Nutritional Biochemistry: Sequential Professedly Unsequential

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by

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NUTRITIONAL BIOCHEMISTRY: SEQUENTIAL PROFESSEDLY UNSEQUENTIAL

The Chancellor,
The Pro Chancellor and Chairman, Governing Council
The Vice Chancellor,
The Registrar,
Other Principal Officers,
Deans, Directors and Heads of Departments,
Fellow Academics and Non-Academic Colleagues,
My Lords Spiritual and Temporal,
Distinguished Guests and Friends of the University,
Ladies and Gentlemen of the Press,
Distinguished Ladies and Gentlemen
Great Lead City University Students

The word inauguration is from the ancient Roman custom of judging the omens for a particular enterprise by studying the flight of birds. It is customary for an inaugural lecture to provide a similar occasion when the omens for one's subject can be considered, drawing any auguries that offer themselves (Beer, 1993). The inaugural lecture serves to set in motion, is delivered once for all, and should have a theme not entirely irrelevant to the special interests and concerns of the lecturer, or of his hearers. With this wide freedom, today's lecture, entitled " Nutritional Biochemistry: Sequential Professedly Unsequential" is not an exercise in, or pretense at linguistics, but an account of the author's random science walk that culminated in a number of 'little' things having impact on the science of nutritional biochemistry. The 'randomness' is captured by a modular approach, thus each module is devoted to a research experience/theme.

I. RANDOM SCIENCE WALK

Mr. Vice-Chancellor sir, I started my research career by asking how the prices of conventional feedstuffs can be reduced using agro-industrial byproducts and/or waste as my PhD thesis theme at the Premier University, University of Ibadan, Ibadan, Nigeria in the early 1990s. In 2004, as a postdoctoral researcher, I looked at the various aspects of nutrition, physiology including housing, and veterinary that could affect the performance of laying birds at the Hebrew University

of Jerusalem, Faculty of Agriculture, Rehovot, Israel. Towards the end of the first decade in the 21st Century, elucidation of the structure and component of the starch of wheat, maize, sweet potato and cassava engaged my attention at our laboratories here in Lead City University. Subsequently I dabbled into the screening of some herbal plants for anti-diabetic and hepatoprotective properties. Here at Lead City University, I have also been involved in the nutritional and microbial activities of some plant parts and condiments. The purification and characterization of some enzymes particularly α-amylase and polyphenol oxidase has also engaged my attention. But first it is appropriate to know what biochemistry entails.

II. WHAT IS BIOCHEMISTRY?

Mr. Vice-Chancellor sir, Biochemistry is a relatively new discipline, spanning approximately 400 years. Though first used in 1882, the term "biochemistry" was first proposed in 1903 by Carl Neuberg, a German Chemist (Wikipedia). Biochemistry began as a separate discipline, distinct from chemistry and other biological sciences under the name 'physiological chemistry' or sometimes also called 'pathological chemistry'. Biochemistry has advanced, especially since the mid-20th century, with the development of new techniques such as chromatography, X-ray diffraction, NMR spectroscopy, radioisotopic labeling, electron microscopy and molecular dynamics simulations. These techniques allowed for the discovery and detailed analysis of many molecules and metabolic pathways of cell, such as glycolysis and the Krebs cycle (citric acid cycle). One of the most prolific of these modern biochemists was Hans Krebs who made huge contributions to the study of metabolism (Kornberg, 2000). He discovered the urea cycle and later, working with Hans Kornberg, the citric acid cycle and the glyoxylate cycle (Krebs and Henseleit, 1932; Krebs and Johnson, 1937; Kornberg and Krebs, 1957).

Biochemistry has been variously defined as "The chemistry of life" "Study of the structure and properties of molecules in living organisms and how those molecules are made, changed, and broken down". Biochemistry is the field of science concerned with chemical substances and processes that occur in plants, animals and

microorganisms. It involves the quantitative determination and structural analysis of the organic compounds that make up cells (proteins, carbohydrates, and lipids) and of those that play key roles in chemical reactions vital to life (e.g., nucleic acids, vitamins, and hormones). Biochemists study cells' many complex and interrelated chemical changes. Examples include the chemical reactions by which proteins and all their precursors are synthesized, food is converted to energy, hereditary characteristics are transmitted, energy is stored and released, and all biological chemical reactions are catalyzed (Stryer,2000). Biochemistry straddles the biological and physical sciences and uses many techniques common in medicine and physiology as well as those of organic, analytical, and physical chemistry.

Biochemistry has long boasted of its roots in exact physical sciences and has never been afraid to divert the attentions of practitioners of those sciences to the study of life. By that route, some of the most spectacular advances of knowledge in the twentieth century have been achieved, perhaps none more so than the birth of Molecular Biology, which nowadays dominates the subject. Today, the terms *molecular biology* and *biochemistry* are nearly interchangeable. It is sometimes hard to imagine how abstract the concept of a gene was prior to the discovery of the structure of DNA by Watson and Crick in 1953. The related field of biophysics brings to biology the techniques and attitudes of the physicist.

Biochemistry is no longer the academic tool of medical researchers but, having embraced its sister disciplines in the physical as well as biological sciences, has taken on new meaning as the huge promise of biotechnology looms before us. Even philosophers and theologians can no longer ignore the prospects of bio-revolution introduced into our daily lives: genetically engineered foodstuffs; new approaches to treating infertility; eradication of diseases.

III. THE ABSOLUTENESS OF BIOCHEMISTRY

Mr. Vice Chancellor sir, one of the paradoxes of my random scientific walk was at the University of Ibadan, department of Animal Science

where I worked with Prof Olumide Tewe, a renowned Swine Nutritionist, in the Agricultural Biochemistry unit.
The high cost of grains and competition from humans led me to seek an alternative for maize and wheat bran in the ration of poultry. My quest for cheaper livestock production cost also led me to the evaluation of reject Cashew nut meal (CNM) as a replacement for Groundnut cake (GNC) in the ration of pullets. Reduction in the cost of feeds and hence overall reduction in animal production is anticipated to reverse the worsening intake of animal protein sources by the populace of sub-Saharan economies.

CNM a by-product of the processing of the seeds of *Anarcadium occidentale* has been reported (Piva *et al.*, 1971; Fetuga *et al.*, 1974) to compare favourably with groundnut (*Arachis hypogea*) and soyabean cakes (*Glycine max*) in nutritional terms. The undefatted CNM contained 215g/kg crude protein, 1.4g methionine/16g nitrogen and 454g/kg ether extract (Fetuga *et al.*, 1974; Mba *et al.*, 1974). The meal can be regarded as a moderate source of protein and an excellent energy resource because of the high fat content.

However, the high fat content of CNM takes on a somewhat equivocal significance when consideration is given to maximizing its inclusion in layer's diets. This arises because, while the lower heat increment associated with dietary fat metabolism may be advantageous in the tropics, diets of high energy content may inflict heat stress in conditions of high ambient temperature. Therefore, to allow a high dietary inclusion rate of CNM it will be necessary to include feedstuffs with low energy contents to constrain the energy value of the diet within the recommended limits. Longe (1984), and Longe and Ogedegbe (1989) have previously indicated that the dilution of high energy diets for layers or pullets in the tropics is necessary to achieve optimum productivity. Such a need allows maize offal and cassava peel to be included as dietary energy diluents.

A study was carried out where both maize offal and cassava peel were combined and included at the expense of maize in all the CNM-based diets for laying pullets. Cassava peel was chosen from a number of

possible by-products for two reasons. Firstly, it is abundant and cheap. Secondly we presupposed that the high dietary fat and methionine content as well as the high quality of the protein in CNM may reduce any toxic effects of residual cyanide in the cassava (Tewe, 1992).

The performance of the pullets on the treatments is summarized in Table 1. Feed intakes of the pullets on the CNM-based diets were, on the average 9.3% lower ($P<0.05$) than those in the control group. It appears that adequacy of dietary energy counteracted the effect of increasing fibre on feed intake, and enabled the pullets to cope with the high inclusion rates of fibrous maize offal and cassava peels.

Table 1: Productive performance and quality of eggs from the pullets fed the experimental diets

The results from this experiment (Onifade *et al.*, 1999) and others

	Diets					
Production indices	1	2	3	4	5	SEM
Food intake (g/bird/d)	105.0^{a}	94.96^{b}	95.40^{b}	96.05^{b}	97.95^{b}	3.06
Hen-day egg production (%)	68.54^{a}	62.02^{b}	58.17^{c}	57.62^{c}	60.97^{b}	2.20
Egg weight (g)	56.20^{a}	$55.30^{a,b}$	56.30^{a}	54.65^{b}	56.43^{a}	1.20
Egg mass (g/bird/d)	38.52^{a}	34.30^{b}	32.83^{c}	31.49^{c}	34.33^{b}	0.80
Shell thickness ($mm \times 10^{-3}$)	35^{a}	36^{a}	34^{b}	36^{a}	36^{a}	0.05
Yolk colour	7.0^{a}	1.2^{b}	1.0^{b}	1.2^{b}	1.0^{b}	0.40
Albumen height (mm)	93.91b	95.74a	94.59b	94.20b	96.49a	0.22
Weight gain (g/bird/d	4.86c	5.54b	4.83c	4.78c	7.2a	1.03
Food conversion (kg food: dozen eggs)	2.89^{a}	3.45b	3.59^{b}	$4.44^{c,d}$	4.58^{d}	0.30

a,b,c,d: means not followed by the same superscript are significantly ($p<0.05$) different (Onifade et al., 1999)

(Longe, 1984; and Osei *et al.*, 1993) carried out in the tropics indicate diet formulations(s) required to maximize the utilization of fat-, protein- and fibrous-rich by-products in the absence of maize.

Cassava Root Sieviate (CRS), is a by-product from 'foo-foo' processing, it is in abundance yet its utilization as a feed ingredient for poultry is limited due to its high fibre content (Aderemi *et al.*, 1999). Exogenous enzyme supplements are used widely in poultry diets in an attempt to improve nutrient utilization, health and welfare of the birds (Acamovic, 2001). The use of Avizyme 1500® and Dried Pure Yeast (DPY) is envisaged to enhance and thus increase the potential

of CRS in growing pullets diet. Constituents of Avizyme and DPY have been reported by Aderemi *et al.*, (1999). A study was thus carried out to evaluate the effect of enzyme supplemented CRS on the metabolizable energy and nutrient digestibility of growers. Conclusively, CRS can be incorporated at 12.5 and 25% for growing pullets, with enzyme supplementation as nutrient digestibility and metabolizable energy of the growers were improved in the study.

The use of cereal grains for human consumption in most developing countries has focused attention on the need to explore the use of non-conventional sources of energy in diets for monogastric animals. However, it has been observed that majority of the feed ingredients required for the production of animal feeds can be met by using agro-industrial by-products, which were hitherto considered as wastes (Amoah, 1985). The utilization of root and tuber crops and their wastes as quantitative sources of energy for livestock is increasing in importance.

Nigeria produces large quantities of the agro-industrial by-products every year, which serves as alternative feed resources to conventional feed ingredients (Fetuga and Tewe, 1985). These agro-industrial by-products have proved valuable in supporting performance of livestock and poultry (Babatunde and Oluyemi, 2000).

Ladokun and Aderemi (2006) concluded that sweet potato tuber meal (SPM) can effectively replace maize in layers diet, without adverse effect on the layers serum metabolites profile. However, there was marked reduction in the performance of the birds on the sweet potato based diets, in terms of weight gain, feed intake and hen-day production. Pelletizing the feed so as to reduce dustiness and improve feed intake could be explored. Also, the SPM could be enriched by microbes before incorporating into the feed. This would increase the crude protein content of SPM as a feed resource and hence its nutritive value.

IV. BIOCHEMISTRY AS AN ALL ENCOMPASSING SCIENCE

4.1 The Starch Component of Some Cereals and Tubers

Food product designers have come to rely on starches fractionated from wheat, maize, sweet potato, cassava and other food crops to provide an ever-expanding range of functionalities: viscosity, texture, pH, heat and freeze-thaw stability, moisture-binding, gel function, encapsulation, film formation, aeration, crispness, volume control, dispersion, suspension the list continues. Starch is a multi-functional ingredient, tailored by the supplier to meet changing consumer needs. Examining the market for starch emphasizes its position in the food industry. Total world starch production in 1996 was approximately 40 million short tons, according to the Corn Refiners Association. Corn dominates this production (83%), followed by wheat (6%), potato (6%), tapioca (4%), and other crops. The United States produced 59% of the world's starch, followed by the European union (15%) and Japan (6%). With the rest of the globe picking up the remaining 20% (Deis, 1998). Due to economics of production, the U.S market is even more dominated by corn starch; Corn Refiners Association statistics indicate that approximately 5.6 billion lbs. of starch products (corn starch modified starch and dextrin) were shipped in 1996.

Food services account for 25% of unmodified food starch use at 184 million lbs., followed by brewing (9%), retail (6%), confectionary (5%) and baking (5%), according to Larry Fernandez, national accounts manager, specialty products, Corn Products International, Summit - Agro IL (1999). Modified food starches are largely dominated by waxy maize (starch containing 100% amylopectin) (approximately 80% to 90%), and the leading user categories are soup (15%), gravies (8.5%), salad dressings (7%) and sauces (7%)

There is also a great variety of value-added applications for starch in non-food industries, and each application requires very particular functional characteristics. Even in the most basic common-food applications of starch, a great deal of value-addition is employed: adhesive starches are acid- or alkali-treated, and modified with oxidizing agents, salts and alcohols.

Textiles starches are esterified oxidized and subject to various cross-

linking agents. The use of sophisticated, value-added starches is especially notable in paper products. Starches are used to give greater strength to tissues and paper towels, and they allow a greater use of recycled paper in linear board and cardboard. The growing demand for bio-degradability promises to provide additional volumes as starch is used in plastic films and sheets as well as natural fibre formulations that will eventually replace plastic foams. The volume of starch going into non-food uses is enormous. In fact, non-food uses of starch are a prime indicator of a country's economy. An active economy needs construction material for buildings, industrial plants and housing, paper for administration, packaging and wrapping various products, and adhesives to stick all this economic activity together. As the economy booms, so does the volume of starches going into non-food uses. As countries develop, so does their demand for high quality, highly functional, value-added starches (FAO, 1998). Ladokun *et al*., (2009) conducted a study focused on comparing the starch as well as the proximate properties of selected tubers with those of cereals and based on this comparison, drew conclusions on whether these tubers could serve as substitutes for the cereals.

Table 2: Proximate components of the sample

Sample	Moisture (%)	Fat (%)	Fibre (%)	Ash (%)	Protein (%)	Carbohydrate (%)
Wheat (W_1)	10.21	3.67	2.13	2.07	11.96	69.98
Sweet potato (SP_1)	70.31	0.15	1.65	1.19	0.25	25.46
Maize (M_1)	9.87	4.30	1.79	1.90	9.95	72.19
Cassava (C_1)	69.87	0.12	1.56	1.76	0.89	25.81

(Ladokun *et al.*, 2010)

Table 3: Starch yield of food samples

Sample	Starch yield (%)
Wheat (W_1)	14.57
Sweet potato (SP_1)	8.83
Maize (M_1)	16.16
Cassava (C_1)	9.15

(Ladokun *et al.*, 2010)

Table 4: Water absorption capacity of starches extracted from the food samples

Samples	WAC (%)
Wheat Starch (WS)	4.0
Sweet potato Starch (SPS)	35.7
MaizeStarch (MS)	57.9
Cassava Starch (CS)	33.3

(Ladokun *et al.*, 2010)

Table 5: Starch color

Samples	Color
Wheat starch (WS)	creamy
Sweet potato (SPS)	Greyish yellow
Maize Starch (MS)	Very pale yellow
Cassava Starch(CS)	Pure white

(Ladokun *et al.*, 2010)

The study revealed that starches can be identified and traced to their sources; also that characteristics and yield of starch is a function of its source. It was revealed that of the four food samples under study, maize yielded the highest quantity of starch. This means that the reserved carbohydrate store in maize as a source of starch is better than the other three sources. This would mean that the extraction of this starch is commercially viable.

With the ongoing global food crisis that has seen the price of maize double and triple that of other cereals in mind, maize not be the ideal

crop for the production of starch meant for commercial use, as most of it is being converted to ethanol for use as fuel...., it is therefore necessary to find an alternative for this 'unavailable' staple food.

Based on the results obtained the authors, concluded that sweet potato can double as a substitute for maize in the production of ethanol and as a staple in these times of food crisis. The fact that starch fractionated from sweet potato based on its low WAC (%) has the tendency to keep longer is an added advantage which can be utilized in the food and textile industries.

4.2 The Common Condiment: Locust Bean

Locust bean, *Parkia biglobosa* or Néré is a tree of the genus *Parkia* in the family Fabaceae. In West Africa, its fruits are fermented to a condiment called 'soumbala' or 'dawa-dawa (Bonkoungou, 1987). It is a perennial deciduous tree with a height ranging from 7 to 20m, although it can reach 30m under exceptional conditions (Hopkins and White, 1984).

In the tropics, especially in Nigeria, locust bean is processed locally into consumable delish and is a part of traditional dishes in most parts of the country. It is sold in the Nigerian consumables markets in two forms, the mashed and the unmashed locust bean, locally called 'Iru pete' and 'Iru woro respectively. During the Nigerian processing of locust bean, salt is usually added to prevent microbial contamination and growth. However, inspite of procedures engaged, locust bean could still harbor loads of microorganisms especially while handling. The author therefore decided to investigate this.

Table 6: Proximate composition of unmashed fermented locust beans (*Parkia biglobosa*) (Iru woro)

Moisture (%)	Ash (%)	Crude firbre (%)	Protein (%)	Fat (%)
5.3 ± 0.20	3.24 ± 0.32	17.68 ± 0.40	39.14 ± 0.31	22.80 ± 0.20

Values were expressed as mean ± standard deviation of triplicate determinations. (Ladokun and Adejuwon, 2013)

Table 7: Proximate composition of mashed fermented locust beans (*Parkia biglobosa*) (Iru pete)

Moisture (%)	Ash (%)	Crude firbre (%)	Protein (%)	Fat (%)
9.62 ± 0.33	3.29 ± 0.35	13.30 ± 0.32	39.84 ± 0.29	49.93 ± 0.36

Values were expressed as mean ± standard deviation of triplicate determinations. (Ladokun and Adejuwon, 2013)

Table 8: Identified Isolate

Samples (S/N)	Bacteria	Fungi observed
1 (Mashed)	*Pseudomonas maltophilia; Streptococcus faecalis*	*Aspergillus niger*
2 (Mashed)	*Pseudomonas maltophilia; Streptococcus faecalis*	*Aspergillus niger*
3 (Mashed)	*Pseudomonas maltophilia; Streptococcus faecalis*	*Aspergillus niger*
4 (Unmashed)	*Pseudomonas maltophilia*	*Aspergillus flavus*
5 (Unmashed)	*Pseudomonas maltophilia*	
6 (Unmashed)	*Pseudomonas maltophilia*	*Aspergillus flavus*

(Ladokun and Adejuwon, 2013)

The study confirmed the nutritional benefits of locust beans produced by traditional methods. However, the different methods of production could affect the overall nutritional components and benefits (Ladokun and Adejuwon, 2013).

4.3 Fermented Milk Products

Milk is a white liquid produced by the mammary glands of mammals. It is the primary source of nutrition for young mammals before they are able to digest other types of food. Early-lactation milk contains colostrum, which carries the mother's antibodies to the baby and can reduce the risk of many diseases in the baby (Eteshola and Oraedu, 2010). The major chemical constituents of milk include water, fats, proteins, carbohydrates, minerals, organic acids, enzymes and vitamins (Dobrzanski *et al.*, 2005). Several legume-based milk and

milk products have been developed in attempts to extend the supply of milk-like products, especially in areas where milk is in short supply. Since legumes are important sources of relatively inexpensive protein, introduction of imitation milk products from legumes may contribute to the alleviation of protein malnutrition (Rao *et al.*, 1998). Traditionally, yoghurt is fermented whole milk and is believed to possess nutritional and therapeutic properties (Reed, 1982; Hughes and Hoover, 1991).Lactic acid fermentation of legume based milks has been used as one of the approaches to prolong the shelf life of the products, create variety, improve the nutritional value and as well enhance the acceptability of the product. Yoghurt-like products have been prepared by some workers from soybean (Terna and Musa, 1998), cowpeas, coconut and mug beans (Rao *et al.*, 1998).

Ladokun and Oni (2014) conducted a study aimed at assessing the proximate analysis of some milk samples, to determine the yielding strength of each milk sample in yoghurt production, taking pH and sensory evaluation as marker for their yields and studying the possibility of using the milk derived from coconut, soybeans, goat and cow as a yoghurt-like product.

Table 9: Proximate Composition of different milk samples

Parameters	Cow Milk	Goat Milk	Soy Milk	Coconut Milk
% Ash	0.71	0.96	0.57	0.52
% Moisture	76.90	73.00	63.34	65.00
pH Values	6.3	6.2	6.4	6.0
% Crude Protein	27.97	32.17	12.59	7.17
% Fat	9.76	14.84	14.44	15.02
Specific Gravity	1.018	1.030	1.016	1.010

(Ladokun and Oni, 2014)

Table 10: Mean scores for acceptability of all the milk samples

Samples	Colour	Appearance	Odour	Mouth feel	Overall acceptability
Skimmed milk	4.1	4.3	5.0	4.8	4.6
Cow milk	4.0	4.2	4.8	4.6	4.3
Goat milk	4.2	4.4	4.7	4.1	4.3
Coconut milk	3.4	3.7	4.2	3.9	3.8
Soy milk	3.6	3.8	4.2	4.3	4.0

(Ladokun and Oni, 2014)

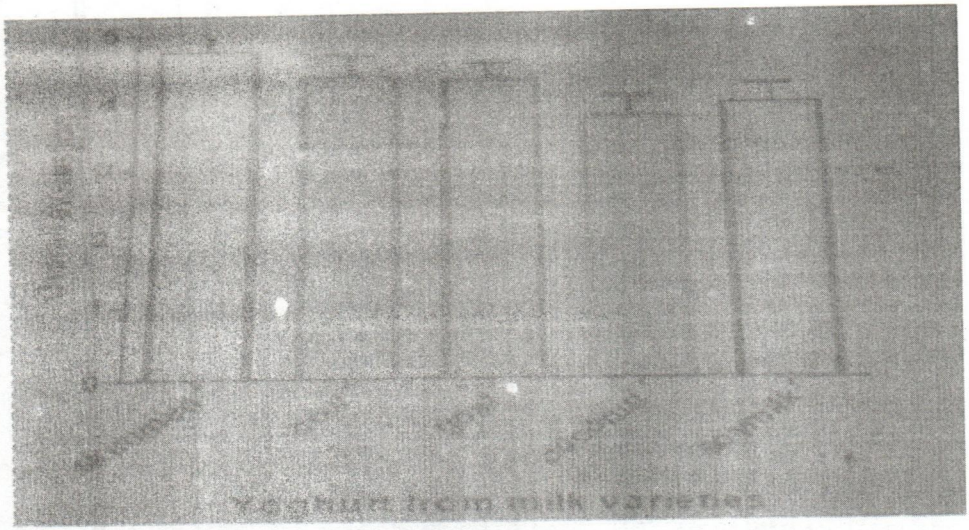


Fig 1: overall evaluation of yoghurt from milk varieties (Ladokun and Oni, 2014)

The authors concluded that milk prepared from coconut and soybean could be used as a beverage for both young and old due to the high fat and protein contents. Based on the sensory evaluation, the soy milk and coconut milk were also acceptable. This indicates that utilization of soy milk and coconut milk may be enhanced when processed into beverage drinks. It is therefore suggested that milk from coconut and soybeans be encouraged so as to solve the problem of protein-calorie malnutrition in Africa in particular and the world in general. The nutritional values derived from proximate analysis of the milk samples are comparable. This clearly shows that either of the food can substitute for each other.

4.4 Water: The Essence of Life

Water is the most abundant substance found on the surface of the earth, covering roughly three quarters of the earth's surface and it plays a very vital role in existence as well as maintenance of life of organisms. Water related diseases continue to be one of the major health problems globally due to consumption of contaminated water. Typhoid fever remains a great socio-economic problem in developing countries, Nigeria inclusive. Perforation of intestines is associated

with high mortality with wound infection occurring in 50 – 75% of survivals. Controlling wound sepsis or wound infection with various complications also affects mortality (Ajao 1982; Badejo and Arigbabu 1980) and unsafe drinking water has been the major source of this infection.

The high incidence of the disease led the author to carry out some study on a water based community in Lagos State, Makoko and two major parts of Ibadan Metropolis. The work on Ibadan metropolis is here presented.

Table 11: Sample Location

SAMPLE	LOCATION
W1 (public tap water)	Molete, Ibadan
W2 (bore hole water)	Molete, Ibadan
W3 (well water)	Molete, Ibadan
W4 (public tap water)	Jericho, Ibadan
W5 (borehole water)	Jericho, Ibadan
W6 (well water)	Jericho, Ibadan

Ladokun and Oni, 2014

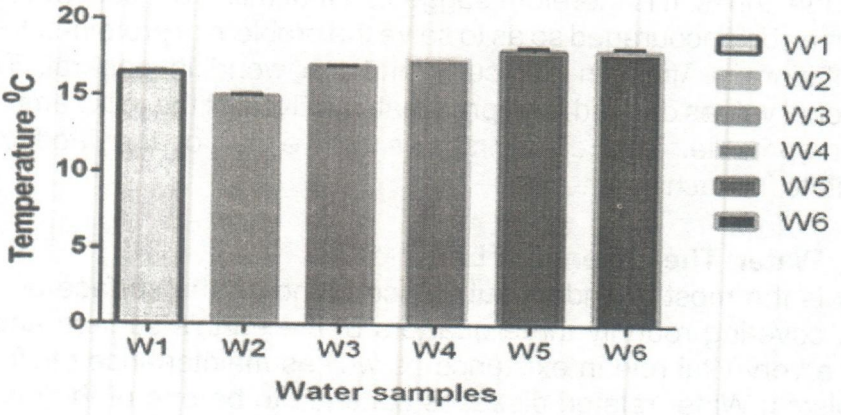


Fig 2: Temperature of the water samples (Ladokun and Oni, 2014

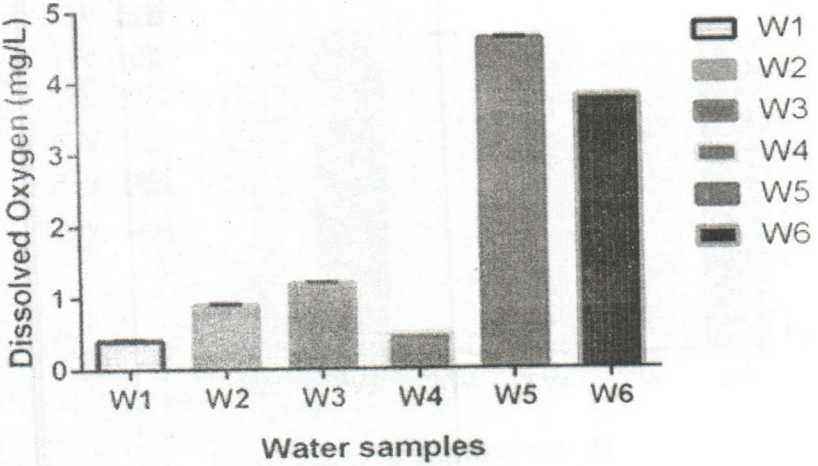


Fig 3: Dissolved Oxygen of water samples (Ladokun and Oni, 2014)

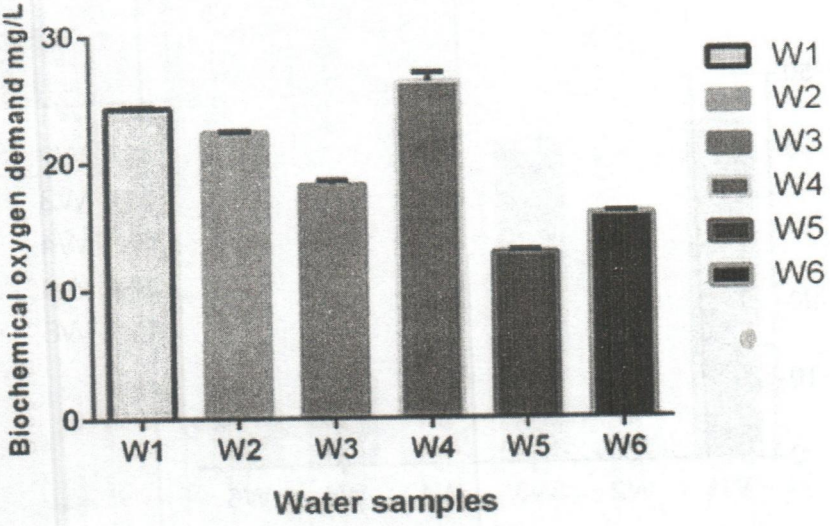


Fig 4: Biochemical Oxygen Demand of water samples (Ladokun and Oni, 2014)

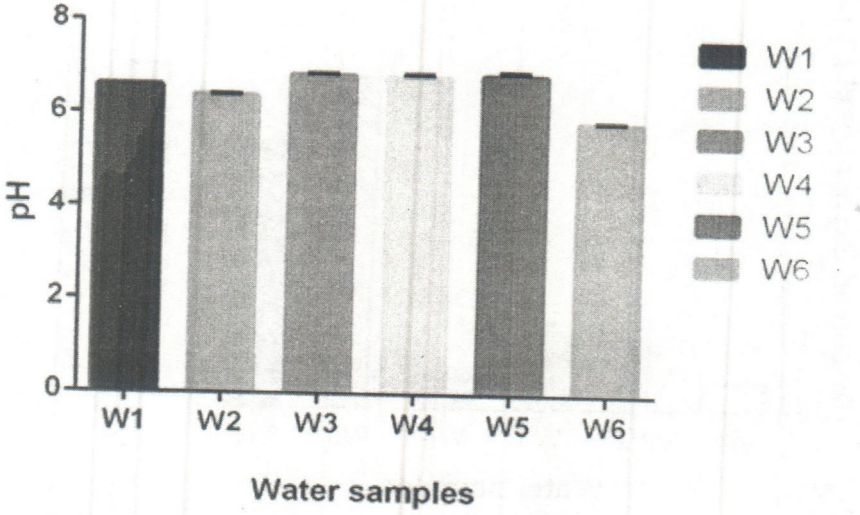


Fig 5: pH of water samples (Ladokun and Oni, 2014)e

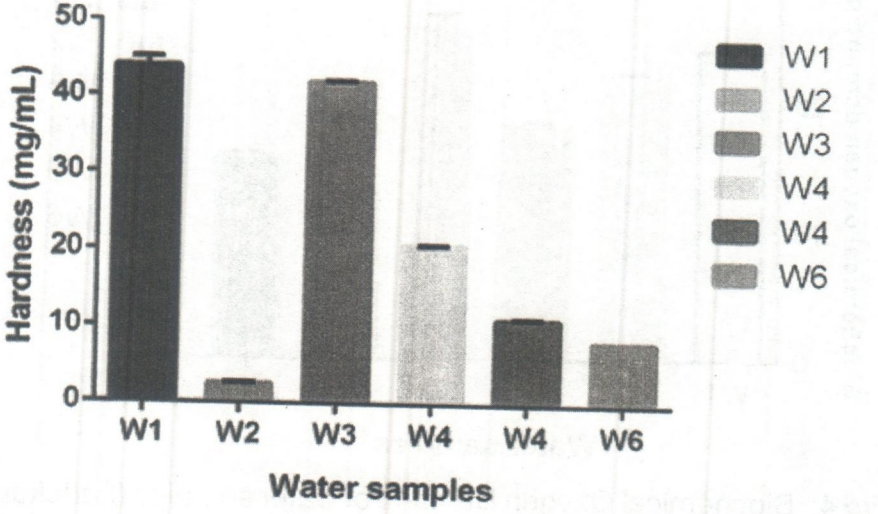


Fig 6: Water Hardness of water samples (Ladokun and Oni, 2014)

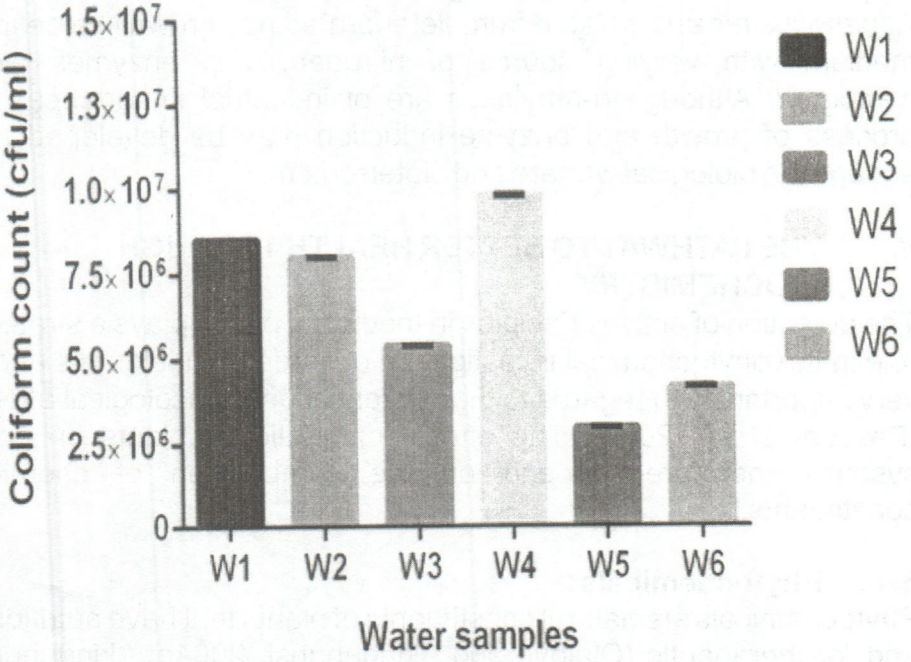


Fig 7: Coliform count of water samples (Ladokun and Oni, 2014)

Water from both Molete and Jericho requires some varying degrees of treatment or purification to make it fit for human consumption. High BOD indicates bacteriological activity demanding oxygen for biodegradation of waste or effluents in water. Therefore, treatment requirement is targeted towards reduction of bacteria (*E. coli* or Coliform) count.

4.5 Biochemistry and Enzymology

Several fungal species including members of *Aspergilli* and *Penicilli* are saprophytes of grains (Streets, 1969). Crop infection may lead to aflatoxin consumption in man and animals (Liang *et al.*, 2005). Apart from the production of aflatoxin, several fungi species are capable of enzyme production when grown on a suitable substrate (Ladokun and Adejuwon, 2011).

Adejuwon *et al.*, (2013) conducted a study to examine inductivity of α-amylases in the phytopathogens *Aspergillus versicolor* and *Aspergillus terreus* isolated from deteriorated rice grown in a defined medium with varying source of nitrogen. The enzymes were compared. Although α-amylases are of industrial importance, the process of growth and enzyme induction may be developed and engaged in biological warfare and bioterrorism.

V. THE PATHWAY TO BETTER HEALTH THROUGH BIOCHEMISTRY

The detection of active principles in medicinal plants plays a strategic role in the phytochemical investigation of crude plant extracts and is very important with regards to their potential pharmacological effects (Pascual *et al.*, 2002). The effects of medicinal plants on body systems therefore, depend on the composition of chemical constituents.

5.1 Phytochemicals

Phytochemicals are natural constituents of plants that have nutritional and /or therapeutic (Olaleye and Akindahunsi, 2004a; Akindahunsi and Olaleye, 2003; Salawu and Akindahunsi, 2007) activities, thus giving rise to a new terminology called nutraceuticals. Plant foods contain many bioactive compounds in addition to the identified nutrients such as proteins, lipids, vitamins, specific minerals and certain hormone precursors (Olaleye and Akindahunsi, 2004b). Moreover, there are growing evidences that vegetables and fruits are good sources of natural bioactive molecules, mainly some vitamins, carotenoids, and phenolic compounds (Adebajo *et al.*, 2006). Most vegetables and fruits have been reported to possess antioxidant activities which allow them to scavenge both active oxygen species and electrophiles, inhibit nitrosation, chelate metal ions and modulate certain cellular enzyme activities.

5.2 Antioxidants

Antioxidants are substances that neutralize free radicals or their actions (Sies, 1996).Nature has endowed each cell with adequate protective mechanisms against any harmful effects of free radicals.

Antioxidants are effective because they are willing to give up their own electrons to free radicals. When a free radical gains electron(s) from an antioxidant, it will not attack the cell and the chain reaction oxidation is broken. After donating an electron, an antioxidant in this stage is not harmful because they have the ability to accommodate the damage in electrons without becoming reactive. Antioxidants limit the free radical damage from:

- Damaging the cell's DNA which may lead to cancer
- Triggering inflammation
- Blocking the normal endothelial cell function and vasodilation in response to nitric oxide, a potential mechanism for heart disease and cancer
- Improving immune function
- Promoting platelets adhesion, which can lead to thrombosis thereby increasing the risk of heart disease with stroke
- Oxidizing low density lipoprotein (LDL) cholesterol, which may increase the risk of atherosclerosis

Their mechanism of action includes:

- Scavenging reactive oxygen and nitrogen free radical species
- Decreasing the localized oxygen concentration thereby reducing molecular oxygen's oxidation potential
- