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THE UBIQUITY, IMPORTANCE AND HARMFUL EFFECTS OF MICROORGANISMS: AN ENVIRONMENTAL AND PUBLIC HEALTH PERSPECTIVE

Awari, V. G.[1], Umeoduagu, N. D.[2], Agu, K. C.[3], Okonkwo, N. N.[4], Ozuah, C. L.[5], Victor-Aduloju, A. T.[6]

[1,2]Department of Microbiology, Tansian University, Umunya, Nigeria.

[3,4,5]Department of Applied Microbiology and Brewing, Nnamdi Azikiwe University, P.M.B. 5025, Awka, Nigeria.

[6]Department of Food Science and Technology, Nnamdi Azikiwe University, PMB 5025, Awka, Nigeria.

*[1]Corresponding Author Email: kc.agu@unizik.edu.ng

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ABSTRACT

This work has discussed the ubiquity, importance and harmful Effects of micro organisms as regards life on Earth. This work has also shown that micro organisms have found both important and harmful effects in areas such as Biotechnology, Environment and public health, recombinant DNA technology and Gene therapy; Agriculture, Nitrogen fixation, bio-fertilizers and post-harvest loss of food crops due to diseases; Medicine and Industry, production of vaccines, vinegar, dairy products and diseases caused to humans; Engineering, bioleaching and biomining; bioremediation; Pharmacy, antibiotic production.

Keywords: Ubiquity, Importance, Harmful Effects, Micro organisms.

1. INTRODUCTION

Microorganisms are living things that, when magnified, can only be seen as individual organisms. They are components of every ecosystem on Earth, many of which are beneficial, and range in complexity from unicellular to multicellular organisms.

Microbes need food, water, air, a way to get rid of waste, and an environment in which to live.

The study of microorganisms is done by observing organisms through direct observation through magnification, observing the colonies of these organisms and their waste, and observing the effects of microorganisms on the environment and other organisms (Rawlings, 1997). Microbiology is the study of organisms and substances that are generally too small to be seen with the naked eye. These organisms include viruses, bacteria, algae, fungi and protozoa. Microorganisms are tiny living organisms that cannot be seen with the naked eye. However, they play a very important role in nature and contribute greatly to the survival of plants, animals and humans. They are generally divided into prokaryotes and eukaryotes. Bacteria and Archaea are the only representatives of the first group of organisms. Microorganisms include algae, protozoa, actinomycetes and fungi under eukaryotes. In agriculture, fungi, bacteria, algae and viruses are important in terms of their contribution to losses or gains in grain, fruit, vegetable, oil, milk, poultry, feed and livestock production (Rawlings, 1997).

Prokaryotes, unicellular eukaryotes, and small multicellular organisms have been suggested to have a global distribution because they are small in size and form dormant stages (cysts, eggs, and spores) that can be easily dispersed by air, dust, and moving animals. This already culminated in 1913 in Beijerink's famous analogy that "microbes have everything and the environment selects", which quickly became the paradigm of microbial ecology. Part of this view probably stems from an intuitive sense that such small creatures must have a simple ecology. However, this hypothesis has not been supported in many recent studies (Keener, 2012). Microorganisms are too small to see without a microscope, but they exist in abundance on Earth. They grow everywhere: in air, soil, stones and water. Some people grow well in heat, while others grow well in cold. Some microorganisms need oxygen to live, while others do not. These microscopic organisms are found in plants and animals as well as in the human body. Some microorganisms cause disease in humans, plants and animals. Other things are essential for a healthy life and we cannot live without them. The relationship between microorganisms and humans is truly nuanced and complex. Most microorganisms are classified into one of four major groups: bacteria, viruses, fungi, or protozoa. The common word for disease-causing microorganisms is "germ." Some people call germs that cause disease "bugs." For example, "I have the flu" is a common phrase heard during the winter to describe an influenza virus infection. Since the 19th century, we have known that microorganisms cause infectious diseases. In the late 20th century, researchers began to discover that microbes contribute to many diseases and chronic conditions (Das, 2006). The atmosphere around a person consists of three components: air, water and soil. Microorganisms play an important role in all three components. Soil is the most important part in agriculture and microorganisms are a part of soil. Most trace and macronutrients in soil are managed by microorganisms through integrated nutrient management (Razzak, 2011; Mbachu et al., 2014; Ifediegwu et al., 2015).

