soil treatments on cassava response to diseases, pests and mycorrhizal symbiosis (Omorusi *et al.,* 2017), development of shot-hole leaf spots on fluted pumpkin (Owoeye and Igeleke, 2016).

As a microbiologist, I also toyed with the effect of microbes on humans, the environment and on formites (inanimate objects). In this light, we looked at the susceptibility of bacteria isolates from parts of the human body to antimicrobial agents at the University of Benin Teaching Hospital (UBTH) Benin City (Mordi *et al.,* 2012), biodegradation of gamalin – 20 by *Micrococcus* sp (Strain 189) in the coastal soils of Southeastern Nigeria (Ugwa *et al.,* 2013), the prevalence of *Alcaligenes feacalis* in bacteremia meningitis in Tertiary Health Care Institutions in Western Nigeria (Mordi *et al.,*

2013), microorganisms associated with public mobile phones along Benin Sapele Express Way, Benin City (Ekrakene and Igeleke (2007a) and microbial isolates from the roasted larva of the palm weevil (*Rhynchophorus* phonicis [F]) from Edo and Delta State of Nigeria (Ekrakene and Igeleke, 2007b).

THE RELEVANCE OF THESE STUDIES

Alcaligenes feacalis is an obligate aerobe that is commonly found in the environment. The organism has been isolated from a range of clinical materials and it is also recognized as an opportunistic pathogen responsible for serious medical infections (Kavuncuoglu *et al.,* 2010; Chandhuri, 1967). The bacterium has been reported to cause meningitis in new born and bacteremia in cancer patients (Knippschill *et al.,* 1996; Ashwath and Katner, 2005) and has been associated with pancreatic abscess and corneal ulcer (Aisenberg *et al.,* 2004; Geong Ho Hwang *et al.,* 2009). Reports have also indicated that *Alcaligenes* species have been associated with bacteremia and respiratory infections (Manfredi *et al.,* 1997). Systemic infections resulting from Alcaligenes species have been described as usually severe and ofthal.

Most strains have been reported to display multiple resistance to numerous antimicrobial agents which has been attributed to the production of extended spectrum beta-lactamases (Mantengoli and Rossolini, 2005). Mordi *et al.,* (2013) carried out the research to determine the recovery rate of the organism from clinical specimens in the healthcare institution. The clinical samples consisted of wound swabs, blood cultures and cerebrospinal fluid. The study identified wound as the most common clinical material from which *Alcaligenes faecalis* can be isolated. The presence of this microorganism in soil and water enhances its chance of contaminating wounds and initiating opportunistic infections in hospitals and in immunocompromised individuals, who should be adequately protected from infection.

The discovery of potent antibiotics was one of the greatest contributions to healthcare delivery in the 20^{th} century. However, the emergence of resistance to these antimicrobial agents became a threat to the advances in health care delivery. The incidence of resistance is multifactorial. It can be a result of horizontal gene transfer or a result of unlinked point mutation in the pathogen genome at a rate of about 1 in 10^{8} per chromosomal mutation (Ricki, 1994).

The antibiotic action against the pathogen can be seen as an environmental pressure. Any population of organisms, naturally includes traits such as the ability to resist antibiotic attack (Castanon, 2007). The drug kills the defenseless organisms, leaving behind or "selecting" those that can resist it. The selected bacteria multiply, increasing their number a million fold in a day and become the predominant organisms. Antibiotics do not technically cause resistance but allow it to happen by creating a situation where an already existing variant can flourish (Ricki, 1994).

In Mordi *et al.,* (2012), the susceptibility of bacteria isolates from parts of the body to antimicrobial agents at the University of Benin Teaching Hospital (UBTH), in Benin City was carried out. The study was aimed at determining the resistance pattern of bacterial isolates from various parts of the body. A total of 310 isolates were obtained and they comprised 287 bacteria and 23 candida species. The percentage occurrence of the isolates are shown in Table 19.

