UNIVERSITY OF PORT HARCOURT

"FOOD, YOUR FRIEND OR FOE"

An Inaugural Lecture

By

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DEDICATION

I dedicate this inaugural lecture to:

- The Almighty, Omnipresent and Omniscient God.

- My Parents, Late Ven. S. Y. Chukuigwe (Rtd) and Matron I. C. Chukuigwe (Rtd).

- My darling husband, Late Sir N.N. Akaninwor, loving children: Buduka, Chinwe, Habinuchi, Manuchimso, Akpenuchi and grandchild, Maxwell Manuchimso Ndy Wenenda.

ACKNOWLEDGEMENT

Vice Chancellor Sir, permit me to appreciate and acknowledge those that made this day of my academic outing possible.

First, I acknowledge my darling, amiable and charming husband, Late Sir N.N. Akaninwor for the privilege and support he gave me to work and study at the same time, irrespective of certain deprivations he must have experienced due to useful time I spent on academic work at the expense of family chores.

My thanks go to my beloved children, Buduka, Chinwe, Habinuchi, Manuchimso and Akpenuchi who have always been my succour in times of tribulations as I was bearing and nurturing them alongside my studies and work; a task that was not very easy for all of us in all ramifications.

My tribute goes to my Parents, Late Ven. S. Y. Chukuigwe (Rtd) and Matron I. C. Chukuigwe (Rtd) who made sure I was educated even when a girl-child education was not of priority, as well as my aunt, Chief (Dame) Eunice Igwe and her late husband, Sir I. Elechi Igwe, who nurtured me to what I am prior to my marriage; they were all indeed, my role models.

Let me use this opportunity to say thank you to my academic mentors Prof. (Mrs.) Bene-Willey Abbey, Prof. E. O. Anosike, Prof. E. Ayalogu, Prof. (Mrs) E. Spiff, Prof. S. Achinewhu, Prof. Otonti Nduka, Prof. E. Ugochukwu, Prof. Nwanze, Prof. A Opoku, Prof. Anusiem, Prof. Ojinnaka and Prof. Kinako, to mention but a few. I also thank all other colleagues of mine including non-academic staff in the Department of Biochemistry in particular and Faculty of Science at large.

Let me pay tribute to Prof. N. D. Briggs, Prof. T. Vincent, Prof Okiwelu, Prof. Oti, Prof. Okoli, Prof. Amajor, Late Prof. Onofeghara, Prof. B. C. Didia, Prof. Nsirim Nduka, Prof. R. Green-Osaoghulu, Prof. Mrs Rose Konya, my secondary school teachers late Prof. Mrs J. Georgewill, Mrs Ngo Ogan, Late Mrs Chinyere Wokedu and Oha Assor,etc., who I admire their prowess in academic excellence and vowed to follow their footsteps.

Special thanks go to my siblings, Late Smyles Chukuigwe, Late Ada Chukuigwe Prof. E. Chukuigwe, Ven (Engr) A. O. Chukuigwe ,Late Engnr N Chukuigwe, Late Engnr Chimezie Chukuigwe, Sir Adindu Chukuigwe, Mrs Carol Madume, Mrs Nkechi Imenwo, Mr Ezemonye Chukuigwe, Mr Guy O Chukuigwe,

Madam Ngozi Chukuigwe, Mr Chijioke Chukuigwe, Mr Nkem Chukuigwe and their individual families. They all gave me support through their good wishes and prayers.

My thanks go to friends and well-wishers, academic and non-academic staff of University of Port Harcourt, University of Benin, University of Science and Technology and Ignatius Ajuru University of Education, PH as well as the Governing Council of Kenule Beeson Ken Sarowiwa Polytechnic, Bori, their staff and students, I sincerely want to use this medium to thank His Excellency, Chief Barrister Ezenwo Nyesom Wike, the Executive Governor of Rivers State, for finding me worthy of an appointment.

Mention must be made of my Spiritual fathers in the Dioceses of Niger Delta North, Ikwerre, Ahoada, Etche and Evo led by Archbishop Dr I.C.O Kattey JP, Rt. Rev Dr B.C. Enyindah, Rt. Rev. Ekpeye, Rt. Rev O Nwala and Rt. Rev. I. Ordu, respectively; may God see them through and water their lives as they have watered mine and those of my family members.

To the entire Isiokpo and Rumueme communities, I pay my tribute to you for giving birth to me and marrying me, respectively. This tribute is passed through all the traditional rulers to you this day.

I thank all my project students (Undergraduate and Graduate) who worked with me as a research team as well as those students that learnt one thing or the other through my tutelage in various Universities. Also very specially Dr. Sampson Okoro & Manuchimso Charles Akaninwor who typed and packaged this work.

My tribute must go to all non-academic staffs that touched my life or were touched by my life in all the universities I found myself (Uniport, RSUST and IAUE). I will send this message through my sisters Mrs. Helen Owhondah-Wopara and the immediate passed Registrar, Mrs. Matilda Nnodim.

Finally, I bow my head down in humility to honour the Almighty God who has kept me alive till this moment despite all the tribulations, persecutions and challenges I have huddled through to achieve this great height. I remain humbled and pledge my worship and service together with my entire family; for we have vowed to serve God all the days of our lives.

OUTLINE

1.0 INTRODUCTION

1.1 Preamble

I wish to express my gratitude to the former Vice-Chancellor Prof. J Ajeinka for approving that I deliver this inaugural lecture today. To the present Vice-Chancellor, Prof. N E S Lale, my friend and mate (as co-arrivers to University of Port Harcourt); I feel great that you are presiding over today's event.

This inaugural lecture is a very special event in my life, as it unveils what happened in my life time, especially my academic career right from my primary school days till today that I stand to speak as a Professor of Nutritional and Environmental Biochemistry. Vice Chancellor Sir, permit me to say that standing here before you is a self-made woman (by the special grace of God), not in terms of financial, parental, mentorship or otherwise sponsorship, but in the aspect of self determination amidst all odds of life. Here, is a woman who decided to stand out amongst her counterparts in early life and shunned all temptations. My life's story started when females in my Ikwerre Ethnic Nationality (in particular) were not seen as good candidates for school (education) but thank God for my mother, Rtd Matron Isabel Chituru Chukuigwe, who happened to have been lucky to be a Mid-wife, knew what education was and swore that all her children will go to school. That began my journey when she decided I will start my primary education at age of 5 and of course I didn't let her down when I also determined to enter the secondary school from Elementary 5 instead of 6; this began my success story against the options of my mates who preferred marriage most times.

Mr. Vice Chancellor Sir, as if that was not good enough, after the disruption of my class one (1) programme in 1965 by the Nigerian Civil war, I eventually came back and joined Girls' Secondary School Harbour road, Port Harcourt. The WAEC results of the exam we took in 1973 were ceased in the whole Rivers State for the first time. You are looking at a woman who never despaired but took the London GCE O' Level exam and damned the consequences when almost all her class mates but a very few decided to go into marriage to bear children – this was the second giant step that landed me into University of Benin after obtaining my

London GCE (A' Level) certificate in then College of Science and Technology Nkpolu, Port Harcourt.

Vice Chancellor Sir, this zeal for academic excellence never quenched after my graduation in 1980, I got a job with the Ministry of Health's Public Health Laboratory in 1981 where I found nothing but an obsolete laboratory with no equipment working and our daily duty that time, somewhere in Borokiri, was to gist and at about 11 am placed order for roasted plantain and fish (Boli and fish) ate and left back to our homes – what a working life and what a wasted career. This made me make up my mind so soon that such was not the best for me (not my portion), and Mr. Vice Chancellor Sir, I took the bull by the horn and left that job, where I was placed on Grade Level 9 salary, to come over to University of Port Harcourt to take up the post of a Graduate Assistant on Grade Level 8, the same year; determined to be meaningful not only to myself, but also to humanity.

Through teaching, Research and community service, Mr. Vice Chancellor Sir, I have been here since 1981 and I am still here for you and the entire University community; still as dedicated and determined as always to move this great Unique Entrepreneurial University to a greater height. I agree there are man-made challenges here and there, but I sincerely believe and trust in the Almighty God (Ps 31:14-15), who has brought me this far to deliver my inaugural lecture, The 131st in the University, and 5thin Biochemistry department; will continue upholding me in His righteous right hand, and will continue to use me to bless lives in and outside the University, as well as wherever I will find myself performing one humble service in Rivers State or any other place in the world.

Suffice it to say that the University of Port Harcourt has played a major role in my academic, social and family lives. I obtained my PhD degree in this University and rose to the rank of a Professor in 2007 in this Unique University; God bless this University. Amen.

Biochemistry department is my second family and home; I want to use this opportunity to say that this Role Model Department of the Faculty of Science stands out as the most peaceful entity of

this University, where teaching, research and community service form their Balanced Diets on daily basis.
Bravo! Biochemistry Department, "ko-izi-rara, "Odirokwa Nfe", Ozikolam Nfee.

1.2 CHOICE OF MY TOPIC "FOOD, YOUR FRIEND OR FOE"

I will start by defining the word 'Biochemistry', which houses food and nutrition, where this topic falls into.

Biochemistry is simply defined as the "The chemistry of life". No wonder its areas of specialization touch all areas of life. They include;

- Nutrition and Toxicology
- Environmental Biochemistry
- Protein and Enzyme Biochemistry
- Medical Biochemistry
- Biochemical Engineering
- Forensic Biochemistry
- Agriculture and Biochemistry

Looking at these areas, it is imperative that food plays an important role in all of them, either in providing energy to be used to study them, or precursors/substrates or even the tools to work with to achieve the desired area of specialization.

On a lay-man's stand, food is eaten by every living thing, be it plant, micro-organisms, animals and man. Why I have decided to choose this topic is that every living creature by God is interested and, in fact, eats food. I decided to ask myself some questions, 'Why is it that, everybody likes food?' it doesn't matter the type, where it is produced, where and how it is prepared, what it contains, what it does to the body (to feel the stomach, just like that?), is it really necessary for survival or is it actually safe? etc. – endless questions. As a nutritional Biochemist, who has spent 32 years looking into various aspects of Nutrition, by way of teaching, research and community service; I have looked at the pros and cons of this word, 'Food' and since everybody in this university and our invitees today will not study Nutritional Biochemistry, I have decided to choose this topic to elucidate some 'good' and 'bad' aspects about this thing

we call food, that we consume everyday; that sometimes if not most times lead us to the sin of greediness, corruption, food abuse, indecency, loss of integrity, diseases and eventual early or untimely death.

I will, however, try as much as I can to be simple enough in my biochemical language for the understanding of all; this may not go well with those in Biochemistry and Science in general who will be expecting me to use all technical terminologies; this is not the purpose of an inaugural lecture. An inaugural lecture should be understood by everybody, whether or not you are in the discipline being presented.

1.3 WHAT IS FOOD?

Food is any edible substance consumed to provide nutritional support for the body. It is usually of plant or animal origin and contains essential nutrients. The substance is ingested by an organism and assimilated by the organism's cells to provide energy, maintain life and stimulate growth.

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Historically, people secured food through two methods, hunting and gathering as well as agriculture; however, most of the food energy required by the ever increasing population of the world is by the food industry.

Food safety and food security are monitored by agencies like the International Association for Food Production, World Resource Institute, World Food Programme, Food and Agriculture Organizations, International Food Information Council, and of course, our own National Agency for Food and Drug Administration Control (NAFDAC). These agencies address issues such as sustainability, biological diversity, climate change, nutritional economics, population growth, water supply and access to food.

Food means differently to different people, for example, the Sociologists, Historians, Anthropologists and the Physiologists all have different perspectives of food from the Biochemist and Nutritionist. Many eat food for the fun of it, probably the smell, look or flavour appeals to them provided they are filled up once they have eaten. However, on the contrary, the Biochemist or Nutritionist looks at food in terms of its value vis-a-vis the atoms and molecules that make up the said food (that is the Nutrients) and their various functions in the body. For this reason, two distinct groups can be categorized between the two examples given, with the former group described as Gastronomic Eaters while the latter group falls into the Scientific eaters. This is the crux of the matter where today's topic leans on.

A gastronomic eater does not bother about what he/she eats, the fate of what is eaten and the ultimate consequences in the over-all functioning of the body. From the Nutritional point of view, food can be further defined as any edible substance that provides the necessary nutrients required for the proper functioning of the body and how the food eaten relates to the health of the body which is known as the Nutritional Status of the person, community or groups that ate the food in question; this actually defines how each of the groups is faring in relation to the type of food they eat. That also sends a signal that there should be good and bad aspects of food, depending on the type, who eats, how and when eaten and of course consequences of eating right or wrong.

1.3.1 PROPER DIETING AS ONE OF THE KEYS TO LONGEVITY

Diet

- The food and beverage a person or animal consumes.
- A controlled regimen of food and drink as to gain or lose weight, or otherwise influence health.

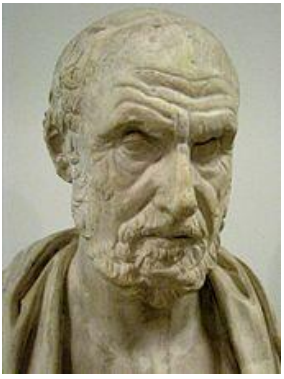
Health

- The state of being free from physical or psychological disease, illness or malfunction; wellness.

1.4 A BRIEF HISTORY ON NUTRITION

Nutrition is the science that interprets the interaction of nutrients and other substances in food (e.g. phytonutrients, anthocyanins, tannins, etc.) in relation to maintenance, growth, reproduction, health and disease of an organism. It includes food intake, absorption, assimilation, biosynthesis, catabolism and excretion.

Antiquity



Hippocrates

Earlier Scientists like Hippocrates and Galen had things to say about Nutrition.

The first recorded dietary advice, carved into a Babylonian stone tablet in about 2500 BC, cautioned those with pain inside to avoid eating onions for three days. Scurvy, later found to be a vitamin C deficiency, was first described in 1500 BC in the Ebers Papyrus.

Around 475 BC, Anaxagoras stated that food is absorbed by the human body and, therefore, contains "homeomerics" (generative

components), suggesting the existence of nutrients. Around 400 BC, Hippocrates, who recognized and was concerned with obesity, which may have been common in southern Europe at the time, said, "Let food be your medicine and medicine be your food." The works that are still attributed to him, *Corpus Hippocraticum*, called for moderation and emphasized exercise.

Followed for a millennium and a half, Galen (1st century) created the first coherent theory of nutrition.

Salt, pepper and other spices were prescribed for various ailments in various preparations for example mixed with vinegar. In the 2nd century BC, Cato the Elder believed that cabbage (or the urine of cabbage-eaters) could cure digestive diseases, ulcers, warts, and intoxication. Living about the turn of the millennium, Aulus Celsus, an ancient Roman doctor, believed in "strong" and "weak" foods (bread for example was strong, as were older animals and vegetables).

Galen to Lind

One mustn't overlook the doctrines of Galen: In use from his life in the 1st century AD until the 17th century, it was heresy to disagree with him for 1500 years.

James Lind conducted in 1747 the first controlled clinical trial in modern times, and in 1753 published *Treatise on Scurvy*. Sometimes overlooked during his life, James Lind, a physician in the British navy, performed the first scientific nutrition experiment in 1747. Lind discovered that lime juice saved sailors that had been at sea for years from scurvy, a deadly and painful bleeding disorder. Between 1500 and 1800, an estimated two million sailors had died of scurvy. The discovery was ignored for forty years, after which British sailors became known as "limeys." The essential vitamin C within citrus fruits would not be identified by scientists until 1932.

Lavoisier and modern science

By containing his assistant, Armand Seguin, inside a rubber suit fitted with a tube sealed to his mouth with putty, Antoine Lavoisier

first measured basal metabolic rate. Drawing by Madame Lavoisier (seated at right).

Around 1770, Antoine Lavoisier discovered the details of metabolism, demonstrating that the oxidation of food is the source of body heat. He discovered the principle of conservation of mass. His ideas made the phlogiston theory of combustion obsolete.

In 1790, George Fordyce recognized calcium as necessary for fowl survival. In the early 19th century, the elements carbon, nitrogen, hydrogen, and oxygen were recognized as the primary components of food, and methods to measure their proportions were developed.

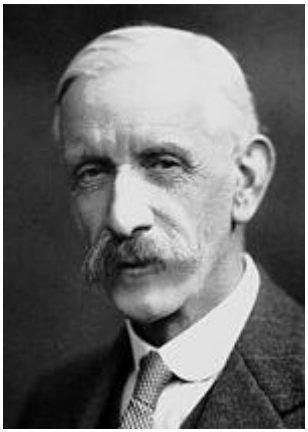
In 1816, François Magendie discovered that dogs fed only carbohydrates (sugar), fat (olive oil), and water died evidently of starvation, but dogs also fed protein survived, identifying protein as an essential dietary component. William Prout in 1827 was the first person to divide foods into carbohydrates, fat, and protein. During the 19th century, Jean-Baptiste Dumas and Justus von Liebig quarreled over their shared belief that animals get their protein directly from plants (animal and plant protein are the same and that humans do not create organic compounds). With a reputation as the leading organic chemist of his day but with no credentials in animal physiology, Liebig grew rich making food extracts like beef bouillon and infant formula that were later found to be of questionable nutritious value. In the 1860s, Claude Bernard discovered that body fat can be synthesized from carbohydrate and protein, showing that the energy in blood glucose can be stored as fat or as glycogen.

In the early 1880s, Kanehiro Takaki observed that Japanese sailors (whose diets consisted almost entirely of white rice) developed beriberi (or endemic neuritis, a disease causing heart problems and paralysis), but British sailors and Japanese naval officers did not. Adding various types of vegetables and meats to the diets of Japanese sailors prevented the disease, (not because of the increased protein as Takaki supposed but because it introduced a few parts per million of thiamine to the diet, later understood as a cure).

In 1896, Eugen Baumann observed iodine in thyroid glands. In 1897, Christian Eijkman worked with natives of Java, who also suffered from beriberi. Eijkman observed that chickens fed the

native diet of white rice developed the symptoms of beriberi but remained healthy when fed unprocessed brown rice with the outer bran intact. Eijkman cured the natives by feeding them brown rice, discovering that food can cure disease. Over two decades later, nutritionists learned that the outer rice bran contains vitamin B1, also known as thiamine.

From 1900 to the present



Frederick Hopkins discovered vitamins, for which he shared a Nobel Prize with Eijkman.

In the early 20th century, Carl von Voit and Max Rubner independently measured caloric energy expenditure in different species of animals, applying principles of physics in nutrition. In 1906, Wilcock and Hopkins showed that the amino acid tryptophan is necessary for the survival of rats. He fed them a special mixture of food containing all the nutrients he believed to be essential for survival, but the rats died. A second group of rats were fed an amount of milk containing vitamins. Sir Frederick Hopkins recognized that there exist "accessory food factors" other than calories, protein, and minerals, as organic materials essential to health but that the body cannot synthesize. In 1907, Stephen M. Babcock and Edwin B. Hart conducted the single-grain experiment, which took nearly four years to complete.

Vitamin	Year Isolated
Thiamin	1926
Vitamin C	1926
Vitamin A	1939
Vitamin D	1931
Vitamin E	1936
Niacin	1937
Biotin	1939
Vitamin K	1939
Pantothenic acid	1939
Folate	1939
Riboflavin	1933
Vitamin B6	1936

Oxford University closed down its nutrition department after World War II because the subject seemed to have been completed between 1912 and 1944.

In 1912, Casimir Funk coined the term vitamin, a vital factor in the diet, from the words "vital" and "amine," because these unknown substances preventing scurvy, beriberi, and pellagra, were thought then to be derived from ammonia. The vitamins were studied in the first half of the 20th century.

In 1913, Elmer McCollum discovered the first vitamins, fat-soluble vitamin A, and water-soluble vitamin B (in 1915; now known to be a complex of several water-soluble vitamins) and named vitamin C as the then-unknown substance preventing scurvy. Lafayette Mendel and Thomas Osborne also performed pioneering work on vitamins A and B. In 1919, Sir Edward Mellanby incorrectly identified rickets as a vitamin A deficiency because he could cure it in dogs with cod liver oil. In 1922, Elmer McCollum destroyed the vitamin A in cod liver oil, but found that it still cured rickets. Also in 1922, H.M. Evans and L.S. Bishop discovered vitamin E as essential for rat pregnancy, originally calling it "food factor X" until 1925.

In 1925, Hart discovered that trace amounts of copper are necessary for iron absorption. In 1927, Adolf Otto Reinhold Windaus synthesized vitamin D, for which he won the Nobel Prize in Chemistry in 1928. In 1928, Albert Szent-Györgyi isolated ascorbic acid, and in 1932 proved that it is vitamin C by preventing scurvy. In 1935, he synthesized it, and in 1937, he won a Nobel Prize for his efforts. Szent-Györgyi concurrently elucidated much of the citric acid cycle.

In the 1930s, William Cumming Rose identified essential amino acids, necessary protein components that the body cannot synthesize. In 1935, Underwood and Marston independently discovered the necessity of cobalt. In 1936, Eugene Floyd DuBois showed that work and school performances are related to caloric intake. In 1938, Erhard Fernholz discovered the chemical structure of vitamin E and then he tragically disappeared. It was synthesized the same year by Paul Karrer.

In 1940, rationing in the United Kingdom during and after World War II took place according to nutritional principles drawn up by Elsie Widdowson and others. In 1941, the first Recommended Dietary Allowances (RDAs) were established by the National Research Council.

In 1992, The U.S. Department of Agriculture introduced the Food Guide Pyramid. In 2002, a Natural Justice study showed a relation between nutrition and violent behavior. In 2005, one inconclusive study found that obesity could be caused by adenovirus in addition to bad nutrition.

World leaders are looking at alternatives like genetically modified foods to tackle the problem of world hunger and food shortages.

2.0 Nutrients

The list of nutrients that people are known to require is, in the words of Marion Nestle, "almost certainly incomplete". As of 2014, nutrients are thought to be of two types: macro-nutrients which are needed in relatively large amounts, and micronutrients which are needed in smaller quantities. A type of carbohydrate, dietary fiber, i.e. non-digestible material such as cellulose, is required, for both

mechanical and biochemical reasons, although the exact reasons remain unclear. Other micronutrients include antioxidants and phytochemicals, which are said to influence (or protect) some body systems. Their necessity is not as well established as in the case of, for instance, vitamins.

Most foods contain a mix of some or all of the nutrient types, together with other substances, such as toxins of various sorts. Some nutrients can be stored internally (e.g. the fat-soluble vitamins), while others are required more or less continuously. Poor health can be caused by a lack of required nutrients or, in extreme cases, too much of a required nutrient. For example, both salt and water (both absolutely required) will cause illness or even death in excessive Amounts.

2.1 Macronutrients

The macronutrients are carbohydrates, fats, protein, and water. The macronutrients (excluding fiber and water) provide structural material (amino acids from which proteins are built, and lipids from which cell membranes and some signaling molecules are built) and energy. Some of the structural material can be used to generate energy internally, and in either case it is measured in Joules or kilocalories (often called "Calories" and written with a capital *C* to distinguish them from little 'c' calories). Carbohydrates and proteins provide 17 kJ approximately (4 kcal) of energy per gram, while fats provide 37 kJ (9 kcal) per gram, though the net energy from either depends on such factors as absorption and digestive effort, which vary substantially from instance to instance. Vitamins, minerals, fiber, and water do not provide energy, but are required for other reasons.

Molecules of carbohydrates and fats consist of carbon, hydrogen, and oxygen atoms. Carbohydrates range from simple monosaccharides (glucose, fructose, galactose) to complex polysaccharides (starch). Fats are triglycerides, made of assorted fatty acidmonomers bound to a glycerol backbone. Some fatty acids, but not all, are essential in the diet: they cannot be synthesized in the body. Protein molecules contain nitrogen atoms in addition to

carbon, oxygen, and hydrogen. The fundamental components of protein are nitrogen-containing amino acids, some of which are essential in the sense that humans cannot make them internally. Some of the amino acids are convertible (with the expenditure of energy) to glucose and can be used for energy production, just as ordinary glucose, in a process known as gluconeogenesis. By breaking down existing protein, the carbon skeleton of the various amino acids can be metabolized to intermediates in cellular respiration; the remaining ammonia is discarded primarily as urea in urine. This occurs normally only during prolonged starvation.

2.1.1 Carbohydrates

Carbohydrates may be classified as monosaccharides, disaccharides, or polysaccharides depending on the number of monomer (sugar) units they contain. They constitute a large part of foods such as rice, noodles, bread, and other grain-based products. Monosaccharides, disaccharides, and polysaccharides contain one, two, and three or more sugar units, respectively. Polysaccharides are often referred to as *complex* carbohydrates because they are typically long, multiple branched chains of sugar units.

Traditionally, simple carbohydrates are believed to be absorbed quickly and therefore to raise blood-glucose levels more rapidly than complex carbohydrates. This, however, is not accurate. Some simple carbohydrates (e.g., fructose) follow different metabolic pathways (e.g., fructolysis) that result in only a partial catabolism to glucose, while, in essence, many complex carbohydrates may be digested at the same rate as simple carbohydrates. Glucose stimulates the production of insulin through food entering the bloodstream, which is grasped by the beta cells in the pancreas.

2.1.2 Fiber

Dietary fiber is a carbohydrate that is incompletely absorbed in humans and in some animals. Like all carbohydrates, when it is metabolized it can produce four Calories (kilocalories) of energy per gram. However, in most circumstances it accounts for less than that because of its limited absorption and digestibility. Dietary fiber

consists mainly of cellulose, a large carbohydrate polymer which is indigestible as humans do not have the required enzymes to disassemble it. There are two subcategories: soluble and insoluble fiber. Whole grains, fruits (especially plums, prunes, and figs), and vegetables are good sources of dietary fiber. There are many health benefits of a high-fiber diet. Dietary fiber helps reduce the chance of gastrointestinal problems such as constipation and diarrhea by increasing the weight and size of stool and softening it. Insoluble fiber, found in whole wheat flour, nuts and vegetables, especially stimulates peristalsis – the rhythmic muscular contractions of the intestines, which move digests along the digestive tract. Soluble fiber, found in oats, peas, beans, and many fruits, dissolves in water in the intestinal tract to produce a gel that slows the movement of food through the intestines. This may help lower blood glucose levels because it can slow the absorption of sugar. Additionally, fiber, perhaps especially that from whole grains, is thought to possibly help lessen insulin spikes, and therefore reduce the risk of type 2 diabetes. The link between increased fiber consumption and a decreased risk of colorectal cancer is still uncertain.

2.1.3 Fat

A molecule of dietary fat typically consists of several fatty acids (containing long chains of carbon and hydrogen atoms), bonded to a glycerol. They are typically found as triglycerides (three fatty acids attached to one glycerol backbone). Fats may be classified as saturated or unsaturated depending on the detailed structure of the fatty acids involved. Saturated fats have all of the carbon atoms in their fatty acid chains bonded to hydrogen atoms, whereas unsaturated fats have some of these carbon atoms double-bonded, so their molecules have relatively fewer hydrogen atoms than a saturated fatty acid of the same length. Unsaturated fats may be further classified as monounsaturated (one double-bond) or polyunsaturated (many double-bonds). Furthermore, depending on the location of the double-bond in the fatty acid chain, unsaturated fatty acids are classified as omega-3 or omega-6 fatty acids. Trans fats are a type of unsaturated fat with *trans*-isomer bonds; these are rare in nature and in foods from natural sources; they are typically

created in an industrial process called (partial) hydrogenation. There are nine kilocalories in each gram of fat. Fatty acids such as conjugated linoleic acid, catalpic acid, eleostearic acid and punicic acid, in addition to providing energy, represent potent immune modulatory molecules.

Saturated fats (typically from animal sources) have been a staple in many world cultures for millennia. Unsaturated fats (e. g., vegetable oil) are considered healthier, while trans fats are to be avoided. Saturated and some trans fats are typically solid at room temperature (such as butter or lard), while unsaturated fats are typically liquids (such as olive oil or flaxseed oil). Trans fats are very rare in nature, and have been shown to be highly detrimental to human health, but have properties useful in the food processing industry, such as rancidity resistance.

Essential fatty acids

Most fatty acids are non-essential, meaning the body can produce them as needed, generally from other fatty acids and always by expending energy to do so. However, in humans, at least two fatty acids are essential and must be included in the diet. An appropriate balance of essential fatty acids—omega-3 and omega-6 fatty acids—seems also important for health, although definitive experimental demonstration has been elusive. Both of these "omega" long-chain polyunsaturated fatty acids are substrates for a class of eicosanoids known as prostaglandins, which have roles throughout the human body. They are hormones, in some respects. The omega-3 eicosapentaenoic acid (EPA), which can be made in the human body from the omega-3 essential fatty acid alpha-linolenic acid (ALA), or taken in through marine food sources, serves as a building block for series 3 prostaglandins (e.g., weakly inflammatoryPGE3). The omega-6 dihomo-gamma-linolenic acid (DGLA) serves as a building block for series 1 prostaglandins (e.g. anti-inflammatory PGE1), whereas arachidonic acid (AA) serves as a building block for series 2 prostaglandins (e.g. pro-inflammatory PGE 2). Both DGLA and AA can be made from the omega-6 linoleic acid (LA) in the human body, or can be taken in directly through food. An appropriately balanced intake of omega-3 and omega-6 partly determines the

relative production of different prostaglandins, which is one reason why a balance between omega-3 and omega-6 is believed important for cardiovascular health. In industrialized societies, people typically consume large amounts of processed vegetable oils, which have reduced amounts of the essential fatty acids along with too much of omega-6 fatty acids relative to omega-3 fatty acids.

The conversion rate of omega-6 DGLA to AA largely determines the production of the prostaglandins PGE1 and PGE2. Omega-3 EPA prevents AA from being released from membranes, thereby skewing prostaglandin balance away from pro-inflammatory PGE2 (made from AA) toward anti-inflammatory PGE1 (made from DGLA). Moreover, the conversion (desaturation) of DGLA to AA is controlled by the enzyme delta-5-desaturase, which in turn is controlled by hormones such as insulin (up-regulation) and glucagon (down-regulation). The amount and type of carbohydrates consumed, along with some types of amino acid, can influence processes involving insulin, glucagon, and other hormones; therefore, the ratio of omega-3 versus omega-6 has wide effects on general health, and specific effects on immune function and inflammation, and mitosis (i.e., cell division).

2.1.4 Protein

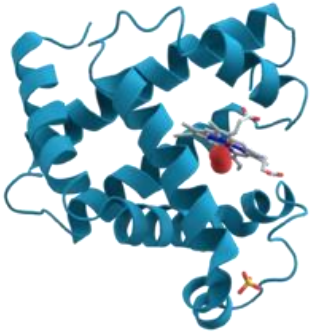


Figure 2. Proteins (chains of amino acids found in most nutritional foods)

Proteins are structural materials in much of the animal body (e.g. muscles, skin, and hair). They also form the enzymes that control

chemical reactions throughout the body. Each protein molecule is composed of amino acids, which are characterized by inclusion of nitrogen and sometimes sulphur (these components are responsible for the distinctive smell of burning protein, such as the keratin in hair). The body requires amino acids to produce new proteins (protein retention) and to replace damaged proteins (maintenance). As there is no protein or amino acid storage provision, amino acids must be present in the diet. Excess amino acids are discarded, typically in the urine. For all animals, some amino acids are *essential* (an animal cannot produce them internally) and some are *non-essential* (the animal can produce them from other nitrogen-containing compounds). About twenty amino acids are found in the human body, and about ten of these are essential and, therefore, must be included in the diet. A diet that contains adequate amounts of amino acids (especially those that are essential) is particularly important in some situations: during early development and maturation, pregnancy, lactation, or injury (a burn, for instance). A *complete* protein source contains all the essential amino acids; an *incomplete* protein source lacks one or more of the essential amino acids.

It is possible with protein combinations of two incomplete protein sources (e.g., rice and beans) to make a complete protein source and characteristic combinations are the basis of distinct cultural cooking traditions. However, complementary sources of protein do not need to be eaten at the same meal to be used together by the body. Excess amino acids from protein can be converted into glucose and used for fuel through a process called gluconeogenesis. The amino acids remaining after such conversion are discarded.

2.1.5 Water

Water is excreted from the body in multiple forms; including urine and faeces, sweating, and by water vapour in the exhaled breath. Therefore, it is necessary to adequately rehydrate to replace lost fluids.

Early recommendations for the quantity of water required for maintenance of good health suggested that 6–8 glasses of water daily is the minimum to maintain proper hydration. However the

notion that a person should consume eight glasses of water per day cannot be traced to a credible scientific source. The original water intake recommendation in 1945 by the Food and Nutrition Board of the National Research Council read: "An ordinary standard for diverse persons is 1 milliliter for each calorie of food. Most of this quantity is contained in prepared foods." More recent comparisons of well-known recommendations on fluid intake health. Therefore, to help standardize guidelines, recommendations for water consumption are included in two recent European Food Safety Authority (EFSA) documents (2010): (i) Food-based dietary guidelines and (ii) Dietary reference values for water or adequate daily intakes (ADI). These specifications were provided by calculating adequate intakes from measured intakes in populations of individuals with "desirable osmolarity values of urine and desirable water volumes per energy unit consumed." For healthful hydration, the current EFSA guidelines recommend total water intakes of 2.0 L/day for adult females and 2.5 L/day for adult males. These reference values include water from drinking water, other beverages, and from food. About 80% of our daily water requirement comes from the beverages we drink, with the remaining 20% coming from food. Water content varies depending on the type of food consumed, with fruit and vegetables containing more than cereals, for example. These values are estimated using country-specific food balance sheets published by the Food and Agriculture Organisation of the United Nations. Other guidelines for nutrition also have implications for the beverages we consume for healthy hydration- for example, the World Health Organization (WHO) recommend that added sugars should represent no more than 10% of total energy intake.

The EFSA panel also determined intakes for different populations. Recommended intake volumes in the elderly are the same as for adults as despite lower energy consumption, the water requirement of this group is increased due to a reduction in renal concentrating capacity. Pregnant and breastfeeding women require additional fluids to stay hydrated. The EFSA panel proposes that pregnant women should consume the same volume of water as non-pregnant women, plus an increase in proportion to the higher energy requirement, equal to 300 mL/day. To compensate for additional

fluid output, breastfeeding women require an additional 700 mL/day above the recommended intake values for non-lactating women.

For those who have healthy kidneys, it is somewhat difficult to drink too much water, but (especially in warm humid weather and while exercising) it is dangerous to drink too little. While over-hydration is much less common than dehydration, it is also possible to drink far more water than necessary, which can result in water intoxication, a serious and potentially fatal condition. In particular, large amounts of de-ionized water are dangerous.

2.2 Micronutrients

The micronutrients are minerals, vitamins, and others.

2.2.1 Minerals

Dietary minerals are in organic chemical elements required by living organisms, other than the four elements carbon, hydrogen, nitrogen, and oxygen that are present in nearly all organic molecules. The term "mineral" is archaic, since the intent is to describe simply the less common elements in the diet. Some are heavier than the four just mentioned, including several metals, which often occur as ions in the body. Some dieticians recommend that these be supplied from foods in which they occur naturally or at least as complex compounds, or sometimes even from natural inorganic sources (such as calcium carbonate from ground oyster shells). Some minerals are absorbed much more readily in the ionic forms found in such sources. On the other hand, minerals are often artificially added to the diet as supplements; the most famous is likely iodine

Macro-minerals

Many elements are essential in relative quantity; they are usually called "bulk minerals". Some are structural, but many play a role as electrolytes. Elements with recommended dietary allowance (RDA) greater than 150 mg/day are, in alphabetical order (with informal or folk-medicine perspectives in parentheses):

- Calcium, a common electrolyte, but also needed structurally (for muscle and digestive system health, bone strength, some forms

neutralize acidity, may help clear toxins, provides signaling ions for nerve and membrane functions)
- Chlorine as chloride ions; very common electrolyte; see sodium, below
- Magnesium, required for processing ATP and related reactions (builds bone, causes strong peristalsis, increases flexibility, increases alkalinity)
- Phosphorus, required component of bones; essential for energy processing
- Potassium, a very common electrolyte (heart and nerve health)
- Sodium, a very common electrolyte; in general not found in dietary supplements, despite being needed in large quantities, because the ion is very common in food: typically as sodium chloride, or common salt. Excessive sodium consumption can deplete calcium and magnesium, leading to high blood pressure and osteoporosis.
- Sulphur, for three essential amino acids and therefore many proteins (skin, hair, nails, liver, and pancreas). Sulphur is not consumed alone, but in the form of sulphur-containing amino acids

Trace-minerals

Many elements are required in trace amounts, usually because they play a catalytic role in enzymes. Some trace mineral elements (RDA < 200 mg/day) are, in alphabetical order:

- Cobalt required for biosynthesis of vitamin B12 family of coenzymes. Animals cannot biosynthesize B12, and must obtain this cobalt-containing vitamin in the diet
- Copper required component of many redox enzymes, including cytochrome c oxidase
- Chromium required for sugar metabolism
- Iodine required not only for the biosynthesis of thyroxine but also — it is presumed — for other important organs as breast, stomach, salivary glands, thymus, etc. (see Extrathyroidal iodine); for this reason iodine is needed in larger quantities than others in this list, and sometimes classified with the macrominerals

- Iron required for many enzymes, and for hemoglobin and some other proteins
- Manganese (processing of oxygen)
- Molybdenum required for xanthine oxidase and related oxidases
- Nickel present in urease
- Selenium required for peroxidase (antioxidant proteins)
- Vanadium (Speculative: there is no established RDA for vanadium. No specific biochemical function has been identified for it in humans, although vanadium is required for some lower organisms.)
- Zinc required for several enzymes such as carboxypeptidase, liver alcohol dehydrogenase, and carbonic anhydrase

2.2.2 Vitamins

As with the minerals discussed above, some vitamins are recognized as organic essential nutrients, necessary in the diet for good health. (Vitamin D is the exception: it can be synthesized in the skin, in the presence of UVB radiation.) Certain vitamin-like compounds that are recommended in the diet, such as carnitine, are thought useful for survival and health, but these are not "essential" dietary nutrients because the human body has some capacity to produce them from other compounds. Moreover, thousands of different phytochemicals have recently been discovered in food (particularly in fresh vegetables), which may have desirable properties including antioxidant activity (see below); however, experimental demonstration has been suggestive but inconclusive. Other essential nutrients that are not classified as vitamins include essential amino acids (see above), choline, essential fatty acids (see above), and the minerals discussed in the preceding section.

Vitamin deficiencies may result in disease conditions, including goitre, scurvy, osteoporosis, impaired immune system, disorders of cell metabolism, certain forms of cancer, symptoms of premature aging, and poor psychological health (including eating disorders), among many others. Excess levels of some vitamins are also dangerous to health (notably vitamin A). Deficient or excess levels of minerals can also have serious health consequences.

2.2.3 Other Nutrients

In general, other micronutrients are more recent discoveries that have not yet been recognized as vitamins or as required. Phytochemicals may act as antioxidants, but not all phytochemicals are antioxidants.

Phytochemicals

Figure 3. Blackberries (a source of polyphenol antioxidants)

Phytochemicals are chemical compounds that occur naturally in plants (phyto means "plant" in Greek). In general, the term is used to refer to those chemicals that may have biological significance, for example antioxidants.

Antioxidants

Figure 4. Colorful fruits (components of a healthy diet)

As cellular metabolism/energy production requires oxygen, potentially damaging (e.g., mutation causing) compounds known as free radicals can form. Most of these are oxidizers (i.e., acceptors of

electrons) and some react very strongly. For the continued normal cellular maintenance, growth, and division, these free radicals must be sufficiently neutralized by antioxidant compounds. Recently, some researchers suggested an interesting theory of evolution of dietary antioxidants. Some are produced by the human body with adequate precursors (glutathione, Vitamin C), and those the body cannot produce may only be obtained in the diet via direct sources (Vitamin C in humans, Vitamin A, Vitamin K) or produced by the body from other compounds (Beta-carotene converted to Vitamin A by the body, Vitamin D synthesized from cholesterol by sunlight). Phytochemicals and their subgroup, polyphenols, make up the majority of antioxidants; about 4,000 are known. Different antioxidants are now known to function in a cooperative network. For example, Vitamin C can reactivate free radical-containing glutathione or Vitamin E by accepting the free radical itself. Some antioxidants are more effective than others at neutralizing different free radicals. Some cannot neutralize certain free radicals. Some cannot be present in certain areas of free radical development (Vitamin A is fat-soluble and protects fat areas; Vitamin C is water-soluble and protects those areas). When interacting with a free radical, some antioxidants produce a different free radical compound that is less dangerous or more dangerous than the previous compound. Having a variety of antioxidants allows any by-products to be safely dealt with by more efficient antioxidants in neutralizing a free radical's butterfly effect.

Although initial studies suggested that antioxidant supplements might promote health, later large clinical trials did not detect any benefit and suggested instead that excess supplementation may be harmful.

Table 1: SUMMARY OF FOOD NUTRIENTS AND THEIR MAIN FUNCTIONS

	NUTRIENT	FUNCTION
1	CARBOHYDRATES	Provide energy for body heat and work
2	PROTEINS	The building and repair substances. Also supply energy.
3	FATS	The chief subsidiary supply of energy. They also provide essential fatty acids.
4	VITAMINS (fat-soluble ones including vitamin A, D, E, & K. Water-soluble ones include B vitamins and vitamin c)	Essential in some small amounts, control growth, repair and metabolism as well as other chemical processes.
5	MINERALS (include calcium, Magnesium, Phosphorus, sodium, potassium chloride, sulphur etc.)	Some provide building materials while others are needed for chemical processes.
6	WATER	The Most Critical Nutrient!Functions in transport, chemical reactions, temperature maintenance, lubrication, etc.
7	FIBRE	Provides bulk and habitat for intestinal flora as well as transport medium for vitamins
8	SPICES & FLAVOURINGS	For palatability as well as improving smell and taste

Source: Retrieved from http://ag.ansc.purdue.edu/nielsen/www245/lecnotes/Nutrition.html

The nutrients are gotten from the following sources.

1. **CARBOHYDRATES**: e.g. sucrose, fructose, starch, cellulose, glycogen, starchyose and raffinose. Food rich in carbohydrate are rice, other cereals, tubers, cereal products such as flour, legumes and some vegetables.

2. **PROTEINS**: Amino-acids are the building block of protein. Food rich in protein include milk, eggs, cheese, meat, fish, soybean other legumes and cereals.
3. **FATS AND OILS:** Sources of fats are both of animal and vegetable origin. They include vegetable oil (including cotton seed, sunflower, corn, olive, peanut, palm, soya, etc), butter, margarine, lard, dripping, milk, cheese, eggs, fish and nuts.
4. **VITAMINS:** Milk, egg, vegetables, cereals, etc.
5. **MINERALS:** They are found in fish, eggs, meat, milk, cereals, cheese, seafoods, etc.
6. **WATER AND FIBRE:** These are found in most foods.

Spices and flavourings include green pepper, curry and many others including synthesized ones that are added as food additives. These are usually added in recommended standard approved quantities. These classes usually referred to as food components or constituents can be determined by various methods in the laboratory. In doing this, it means that one is carrying out the Proximate Analysis of the food in question which is very important in all Nutritional Surveys.

It should also be noted that adequate proportions of these nutrients in our daily diets go a long way in controlling diseases associated with them. In other words every meal we eat must contain all the nutrients in the adequate proportions to achieve a Balanced Diet. There are daily dietary allowances for each of these nutrients to make a healthy living without which the body encounters malfunctions of various types resulting to various diseases associated with deficiencies and/ or excesses of these nutrients in the body.

Individuals can have deficient, adequate or toxic intakes of any essential nutrient. A DEFICIENCY occurs when the intake is too low to meet a person's need for specific nutrient. ADEQUACY occurs when a person gets enough, but not too much of a nutrient; while, **NUTRIENT TOXICITY** occurs when a person gets an overdose of a given nutrient. Every individual should therefore learn to participate in **Healthy Eating.**

2.3 RECOMMENDED DIETARY REQUIREMENTS OF NUTRIENTS

Carbohydrate

According to the Institute of Medicine, Harvard University children and adults should consume 45 to 65 percent of their calorie intake as carbohydrate and at least 130 grams of carbohydrate per day. Individuals should thrive to meet their daily carb requirements with healthy carbohydrates instead of refined grains and sugars, this will help maintain a healthy body weight and boost their energy levels. Examples of nutritious carbs include whole grains, fruits, vegetables, legumes, low fat milk, low fat yoghurt, nuts and seeds. The type of carbohydrate you choose to include in your diet can make a difference in your health.

Fats

First, you need to know how many calories you should eat day. Once you know this, you can determine how many grams of fat and saturated fat you can eat without exceeding your limit of fat. These limits are 25% to 35% of calories from fat and less than 7% of calories from saturated fat.

What are essential fatty acids?

Fats or fatty acids (FA) are important nutrients in our diet providing energy and palatability to foods. However, foods with high content of saturated fatty acids (SFA) are known to cause myriad of health problems. Foods high in unsaturated FAs, especially essential polyunsaturated fatty acids (PUFA) have been found to contribute to good health. Among PUFA, alpha-linolenic acid, an omega-3 fatty acid (abbreviated ALA) and linoleic acid, an omega-6 fatty acid, (abbreviated LA) are essential for human metabolism and their short fall can affect the healthy functioning of our body. Our body cannot synthesize these essential FAs and to meet their nutritional requirements, we have to source them through our diet.

Though LAs are essential, in excess they can be detrimental to the health as they have been found to accelerate the tumour growth. However, ALAs have anti-cancer effects and slow the

growth rate of tumours. ALAs help in the normal development and function of the brain, eyes and nerves.

Excess of LAs in the blood stream may result in the exhaustion of the enzymes required for breaking up of these FAs affecting the synthesis of DHA out of ALA. Hence, there has to be a balance in the proportion of essential omega-3 and omega-6 fatty acids, the ideal ratio being between 1:1 and 1:4.

How do you know the amount of fat to consume?
The table below gives a guide to the required maximum quantities of calories that should come from fat on a daily basis.

TABLE 2: RECOMMENDED VALUES FOR FATS

Total Daily Calories	**Maximum Calories from Fat**	**Maximum Grams of Fat***	**Maximum Calories from Saturated Fat****	**Maximum Grams of Saturated Fat**
1,600	400 to 560	44 to 62	112 or less	12 or less
1,800	450 to 630	50 to 70	126 or less	14 or less
2,000	500 to 700	56 to 78	140 or less	16 or less
2,200	550 to 770	61 to 86	154 or less	17 or less
2,400	600 to 840	67 to 93	168 or less	19 or less
2,600	650 to 910	72 to 101	182 or less	20 or less
2,800	700 to 980	78 to 109	196 or less	22 or less

Source: Institute of Medicine, Harvard University

*By following this, you will get the recommended 25% to 35% or less of your calories from fat.

*By following this, you will get the recommended less than 7% of your calories from saturated fat.

After you know your limits, try this experiment

- Write down your limits
- During the day, read your food labels to see how many grams of fat and saturated fat you are getting. Remember, food labels tell

you how many grams are in one serving as defined on the food label. If you eat a smaller or larger serving, then you're eating fewer or more grams of fat. Write down the amounts of fat and saturated fat from each of your meals and snacks.

- At the end of the day, add up the amounts to get a total for fat and a total for saturated fat. Repeat this experiment for several days, and then look at your totals. Are you at or below your limits on most days? If so, you're doing well. If not, you need to try to cut some fat and saturated fat from your diet. You need to add up your actual fat intake every day of your life. But it's a good idea to this when you begin making diet changes so you know where you are at the outset. This will also help you become more aware of serving sizes. Then do it again every few months as you make changes to see whether your eating habits are really improving.

Proteins

Proteins are essential nutrients for the human body. They are one of the building blocks of body tissues and can also serve as a fuel source. As a fuel, proteins contain 4Kcal per gram, just like carbohydrates and unlike lipids (fats) which contain 9Kcal per gram. The most important aspect and defining characteristics of proteins from a nutritional standpoint is the amino acid composition; they are polymer chains made of amino acids linked together by peptide bonds.

There are nine amino acids which humans must obtain from their diet in other to prevent Protein Energy Malnutrition; there are five dispensable amino acids which humans are able to synthesize in the body, while there are six conditionally essential amino acids whose synthesis can be limited.

Humans need the essential amino acids in certain ratios. Some protein sources contain amino acids in a more or less complete sense. This has given rise to various ranking systems for protein sources.

Animal sources of proteins include meat, dairy products, fish and egg. Vegan sources of protein include whole grains, pulses, legumes, soy and nuts. Vegetarians and vegans get enough essential

amino acids by eating a variety of plant proteins. It is commonly believed that athletes should consume a higher-than-normal protein intake to maintain optimal physical performance.

Protein is a nutrient needed by the human body for growth and maintenance. Aside from water, proteins are the most abundant kind of molecules in the body. Proteins can be found in all cell of the body and is the major structural component of all cells in the body, especially muscle. This also includes body organs, hair and skin. Proteins are also used in membranes, such as glycoproteins. When broken down into amino acids, they are used as precursors to nucleic acid, co-enzymes, hormones, immune response, cellular repair, and other molecules essential for life. Additionally, protein is needed to form blood cells.

Proteins can be found in a wide range of food. The best combination of protein sources depends on the region of the world, access, cost, amino acid types, and nutrition balance, as well as acquired tastes and the anti-nutritional factors present in these foods make them of limited value in human nutrition. Therefore, one must consider digestibility and secondary nutrition profile such as calories, cholesterol, vitamins and essential mineral density of the protein source. On a worldwide basis, plant protein foods contribute over 60% of the per capita supply of protein, on average. Meat, products from milk, eggs and fish are sources of complete protein.

Whole grains and cereals are another source of proteins. However, these tend to be limiting in the amino acid lysine or threonine, which are available in other vegetarian sources and meats. Examples of food staples and cereal sources of protein, each with a concentration greater than 7% are (in no particular order) buckwheat, oats, rye, millet, maize, rice, wheat, bulgur, sorghum, amaranth, and quinoa.

Vegetarian sources of proteins include legumes, nuts, seeds and fruits, legumes, some of which are called pulses in certain parts of the world. Have higher concentrations of amino acids and are more complete sources of protein than the whole grains and cereals. Examples of vegetarian foods with protein concentrations greater than 7% include soybeans, lentils, kidney beans, white beans, mug beans, chickpeas, cowpeas, lima beans, pigeon peas, lupines, wing

beans, almonds, Brazil nuts, cashews, pecans, walnuts, cotton seeds, pumpkin seeds, sesame seeds, and sunflower seeds.

Food staples that are poor sources of protein include roots and tubers such as yam, cassava and sweet potato. Plantains, another major staple, are also a poor source of essential amino acids. Fruits, while rich in other essential nutrients are another poor source of amino acids. The protein content in roots, tubers and fruits is between 0 and 2%. Food staples with low protein content must be complemented with foods with complete, quality protein content for a healthy life, particularly in children for proper development. A good source of protein is often a combination of various foods, because different foods are rich in different amino acids.

The amount of protein to be taken per day (i.e. the Dietary Reference Intake {DRI}) is 0.8 grams per kilogram of body or 0.36 grams per pound which amounts to 56grams per day for the average sedentary man and 46 grams per day for the average sedentary woman.

Vitamins and Minerals

Vitamins and Minerals are nutrients that must be included in the diet to aid metabolism and make for normal healthy performance of the body systems. There are micro and macro types of these nutrients which vary in their requirements. Trace elements are usually needed in the body in minute amounts, excess of which will cause toxicity in the body. The Recommended Dietary Allowances (RDAs) for selected nutrients commonly displayed on food labels are shown in table 3 below.

TABLE 3: RECOMMENDED DIETARY ALLOWANCES (RDAs) FOR SELECTED NUTRIENTS COMMONLY DISPLAYED ON FOOD LABELS

Micronutrient	Vitamin A (mcg*/day)	Vitamin C (mg**/day)	Potassium (mg**/day)	Calcium (mg**/day)	Iron (mg**/day)
For women > 51 years	700	75	4,700	1,000-1,200	8
For men > 51 years	900	90	4,700	1,000-1,200	8

*mcg = micrograms, **mg = milligrams

Source: Institute of Medicine, Harvard University

TABLE 4: SELECTED FOOD SOURCES OF VITAMIN A

Food	Vitamins A (micrograms)
Carrots, sliced, boiled, ½ cup	1,069
Spinach, frozen, boiled, ½ cup	573
Kale, frozen, boiled, ½ cup	956
Apricots with skin, juice packed ½ cup	207
Mango, sliced 1 cup	89
Milk, fortified, skim, 8 ounces	149
Eggs, hard-boiled, 1 large	203
Cheese, cheddar, 1 ounce	350

Source: Institute of Medicine; Harvard University

TABLE 5: SELECTED FOOD SOURCES OF VITAMIN C

Food	Vitamin C (milligrams)
Red sweet pepper, raw, ½ cup	142
Kiwi fruit, 1 medium	70
Orange, 1 medium	70
Green sweet pepper, raw, ½ cup	60
Grapefruit juice, ¾ cup	50-70
Vegetable juice cocktail, ¾ cup	50
Strawberries, ½ cup	49

Source: USDA National Database for Standard Reference

TABLE 6: SELECTED FOOD SOURCES OF CALCIUM

Food	Calcium (milligrams)
Yoghurt, plain, 1 cup	415
Cheddar Cheese, 1 ounce	306
Milk, non-fat, 1 cup	
Yoghurt, fruit, low-fat, 1 cup	
Orange juice, calcium-fortified, 6 ounces	200-260
Tofu, firm, made with calcium sulphate, ½ cup	204
Salmon, pink, canned, with bones, 3 ounces	181
Cottage cheese, 1% milk fat, 1 cup	138
Spinach, cooked, ½ cup	120
Chinese cabbage, raw, 1 cup	74

Source: USDA National Database for Standard Reference

TABLE 7: SELECTED FOOD SOURCES OF IRON

Food	Iron (milligrams)
Raisin Bran, 1 cup	18.7
White beans, canned, 1 cup	17.8
Boiled spinach, 1 cup	6.4
Raw oat bran, 1 cup	5.0
Boiled soybeans, 1 cup	4.5
Canned lima beans, 1 cup	4.5
Boiled peas, 1 cup	3.8
Stewed tomatoes, canned, 1 cup	3.3
Canned prune juice, 1 cup	3.0
Lean bottom round steak, 3 ounces	2.4

Source: USDA National Database for Standard Reference

TABLE 8: SELECTED FOOD SOURCES OF POTASSIUM

Food	Potassium (milligrams)
Sweet potato, baked, 1 medium	694
Tomato paste, ¼ cup	664
Baked potato, without skin, 1 medium	610
White beans, canned, ½ cup	595
Yoghurt, plain, low-fat, 8 ounces	531
Halibut, cooked, 3 ounces	490
Soybeans, green (edamame), cooked, ½ cup	485
Yellowfin tuna, cooked, 3 ounces	484
Banana. 1 medium	422
Spinach, cooked, ½ cup	419
Milk, non-fat, 1 cup	382
Apricots, dried, ¼ cup	378

Source: USDA National Database for Standard Reference

2.4 INTESTINAL BACTERIAL FLORA AND NUTRITION

Animal intestines contain a large population of gut flora. In humans, the four dominant phyla are *Firmicutes*, *Bacteroidetes*, *Actinobacteria,* and *Proteobacteria*. They are essential to digestion and are also affected by food that is consumed. Bacteria in the gut perform many important functions for humans, including breaking down and aiding in the absorption of otherwise indigestible food; stimulating cell growth; repressing the growth of harmful bacteria, training the immune system to respond only to pathogens; producing vitamin B_{12}; and defending against some infectious diseases. Note

that indiscriminate destruction of these intestinal flora by drug abuse, especially antibiotics is highly discouraged.

2.5 NUTRITION LITERACY

Statistics available in literature point to the complexities surrounding the lack of health/nutrition literacy and reveal the degree to which they are embedded in the social structure and interconnected with other problems. Among these problems are the lack of information about food choices, a lack of understanding of nutritional information and its application to individual circumstances, limited or difficult access to healthful foods, and a range of cultural influences and socioeconomic constraints such as low levels of education and high levels of poverty that decrease opportunities for healthful eating and living.

The links between low health literacy and poor health outcomes has been widely documented and there is evidence that some interventions to improve health literacy have produced successful results in the primary care setting. More must be done to further our understanding of nutrition literacy specific interventions in non-primary care settings in order to achieve better health outcomes.

With the knowledge of all I have said hitherto concerning "healthy dieting", I would want to elucidate some points concerning MALNUTRITION vis a vis "Unhealthy dieting" to highlight the risks a human being will be exposed to by not eating right. Most diseases are associated with our nutrition including the pattern, quality and quantity of food eaten each day of our lives.

2.6 MALNUTRITION

Malnutrition refers to insufficient, excessive, or imbalanced consumption of nutrients by an organism. In developed countries, the diseases of malnutrition are most often associated with nutritional imbalances or excessive consumption. In developing countries, malnutrition is more likely to be caused by poor access to a range of nutritious foods or inadequate knowledge. In Mali the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the Aga Khan Foundation, trained women's groups

to make *equinut*, a healthy and nutritional version of the traditional recipe *di-dèguè* (comprising peanut paste, honey and millet or rice flour). The aim was to boost nutrition and livelihoods by producing a product that women could make and sell, and which would be accepted by the local community because of its local heritage.

Although there are more organisms in the world who are malnourished due to insufficient consumption, increasingly more organisms suffer from excessive over-nutrition; a problem caused by an overabundance of sustenance coupled with the instinctual desire (by animals in particular) to consume all that it can.

This varies amongst adults, children and the Elderly. Within the household, there may be differences in levels of malnutrition between men and women, and these differences have been shown to vary significantly from one region to another, with problem areas showing relative deprivation of women. Samples of 100 women in India in 2008 demonstrated that malnutrition in women is associated with poverty, lack of development and awareness, and illiteracy. The same study showed that gender discrimination in households can prevent a woman from having sufficient food and healthcare.

Women have unique nutritional requirements, and in some cases need more nutrients than men; for example, women need twice as much calcium as men. Studies on nutrition concerning gender bias within households look at patterns of food allocation, and one study in 2003 suggested that women often receive a lower share of food requirements than men. Gender discrimination, gender roles, and social norms affecting women can lead to early marriage and childbearing, close birth spacing, and under-nutrition, all of which contribute to malnourished mothers. Frequent pregnancies with short intervals between them and long periods of breastfeeding add an additional nutritional burden. During pregnancy and breastfeeding, women must ingest enough nutrients for themselves and their child, so they need significantly more protein and calories during this periods, as well as vitamins and minerals (especially iron, iodine, calcium, folic acid, and vitamins A, C and K).

Children

The World Health Organization estimates that malnutrition accounts for 54% of child mortality worldwide, about 1 million children. Even mild degrees of malnutrition double the risk of mortality for respiratory and diarrheal disease mortality and malaria. The risk is greatly increased in more severe cases of malnutrition. There are three commonly used measures for detecting malnutrition in children: stunting (extremely low height for age), underweight (extremely low weight for age), and wasting (extremely low weight for height). These measures of malnutrition are interrelated, but studies for the World Bank found that only 9% of children exhibit stunting, underweight, and wasting. According to a 2008 review an estimated 178 million children under age 5 are stunted, most of who live in sub-Saharan Africa. A 2008 review of malnutrition found that about 55 million children are wasted, including 19 million who have severe wasting or severe acute malnutrition.

Children suffering from severe acute malnutrition are very thin, but they often also have swollen hands and feet, making the internal problem more evident to health workers. Under-nutrition in children causes direct structural damage to the brain and impairs infant motor development and exploratory behaviour. Children, who are undernourished before age two and gain weight quickly later in childhood and adolescence, are at high risk of chronic diseases related to nutrition; inadequate food intake, infections, psychosocial deprivation, the environment, and perhaps genetics contribute to these. Children with severe malnutrition are very susceptible to infection. However, children with chronic diseases like HIV have a higher risk of malnutrition since their bodies cannot absorb nutrients as well. Diseases such as measles are a major cause of malnutrition in children; thus immunizations present a way to relieve the burden.

The Elderly

Malnutrition and being underweight are more common in the elderly than in adults of other ages. If the elderly people are healthy and active, the aging process alone does not usually cause malnutrition. However, changes in body composition, organ function, adequate energy intake and ability to eat or access food are associated with

aging and may contribute to malnutrition. Sadness or depression can play a role, causing changes in appetite, digestion, energy level, weight and well-being. A study on the relationship between malnutrition and other conditions in the elderly found that malnutrition in the elderly can result from gastrointestinal and endocrine system disorders, loss of taste and smell, decreased appetite and inadequate dietary intake. Poor dental health, ill-fitting dentures, or chewing and swallowing problems can make eating difficult. As a result of these factors, malnutrition is seen to develop more easily in the elderly. Rates of malnutrition tend to increase with age in the elderly population; a study in *Clinical Nutrition* noted that less than 10% of the "young" elderly (up to age 75) are malnourished, while 30 to 65% of the elderly in home care, long-term care facilities, or acute hospitals are malnourished. Many elderly people require assistance in eating, which may contribute to malnutrition. Because of this, one of the main requirements of elderly care is to provide an adequate diet and all essential nutrients.

Table 9: SOME DISEASES ASSOCIATED WITH MALNUTRITION OF VARIOUS NUTRIENTS

CARBOHYDRATE	LIPIDS	PROTEINS	VITAMINS/ MINERALS
Acidosis (Change of pH levels from 7.35 to 7.45)	Lack of Essential fatty acids (EFAs) increases the risk of getting affected by cancer atherosclerosis, Coronary heart disease, behavioural problems, depression, cognitive decline and chronic inflammation, low absorption of Vitamins A, D, E, & K.	Kwashiorkor and Marasmus	Thrombosis (lack of Vitamin K)
Ketosis	Symptoms of essential fatty acid deficiency include achy joint, attention deficit, brittle nails, coarse/ unruly hair, cold intolerance, cracked skin on heels, eczema, excessive thirst, frequent urination, gastro-intestinal problems, hypertension, hyperactivity, irregular bowel movement, irritability, low concentration, low mental energy, low body weight, poor memory,	Thrombosis (abnormal clothing in the veins).	Night blindness, growth impairment, dry hair, acne and other eye problems (Lack of Vitamin A).

	poor wound healing, suicidal tendency, weakness and patches of dry skin.		
Hypoglycaemia	Coronary heart disease, hypertension, stroke, cardiac arrest, atherosclerosis. (Lack of omega-3 fatty acid).	Difficulty in breathing, Wheezing, vision problems and weakness (lack of Alpha-1-antntrysin)	Beriberi leading to damage of peripheral nerves with difficulty in walking and numbness in hand/feet, confusion, involuntary eye movements, speech dyfraulties and nausea (lack of thiamine Vitamin B1)
Fatigue and Decreased Energy levels	Cognitive decline during ageing and Alzheimer (lack of DHA)	Low blood sugar, weakness, cardiac and hepatic problems, wasting of muscles and difficulty in seeding (lack of tri-functional protein).	Photophobia, bloodshot eyes, inflammation of the linning of mouth and tongue, mouth ulcers, iron deficiency, anaemia, dry skin etc. (lack riboflavin Vitamin B2).
Muscle Wasting	Food high in saturated fatty acids causes a myriad of health problems while food high in polyunsaturated fatty acids contributes to good health).	Anaemia, lowered zinc absorption and lowered immune responses (lack of Histidine)	Pellagra with edema, cardio-myopathy, emotional disturbances etc (lack of Niacin vitamin).
Unhealthy Weight loss		Headaches, giddiness, weakness, depression, confusion and	Red, Patchy rashes near the mouth and dermatitis (lack of Biotin Vitamin B7)

		irritability (lack of Isoleucine, methionine and other amino acids)	
Dehydration & reduced body secretions		Low serotonin levels associated with depression, anxiety, panic, irritability, mood change, impatience, increase in weight, food cravings, aggressiveness and insomnia (lack of tryptophan).	Loss of appetite, low birth weight, neural tube defects, anaemia slow growth rate (lack bof folic Acid Vitamin B9).
Loss of Sodium			Scurvy with swollen and tender joints breathlessness, haemorrhages in various tissues, bones, joint pains, bleeding gums, loose teeth, jaundice edema etc. (lack of vitamin C).
Weakened Immune System			Rickets in children & osteomalacia in adults with weak malfunctioned brittle bones etc., resulting in muscular pairs fractures and loss of bones (Lack of Vitamin D).
Constipation			Anaemia, liver vecrosis, retinopathy, reproduction failure, male infertility etc (lack

			of Vitamin E)
Mood Swing and depression			Massive uncontrolled bleeding at sites of injury or surgery (lack of Vitamin K).
			Mineral deficiency diseases symptoms and impacts very according to the mineral involved and severity of the deficiency.
			The presence of a particular mineral may contribute to the absorption efficacy of another and sometimes lead to its toxic levels.
			Arthritis and osteoporosis (lacking Boron)
			Convulsions and tetany, 'pins and needles' sensation, numbness, abnormal heart rythms and muscle cramps (lack of Vitamin/Calcium).
			Loss of electrolyte balance, weakness, cramps, loss of potassium in the urine, low blood pressure etc (lack of chloride0. Note that excess will increase blood pressure.
			Impaired glucose tolerance, emaciation and

			mental debility etc (lack of chromium).
			Damage of the brain and nervous system with dementia, weakness, psychosis and pernicious anaemia.
			Copper, fluorine, iodine, iron, magnesium, manganese, molybdenum, phosphorus, nickel, potassium, zinc and other minerals cause various diseases ranging from anorexia, muscle pain, weak muscles, spasms, alkalosis, retarded growth, altered lipid levels, altered glucose levels, inflammation, tetanus, insular resistance to nausea.

Table 10: Further illnesses caused by improper nutrient consumption

Nutrients	Deficiency	Excess
Macronutrients		
Calories	Starvation, marasmus	Obesity, diabetes mellitus, cardiovascular disease
Simple carbohydrates	Low energy levels.	Obesity, diabetes mellitus, cardiovascular disease
Complex carbohydrates	Micronutrient deficiency	Obesity, cardiovascular disease (high glycemic index foods)
Protein	Kwashiorkor	Rabbit starvation, ketoacidosis (in diabetics)
Saturated fat	Low testosterone levels, vitamin deficiencies.	Obesity, cardiovascular disease
Trans fat	None	Obesity, cardiovascular disease
Unsaturated fat	Fat-soluble vitamin deficiency	Obesity, cardiovascular disease
Micronutrients		
Vitamin A	Xerophthalmia and night blindness	Hypervitaminosis A (cirrhosis, hair loss)
Vitamin B_1	Beri-Beri	?
Vitamin B_2	Skin and corneal lesions	?
Niacin	Pellagra	Dyspepsia, cardiac arrhythmias, birth defects
Vitamin B_{12}	Pernicious anemia	?
Vitamin C	Scurvy	Diarrhea causing dehydration
Vitamin D	Rickets	Hypervitaminosis D (dehydration, vomiting, constipation)
Vitamin E	Neurological disease	Hypervitaminosis E (anticoagulant: excessive bleeding)
Vitamin K	Hemorrhage	Liver damage
Omega-3 fats	Cardiovascular Disease	Bleeding, Hemorrhages, Hemorrhagic stroke, reduced glycemic control among

			diabetics
Omega-6 fats	None		Cardiovascular Disease, Cancer
Cholesterol	None		Cardiovascular Disease
Macrominerals			
Calcium	Osteoporosis, carpopedal laryngospasm, arrhythmias	tetany, spasm, cardiac	Fatigue, depression, confusion, nausea, vomiting, constipation, pancreatitis, increased urination, kidney stones
Magnesium	Hypertension		Weakness, nausea, vomiting, impaired breathing, and hypotension
Potassium	Hypokalemia, arrhythmias	cardiac	Hyperkalemia, palpitations
Sodium	Hyponatremia		Hypernatremia, hypertension
Trace minerals			
Iron	Anemia		Cirrhosis, Hereditary hemochromatosis, heart disease

2.6 SUMMARISED FACTS ABOUT NUTRIENTS

Please note the following summarised facts about nutrients needed in the body generally.

ENERGY

- Energy is not nutrient but Kilojoules (food energy); are important for providing energy for your daily activities.
- Proteins, fats and carbohydrates are converted into energy in different quantities. Vitamins and minerals are also essential nutrients for the body, but they are not converted into energy.
- Energy is required to fuel body processes (metabolism) and physical activity. If we consume more energy than we use for metabolism and physical activity, the excess is stored as body fat. You need to be sure to balance the energy you consume through foods with the energy you expend during the day. The more active you are the more energy you need and vice versa.
- The reference value for an average adult is 8,700 KJ.

- Fat contributes to energy intake and helps you absorb vital vitamins; therefore, a healthy diet should always contain a certain amount of fat. The two main forms of fat are saturated, predominantly from animal sources, and unsaturated, predominantly from vegetable sources.
- Because fat is a rich source of energy, you should try and eat no more than your recommended intake. It is also important to choose unsaturated fats as much as possible, such as those found in oily fish, nuts and seeds, avocado, and spreads made from sunflower, rapeseed and olive oil.
- The reference value for fat for an average adult is 70 grams.
- Too much saturated fat can raise blood cholesterol, which can increase the risk of heart disease. You should, therefore, consume no more than your recommended daily intake.
- The reference value for saturated fat for an average adult is 24 grams.
- Excessive spicing and use of food additives against food standard values are not only dangerous but can lead to diseases and eventual death.
- Enough water must be taken daily for proper metabolism, body fluid balance and maintenance of body temperature.

2.7 MENTAL AGILITY AND NUTRITION

Research indicates that improving the awareness of nutritious meal choices and establishing long-term habits of healthy eating have a positive effect on cognitive and spatial memory capacity, with potential to increase a student's ability to process and retain academic information.

Some organizations have begun working with teachers, policymakers, and managed foodservice contractors to mandate improved nutritional content and increased nutritional resources in school cafeterias from primary to university level institutions. Health and nutrition have been proven to have close links with overall educational success. Currently, less than 10% of American college students report that they eat the recommended five servings of fruit and vegetables daily. Better nutrition has been shown to have an impact on both cognitive and spatial memory performance; a study

showed those with higher blood sugar levels performed better on certain memory tests. In another study, those who consumed yogurt performed better on thinking tasks when compared to those that consumed caffeine-free diet soda or confections. Nutritional deficiencies have been shown to have a negative effect on learning behaviour in mice as far back as 1951.

"Better learning performance is associated with diet-induced effects on learning and memory ability".

The "nutrition-learning nexus" demonstrates the correlation between diet and learning and has application in a higher education setting.

"We find that better-nourished children perform significantly better in school, partly because they enter school earlier and thus have more time to learn but mostly because of greater learning productivity per year of schooling."

91% of college students feel that they are in good health, whereas only 7% eat their recommended daily allowance of fruits and vegetables.

Nutritional education is an effective and workable model in a higher education setting.

More "engaged" learning models that encompass nutrition is an idea that is picking up steam at all levels of the learning cycle.

There is limited research available that directly links a student's Grade Point Average (G.P.A.) to their overall nutritional health. Additional substantive data is needed to prove that overall intellectual health is closely linked to a person's diet, rather than just another correlation fallacy.

2.8 MENTAL DISORDERS AND NUTRITION

Nutritional supplement treatment may be appropriate for major depression, bipolar disorder, schizophrenia, and obsessive compulsive disorder, the four most common mental disorders in developed countries. Supplements that have been studied most for mood elevation and stabilization include eicosapentaenoic acid and docosahexaenoic acid (each of which an omega-3 fatty acid contained in fish oil but not in flaxseed oil), vitamin B12, folic acid, and inositol.

2.9 CANCER AND NUTRITION

Cancer is now common in developing countries. According to a study by the International Agency for Research on Cancer, "In the developing world, cancers of the liver, stomach and oesophagus were more common, often linked to consumption of carcinogenic preserved foods, such as smoked or salted food, and parasitic infections that attack organs." Lung cancer rates are rising rapidly in poorer nations because of increased use of tobacco. Developed countries "tended to have cancers linked to affluence or a 'Western lifestyle' — cancers of the colon, rectum, breast and prostate —, that can be caused by obesity, lack of exercise, diet and age."

2.10 METABOLIC SYNDROME AND NUTRITION

Several lines of evidence indicate lifestyle-induced hyperinsulinaemia and reduced insulin function (i.e., insulin resistance) as a decisive factor in many disease states. For example, hyperinsulinaemia and insulin resistance are strongly linked to chronic inflammation, which in turn is strongly linked to a variety of adverse developments such as arterial micro-injuries and clot formation (i.e., heart disease) and exaggerated cell division (i.e., cancer). Hyperinsulinaemia and insulin resistance (the so-called metabolic syndrome) are characterized by a combination of abdominal obesity, elevated blood sugar, elevated blood pressure, elevated blood triglycerides, and reduced HDL cholesterol. The negative impact of hyperinsulinaemia on prostaglandin PGE1/PGE2 balance may be significant.

The state of obesity clearly contributes to insulin resistance, which in turn can cause Type 2 diabetes. Virtually all obese and most type 2 diabetic individuals have marked insulin resistance. Although the association between overweight and insulin resistance is clear, the exact (likely multifarious) causes of insulin resistance remain less clear. It is important to note that it has been demonstrated that appropriate exercise, more regular food intake, and reducing glycemic load (see below) all can reverse insulin resistance in overweight individuals (and thereby lower blood sugar levels in those with type 2 diabetes).

Obesity can unfavourably alter hormonal and metabolic status via resistance to the hormone leptin, and a vicious cycle may occur in which insulin/leptin resistance and obesity aggravates one another. The vicious cycle is putatively fuelled by continuously high insulin/leptin stimulation and fat storage, as a result of high intake of strongly insulin/leptin stimulating foods and energy. Both insulin and leptin normally function as satiety signals to the hypothalamus in the brain; however, insulin/leptin resistance may reduce this signal and therefore allow continued overfeeding despite large body fat stores. In addition, reduced leptin signalling to the brain may reduce leptin's normal effect to maintain an appropriately high metabolic rate.

There is a debate about how and to what extent different dietary factors— such as intake of processed carbohydrates, total protein, fat, and carbohydrate intake, intake of saturated and Trans fatty acids, and low intake of vitamins/minerals—contribute to the development of insulin and leptin resistance. In any case, analogous to the way modern man-made pollution may possess the potential to overwhelm the environment's ability to maintain homeostasis, the recent explosive introduction of high glycemic index and processed foods into the human diet may possess the potential to overwhelm the body's ability to maintain homeostasis and health (as evidenced by the metabolic syndrome epidemic).

2.11 ANTI-NUTRIENTS

Anti-nutrients are natural or synthetic compounds that interfere with the absorption of nutrients. Nutrition studies focus on anti-nutrients commonly found in food sources and beverages. Examples include Phytates, Tannins and Saponnins etc. These compete with valuable nutrients and cause harm to the body by inhibiting proper metabolism of ingested food.

2.12 SUGAR CONSUMPTION AND HEALTH

The relatively recent increased consumption of sugar has been linked to the rise of some afflictions such as diabetes, obesity, and more recently, heart disease. Increased consumption of sugar has been tied to these three, among others. Obesity levels have more than doubled

in the last 30 years among adults, going from 15% to 35% in the United States. Obesity and diet also happen to be high risk factors for diabetes. In the same time span that obesity doubled, diabetes numbers quadrupled in America. Increased weight, especially in the form of belly fat, and high sugar intake are also high risk factors for heart disease. Both sugar intake and fatty tissue increase the probability of elevated LDL cholesterol in the bloodstream. Elevated amounts of Low-density lipoprotein (LDL) cholesterol, is the primary factor in heart disease. In order to avoid all the dangers of sugar, moderate consumption is paramount.

2.13 EARLIER STATISTICS

Number of undernourished people (million) in 2001-2003, according to the FAO, the following countries had 5 million or more undernourished people.

Table 11: Number of undernourished people (million) in 2001-2003

COUNTRY	NUMBER OF UNDERNOURISHED (MILLION)
India	212.0
China	150.0
Bangladesh	43.1
Democratic Republic of Congo	37.0
Pakistan	35.2
Ethiopia	31.4
Tanzania	16.1
Philippines	15.2
Brazil	14.4
Indonesia	13.8
Vietnam	13.8
Thailand	13.4
Nigeria	11.5
Kenya	9.7
Sudan	8.8
Mozambique	8.3
North Korea	7.9
Yemen	7.1
Madagascar	7.1
Colombia	5.9
Zimbabwe	5.7

These figures definity have increase tremendously in recent times due to economic recession and poverty as recently announced by the United Nations

3.0 EXTRACTS FROM MY WORK

Over the years we have tried to look at the nutrient compositions of both individual and grouped food stuffs. Below are few out of many under this sub heading.

3.1 AVAILABLE NUTRIENTS IN NATURE

3.1.1 Nutritive values of fruits and seeds eaten raw in Nigeria (Akaninwor and Arachie, 2002)

The fruits and seeds studied include avocado pear (*Persea americana*), Pawpaw (*Garcine papaya*), Banana (*Musa sapietum*), Coconut (*Cocos nucifera*), Bitter cola (*Garcine Kola*) Black tamarid (*Dalilium guineesis*), Mango (*Mangifera indica*) and Garden egg (*Solanum melongena*).

Results showed that these fruits and seeds eaten raw are good sources of essential nutrients particularly vitamin C which is usually destroyed by high temperature during preparation.

Table 12: Chemical composition of some Fruits and Seeds usually eaten raw in Nigeria

Sample	% Moisture	% Protein	% Ash	% Calcium	% CHO	% Fat	Vitamin C mg/100
Avocado pear	66.4 ± 3.2	2.2±0.1	2.8±0.05	13.9±2.1	2.9±0.1	18.1±1.2	3.4±1.0
Garden egg	73.5 ± 3.2	1.7±0.1	0.98±0.01	4.7±0.01	2.8±0.01	1.2±0.03	6.5±1.2
Banana	68.8 ± 3.1	1.1±0.01	5.5±0.1	8.0±0.2	6.4±0.1	1.9±0.01	9.9±1.5
Coconut	53.4±2.8	3.0±0.2	2.9±0.02	19.30±0.20	2.1±0.1	30.2±2.5	2.1±0.4
Pawpaw	81.9±4.2	0.8±0.01	2.9±0.02	1.38±0.02	9.9±1.2	0.12±0.01	87.7±4.5
Black Tamad	35.5±1.5	1.3±0.03	1.8±0.1	13.55±0.3	3.8±0.3	0.2±0.01	1.8±0.1
Bitter kola	41.2±2.1	1.1±0.05	3.4±0.1	13.80±2.1	4.0±0.9	4.3±1.2	7.2±0.1

3.1.2 Physico-chemical Parameters of Mono pump and well waters in Igbo-Etche (Nwala, Akaninwor and Abbey, 2007)

Water being one of the most essential needs of human beings and all other living organisms usually found in most foods and diet was investigated in a rural area of Rivers State. Ground water is an important source of water for domestic use especially in developing countries, (Ochen and Kolhatkar, 2003), often times have long retention and natural filtering capacity of aquifers and is often unpolluted; however, leachate from municipal solid-waste landfills are potential sources of contamination of both ground water and surface water (Odukoya *et al*., 2002). Water contamination is one of the major problems of man today identifying the fact that water quality is as important as its quantity. When water at its sources is contaminated by domestic, industrial and agricultural wastes, it is rendered unacceptable for its best usage and said to be polluted with the substances causing unfavourable alterations called pollutants (Ekpete, 2002). This study presented the following results in the tables below.

Table 13: Chemical Parameters of Water Samples

Samples	Total Alkalinity mg/l	Total Hardness mg/l	BOD mg/l	PO_4^{3-} mg/l	Cl mg/l	SO_4^{2-} mg/l	NO^{3-} mg/l
MW_1 (Chokota)	13.00±1.41	ND	4.98±0.26	0.05±0.02	3.71±0.30	1.04±0.10	0.17±0.07
MW_2 (Ikwerrengwo)	14.00±0.82	ND	9.25±0.20	0.80±0.04	3.21±0.20	2.15±0.20	0.59±0.13
MW_3 Umuebulu I	19.00±0.00	ND	8.41±0.28	0.06±0.01	0.98±0.10	2.48±0.40	0.20±0.14
MW_4(Umuebulu II)	12.00±1.41	ND	4.98±0.30	0.19±0.07	4.94±0.20	13.15±0.10	0.19±0.10
MW_1 (Nkwerrengwo)	215.00±1.41	91.00±0.14	3.61±0.03	0.52±0.03	5.43±0.24	14.19±0.26	0.52±0.06
MW_2 (Umuebulu V)	24.00±082	14.37±0.82	4.27±0.10	0.13±0.04	3.46±0.00	8.85±0.41	0.07±0.00

Table 14: Results of Analysis for Metals in Water Samples

Samples	Na mg/l	K mg/l	Mg mg/l	Ca mg/l	Pb mg/l	Cd mg/l	As mg/l
MW_1 (Chokota)	0.38±0.08	1.38±0.08	ND	ND	ND	ND	ND
MW_2 (Ikwerrengwo)	0.64±0.03	2.51±0.11	ND	ND	ND	ND	ND
MW_3 Umuebulu I	0.11±0.01	0.11±0.01	ND	ND	ND	ND	ND
MW_4 (Umuebulu II)	0.53±0.06	1.30±0.07	ND	ND	ND	ND	ND
WW_1 (Ikwerrengwo)	1.91±0.00	3.47±0.10	21.17±0.24	4.22±0.17	ND	ND	ND
WW_2 (Umuebulu V)	0.85±0.04	0.91±0.04	2.76±0.23	3.07±0.10	ND	ND	ND

The tables above show the chemical analyses of water sample.
Though all results obtained were however not significantly different from WHO values, the slightly higher concentrations of the parameters (pH and BOD) however indicated some levels of pollution which therefore calls for appropriate treatment measures of all waters before consumption by this populace in this study and all other populace concerned in drinking borehole and well waters as part of food.

3.1.3 Nutritional Evaluation of some Traditional weaning Foods from Akwa Ibom State of Nigeria (Essien E.B. *et al.)*

Exclusive breastfeeding for the first 4 – 6 months is the World Health Organisation (WHO's) recommended method of feeding full term infants by healthy well-nourished mothers (WHO 2000). However, after 6 months, breast milk alone is insufficient both in quantity and quality to meet nutritional requirements of the child, it therefore becomes necessary to supplement the breast milk with other foods, which starts as liquid foods and slowly progresses to solid foods as the child grows older while slowly reducing breast feeding (Cameron, 1983; WHO, 2000).

This is the weaning process. The nutritional status in children is most critical during the weaning stages when both macro and micro nutrients may be insufficient to maintain growth and development. It is worthy of note that several types of commercial weaning food are marketed in many countries including Nigeria and are priced beyond the reach of the majority of the population in the

rural areas. Rural mothers therefore depend on available low-cost food mixtures to wean their infants; these consist of un-supplemented cereal porridges made from maize, sorghum or millet, fruits like banana, and roots/tubers like cocoyam, yam or cassava which are later replaced by foods eaten by older family members.
This study thus saw the need to evaluate the potentials of some low-cost traditional weaning diets of the rural areas, emphasizing on their nutritive values in comparism with commercial products for their suitability as weaning foods.

Feeding trials using weaning albino rats showed that organ weights were higher in rats fed Nutrend (Commercial Control diet) than in rats fed any traditional diet. Most of the traditional diets however were better than pap (maize) alone which is the weaning diet still used the rural areas. Again, when compared with nutrient, these traditional diets were inadequate and would need fortification.

Table 15: Performance characteristics of Rats fed the local formulations

	Diets							
Parameter	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Feed intake (g)	233.40±6.7	236.00±4.8	234.4±2.3	250.60±3.5	328.30±8.9	273.00±4.3	208.10±4.5	416.90±5.6
Nitrogen intake (g)	5.28±0.15	7.46±0.10	11.40±0.1	9.10±0.13	7.99±0.20	8.37±0.13	1.17±0.02	10.70±0.14
Protein intake(g)	32.76±0.94	47.42±0.97	71.30±0.7	56.90±1.75	49.90±1.20	52.30±0.83	7.33±1.16	66.70±0.91
Carcass Nitrogen(g)	3.77±0.09	4.97±0.17	8.80±0.27	5.40±0.11	5.66±0.08	4.13±0.11	1.74±0.24	7.72±0.11
Fecal Nitrogen(g)	1.63±0.08	1.29±0.05	1.85±0.09	2.26±0.09	1.08±0.03	1.89±0.12	0.08±0.03	2.90±0.03
Weight Gain (g)	29.30±5.31	43.80±4.27	80.00±3.5	43.00±2.71	52.00±4.81	36.00±2.00	7.50±2.5	113.80±8.0
FCR	0.12±0.02	0.19±0.02	0.35±0.02	0.22±0.02	0.16±0.03	0.14±0.01	0.04±0.01	0.27±0.01
NPR	1.81±0.13	1.56±0.09	1.54±0.05	1.49±0.10	1.62±0.16	1.31±0.08	-	2.23±0.05
PER	0.89±0.14	0.92±0.09	1.09±0.08	0.47±0.04	0.56±0.02	0.73±0.07	1.02±0.34	2.06±0.13
NPU (%)	61.20±1.80	58.10±3.04	69.80±7.1	52.90±3.83	63.60±2.42	42.60±3.61	-	66.90±2.85
TD (%)	71.17±5.23	84.20±0.57	82.90±5.8	83.30±5.59	87.50±0.39	81.60±3.53	-	73.50±0.62
BV (%)	86.10±6.78	69.00±3.93	84.30±0.62	64.20±5.68	72.70±5.34	52.30±5.35	-	91.10±4.09

3.2 EFFECT OF PROCESSING ON FOOD WE CONSUME:

There are quite a number of work done under these sub heading but permit me to mention a few.

3.2.1 Effect of Processing on the Nutritional Quality of African Yam Beam (*Spenostylis Sternucarpa*) and Bambara Groundnut (*Voandzeia Subterrenea*) (Essien and Akaninwor, 2002)

The nutrient and anti-nutrient contents of African Yam Bean (AYB) and Bambara Groundnut (BG) subjected to three processes: cooking, dehuling and germination were investigated. Results showed that such pre-treatment had significant effects on the chemical composition of whole been samples. The anti-nutrients were reduced in all treatment with germination being the most effective method of reducing them in legumes (sometimes we find germinated beans in canned foods); it is worthy to note that tannins are nonspecific inhibitors of enzymes and may reduce protein quality by directly complexing with protein (Tan *et al*, 1983).

However, this study showed that processing methods employed are considered effective in removing the anti-nutritional factors in these legumes to levels considered not to pose any damage or toxicity to consumers aside maintaining good levels of available nutrients.

Thus the nutritional values of these legumes are enhanced by those treatments. It is therefore advised that pulses and other foodstuffs that have high levels of anti-nutrients must undergo heat treatments as well as other methods of depleting anti-nutrient levels before consumption; see tables below.

Table 16: Proximate Composition of Unprocessed and Processed African Yam Bean and Bambara Groundnut

Sample	Moisture	Dry Matter	Ash	Crude Protein	Crude Fat	Crude Fibre	Carbohy drate
AFRICAN YAM BEANS							
Unprocessed	10.2±0.10	89	3.7±0.70	22.4±0.10	2.2±0.10	5.7±0.01	59.3±0.10
Boiled	9.3±0.10	90.7	3.4±0.01	22.6±0.10	1.8±0.02	5.4±0.011	60.6±0.1
Dehulled	17.6±0.10	87.4	4.0±0.01	25.6±0.05	1.9±0.00	4.5±0.01	55.7±0.10
Germinated	13.2±0.20	80.8	4.3±0.01	19.9±0.10	0.9±0.00	6.9±0.10	57.7±0.30
BAMBARA GROUNDNUT							
Unprocessed	88±0.10	91.2	3.9±0.10	22.5±0.03	6.7±0.03	5.6±0.10	60.0±0.01
Boiled	72±0.10	92.8	3.3±0.10	22.6±-0.20	4.4±0.20	4.3±0.011	60.7 ±0.01
Dehuled	10.3±0.10	89.7	3.9±0.01	25.6±0.50	5.7±0.50	4.0±0.00	56.0±0.20
Germinated	11.0±0.05	89.0	5.3±0.10	20.3±0.01	5.0±0.01	6.3±0.10	55.9±0.20

Table 17: Phytate and Tannin Content of Unprocessed Africa Yam Bean and Bambara Groundnut (mg/100g Dry Matter)

Sample	PHYTATE CONTENT	APPARENT LOSS ON PROCESSING (%)	TAMNIN CONTENT	APPARENT LOSS ON PROCESSING (%)
AFRICAN YAM BEANS				
Unprocessed	742.5±9.6		883.6±2.80	
Boiled	671.4±5.20	9.6	465.5±2.50	47.3
Dehulled	762.9±9.60	2.1**	177.7±2.80	79.9
Germinated	444.4±0.60	40.1	490.8±2.90	44.5
BAMBARA GROUNDNUT				
Unprocessed	815.7±0.01		494.7±5.40	
Boiled	727.0±1.3	10.3	249.7±2.7	49.5
Dehulled	829.3±0.10	1.7**	154.1±5.40	68.8
Germinated	481.0±3.00	47.0	266.1±1.30	46.2

3.2.2 Comparative Nutrient and Anti-Nutrient Levels in Commercial and Formulated Weaning Food (Akaninwor and Okechukwu, 2004)

Low cost effective local diet mixtures such as sweet potato – crayfish – soya bean – banana – groundnut mixture when subjected to heat treatment (autoclaved) can compete favorably with commercial weaning diets with reduced anti-nutrients and provision of required nutrients necessary to wean a child.

3.2.3 The Effect of Storage on the Nutrient Composition of some Nigerian Foodstuffs: Banana, Yam & Plantain (Akaninwor J.O. and Sodje M., 2005)

Storage methods affect the availability of nutrients in foods and depend on the type of food being stored. For this study, open air storage was infact better than deep freezer storage provided consumption is hastened to avoid spoilage since the deep freezer subjects the food stuffs to chilling injury and nutrient loss. However, the storage of yam, cocoyam, plantain and banana can be longer in a refrigerator than open air.

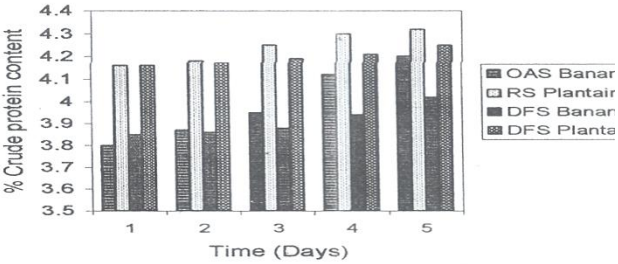


Figure 5: Percent Crude protein of banana and plantain

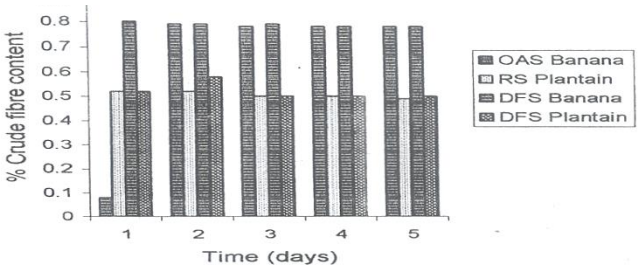


Figure 6: Percent Crude Fibre content of banana and plantain

3.2.4 Phytate – Phosphorus and Mineral changes during processing of African Yam Beans and Bambara Groundnut (Akaninwor and Essien, 2005)

Although these legumes were found to be good sources of calcium, magnesium and iron with low sodium and copper, all the processing methods decreased the mineral content of the legumes. On the other hand cooking and germination decreased the Phytate – Phosphorus levels which usually reduce availability of mineral element to human, implicating marked improvement on the availability of mineral elements in this legumes to humans. Cooking and germination are therefore recommended processing methods.

3.3 POLLUTION AND FOOD SAFETY

Various types of pollution have been studied over the years. The following are some of our work amongst many others on environmental pollution and food safety. Most of the work had looked at the various food stuffs consumed by human that are grown in polluted areas of Niger Delta as well as the effects of their consumption on haematological, toxicological and biochemical parameters that hinder good health and body performance.

3.3.1 Trace Metal Levels in Raw and Heat Processed Nigerian Staple Foods from Oil-Producing Area of Rivers and Bayelsa States (Akaninwor, J.O. *et al*, 2006)

The levels of some metals (Fe, Zn, Cu, Ni, Cd) were quantitatively determined in raw and heat processed staple food cultivars (Yam, cassava, cocoyam and maize) from oil producing area of part of Niger Delta and compared with non-oil producing area of Ebonyi State as control.

This survey evaluated the role of food as exogenous source of these metals amongst inhabitants.

Results showed that exceedingly higher levels of these metals characterized the raw staple food cultivars from oil producing areas than those from non-producing areas and on heat treatment the levels were reduced. These high levels are indicative of extensive pollution in these areas under studied suggesting possible health risks in consumption of food cultivars from such areas.

Table 18: Concentration of Trace Metals (ppm) of Raw and Heat Processed Yam Tuber from different locations (Eleme, Ogoni, Okrika, Nembe and Abakaliki)

CONSTITUENTS CONCENTRATIONS OF TRACE METALS (PPM)										
	Raw Samples in Locations					Heat Processed Sample in Locations				
	Eleme	Ogoni	okrika	Nembe	Abakaliki	Eleme	Ogoni	Okrika	Nembe	Abakaliki
Fe	52.75±0.00[a]	48.75±0.25	41.50±0.25[d]	46.76±0.00[e]	33.58±0.14[e]	49.50±0.25[a]	41.00±0.25[b]	26.25±0.25[d]	36.67±0.14[e]	26.42±0.14[d]
Zn	33.27±0.03[a]	28.58±0.00	15.73±0.00[a]	15.90±0.00[j]	16.44±0.01[e]	28.30±0.15[a]	24.70±0.00[b]	13.78±0.03[c.d]	15.60±2.43[e]	13.55±0.00[d]
Cu	5.83±0.14[a]	4.08±0.14[b]	3.33±0.25[a]	3.92±0.14[b]	3.83±0.14[b]	3.17±0.14[a.b]	3.08±0.29[a.b.c]	3.33±0.15[a]	2.83±0.14[e]	3.08±0.14[b.e]
Ni	4.50±10.00[a]	3.17±0.28	3.08±0.14[b]	4.25±0.25[a]	3.08±0.14[b]	3.50±0.25[b]	3.00±0.14[e]	2.92±0.14[a]	3.50±0.14[a]	3.25±0.14[b]
Cd	0.28±0.03[a]	BDL	BDL	BDL	BDL	0.23±0.03[a]	BDL	BDL	BDL	BDL
Pb	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Table 19: Concentrations of Trace Metals (ppm) of Raw and Heat Processed Yam Tuber from Oil Producing Areas (Eleme, Ogoni, Okrika, Nembe) and Abakiliki Concentrations of Trace Metals (ppm)

	Heat Processed Sample in Locations				
	Eleme	**Ogoni**	**Okrika**	**Nembe**	**Abakaliki**
Fe	49.50±0.25[a]	41.00±0.25[b]	26.25±0.25[d]	36.67±0.14[e]	26.42±0.14[d]
Zn	28.30±0.15[a]	24.70±0.00[b]	13.78±0.03[c.d]	15.60±2.43[e]	13.55±0.00[d]
Cu	3.17±0.14[a.b]	3.08±0.29[a.b.c]	3.33±0.15[a]	2.83±0.14[e]	3.08±0.14[b.e]
Ni	3.50±0.25[b]	3.00±0.14[e]	2.92±0.14[a]	3.50±0.14[a]	3.25±0.14[b]
Cd	0.23±0.03[a]	BDL	BDL	BDL	BDL
Pb	BDL	BDL	BDL	BDL	BDL

3.3.2 Toxicological Effects of the Crude Oil (Bonny Light and Forcados) on *Clarias Gariepinus* and*Oreochromis Niloticus*) (Akaninwor et *al.*, 2006)

This study examined the effect of pollution of two types of fish (using fry, fingerlings and adults).

Results showed high toxicity of the two brands of crude oil attributed to low level of dissolved oxygen (DO).

The study revealed a decrease in haemoglobin (Hb) levels and Packed Cell Volume (PCV) of adult fish exposed to water soluble fractions of both petroleum samples with a concomitant elevation of white blood count (WBC). It is therefore envisaged that the level of environmental toxicity caused by the pollution with Bonny light and Forcados will negatively affect the nutritional and toxicological status of people living in polluted areas. They will also be harmful to lives of aquatics organisms found around such areas and will consequently be harmful to human lives since they consume these fishes.

Table20: Haematological Parameters of Adult *Clarias Gariepinus* Exposed to Water Soluble Fraction (WSF) Of Bonny Light and Forcados

Sample	PCV (%)	Hb g/100ml	WBC x 10^3/L
CONTROL	14.02 ± 0.02	20.00 ± 0.02	12.00 ± 0.01
BONNY LIGHT	10.01 ± 0.01	15.00 ± 0.02	20.02 ± 0.02
FORCADOS	16.01 ± 0.02	10.00 ± 0.01	18.01 ± 0.02

Table 21:Haematological Parameters of Adult *Oreochromis Niloticus* Exposed to Water Soluble Fraction (WSF) Of Bonny Light and Forcados

Sample	PCV (%)	Hb g/100ml	WBC x 10^3/L
CONTROL	14.02 ± 0.02	20.00 ± 0.02	12.00 ± 0.01
BONNY LIGHT	11.02 ± 0.02	18.00 ± 0.04	16.01 ± 0.02
FORCADOS	8.02 ± 0.03	16.00 ± 0.01	14.04 ± 0.01

3.3.3 Physicochemical Properties of Soils and Borehole Water from Oil Producing Areas (Akaninwor *et al*., 2005)

The physicochemical properties, trace metals and anions were evaluated in soil and borehole water from oil producing areas and Abakaliki (noted for agricultural activities). This has become necessary as the monitoring of inorganic ions in the environment (soil and water) is fast becoming an essential aspect of pollution studies particularly in industrialized areas.

The study has shown that pollution affected the concentrations of anions and trace metals in the soils of oil producing areas. The concentrations of some ions analyzed were on the high side indicating their high pollution potentials especially if no treatment measures are undertaken, suggesting therefore that farmland of oil producing areas are getting polluted with inorganic ions and would not be suitable for agricultural purpose if not treated; this is dangerous in terms of food production as well as consumption of such food stuffs. Also the borehole water from Abakaliki, Eleme and Ogoni would be unacceptable as sources of portable water for domestic and industrial purposes if not treated.

There is therefore a call for routine monitoring around those areas in order to maintain safe levels of these contaminants so as to have safer and healthier environment.

Table 22:Physico-Chemical Properties of Soil from the different locations (Eleme, Ogoni, Okrika, Nembe And Abakaliki)

SAMPLING LOCATIONS					
Parameter	Eleme	Ogoni	Okrika	Nembe	Abakaliki
pH	4.14 ± 0.01^{d}	4.24 ± 0.01^{c}	4.36 ± 0.01^{b}	4.24 ± 0.00^{c}	5.64 ± 0.0^{a}
Temperature (^{0}C)	28.00 ± 0.00^{a}	28.00 ± 0.00^{a}	25.00 ± 0.00^{a}	27.00 ± 0.00^{a}	26.00 ± 0.00^{a}
Organic matter (%)	7.88 ± 0.03^{b}	6.73 ± 0.03^{d}	9.97 ± 0.12^{a}	6.88 ± 0.03^{a}	4.85 ± 0.0^{e}
Conductivity (u/cm)	285.33 ± 0.58^{a}	266.67 ± 01.15^{c}	261.67 ± 0.58^{d}	273.00 ± 0.00^{b}	130.00 ± 0.00^{e}
Salinity (%)	18.08 ± 000^{a}	14.47 ± 0.00^{d}	16.28 ± 0.00^{c}	16.88 ± 1.38^{b}	12.12 ± 0.16^{e}

Table 23: Physicochemical Properties of Borehole Waters from the different locations (Eleme, Okrika, Nembe and Abakaliki)*

SAMPLING LOCATION					
PARAMETERS	**Eleme**	**Ogoni**	**Okrika**	**Nembe**	**Abakaliki**
pH	5.03±0.00^{d}	5.37±0.00^{d}	6.80±0.00^{a}	6.57±0.01^{b}	4.79±0.01^{e}
Temperature (^{0}C)	25.00±0.00^{a}	2800±0.00^{a}	25.50±0.00^{a}	26.00^{a}±0.00	24.50±0.00^{a}
Conductivity	292.00±0.00^{b}	27.00±0.00^{e}	272.33±0.58^{c}	67.67±0.58^{d}	327.00±0.00^{a}
Total Dissolved Solic (ppm)	2540.00±0.00^{b}	420.00±0.00^{e}	1933.33±11.55^{c}	600.00±0.00^{d}	6633.33±11.5
Total Suspended Solid (ppm)	520.00±0.00^{a}	240.00±0.00^{a}	340.00±0.00^{e}	400.00±0.00^{a}	260.00±0.00^{a}
Salinity	54.77±1.03^{c}	9.06±0.00^{d}	9.06±0.00^{d}	63.51±0.52^{b}	76.74±0.00^{a}
Biochemical Oxygen Demand (ppm)	0.11±0.03^{a}	0.66±0.00^{b}	0.03±0.00^{b}	0.04±0.02^{b}	0.13±0.02^{a}
Chemical Oxygen Demand (ppm)	20.00±0.00^{a}	14.40±0.23 ^{e}	18.00±0.00^{c}	16.53±0.46^{d}	18.53±0.23^{b}

Table 24: Concentrations of Trace Metals (mg/g)* in Soil Samples from the Different Locations (Eleme, Ogoni, Okrika, Nembe and Abakaliki)

SOLID SAMPLING LOCATION					
Constituents	**Eleme**	**Ogoni**	**Okrika**	**Nembe**	**Abakaliki**
Iron (Fe)	9199.50±0.50^{a}	4468.75±0.00^{c}	4656.25±0.00^{b}	4150.88±0.87^{d}	3154.74±0.20^{e}
Zinc (Zn)	92.92±0.01^{a}	41.23±0.00^{d}	21.83±0.08^{e}	45.32±0.01^{c}	61.96±0.21^{b}
Copper (Cu)	8.08±0.14^{a}	7.88±0.38^{a}	8.08±0.14^{a}	5.38±0.63^{b}	5.38±0.13^{b}
Nickel (Ni)	11.92±0.14^{a}	6.50±0.50^{c}	5.00±0.50^{d}	11.25±0.25^{b}	4.75±0.25^{d}
Cadmium (Cd)	0.94±0.06^{a}	0.51±0.09^{b}	0.84±0.06^{a}	0.90±0.00^{a}	0.45±0.03^{b}
Lead (Pb)	24.83±0.14a	24.58±0.14^{a}	16.63±0.38^{c}	21.33±0.75^{b}	5.33±0.14^{d}

Table 25: Concentration of Trace Metals (mg/g) of Borehole Waters from the different locations (Eleme, Ogoni, Okrika, Nembe and Abakaliki)*

WATER SAMPLING LOCATIONS					
Parameter	**Eleme**	**Ogoni**	**Okrika**	**Nembe**	**Abakaliki**
Iron (Fe	1.02 ± 0.08^{b}	0.54 ± 0.08^{b}	0.06 ± 0.01^{c}	0.15 ± 0.03^{C}	0.06 ± 0.01^{c}
Zinc (Zn	0.22 ± 0.00^{b}	0.29 ± 0.01^{a}	0.17 ± 0.00^{c}	0.12 ± 0.01^{d}	0.07 ± 0.00^{e}
Copper (Cu)	BDL	1.50 ± 0.25^{a}	BDL	BDL	BDL
Nickel (Ni)	BDL	BDL	BDL	BDL	BDL
Cadmium (Cd)	BDL	BDL	BDL	BDL	BDL
Lead (Pb)	BDL	BDL	BDL	BDL	BDL

Table 26: Concentrations of Anions (mg/L) In Soil from the different locations (Eleme, Ogoni, Okika, Nembe and Abakaliki)

SAMPLING LOCATIONS					
Constituents	**Eleme**	**Ogoni**	**Okrika**	**Nembe**	**Abakaliki**
Sulphate ($S0_4^{2-}$)	66.65 ± 0.40^{a}	18.88 ± 0.00^{c}	22.32 ± 0.00^{b}	15.11 ± 0.00^{d}	13.35 ± 0.20^{e}
Phosphate Po_4^{3-}	6.79 ± 0.01^{b}	3.64 ± 0.00^{d}	6.09 ± 0.00^{c}	6.09 ± 0.00^{d}	7.50±0.00a
Nitrate ($N0_3$)	2.25 ± 0.00^{c}	4.35 ± 0.00^{b}	2.25 ± 0.00^{c}	1.60 ± 0.01^{d}	5.44 ± 0.01^{a}
Chloride (CI-)	10.00 ± 0.00^{a}	8.00 ± 0.00^{d}	9.00 ± 0.00^{d}	9.67 ± 0.58^{b}	6.33 ± 0.29^{e}

TABLE 27: Concentrations of Anions (mg/l) in Borehole Waters from the different locations (Eleme, Ogoni, Okrika, Nembe and Abakaliki)

SAMPLING LOCATIONS					
Parameters	**Eleme**	**Ogoni**	**Okrika**	**Nembe**	**Abakaliki**
Sulphate ($S0_4^{2-}$	30.76 ± 0.01^{a}	6.87 ± 0.00^{d}	10.36 ± 0.10^{b}	8.59 ± 0.00^{c}	6.24±0.20e
Phosphate Po_4^{3-}	0.01 ± 0.00^{d}	$0.01\pm0.00^{\cdot d}$	0.02±0.00c	0.09 ± 0.00^{b}	0.10±0.00a
Nitrate ($N0_3$)	13.69 ± 0.05^{b}	4.15 ± 0.00^{c}	2.50 ± 0.05^{d}	2.50 ± 0.00^{d}	18.15 ± 0.05^{a}
Chloride (CI-)	30.33 ± 0.58^{c}	5.00 ± 0.00^{d}	5.00 ± 0.00^{d}	35.17 ± 0.29^{b}	42.50 ± 0.00^{a}

3.3.4 Changes in the activity values of Some Selected Liver Marker Enzymes in Sera of Pregnant Women Feeding on Staple Foods from Oil Producing Areas of Rivers State (Akaninwor et *al.*, 2006)

Activity levels of selected marker enzymes were investigated as biochemical probes in health screening of pregnant and non-pregnant women feeding on some Nigeria staple foods grown in oil producing areas of Rivers State.

The activity levels of the three marker liver enzymes (ALT, AST and ALP) in sera of non-pregnant women from oil producing areas were generally higher than those of non-pregnant women from non- oil producing areas, the higher levels of these enzymes in various stages of pregnancy in women feeding on staple foods from oil producing areas of Rivers State are indicative of possible susceptibility to diseases such as Jaundice and hepatitis and might be the cause of neonatal Jaundice often found in such areas. This therefore calls for caution; pregnant women in particular should minimize consumption of food cultures from polluted areas and should have constant check of the activities of these enzymes as part of their routine antenatal checkup.

Other works on pollution and food safety include;

3.3.5 Effect of Diets Contaminated With Crude Petroleum Products on Enzyme Activities of Wistar Albino rats (Akaninwor and Okeke, 2006)

A significant change in some liver enzymes implicated myocardial infarction and hepatocellular damages suggesting that these petroleum crude samples (Bonny light and Forcados) on long term exposure to animals or even humans that feed on these animals in an environment polluted with them will cause deleterious effects on the liver of such and may reduce the population around these areas hence a close a monitor/treatment of the levels of xenobiotics accruing from effluent discharge or total spillage from companies is highly necessary to maintain safe levels in the environment.

3.3.6 Effect of Diets Contaminated with Petroleum Products on the Hematological parameters of Wistar Albino Rats (Okeke *et al.*, 2006)

Here, the female rats showed decreases in Hb, PCV, Lymphocytes and eusinophils when compared with the male counterparts. Long term exposure of rats to petroleum samples induced anaemia through the reduction of Hb and PCV and this reduction may be related to the degree of toxicity of crude oil samples. Erythrocytopenia observed in this study must be as a result of suppressing effects of petroleum samples on erythropoiesis and should be monitored in polluted areas.

3.3.7 Effect of Indo-food (Indomie) Industrial effluent discharge and physicochemical properties of new Calabar River in Choba, Rivers State (Akaninwor and Egwim, 2006)

The result of the various analyses indicated a significant difference in the physicochemical properties except turbidity, nitrate and hardness at 200m sampling point, hardness and chlorine free at 400m sampling point, hardness, copper and pH at 600m sampling point suggesting that these sampling points were relatively polluted; majority of the physicochemical parameters measured consistently increased from headwater to down water, (i.e. conductivity, total dissolved solutes, colour, turbidity, sulphate, nitrite , nitrate, phosphorous, chlorine, chloride, iron, copper, manganese, Biochemical Oxygen Demand, temperature, hardness and Chemical Oxygen Demand. On the contrary, notably, Dissolved Oxygen and pH showed remarkable decrease from the upstream values to downstream thus suggesting that the water analysis is slightly acidic and contain less dissolved oxygen caused by increased organic and inorganic contents of the industrial effluent. The elevated levels of the physicochemical pollution indicators of these sampling points would invariably affect the taste, appearance and aesthetic properties of the river water posing a potential health hazard of varying degrees to various life forms which depend on the water for survival and recreational purposes. A routine treatment of the effluents before discharge is therefore highly recommended to maintain safe levels of

these physicochemical parameters, effluent pollution and environment.

A similar study by Anosike, Akaninworand Egwin (2007) on the effect on microbial properties of New Calabar River had also shown elevated levels of microbial pollution indicators where the visible bacterial counts of samples ranged from $5.4x10^3$ to 26×10^3 cfu suggesting that the water samples contained heavy microbial load. Infact, the biochemical identification of the isolate in water samples showed that *Staphylococcus aureus*, *Shigella sp*., *Proteus vulgaris,Escherichia coli* and *Citrobacter sp.* predominated the water samples while the fungal microscopy identified *Candida* species, Fusarium, *Circinotrich* and *Cephaliaphora* in water samples. The elevated levels are microbial pollution indicators.

3.4 MALNUTRITION

Many research works have been done under this heading. My team and I have looked at the following:

3.4.1 Profile of Protein Energy Malnutrition amongst Children under four Years in Urban and Rural Areas of Rivers State (Akaninwor *et. al*., 1996)

The incidence rate for a period of 30 months investigated ranged from 3.97 to 4.81% of the total number of patients examined while the point prevalence of a range of 0.13 to 0.99% of the total urban population of children aged 0.4 years. This of course will not be the same in 2016 especially with the global recess poised with gross poverty level that is eating deep into our system. When this work was done PEM was found to occur at a very low rate in Rivers but persisted throughout the period of investigation. PEM occurred in both males and females with the mean difference between the two sexes not significant ($p>0.05$) suggesting a non sex dependent PEM within the age range.

3.4.2 Anthropometric changes during Protein Energy Malnutrition (PEM) in Nigerian children (0-28 months) living in Rivers state (Akaninwor *et.al.*, 1998)

Generally there was stunting amongst children and the level of reduction in the weight for age indicated severe wasting of muscles (at a faster rate than weight for length) an application of marasmic type over other types of PEM. The results obtained present weight for age a better index for diagnostic purposes while weight for length could severe as a useful index for prognosis.

3.4.3 Hematological and Enzyme changes in malnourished children under four years in selected areas of Rivers State of Nigeria (Akaninwor *et. al.*, 1999)

There were low hematological values in this study implicating anemia amongst these children. On the other hand there was marked increase of the liver enzymes due to infections associated with PEM. The biochemical parameters (total protein and albumin levels) were also reduced suggesting inadequate protein intake by these children.

3.4.4 Protein Energy Malnutrition: A nutritional Assessment and Alleviation Study of Locally Formulated Weaning Diets (Akaninwor and Abbey, 2006)

Protein Energy Malnutrition (PEM) was induced in weaning rats within a period of 30 days by feeding a Kwashiokorigenic diet (with only 3.47 protein). The rats were then fed with five different alleviation diets formulated from local foodstuffs. These foodstuffs are always available and comparatively cheaper than commercial weaning foods. The diets increased the hematological, biochemical, biological and anthropometrics parameters that were hitherto reduced due to the malnourished state of the rats, suggesting recovery on rehabilitation. A general decrease in enzyme activities over that obtained for PEM state was also observed showing a drive from abnormal to normal in the mechanism that caused excess production or leakage from the cells where these proteins exist and hence the high activities at the onset. A follow up study with

formulated diets on human PEM infants in the rehabilitation center had similar effect on their weights while the mean arm and head circumferences did not show any appreciable difference in both test and control diets. There was 20.93% increase in weight when cowpea / Ogi was added to the normal diet of PEM children under two years of age as against an 1800% weight increase obtained with the normal diets of the rehabilitation center Such cheap and yet protein rich diets could be used as a complement to breast milk.

It is interesting to note that several research works have been carried out bothering on Nutrition and Toxicology, General Malnutrition and Environmental studies that time will not permit me to enumerate all of them. Other areas include works on Pharmacological and Clinical properties of Extracts of hitherto well known plants naturally grown in our locality especially in the treatment of diabetes, liver diseases and wound healing, as well as use of agricultural wastes in production of useful nutritional products and such include;

- Effects of Aqueous Entracts of Hensia crinnata on Blood Glucose Levels in Non Diabetic Wistar Albino rats (Mikue-Yobe *et al*, 2013).
- Physicochemical screening and wound healing activities of extracts of Jatrophacurcus leaf formulated in a simple Ointment Base (Nwalu *etal*, 2013).
- Nutritional Status of Rats Fed Diets Formulated from Treated and Raw Samples of Jatropha Curcus Seed (Nwala *et. al*, 2013).
- Anti-Diabetic Effects of Aqueous Extract of Heinsia Crinata on Key Enzymes and Glycogen in Streptazotocin (Mikue-Yobe *etal*, 2015).
- Utilization of Agricultural Waste in the Production of Fermentation Products (Ethanol, Single Protein and Organic Acid) (Ogunka *et al*, 2012).
- Evaluation of Hepatoprotective and In Vivo Antioxidant Activity of The Stem extract of *Coastus afer* (Bush cane) in Alcohol Induced LiverCirrhosis in Rats, (Ayakeme *etal*, 2014).

It is pertinent to state that all these research works are geared towards making Food our Friend instead of our Foe. The simple

reason is that "NO LIVING ORGANISM CAN SURVIVE WITHOUT FOOD"- WE MUST EAT FOOD.

4.0 CONCLUSION AND RECOMMENDATION

4.1 CONCLUSION

Food contains essential nutrients that nourish the body for growth, maintenance and longevity.

Food must be better assessed through natural sources; however, food substances that contain antinutrients must be properly processed before consumption.

Inadequate or excess food intake poses danger to the body causing nutritional and associated diseases, most of which can be corrected by specified diets or through supplementation with approved nutritional supplements.

Pollution and processing methods (including cooking methods) threaten availability, quality, quantity, food safety of individuals, groups, communities and the Country as a whole.

Good choices of food must be uppermost in establishing the Nutritional Status of every individual, group and community in any given Country under surveillance; that in fact determines whether food is your Friend or Foe.

Every living organism must eat to survive bearing in mind the type, source, quality and quantity that determine good and adequate food. However, ignorance, poverty and greed undermine all these facts already stated above. Moderate food intake at all times is the key to healthy eating and longevity.

In conclusion, I will ask a simple question "where are we getting it right or wrong? To answer this we should be conscious of the type, source, nutrient compositions, preparation methods/handling and tolerance of food as well as how knowledgeable or ignorant you are concerning food.

The fact remains that we must eat right, moderately and wisely to determine whether food is our Friend or Foe.

4.2 RECOMMENDATIONS

The following recommendations are thus made.

- Government (state of federal) should ensure that nutrition units attached to health centers are sited in all Local Government Areas for close and easy access by the grassroots. This will provide places for both the illiterate and poor to visit as often as possible, ask questions on their nutritional status and problems, it will also reduce the incidence rate of most nutritional diseases caused by simple 'over-eating' and 'under-eating' properly known as under-nutrition and over-nutrition as well as ignorance.
- They should establish Food Banks at strategic points including the educational institutions for the poor, elderly, handicap and sick individuals of this our great country Nigeria not forgetting that most students are sponsoring themselves or are sponsored by poor retired parents and would need to feed properly for innovative academic performance.
- There should be caution in the marketing and consumption of foods grown in polluted areas. Food laboratories should be cited in all oil producing areas of the country because it has become necessary that both aquatic and terrestrial lives of such areas should not be consumed as food until adequate treatment of waters and land are carried out to restore the safety of flora and fauna as well as human beings within and around such areas. There should be training and retraining of biochemists and nutritionists to meet the demand of these laboratories.
- While we wait for the government, all universities in the country should establish nutrition centers that will work in collaboration with their teaching hospitals because greater percentages of diseases found in our hospitals are nutritionally based; an adequate food intake in the right proportions will increase immunity and reduce the risk of being prone to these diseases and of course help in diagnosis, recovery and even prognosis.
- University of Port Harcourt which is cited in a highly industrialized area as Rivers State with faculties of Science, Agriculture and Social Sciences should have a Nutrition and Disease Research Center that will collaborate with our Teaching

Hospital with a view to achieving sound health and longevity for students, staff as well as all communities around this Unique University.

- Government should thrive to provide food on every citizen's table by providing employments, improving agricultural products that can be sourced as food; citing of locations for Government owned massive agricultural farms must be devoid of heavy metals(industrial pollution) and should not be politicized
- Local, State and Federal Governments should as a matter of urgency have Research Institutes scattered all over, very accessible to rural farmers to have their farm products tested before going to the consumers via the markets; these institutes should also carry out Nutritional Surveys of such communities from time to time.
- Good recognized and approved food supplements should always be recommended by nutritional experts to fill the gap of unavailable nutrients that cannot ordinarily be obtained from the food we eat daily due to wrong choice of food/diet, high cost of living as well as natural and man-made disasters such as Flood, pollutionterrorist activities and poverty.
- Regular checks of your Nutritional Status should be well encouraged and on a regular basis while consultations with food experts is unavoidably important to all and sundry.
- It is pertinent to note that children are more prone to Malnutrition than adults especially during the weaning period; adequate attention should be focused on feeding of children in every home, failure of which will lead to stunted growth, dull brain, anaemia, poor body development, all being attributes of Protein Energy Malnutrition (PEM), a very close friend of Malnourished Children.

I will end this lecture reminding us some of the adjectives that qualify the food we eat which should all the time ring a bell in our minds as we choose, buy and decide our daily diets.

Insufficient
In general, *under-consumption* refers to the long-term consumption of insufficient sustenance in relation to the energy that an organism expends or expels, leading to poor health.

Excessive
In general, *over-consumption* refers to the long-term consumption of excess sustenance in relation to the energy that an organism expends or expels, leading to poor health and, in animals, obesity as well as causing excessive hair loss, brittle nails, and irregular premenstrual cycles for female humans.

Unbalanced
When too much of one or more nutrients are present in the diet to the exclusion of the proper amount of other nutrients, the diet is said to be unbalanced. It is therefore pertinent to note that for an individual to achieve longevity the proper food must be eaten at the proper time, in adequate proportions of a balanced diet, and above all moderation in food intake is the key to a healthy life.

Please before you leave this auditorium remember these factors that determine your Nutritional Status.

1. Age
2. Existing health status (present)
3. Type/ composition of food you consume
4. Body constitution differs from person to person.
5. Level of education/Ignorance.
6. Poverty/ Self negligence.
7. Socio-cultural background/ Habits

LET FOOD BE YOUR FRIEND AND NOT YOUR FOE

THANK YOU AND GOD BLESS!

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APPENDIX

WHAT TO KNOW ABOUT GLYCEMIC INDEX (GI) AND GLYCEMIC LOAD (GL)

For one serving of a food, a GL greater than 20 is considered high, a GL of 11 – 19 is considered medium and a GL of 10 or less is considered low. Foods that have a low GL in a typical serving size almost always have a low GI. Foods with an intermediate or high GL in a typical serving size range from a very low to very high GI.

With the GI, it is all about the quality of carbohydrates, not the quantity (though if the desire is to include both GI and 'quantity', then GL foods of <20 should be stuck with.

Table 27. Glycaemic Food List with their GI & GL

FOOD	GLYCAEMIC INDEX (GLUCOSE=100)	SERVING SIZE (GRAMS)	GLYCAEMIC LOAD PER SERVING
BAKERY PRODUCTS & BREAD			
Banana cake with Sugar	47	60	14
Banana cake, made with sugar	55	60	12
Sponge cake, plain	46	63	17
Vanila cake made from packet mix with Vanilla frosting (Betty Crocker)	42	111	24
Apple, made with sugar	44	60	13
Apple without sugar	48	60	9
Quaker Oats	76	35	10
Hamburger bun	61	30	9
White wheat flour bread	71	30	10
Whole wheat bread, average	71	30	10
Corn tortilla	52	50	12
Wheat tortilla	30	50	8
BEVERAGES			
Coca Cola	63	250ml	16
Fanta	63	250ml	23
Lucozade (sparkling glucose drink)	95	250ml	40
Apple juice, unsweetened	44	250ml	30
Orange juice, unsweetened	50	250ml	12
Tomato juice, canned	38	250ml	4
BREAKFAST CEREALS & RELATED PRODUCTS			
Cornflakes	93	30	22
Cream of wheat	74	250	22
Oatmeal, average	55	250	13
Instant Oatmeal, average	83	250	30
Raisin Brana Kellogg	61	30	12
Special Ka Kellogg	69	30	14
GRAIN			
Sweet corn on cob	60	150	20
White rice	89	150	43
Brown rice	50	150	16
Converted White rice (Uncle Ben ®)	38	150	14
COOKIES AND CRACKERS			
Crackers	74	25	14

6

Wafers	77	25	14
Shortbread	64	25	10
Rice cakes	82	25	1711
Rye crisps	64	25	
DAIRY PRODUCTS AND ALTERNATIVES			
Ice cream, regular	57	50	6
Ice cream, premium	38	50	3
Milk, full fat	41	250ml	5
Milk, skim	32	250ml	4
Yogurt	33	200	11
FRUITS			
Apple	39	120	6
Banana, ripe	62	120	3
Dates, dried	42	60	18
Grapefruit	25	120	3
Grapes, average	59	120	6
Orange, average	40	120	4
Pear, average	38	120	4
Pear, canned in pear juice	43	120	5
Watermelon	72	120	4
BEANS AND NUTS			
Baked beans, average	40	150	6
Black beans	30	150	7
Kidney beans, average	29	150	7
Soy beans, average	15	150	1
Cashew nuts,	27	50	3
Peanuts, average	7	50	0
PASTA AND NOODLES			
Macaroni, average	47	180	23
Spaghetti, white, boiled, average	46	180	22
SNACK FOODS			
Corn chips	42	50	11
Popcorn	55	20	6
Potato chips	51	50	12
Fruit Roll	99		
VEGETABLES			
Green peas, average	51	80	2
Carrots, average	35	80	4
Boiled white potato, average	82	150	21
Sweet potato, average	70	150	22
Yam, average	54	150	20

CITATION ON

PROFESSOR (MRS) JOYCE ORONNE AKANINWOR
BSc. MSc. (UNIBEN), PhD (UNIPORT), FHNR

Born to Late Ven. S. Y. Chukuigwe and Rtd. Matron Isabel Chukuigwe of IsiokpoKingdom in Ikwerre LGA of Rivers State on November 20, 1955, Professor (Grand Dame) Joyce Oronne Akaninwor demonstrated a great aptitude for academic pursuit early in life. She gained entrance into St. Peter's Primary School, Isiokpo in 1961 ending with a 1st School leaving certificate in 1966. Professor Akaninwor subsequently gained admission into Class 1 at the prestigious Girl's Secondary School, Isiokpo, Rivers State in 1966 but was disrupted by the Nigeria civil war. At the end of the war, she moved to Port Harcourt to attend Government Girl's Secondary School, Harbour Road Port Harcourt in 1970 and completed her Secondary Education in 1973 obtaining the London General Certificate of Education ("O" Level). In 1974, she was admitted into the College of Science and Technology, Port Harcourt where she obtained the London General Certificate of Education ("A" Level) in 1976. Soon after, she proceeded to the University of Benin to read Biochemistry. Professor Akaninwor obtained a Second Class (Upper Division) honour degree in 1980. After her National Youth Service, she was offered admission in 1983 for a Post

Graduate programme in the University of Benin. This fetched her Master of Science Degree in Biochemistry in 1985. Her excellent performance in her M. Sc. days motivated her to proceed for a Ph. D. programme at the University of Port Harcourt. Prof. Akaninwor successfully bagged a Ph. D. degree in Nutritional Biochemistry in 1992.

Professor (Grand Dame) Joyce Oronne Akaninwor has a 32-year teaching experience in the University of Port Harcourt. She joined Biochemistry Department of the University in 1981 as a Graduate Assistant, her appointment confirmed in 1983 and rose through the ranks being appointed as Assistant Lecturer in 1983, Lecturer II in 1986, Lecturer I in 1991 and Senior Lecturer in 1997. Professor (Grand Dame) Akaninwor has made meaningful contributions to the growth of Biochemistry as a field of study, the Biochemistry Department and the University of Port Harcourt at large, in many ways, and was promoted to Professor of Nutritional Biochemistry in 2007.

Professor (Grand Dame) Akaninworserved as Adjunct Professor, Department of Home Economics, Ignatius Ajuru University of Education in 2011 and part-time Lecturer ISLT (now SSLT), University of Port Harcourt till date. Professor Akaninwor was the Head of Department of Biochemistry between 1999 and 2001 where she made remarkable upliftment of the Department.

Professor (Grand Dame) Akaninwor has held various academic and/or senior administrativepositions at several Universities across Nigeria. She was Associate Dean School of Science Laboratory Technology (SSLT) University of Port Harcourt from May 2012 to April 2013 and served as Acting Dean from May 2013 to November, 2014. She is presently the Chairman, Postgraduate Studies Committee of Biochemistry Department in the University of Port Harcourt.

Professor (Grand Dame) Akaninwor is a member of various Learned Societies/Professional Associations including Nigerian Association of Biochemistry and Molecular Biology (NSBMB) and National Association of Women in Science. She has bagged various awards including:

- The Great Woman of the 21st Century by American Biographical Institute (2004)

- Award of Honour by St. Peter's Cathedral Isiokpo Ikwerre Diocese (2011)
- Legends Milestone Award (2014)
- African Role Model Award of Excellence (African Age Magazine 2014)
- National Academic Medal Award, Afrinews Independent Magazine (2014)
- Award of Excellence, Nye Newali Isiokpo, HRM King Blessing Wagor JP, (Wagidi XL) in conjunction with Isiokpo Central Age Grade (2014)
- Honours Award for Ladies of Letters for Outstanding Academic Accomplishment (2015) and many other awards too numerous to mention.

Professor (Grand Dame) Akaninwor was recently appointed by His Excellency, the Executive Governor of Rivers State, Chief (Barr.) Ezenwo Nyesom Wike as a member of the Governing Council Kenule Beeson Sarowiwa Polytechnic, Bori.

Professor (Grand Dame) Akaninwor is a very committed servant in God's vineyard. She is the Treasurer Mother's Union (St. Stephen's Rumueme Deanery), Board member Diocese of Niger Delta North, Member Primate Advisory Committee Church of Nigeria, Anglican Communion and a host of other roles in the Church too numerous to mention. Her hobbies include reading, dancing, indoor games, cooking, child-care, creativity (hat making, bead making and general fashion) and Entrepreneurship.

Professor (Grand Dame) Akaninwor is a licensed Lay Reader, Diocese of Niger Delta North of the Anglican Communion of Nigeria and was married to Late Sir Ndy Nyeche Akaninwor. The family is blessed with five children (Buduka, Chinwe, Habinuchi, Manuchimso and Akpenuchi) and a grandchild Maxwell, Manuchimso, Ndy Wenenda.

My Vice - Chancellor Sir and distinguished ladies and gentlemen, please permit me to introduce an academic of great reputation, an academic per excellence, a Philanthropist, an ardent Christian and mother indeed. I present to you Professor (Grand Dame) Joyce Oronne Akaninwor as our 131st Inaugural Lecturer for the day.

Professor A. A. Uwakwe