In agriculture, plant diseases and their control are one of the important factors that do not receive the expected attention, and diseases caused by microorganisms (bacteria, fungi, viruses) are the negative role of these organisms (Agu et al., 2015; Ogbo). and Agu, 2015; Okigbo et al., 2015).

Microorganisms are a major cause of storage spoilage, contributing to postharvest storage losses of food crops. In addition, some of these organisms benefit agriculturally important crops and play a positive role in providing nitrogen, phosphorus, sulfur and other macro and micro elements through metabolism. Plants are reservoirs of microbial metabolites.

The pharmacy is used for various antibiotics, such as pharmacy, penicillin, ampicillin, kuprofloxine and chlorampenicol. Microorganisms were also used to evaluate the effect of sterilization or equipment, which were used by those to evaluate the efficiency of the clav.

Microorganisms to promote metal production. Microorganisms are also useful in biotechnology applications. As the name suggests, biotechnology is not an independent technology. Rather, it is a group of technologies that have two (common) characteristics: That is, they work with living cells and their molecules, and they have a wide range of practical applications that can improve our lives. Biotechnology can be broadly defined as “the commercial exploitation of organisms or their products” (Keener, 2012).

The purpose of this paper is to describe the ubiquity, importance and harmful effects of microorganisms to demonstrate the different areas in which they are deployed to meet human needs. Agriculture, biotechnology, engineering, environmental sciences, medicine and pharmaceutical sciences

Glossary

1. **algae**: Protists that usually live in water and can produce their own food.
2. **Bacteria**: Microscopic, single-celled organisms that exist around you and inside you.
3. **Conclusion**: The summary of an experiment, based on data related to a hypothesis.
4. **Culture**:To grow microorganisms in a specially prepared nutrient medium.
5. **Decomposer**: An organism, often a bacterium or fungus, that feeds on and breaks down dead plant or animal matter.
6. **Experiment**: A series of steps to find the answer to a question.
7. **Fungi**: Organisms that are neither plant nor animals, but have characteristics of both and absorb food from whatever they are growing on.
8. **Hypothesis**: An idea made into a statement that can be tested.
9. **Investigation**: A process designed to answer a question.
10. **Microorganism**: A living thing that can only be seen with the aid of magnification.
11. **organism:** A living thing.
12. **Producer**: A living thing, like a green plant, that makes its food from simple substances usually using sunlight.
13. **Protozoan**: Microscopic organisms that usually live in water.
14. **Single-celled:** Any organism that has only one cell, the smallest unit of life.
15. **Variable**: (experimental) A part of an experiment that is changed in order to find out the effects of that change.
16. **Control**: A part or variable of an experiment that is kept the same to be used for comparison.

Ubiquity of Micro organisms

Prokaryotes, unicellular eukaryotes, and small multicellular organisms have been suggested to be globally distributed due to their small size and their ability to form latent stages (cysts, eggs, spores) that facilitate dispersal by air, dust, and migrating animals. This culminated in Beijerink's famous 1913 analogy that "microbes have everything, and the environment selects", which quickly became the paradigm of microbial ecology. Microorganisms have been an integral part of the history and functioning of life on Earth. They have played a central role in Earth's climate, geology, geochemistry and biological evolution (Xu, 2006). Prokaryotes appeared about 3.8 billion years ago, about 2 billion years before eukaryotes, and created the conditions for the survival of all other species on Earth (Das, 2006).

Microorganisms represent the richest repertoire of molecular and chemical diversity in nature. Microorganisms are the guardians of the Earth. Although microorganisms are rarely found in the natural environment, about half of the biomass on Earth consists of microorganisms. In addition, microbial life is widespread. Wherever there is life on Earth, there is microbial life. They are found in every imaginable ecological niche on Earth, from the tropics to the North and South Poles, from underground mines and oil fields to the stratosphere and high mountain tops, from deserts to the Dead Sea and geothermal hot springs at underwater hydrothermal vents (Das, 2006).

The expression microorganism ubiquity refers to the concept that microorganisms exist everywhere. Microorganisms (especially prokaryotes) occupy a surprisingly diverse range of niches. For example, some archaea live in hot springs with temperatures above their boiling point. Other microorganisms can live in solid rocks. Some bacteria have come back to life in amber (fossilized tree sap) after tens of millions of years! Microorganisms are virtually ubiquitous in our daily experiences. They are in the air we breathe, the food we eat and the water we drink.

Microorganisms contaminate the objects we use (such as paper) and the skin of our fingers.