Table 19: Percentage Occurrence of the Various Bacterial Isolates

Bacterial isolates	Percentages occurrence
Escherichia coli	33 (10.6%)
Klebsilla pneumonia	33 (10.6%)
Pseudomonas	32 (10.3%)
Aeruginosa	
Proteus mirabilis	39 (12.6%)
Proteus vulgaris	6 (3%)
Morganellamorganii	4 (1.2%)
Proteus rettgerri	2 (0.6%)
Streptococcus	1 (0.3%)
Pyogenes	
Staphylococcus aureus	124 (40%)
Providencia stuartii	7 (2.3%)
Alkaligenes faecalis	6 (2%)
Candida species	23(7.4%)

The sensitivity pattern of the isolates to the antibiotics used is shown in Table 20

Table 20: Antibacterial Susceptibility of the Clinical Isolates to Antimicrobial Agents

		Pef	Sp	Cxm	Amx	CN	OB	E	SXT	Te	CIP	AUG	C
Isolate	NO												
Escherichia coli	33	23 69.7%	26 78.8%	22 66.6%	2 6%	21 63.6%	2 6%	2 6%	Nil	1 3%	30 90.9%	6 18.2%	12 36.4%
Klebsiella Pneumoniae	33	25 75.8%	28 84.8%	17 51.5%	4 12.1%	13 39.4%	3 9.1%	2 6.1%	2 6.1%	1 3.0%	29 87.9%	10 30.3%	7 21.2%
Pseudomonas aenuginosa	32	17 53.1%	19 59.4%	10 31.3%	Nil	11 34.4%	Nil	Nil	Nil	Nil	28 87.5%	2 6.3%	Nil
Proteus vulgaris	6	3 50%	2 50%	4 66.7%	Nil	2 33.3%	Nil	Nil	Nil	Nil	5 83.3%	Nil	3 50%
Proteus rettgeri	2	1 50%	1 50%	1 50%	Nil	Nil	Nil	Nil	Nil	Nil	1 50%	Nil	1 50%
Proteus mirabilis	39	26 66.6%	27 69.2%	20 51.3%	Nil	21 53.8%	3 7.7%	1 2.6%	Nil	Nil	29 74.4%	4 10.3%	11 28.2%
Morganella morganii	4	3 75%	2 50%	2 50%	Nil	3 75%	Nil	Nil	Nil	Nil	3 75%	1 25%	1 25%
Staphylococcus aureus	124	75 60.5%	75 60.5%	92 74.2%	10 8.1%	60 48.4%	15 12.1%	35 28.2%	Nil	2 1.6%	106 85.5%	30 24.2%	42 33.9%
Providencia stuartii	7	6 85.7%	7 100%	4 57.1%	Nil	3 42.8%	Nil	Nil	Nil	Nil	6 85.7%	Nil	1 14.3%
Streptococcus pyogenes	1	Nil	Nil	Nil	1 100%	Nil	Nil	1 100%	Nil	Nil	1 100%	1 100%	Nil
Alkaligenes faecalis	6	4 66.7%	4 66.7%	3 50%	1 14.3%	Nil	Nil	Nil	1 14.3%	2 28.6%	4 66.7%	1 14.3%	1 14.3%
Total Isolate	287												

Footnote:
PEF = Perflacin
CXM = Cefuroxime
CN = Gentamycin
E = Erythromycin
TE = Tetracycline
AUG = Amoxicilin clavulanate
SP = Sparfloxacin
AMX = Amoxicillin
OB = Cloxacillin
SXT = Cotrimoxazole
CIP = Ciprofloxacin
C = Chloranphenicol

The study demonstrated the increased emergence of resistance to commonly used antimicrobial agents in UBTH as evidenced by the antibiogram of the bacterial isolates. It provided evidence to show the increasing rate of bacterial resistance to antimicrobial agents, and this constitutes a big challenge to clinicians in the management of infections. This trend in antibiotic resistance gives cause for concern especially in developing countries, where these drugs are used as first line drugs. The easy access of antibiotic in shops and open markets, as well as the consumption of drugs without doctor's prescription should be discouraged. Routine sensitivity testing of clinical isolates to antibiotics before prescription should be encouraged.

CONCLUSION

Mr. Vice Chancellor Sir and distinguished audience, through this lecture, we can conceptualize that microbes are not all bad. They are ubiquitous, being everywhere, living in and on man, animals, plants, the environment and inanimate objects. Indeed, they form part of the ecological diversity of the ecosystem, the good, the bad and the fascinating. Humans cannot live without microbes, but with knowledge, they can be effectively managed and exploited to the benefit of man in diverse spheres such as agriculture, medicine, biotechnology, environmental cleaning, oil spillage clean-up, food sources and supplements.

Managing microbes effectively, our nation can derive great economic benefits which other great nations of the world derive from microbes. God has given man authority to subdue, dominate and manage microbes. You and I would be cheating ourselves if we allow the things God has given us authority over to rule over us. I hope that after this lecture, we shall not sentence microbes to eternal condemnation but effectively manage them to benefit us, even in our homes.

Mr. Vice Chancellor Sir and distinguished audience, thank you for listening and God bless you all.

RECOMMENDATIONS

- Microbes are ubiquitous, being all around us, but with knowledge we can exploit them to our advantages, as is done in other developed countries.
- Nigerians should make concerted efforts to keep their environments clean in order to avoid being overwhelmed by microbes.
- State and Local Governments should provide proper storage facilities for farmers to enhance prolonged storage of agricultural products, which would ensure agricultural food supply all year round for Nigerian citizens.
- The Senate should legislate on the legalization of the small industries in Edo, Delta and the South, South States of Nigeria where local gins are brewed. The products can be refined to meet international standards and produce Nigerian brand of alcoholic and non-alcoholic beverages which could be exported to boost Nigeria Foreign Exchange.
- The Federal Government should include Private Universities on the list of beneficiaries of Financial Assistance and Aids to enhance meaningful researches

directed at national goals.

- More funds should be allocated to Research Institutes by the Federal Government and Multinational Companies to carry out specific researches directed at solving some national challenges.

ACKNOWLEDGEMENTS

First and foremost, my unreserved gratitude goes to the Almighty God, who has bestowed so much love and grace on me and my family.

I acknowledge the love and support of my beloved parents, late Chief Edmund Olufusi Okotie and my late sweet mother, Princess Abigail Tebine Okotie (nee Emiko) who made so much sacrifice to train me up to the university level.

I am also grateful to the entire Okotie-Dudu and Emiko families for the great love and unity in both families.

My special thanks to my royal father, His Royal Majesty, Ogiame Ikenwoli I, the Olu of Warri, who has always been a strong pillar to my family. Your love and prayers are highly appreciated. May God Almighty envelope you, your family and the Iwere Kingdom with His everlasting love.

I must mention specially my academic father and mentor, Prof. D.K.G. Ayanru and the wife, who opened their home to me and took me as a daughter while I was researching on my Ph.D, to the extent that Prof. himself, personally brought fresh diseased specimen of plantain fingers to my house one cool evening when I was almost frustrated searching for those specimen. While he was

leaving Benson Idahosa University and lecturing for good, he gave many of his books on mycology to me. Sir, many thanks to you and mummy. God will continue to protect and provide for you and your family all the days of your earthly sojourn.

My special appreciation goes to my spiritual mother, Archbishop Margaret E. Idahosa for her prayers and encouragement, Bishop F.E.B Idahosa, President of Benson Idahosa University and his amiable wife, Rev. Laurie Idahosa, Director of Campus Life, my immediate past Resident Pastor, Bishop Dickson Ogbahon and his beloved wife. My caring and loving daddy and mummy, Elder and Rev. Mrs. Kpere-Daibo, who are always there for me in times of need. Bishop Vincent Iyawe and his wife, Helen Iyawe. All the Bishops and Pastors of Church of God Mission International (CGMI) and all Ministers of Faith Arena, CGMI.

I must take out time to appreciate my Christian brethren at the Gospel Bankers Int. Inc., whose ministry it is to pray and give out supports to ministers and missionaries of the gospel in remote, obscure and unreached places of the north, south, middle-belt and riverine areas of Nigeria; places with difficult terrain where people are scared of reaching. Your labour of love shall never go unrewarded.

I wish to specially single out my two special brothers, Prof. John Aroye Unoma Okhuoya and Prof. MacDonald Idu, who are my senior colleagues in academics and are always there to give me advice on both academic and spiritual matters. The Almighty God will always be there for you and your families in your times of need.

My Special gratitude goes to my beloved sister by another mother, Prof. (Mrs.) Francesca Egbokhare who has been a friend and a sister since she came to BIU for her sabbatical leave in 2017. She is always there for me when I need her assistance in any aspect that has to do with computer. She helped to prepare my slides for this presentation. God richly bless you and your entire family. Also I would want to appreciate my beloved friends, Mrs. Preye Otoide for her encouragement throughout the period of the preparation of this lecture. God Almighty will continue to shower His blessings on you and your family.

My special thanks to the Pro-Chancellor and Chairman of B.I.U. Council, Engr. (Dr.) Goddie Isibor, Rev. (Dr.) Emmanuel Egbagbe, Bishop Festus Akhimien, Bishop Sam Imokhuede and other members of BIU Council, for being a wonderful team to work with.

I must not forget to appreciate all the past Vice-Chancellors of BIU, that I have been opportuned to work with, Prof. Eghosa

Osagie, Prof. Uche Gbinedio, Prof. Gideon Omuta, Prof. MacDonald Idu, Prof. Ernest Izevbigie (who elevated me to the position of a full professor) and my incumbent V.C. Prof. Sam Guobadia (who will always call me I-G-E-L-E-K-E). I salute you all!

I thank all the Principal Officers of BIU, the immediate past Registrar, Mr. T.M. Dogun II, the present Registrar, Dr. Michael Okagbare, the Bursar, Mr. Gladday Igwaegbara immediate past Librarian, Mrs. Bamidele Sanni The librarian-in-charge Mr. Okonsun, The Immediate Past Dean of the Post Graduate School, Prof. Ayodeji Bamidele Sanni, The present Dean of the Post Graduate School, Prof. J.O. my Dean, Prof. Osundu Akoma, all other Deans, past and present, my Head of Department, Dr. Emmanuel Odjadjare, my colleagues in the Faculty of Science, Prof. F.O.J. Oboh, Prof. Taidi Ekrakene, Dr. Steven Enabulele, Dr. Obayabon, Dr. Enagboma, Dr. (Mrs.) Ojuh, Dr. (Mrs.) Tinu Okugbo, Dr. (Mrs.) Philomena Okanibhuan, Mr. Monday Idemudia Dr. (Mrs) Olisaka, Mr. Derek Ahamoje, Mr. Uyi and all other members of staff. You are a wonderful family.

My special thanks goes to Prof. A.O. Oronsaye, who immediately I was mentioned as the next Inaugural Lecturer, brought materials to assist me in my write-up. May God bless you and your wonderful family abundantly.

I would at this point in time appreciate my former research

Omorusi, the current head of the Pathology Department. He has always been ready to assist me with research materials on rubber. Indeed, he is my research partner. Also I must appreciate Mr. Irase Ohiokpehai, the former Chief Accountant, Dr. Okaisabor, who was the Director, when I was a staff at RRIN, late Miss Edith Begho and many others. God bless you all and your families.

My gratitude also goes to my colleagues at Western Delta University, Oghara, Delta State, where I spent my sabbatical leave, the likes of Dr. R.M. Mordi, Dr. Festus Otajefe and others. God bless

you all.

How can I forget my classmates at the great University of Benin. People like Dr. Emmanuel E. Odigie, Engr. Dr. Mike Oisamoje, Mrs. Betty Ivie Nwanbineli (now in New Castle Upon Tyne), Prof. Angela Ejale, Ruth Aburime and others. We shall continue to shine wherever we are.

I want to sincerely appreciate Divine Document Centre, Mrs. Okungbowa Patience and Izevbigie Prince Ekowenhen for the special attention given to the production of the work and for typesetting the draft of the lecture.

My Special thanks goes to my two older sister, Mrs. Philomena Ogiewonyi and Mrs. Rita Arugha Akperi. They have

replaced my late mother in taking care of me. I always have their shoulders to lie on in times of emotional needs. God bless you and your families richly. My brother Mr. Emmanuel Egbejule Okotie and his family are not left out. I must take time off to appreciate my first son, Mr. Mike Omagbitse Akperi and his family, He is a son indeed to me. God bless you mightily and prosper you in all your endeavours in life. I will also appreciate Mr. and Mrs. Onogho Akperi, my nephews, Mrs. Olumewo Memeh my wonderful niece and all my other nieces and nephews God bless you and your families abundantly.

Finally, I want to specially appreciate my wonderful husband who is my strong pillar, brother, friend, adviser, companion and confidant. He is so loving, patient, understanding, kind and gentle. He would always go the extra mile for me and the children. What would I have done without you. Together we have weathered the storms of life. My beloved, words cannot express my love to you. Saying I LOVE YOU is an understatement. God Himself will reward you for your great love. What do I say of my wonderful, sweet, amazing children, Precious, Marvelous and Emmanuel, who have brought so much warmth, fun and love to our lives. You sweet darlings, I love you so so much. Thank you for bringing meaning to my life. Without you my marriage would have been meaningless

and my home empty. May God fulfill all your dreams and heart desires and grant you long life and all the blessings of life.

I wish to also appreciate my many other friends, students and colleagues both in BIU, the church, other Christian Fellowships and elsewhere, whose names time will not permit me to mention. I love and thank you all and pray God to bless all your endeavours in life.

To this great audience, thank you for taking time off your busy schedules to grace this occasion. May God bless you all!

Thank you!

Thank you!!

Thanks you!!!

REFERENCES

1. Adebanjo, A.O., Adewumi, C.O. and Essien, E.E. (1985). Anti-infective agents in higher plants. 5th International Symposium of Medicinal Plants. University of Ife, Nigeria. Pp152 – 158.

2. Ahonkai, I. (2009). They are in and around us: good or bad, but with knowledge we co-exist. Inaugural Lecture Series 103. University of Benin Press. Pp 52.

3. Aigbodion, A.I. (1991). Preliminary studies on the preparation of rubber seed oil alkyds. Indian Journal of Natural Rubber Research 7(2): 141 – 143.

4. Akinwumi Adesina (2018). Food Security and National Development. The Nigerian Observer, June 25, 2018.

5. Ameer, M.J.B., Benudevan, B., and Jayanthi M. (2013). Storage fungi in groundnut and the associate seed quality deterioration – A Review. Plant Pathology Journal 12(3): 127 – 134.

6. Bhattacharya, Kashinath, Raha and Subrata (2004). Deteriorative changes of maize, groundnut and soybean seeds of fungi in storage.

7. Castanon, J.J. (2007). History of the use of antibiotics as growth promoters in Europe. Poultry Feeds. Poult Sci. 86 (11): 2466 – 2471.

8. Chandhuri, K.C. (1967). *Alcaligenes feacalis*; a case of septicemia and meningitis in the new born. Indian J. of Pediatrics 34(3): 242 – 244.

9. Cousens Gabriel (2007). Cure for Daibetes. http://books.google.com.ng

10. Delving, R.M. (1967). Plant physiology. 2nd Edn. Reinhold Publishing Corporation, New York. Pp 564.

11. Gandhi, V.M., Cherian, K.M. and Mulky, M.J. (1990). Nutritional and Toxicological Evaluation of rubber seed oil. JACOBS 67(11): 883 – 886.

12. Hosin, S.B.M., Chin, H.F. and Hor, Y.L. (1981). Fruit and seed development in *Hevea* (Clone RRIM 600) in Malaysia. Journal of Rubber Research Institute of Malaysia, 29: 101 – 110.

13. Idu, M; Omonigho, S.E. and **Igeleke**, C.L. (2007). Preliminary investigation on the phytochemistry and Antimicrobial Activity of Senna alata L. flower. Pakistan Journal of Biological Sciences, 10(5): 806 – 809.

14. Idu, M. and **Igeleke**, C.L. (2012). Antimicrobial Activity and Phytochemistry of *Khaya* senegalensis roots. International

15. **Igeleke**, C.L. (1980). Preliminary studies on the Abnormal leaf fall of rubber in the Rubber Research Institute of Nigeria, Iyanomo. In: Annual Reports of the Rubber Research Institute of Nigeria. Pp 96.

16. **Igeleke**, C.L. and Ekpebor, S.M.C. (1986). Fungal species associated with deterioration of rubber seeds during storage. In: Proceedings of National Conference on Industrial Utilization of natural rubber (*Hevea brasiliensis*) seed, latex and wood (ed. E.E. Enabor), Pp.135 – 145.

17. **Igeleke**, C.L. Odetola, J.A., Sagay, G.A. and Duze, F.O. (1986). Analysis of some factors affecting seed production and availability in rubber (*Hevea brasiliensis*). In: Proceedings of National Conference on Industrial Utilization of natural rubber (*Hevea brasiliensis*) seed, latex and wood. (ed. E.E. Enabor), Pp. 88 – 95.

18. **Igeleke**, C.L. and Olapade, E.O. (1989). Situation Report on tapping panel dryness of *Hevea brasiliensis* in Nigeria. In: Proceedings of Workshop on Tree Dryness by International Rubber Research and Development Board (IRRDB), Penang, Malaysia. 26th – 27th June, 1989.

19. **Igeleke**, C.L. (1990). Effect of Temperature on the storability of Rubber Seeds. Nigerian J. Horticultural Science 1(1): 27-30.

20. **Igeleke**, C.L. and Ayanru, D.K.G. (2004). Incidence and Severity of Fruit-Tip Rot Disease of Plantain (*Musa paradisiacal L.*) in Delta and Edo States of Nigeria. Benin Science Digest. 29:

21. **Igeleke**, C.L. and Ayanru, D.K.G. (2006a). elemental content of susceptible and Resistant varieties of plantain (*Musa paradisiaca L.*) to cigar-end rot disease. Asian Journal of Plant Science 5(5): 822-826.

22. **Igeleke**, C.L. and Ayanru, D.K.G. (2006b). sugar and Amino acid contents of fruit and foliar tissues from two cultivars of plantain (*Musa paradisiaca L.*) susceptible and resistant to cigar-end rot disease. Journal of Biological Sciences, 6(5): 916 – 920.

23. **Igeleke**, C.L., and Ayanru, D.K.G. (2006c). growth and sporulation of verticillium theobromae on six plantain exract media. Journal of Tropical Biosciences. 6: 73 – 77.

24. **Igeleke**, C.L. and Omorus, V.I. (2007). Review of Post-harvest deterioration of rubber seeds: A review. Journal of Agriculture and Social Research (JASR). 7(2): 11 – 19.

25. **Igeleke**, C.L. and Ayanru, D.K.G. (2007). Evaluation of Fungicide on Growth and Conidial Germination of *Verticillium theobromaei* isolated from plantain. Journal of Applied Sciences, 7(4): 531 – 535.

26. **Igeleke**, C.L., Nkiri, G.I. and Odeh, O.H. (2012). Antimicrobial Activities of *Stachytarpheta cayannensis* leaf extract on some medically important pathogens. In: Proceedings of 12th Annual Scientific Conference and General Meeting of the Nigerian Society for Experimental Biology (NISEB), held at the University of Benin, Benin City, Edo State, Nigeria from 14th – 17th March.

27. Irorere, U.V. and **Igeleke**, C.L. (2012). Antimicrobial Properties of the extracts of locally sold garlic and neem leaf in Benin City, Nigeria. International Journal of Biosciences 2(4): 21 – 27.

28. Manisha, K.S. and Chaugule, B.B. (2014). Effect of Magnetic Field on the growth of chlorella and spirulina sp. https://books.google.com.ng

29. Mary Kensa V. (2011). Bioremediation an overview.

30. Mordi, R.M., Borke, M.E., Isah, A., Hugbo, P.G. and **Igeleke**, C.L. (2012). The Susceptibility of bacteria isolates from parts of the body to Antibacterial agents at the University of Benin Teaching Hospital (U.B.T.H), Benin City, Edo State Nigeria. Journal of Medicine and Biomedical Research 11(1): 94 – 103.

31. Mordi, R.M., Yusuf, E.O; Onemu, S.O, **Igeleke**, C.L. and Odjadjare, E.E. (2013). The prevalence of *Alcaligenes feacalis* in bacteremia meningitis and wound sepsis in tertiary health care institutions in Western part of Nigeria. International Journal of Biotechnology 2(7): 123 – 129.

32. Nair, N.M., Unnikrishan, K.C., Unnikrishan, M. and Nair, C.S.B. (1981). Utilization of rubber seed oil and karinnota oil for the preparation of air-drying oil modified alkyd resins. Paintindia 31(5): 5 – 9.

33. Nason, A. and McElroy, W.D. (1963). Modes of action of the Essential Mineral Elements. In: Steward, F.C. (Ed.) Plant Physiology. Academic Press, New York, Pp: 451 – 453.

34. Nester, E.W., Andersons, D.G., Roberts, C.E., Pearsall, N.N. and Nester, M.T. (2004). Microbiology – A human perspective. 4th edition. McGraw Hill Publishers. pp817.

35. Nwokolo, E. (1985). Rubber (*Hevea brasiliensis L.*) seed, oil and meal. In: Food and feed from legumes and oilseeds.

Chapter 35, Eds. Nwokolo and Smart. Chapmann and Hall Publishers. Pp340.

36. Nwokolo, E. and Akpanunam, M.A. (1986). Content and availability of nutrients in rubber seed meal. Tropical Sci. 26: 83 – 88.

37. Obafemi, C.A., Akinpelu, D.A., Taiwo, O.O. and Adeloye, A. (2006). Antimicrobial activity of solvent extracts of *Terminalia* catappa Lin Leaves. Ife Journal of Science. 8(1): 29 – 33.

38. Odjadjare, E.E., Igbinosa, E.O., Mordi, R.M., Bright I., **Igeleke**, C.L. and Okoh, A.I. (2012). Prevalence of Multiple Antibiotics Resistant (MAR) *Pseudomonas* species in the Final Effluents of three municipal wastewater Treatment Facilities in South Africa. International Journal of Environmental Research and Public Health 9: 2092 – 2107.

39. Okorie, D.O., Eleazu, C.O. and Nwosu, P. (2015). Nutrient and heavy metal composition of plantain (*Musa paradisiaca*) and banana (*Musa paradisiaca L.*) Peels. Journal of Nutri. And Food Sci. 5: 370.

40. Oyeniran, J.O. (1978). The role of fungi in the deterioration of tropical stored products. Report of the Nigerian Stored Products Research Institute. Occasional Paper Series 2: P.25.

41. Omorusi, V.I., **Igeleke**, C.L., Ogbebor, N.O., Evueh, G.A. and Omo-Ikiirodah, E.E. (2012). Current status of

mycorrhizal spore numbers and root colonization of *Hevea* seedlings as affected by seasonal variations in plantations of Rubber Research Institute of Nigeria, Iyanomo. *Research* 4(1): 37 – 41.

42. Omorusi, V.I., **Igeleke**, C.L., Ogbebor, N.O., Evueh, G.A., Orumwense, K., Ijie, K. and Ogieriakhi, S. (2011). Bacteriological Evaluation and Preservation of *Hevea brasiliensis* Field Latex. Nig. J. Plant Protection 25(2): 214 – 220.

43. Oyeniran, J.O. and Adeniji., M.O (1975). Mould deterioriation of cocoa during processing and storage in Nigeri. Nig. J. Plant Protection 1(1): 48 – 51.

44. Pozhamkandath, K.V., Tharian, G.K. and Chakkaseril, K.J. (2005). Crop loss in rubber due to abnormal leaf fall: An analysis on the economic feasibility of plant protection measures in India. J. Plant Protection Research. 45(4): 235 – 248.

45. Prescott, L.M., Harley, J.P. and Klein, D.A. (2008). Microbiology 7th Edition. McGraw-Hill Companies Inc. New York, USA. Pp1088.

46. Ramakrishnan, T.S. and Radhakrishna Pillai, P.N. (1961). Abnormal leaf fall disease of rubber caused by *Phythophthora palmivora* (Butl). Rubber Board Bull. 5: 11 – 20.

47. Ramakrishnan, T.S. (1960). Experiments on the control of

abnormal leaf fall on *Hevea* caused by *Phytophthora palmivora* in South India. Proceedings of Natural Rubber Conference, Kuala Lumpur.

48. Rao, B.S. (1975). Maladies of *Hevea* in Malaysia. Rubber Research Institute of Malaysia, Kuala Lumpur. Pp389.

49. Ricki Lewis (1994). The rise of antibiotic resistant infections. *New Eng. J. Med.* US Food and Drug Administration.

50. Rubber Research Institute of Nigeria (1985). Highlights of research on rubber seed meal as a constituent of livestock diets. Federal Ministry of Education, Science and Technology. Pp14.

51. Rubber Research Institute of Nigeria (1989). Industrial utilization of natural rubber seed oil. Advisory Circular No.8.

52. Shajahan, A. and Ramesh, S. (2004). Antimicrobial activity of crude ectocarp extract of Punica *granatum* against some selected enteropathogenic bacteria. Association J. Microbiology and Biotechnology Environmental Science 6: 647 – 648.

53. Suleiman, R.A., Rosentrater, K.A. and Chove, B. (2014). Understanding postharvest practice, knowledge and actual mycotoxin levels in maize in three agro-ecological zones in Tanzania. Journal of Stored Products and Postharvest Research 8:7.

54. Ugwa, I.K., Ukponu, A.F., Omorusi, V.I. and **Igeleke**, C.L. (2013). Biodegradation of Gamalin – 20 by *Micrococcus* sp. (Strain 189) in the coastal soils of Southeastern Nigeria. Nature and Science 11(5): 86 – 90.

55. Viswanathan, P.K., Tharian, G. and Kuruvilla Jacob (2005). Crop loss in rubber due to abnormal leaf fall: An analysis on the economic feasibility of Plant Protection Measures in India. Journal of Plant Protection Research 45: 235 – 248.

56. Walker, J.C. (1957). Plant Pathology 2nd Edn. McGraw-Hill Book Company Inc. New York. Pp642.

BENSON IDAHOSA UNIVERSITY
INAUGURAL LECTURE SERIES
S/NNAMETITLE DATE

1. Professor Johnson Olajide OyedejiBricks with Little Straws: How Efficient are the meat of Egg Type Chickens".July 27th, 2010

2. Professor R.A. Masagbor"Language: A Complementary of Being".April 17th, 2012

3. Professor A.A. Borokini"Female Genital Mutilation: The nexus between Anthropology, Law and Medicine".May 19th, 2015

4. Professor Earnest B. Izevbigie"From Growth Biology to HIV associated Neuropathy to the Discovery of Anti-Cancer Agents: Economic Implications".December 8th, 2015

5. Professor Andrew O. Oronsaye"The Anatomy of Nigeria Federalism and the Physiological Imperatives for Sustainable Development".March 22nd, 2016

6. Professor Rex O. Aruofor"Economic Systems Underdevelopment: A Quest for Solution and Imperatives for Developing the Nigerian Economy"March 6th, 2017

7. Professor Sam Guobadia"It's the Environment".October 19th, 2017