In fact, the only places where microorganisms do not appear are the places where we have intentionally removed them. For example, microorganisms are not usually found in blood or spinal fluid. We spend a lot of energy on our immune system to keep these body fluids sterile (free of microbial contamination), and when our immune system fails, we get very sick. Silicon wafer factories spend millions of dollars on "clean rooms" designed to eliminate contamination. In microbiology labs, we spend a lot of time and energy sterilizing growth media to grow only the microorganisms we want to grow.

A growth medium is a laboratory preparation consisting of nutrients suitable for the growth of microorganisms. The mix of nutrients in a given growth medium determines the range of microorganisms that can grow. The growth medium can be liquid. This is called soup. When a gelatinous substance called agar is added to a liquid medium, it becomes a solid medium (Das, 2006).

Prokaryotes and Eukaryotes

Microorganisms and all other living organisms are classified as prokaryotes or eukaryotes. Prokaryotes and eukaryotes are distinguished on the basis of their cellular characteristics (Razzak, 2011).

Prokaryotes

Prokaryotes are creatures composed of cells that lack a nucleus and any membrane-encased organelles. This indicates that in prokaryotes, the genetic material DNA is not contained within a nucleus. Furthermore, DNA in prokaryotes is less organised than in eukaryotes. DNA is a single loop in prokaryotes. DNA is organised into chromosomes in Eukaryotes. Most prokaryotes are composed of a single cell (unicellular), although a few are composed of groups of cells (multicellular). Scientists have classified prokaryotes into two groups: Bacteria and Archaea (Razzak, 2011).

Eukaryotes

Eukaryotes are organisms composed of cells with a membrane-bound nucleus (which contains genetic material) and membrane-bound organelles. In eukaryotes, genetic material is contained within the cell's nucleus, and DNA is organised into chromosomes. Eukaryotic organisms can be either multicellular or single celled. Sterols are found in eukaryotic cell membranes, but not in prokaryotic membranes, with the exception of the Mycoplasma wall. Eukaryotes are all creatures. Plants, fungi, and protists are examples of eukaryotes (Razzak, 2011).

Table 1: The differences between Eukaryotic and Prokaryotic Cell

	Eukaryotic Cell	**Prokaryotic Cell**
Nucleus:	Present	Absent
Number of Chromosomes:	More than one	One--but not true chromosome: Plasmids
Cell Type:	Multicellular	Unicellular
True Membrane bound Nucleus:	Present	Absent
Example	Animals and Plants	Bacteria and Archaea
Lysosomes and peroxisome	Present	Absent
Microtubules	Present	Absent or rare
Endoplasmic reticulum:	Present	Absent
Mitochondria	Present	Absent

Ribosomes	Larger 80s	Smaller 70s
Vesicles	Present	Present
Golgi apparatus:	Present	Absent
Chloroplasts	Present (in plants)	Absent
Flagella	Microscopic in size; membrane bound; usually arranged as nine doublets surrounding two singlets	Submicroscopic in size, composed of only one fiber
Permeability of Nuclear Membrane	Selective	not present
Plasma membrane with steroid:	Yes	Usually no
Vacuoles	Present	Present
Cell size:	10-100μm	1-10μm

Source: (Razzak, 2011).

A. History (Das, 2006).

Discovering the "organisms"

1. 1676: A. Leeuwenhoek – first, precisely examine and describe germs
2. C. Chamberland built a bacterial filter that allowed viruses to be identified in 1884.
3. Loeffler and Frosch identified a filterable infectious agent as the cause of cattle foot-and-mouth disease in 1898.
4. M. Beijerinck discovered the tobacco mosaic virus in 1898-1900.
5. S. Prusiner described prions (infectious proteins that cause a certain normal protein to change form and become a prion) in 1982.

B. Demonstrating the impossibility of spontaneous genesis (the formation of life beings from nonliving substance).

1. F. Redi - the first to dispute the hypothesis of spontaneous generation by demonstrating that if raw meat was protected from flies, maggot formation was inhibited.
2. 1748: R. Needham - supported spontaneous generation of microbes by demonstrating that growth of microbes occurred even after boiling mutton broth and pouring into sealed containers.
3. 1776: L. Spallanzani - questioned spontaneous generation of microbes by demonstrating that boiled sealed vessels do not produce microorganisms
4. L. Pasteur rigorously denied spontaneous generation in 1861.

a) filtered air and discovered microbiological creatures in it
b) built flasks with curved necks that allowed air to enter but dust and other impurities stayed in the neck, put broth into the flasks, cooked it, and demonstrated that no microbial growth occurred unless the flasks were tipped to let the broth into the neck.

C. The disease germ theory

1. Previously, people believed that disease was a punishment for a person's transgressions, caused by toxic vapours and/or an imbalance of the "four humours."
2. Lucretius (B.C.) and Fracastoro (1546) were the first to advocate the theory that unseen organisms caused disease.

Microorganisms in Biotechnology (Bacher *et al.*, 1996)

Microbial biotechnology involves the exploitation, genetic manipulation and alterations of micro-organisms to make commercial valuable products and that also involves fermentation and various upstream and downstream processes. Microorganisms produce an amazing array of valuable products such as macromolecules (e.g. proteins, nucleic acids, carbohydrate polymers, even cells) or smaller molecules and are usually divided into metabolites that are essential for vegetative growth (primary metabolites) and those which give advantages over adverse environment (secondary metabolites).

They usually produce these compounds in small amounts that are needed for their own benefit. Genetic engineering: also called bioengineering This involves altering DNA outside an organism to code for a different function, then re-inserting the new DNA into a host so the new product will be formed.

Two important processes of microbial biotechnology include:

1. Recombinant DNA technology
2. Gene therapy using Viral vectors

A. Recombinant DNA Technology (Bacher *et al*., 1996)

Inserting DNA from other organisms (for example, humans) into bacteria - the bacteria multiply exponentially (very quickly) to make millions of copies and thus become factories for the desired product e.g. - the gene (piece of DNA) that codes for the production of INSULIN is inserted into a bacteria - the bacteria with the altered DNA grows exponentially - these bacteria now form insulin, which is collected and purified

1. A normal, healthy PANCREATIC cell's insulin-producing gene is extracted.
2. Next, RESTRICTION ENZYMES (chemical scissors) sever this segment of DNA at specified spots.
3. A appropriate bacteria (for example, E. coli) has its PLASMID (single chromosome) cleaved utilising restriction enzymes as well.
4. The human insulin gene is ADDED to the plasmid between the cut ends and sealed, resulting in the presence of the human insulin gene on the plasmid.
5. Bacteria are produced under sterile, proper circumstances.
6. Insulin is extracted and purified from the bacterial factory.

- Human growth hormone • Blood factors for haemophilia sufferers (helps blood clot) • Hepatitis B vaccination • Interferons for cancer treatments are all made using recombinant DNA technology.

B. Gene Therapy and Viral Vectors Viral vectors are viruses that transport changed DNA into cells.

Developing a viral vector:

1. extract some genes from a virus; 2. replace with desired gene (DNA)
2. in vitro - lab, outside body - introduce vector (virus) to developing cells (tissue culture)
3. The vector enters cells and inserts NEW GENE into them.
4. Normal cells proliferate and pass on the desired gene

This procedure may attempt to correct HUMAN GENETIC DISORDERS.

Neurological disorders such as Parkinson's disease and Alzheimer's disease cannot be treated in this manner since the cells involved (brain and spinal cord) are not proliferating. This strategy, however, is being utilised to create remedies for fighting AIDS or cancer. In some cases, the body is not producing the necessary chemicals in sufficient quantities. By inserting the required gene into the body via viral vectors, the body may be able to produce the correct chemical again, leading the condition to subside.

This approach is still in the experimental stage. Viral vectors have not yet been implanted in living human patients.

2. ROLES OF MICROBES IN AGRICULTURE

Biofertilizers: Biofertilizers are increasingly regarded as the most critical component of an integrated nutrient system. A biofertilizer is a vast population (millions and billions) of a specific or a group of beneficial microorganisms that are aseptically integrated into sterile carrier material such as peat, lignite, or charcoal and used to enrich the soil in order to increase crop output. Approximately 200 gms of such material is put in a polythene bag and supplied to farmers as biofertilizers. By providing aeration, biomass, and nutrients, they improve soil property and maintain soil fertility. They promote plant growth by releasing harmones, vitamins, and auxins.

They also serve as a biocontrol agent, slowing the growth of organisms known to cause soil-borne diseases. They also transform hazardous metals into non-toxic molecules. The effect of plant growth promoting bacteria (PGPRs), which may be employed as an inoculum in biofertilizer, is caused by one or more of the following mechanisms:

- Phytohormone production
- Fungal growth suppression
- Nitrogen fixation
- Increased nutrient utilisation efficiency
- Antibiosis against phytopathogens
- Induction of systemic disease resistance

Role of microbes in composting: Composting of plant material is a dynamic process caused by the action of a series of mixed microbial populations, each of which is suited to a relatively short-term habitat and all of which are interconnected in the overall process.

Bacteria, actinomycetes, fungus, algae, viruses, protozoa, and other microorganisms play an important role in the breakdown of live material and human and animal secreta in succession, depending on climatic parameters such as aeration, pH, temperature, moisture, and so on. The composting process can be sped up by using microbial inoculants. There are several kinds of organisms that are appropriate for degrading the type of tissue and its chemical composition.

The activities of bacteria are also very important in agriculture in the following aspects:

(a) Decaying of organic substance: Most bacteria are particularly effective in causing the decomposition of dead organic matter of plants and animals by the release of enzymes. Enzymes break down lipids, carbohydrates, and nitrogenous substances into simpler forms such as CO2, water, ammonia, hydrogen sulphide, phosphates, nitrates, and so on, which are then used as raw materials by green plants. As a result, these bacteria not only degrade organic substances but also eliminate toxic trash from the environment, acting as nature's scavengers.

(b) Fertility of the soil: Some bacteria preserve soil fertility while others increase it. They affect the soil's physical and chemical properties by transforming insoluble minerals into soluble ones. These bacteria are ammonia-producing, nitrifying, and nitrogen-fixing bacteria.

(c) Ammonifying Bacteria: Proteinaceous molecules are decomposed by decay bacteria into amino acids, which are then converted to ammonia by ammonifying bacteria. In the soil, free ammonia reacts to generate ammonium salts. This is referred to as ammonification. Bacillus ramosus and Bacillus vulgaris are two examples.

(d) Nitrifying Bacteria: Ammonium salts are converted by these bacteria into nitrates, which are absorbed by plants. Nitrobacter and Nitrosomonas are nitrifying bacteria. Nitrosomonas oxidise ammonium salts to generate nitrous acid, which then forms nitrites in the soil. The nitrites are then converted into nitrates by the Nitrobacter. Nitrification is the process of converting ammonium salts into accessible nitrates.

(e) Nitrogen Fixing Bacteria: These bacteria absorb atmospheric nitrogen and transform it into organic nitrogen molecules. It is referred to as nitrogen fixation. There are two kinds of nitrogen-fixing bacteria. Azotobacter and Clostridium are two types of bacteria that live freely in soil and fix atmospheric nitrogen in their bodies in the form of nitrogenous organic compounds. Bacillus radicicola and nodule bacteria are the other forms of bacteria. Rhizobium develops nodules as a symbiont in the roots of leguminous plants. Free nitrogen is absorbed by these bacteria from the bacterial cell. As a result, leguminous plants improve soil fertility. They are grown for green manuring and crop rotation. Fungi, which include mushrooms, moulds, yeasts, and mildews, are eukaryotes. Fungi lack chlorophyll and are therefore incapable of photosynthesis. Fungi have several culinary, medicinal, agricultural, and industrial applications. Fungi can be utilised to make pigments, pharmaceuticals, and environmentally beneficial building materials. In biotechnology, fungi are incredibly helpful creatures. Fungi use established metabolic processes to create unique complex compounds. diverse taxa synthesise diverse sets of linked compounds with slightly different end products. Metabolites produced in the metabolic route may be physiologically active as well. Furthermore, the end products are frequently discharged into the environment. Manipulation of the genome and environmental circumstances during compound creation allow for the optimisation of product formation.

ROLE OF FUNGI IN AGRICULTURE

In agriculture, fungi perform both good and bad roles. The harmful activities outnumber the beneficial activities. Saprophytic fungi in the soil breakdown the decaying matter of animals and plants. These fungi secrete enzymes that transform the lipids, carbohydrates, and nitrogen molecules of dead animals and plants into simpler chemicals like carbon dioxide, ammonia, hydrogen sulphide, water, and some other nutrients that green plants may use. Some will end up in the soil as humus, while the rest will end up in the air as raw materials for food synthesis. By releasing carbon dioxide, these fungi contribute to nature's never-ending carbon cycle. Carbon dioxide is essential for green plants in the photosynthesis process that produces food. Some fungus live in symbiotic relationships with plant roots. Only when the specific fungal companion is present inside the plant's roots can satisfactory growth be detected. Mycorrhiza is the name given to this sort of fungus-plant interaction. Some nematodes are known to directly cause major crop losses, and others are known to transfer disease-causing viruses. Mycelial loops are produced by these predatory fungus. These loops tighten as the worms pass through, catching the nematodes. Some rhizosphere fungi capable of supporting plant development upon root colonisation are functionally characterised as 'plant-growth-promoting-fungi' (PGPF), similar to PGPR (plant growth promoting rhizobacteria).Penicillium, Trichoderma, Fusarium, and Phoma are the genera that contain PGPF. Several PGPF species have been demonstrated to induce systemic resistance against a variety of diseases in cucumber plants. Plant growth-promoting fungi (PGPF), which are non-pathogenic soil-dwelling saprophytes, have been shown to be advantageous to a variety of crop plants, not only by encouraging growth but also by protecting them from disease. Among these PGPF, certain isolates of Phoma sp. and Penicillium simplicissimum GP17-2 were extremely effective in developing systemic resistance against Colletotrichum orbiculare-caused cucumber anthracnose.One of the most important roles of filamentous fungi in soil is to breakdown organic materials and aid in soil aggregation. Aside from this feature, certain Alternaria, Aspergillus, Cladosporium, Dematium, Gliocladium, Helminthosporium, Humicola, and Metarhizium species produce substances that are similar to humic substances in soil and may thus be useful in the conservation of soil organic matter.

ROLE OF BACTERIA IN INDUSTRY AND MEDICINE:

There are numerous microorganisms that have medical applications. Some of them have even been utilised in biological warfare.However, in order for a bacteria to be useful in medicine, it must possess some desirable trait. Bacteria are typically toxic to humans when they proliferate quickly and create toxins. It eats away at us in order to generate toxins and multiply. Some of the toxins produced by bacteria can actually be beneficial, and these beneficial toxins are cultured in a nutritious combination and the toxins are distilled off. These toxins can then be used in medicine to help cure various illnesses and even kill off other viruses we don't want in our systems. Bacteria also play a very important role in various industries. The products obtained as a result of bacterial activities cannot be chemically prepared. Their activities are involved in the following industries:

(a) Preparation of Alcohols: Ethyl alcohol and butyl alcohol are manufactured by the bacterial activities in the sugar solution, e.g., *Clostridium acetobutylicum*.

(b) Preparation of Vinegar: Vinegar is prepared by the activities of *Acetobacter acetii* in the sugarcane juice.

(c) Preparation of Butter, Cheese and Yoghurt (Dairy products):

The preparation of butter, cheese etc. is done by bacteria. *Lactobacillus lactis* is responsible for souring of milk resulting in curd (dahi) preparation. Bacterial activities also impart the typical flavours. Yogurt is a commonly consumed drink because of its energy constituent and health benefit (Agu *et al*., 2014b).

(d) Preparation of Tea and Coffee: Bacteria are very useful in preparation and flavouring of tea, coffee and cocoa. e.g., *Micrococcus*.

(e) Preparation of Tobacco: Tobacco leaves are cured and flavoured by the bacteria. Typical types of bacteria are cultured for this purpose, e.g., *Micrococcus*.

(f) Preparation of Hemp fibres: Fibres from the hemp are isolated after rotting the stems by activity of bacteria (e.g., *Clostridium butyricum*). The bacteria eat up the protoplasmic tissues but do not eat the sclerenchyma fibres.

(g) Preparation of Leather and Tanning: The hairs and fats are removed from the skin by the action of bacteria in the leather industry.

ROLE OF FUNGI IN MEDICINE

A combination of alkaloids from Claviceps purpurea (the causative organism of rye ergot) is extremely dangerous. This is used to keep bleeding under control during childbirth. Clavacin, a chemical derived from Clavatia, helps to prevent stomach tumours. In humans, fungi contain a variety of chemicals that can increase immune function and suppress tumour growth. Polysaccharides, which are long, complex chains of molecules made up of smaller units of sugar molecules, are also present in lichens (a symbiosis of fungus and green alga), bacteria, and even yeast cell walls (a carbohydrate called zymosan). These immune-activating polysaccharides are comparable to those found in more complex plants like echinacea and astragalas (a popular Chinese herb), and they are now known to perform incredible things in human bodies. These giant polysaccharide molecules are similar to ones found in the cellular membranes of bacteria, and thus, trick our immune system into believing it is being invaded, and accordingly, it mounts an immune response. While this perceived threat poses no actual danger to our bodies, this immune response triggers the increase of a number of powerful immune activities including macrophage and “killer” T -cell (white blood cell) activity. But polysaccharides are not the only active components found in fungi, nor are immune and anti-tumor activity the only influence they have. Smaller compounds such as terpenes and steroids present have also been shown to resist the growth of tumors, and a number of what are called “protein -bound” polysaccharides have even shown to have antibiotic and antiviral properties, as well as the ability to lower blood pressure and reduce blood-level lipids (fats) and sugar. These properties make fungi especially useful in treating infections, flu, diabetes, various heart conditions, and according to many studies, perhaps the HIV.

Role of Micro organisms in Pharmacy

Alexander Fleming. It was a warm September day in 1928. Alexander Fleming was working with bacterial cultures in a London hospital. He left the windows of the lab open. After studying some laboratory plates of staphylococci bacteria, he accidentally left a plate by the open window and forgot about it. A few days went by. He returned and found that the plate by the window was contaminated. Was his experiment ruined? Fleming didn’t throw the plate away. He re-examined it under a microscope and found mold growing on the staphylococci. He noticed a clear zone that existed all around the mold. The mold was killing the deadly bacteria. Penicillium was the mold that killed bacteria. It was Alexander Fleming’s mistake that gave the world penicillin. This is now considered one of the greatest discoveries of the 20th century. Fleming received the Nobel Prize in 1945, and millions of people worldwide have survived disease because of his discovery.

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(a) Preparation of Antibiotics:

Antibiotics are small molecular weight compounds that inhibit or kill microorganisms at low concentrations. Antibiotics are produced by various bacteria, actinomycetes and fungi such as Bacillus, Streptomyces, and Penicillium. The significance of antibiotic production in micro organisms is still unclear which may be for ecological adaptation for the organism in nature. The bacteria are also used in the preparation of antibiotics. According to Sir Alexander Flemming, the growth of harmful *Staphylococcus* is inhibited by *Penicillium notatum*. With this discovery, large number of antibiotics has been prepared which are of great importance in the medical world. Tyrothricin, Subtillin, Polyximin -B, Bacitracin, Streptomycin, Aureomycin, Terramycin are some well-known antibiotics.

Fungi with antimicrobial and other biological activities can produce wide ranges of natural products which is why they are used in drug manufacturing industries. They are widely used for the production of antibiotics, anti -cancer, vitamins and cholesterol lowering drugs. Antibiotics produced by fungi, have gained a high popularity because of their extensive use in disease treatment. The production of antibiotics by fungi was first discovered by Alexander Fleming in 1929. He discovered Penicillin, the wonder antibiotic, which is produced by *Penicillium notatum*. Penicillin kills several bacteria and it has no harmful effects on the human calls. The limited use of penicillin against the vast number of diseases made the researchers to search for other antibiotics. This search resulted in the discovery of several other antibiotics. Fumigallin from *Aspegillus fumigatus* inhibits certain phages and amoebae. Griseofulvin, another antibiotic from *Penicillium griseofulvum*, is used against the skin diseases such as ring worm and athletes foot. This antibiotic interferes with the wall formation of the disease causing fungi. Consequently the pathogens cease to grow. The compound accumulates in skin and hair when taken orally and so it is effective against skin diseases.

ROLES OF MICROBES IN THE ENVIRONMENT

Bioremediation: use of microorganisms to remove toxic chemicals from the environment.

Chemolithoautotroph: A microorganism that fixes CO_2 and obtains its energy by the oxidation of inorganic compounds.

Petroleum based products are the major source of energy for industries and daily living. It is at present Nigerians and indeed, the world’s most important derived energy source (Moffat and Linden, 2005). pollution is defined as the addition to any segment of the environment, any material which has detrimental effect on the ecosystem (Aboribo, 2001). The process of bioremediation is defined as the use of microorganisms to detoxify or remove pollutants (Medina-Bellver, 2005). In addition, bioremediation technology is believed to be non-invasive and relatively cost effective (April, 2000). By nature, populations of micro-organisms represent one of the primary mechanisms by which petroleum and other hydrocarbon pollutants can be removed from the environment and is cheaper than other technologies (Ulrici, 2000; Leahy and Colwell, 2000).

The principle by which a consortium of microorganisms act to bring about the oxidation of complex compound is known as co-metabolism. This principle is employed by oil companies in Nigeria to remediate oil polluted sites in a process known as remediation by enhanced natural attenuation (RENA) this is because the microbial degradative mechanism appear to be a natural processes which eliminate the bulk of oil pollutant after initial physical and chemical breakdown has occurred. The success of oil spill bioremediation depends on one’s ability to establish and maintain condition that favors enhanced oil biodegradation rate in the contaminated environment. Numerous scientific articles have covered various factors that influence the rate of biodegradation. One important requirement is the presence of microorganisms with the appropriate metabolic capabilities, if these microorganisms are present, then optimal rate of growth and hydrocarbon biodegradation can be sustained by ensuring that adequate concentration of nutrient and oxygen is present and that the pH is between 6 and 9. The ability of microbes to degrade organic contaminants into harmless constituents has been explored as a means to biologically treat contaminated environments. It is the subject of many research investigations and real-world applications and is the basis for the emergent field of bioremediation. The physical and chemical characteristics of the oil and the oil surface area are also important determinants of bioremediation success. There are two main approaches to oil spill bioremediation (a) bio-augumentation in which known oil degrading bacteria are added to supplement the existing microbial population and (b) bio-stimulation in which the growth of indigenous oil degraders is stimulated by the addition of nutrient and other growth limiting co-substrate (Agu *et al*., 2014a; Agu *et al*., 2014c; Orji *et al*., 2014, Anaukwu *et al*., 2016). Also micro organisms play vital roles in nutrient cycling in important biogeochemical cycles such as Carbon cycle, Phosporus cycle, water cycle and nitrogen cycle.

ROLES OF MICROBES IN ENGINEERING

Bioleaching: Refers to the microbial conversion of an insoluble metal (usually a metal sulfide or oxide) into a soluble form (metal sulfate).

Biomining: The use of microorganisms to recover metals in industrial operations.

Biomining is a general term used to describe the use of microorganisms to facilitate the extraction of metals from sulfide or iron-containing ores or concentrate (North Carolina Biotechnology Center, 2011). The metal-solubilization process is due to a combination of chemistry and microbiology: chemistry , because the solubilization of the metal is considered to be mainly a result of the action of ferric iron and/or acid on the mineral, and microbiology, because microorganisms are responsible for producing the ferric iron and acid. Since the metal is extracted into water, the process is also known as bioleaching and sometimes as biooxidation (used in the case of gold recovery where the metal remains in the mineral, and, therefore, the term bioleaching is inappropriate) (USDA, 2012). The use of microbes in bioleaching process has some distinct advantages over traditional physicochemical methods. One of these is that provided a mineral is amenable to bioleaching, the metal can be economically extracted even if the metal grade of the ore is very low (e.g., the leaching of copper from waste copper dumps). As higher-grade mineral deposits become worked out, there is an increasing need to recover metals from lower-grade minerals. Furthermore, bioleaching is generally more environmentally friendly than many physicochemical metal extraction processes (USDA, 2012).

It is also a natural process, so that wherever an iron- and sulphide containing mine dump is exposed to rain, metal-laden, acid solutions tend to leach out of the dump and pollute the surrounding environment. Where irrigation of the dump is carried out as a deliberate extraction process, the metal is recovered, the acid is neutralized, the disposal of the solutions is controlled, and the environment is protected. More recently, bioleaching is being used to also recover metals from higher-grade ores as these processes are frequently more economic than alternate methods. Biomining has a long and interesting history.

The use of microorganisms to extract copper has roots deep in antiquity, although the early miners would not have understood the chemistry or known that microbes were involved. For many years bioleaching was thought as a technology for the recovery of metals from low-grade ores, flotation tailings or waste material. Today bioleaching is being applied as the main process in large-scale operations in copper mining and as an important pretreatment stage in the processing of refractory gold ores (USDA, 2013). Metals for which this technique is mainly employed included copper, cobalt, nickel, zinc and uranium. For recovery of gold and silver the activity of leaching bacteria is applied only to remove interfering metal sulfides from ores bearing the precious metals prior to cyanidation treatment (USDA, 2014).

3. CONCLUSION

Microorganisms are more important than they are harmful. They are also ubiquitous. Thus, their metabolism, physiology and enzymology should be hijacked to produce more important products and services that will be beneficial to life. They have been employed in various fields of enquiry namely: Agriculture, Biotechnology, Engineering, Environmental science, Medicine and Pharmacy. More work should be done in order to explore novel grounds where microbiological applications can benefit life further.

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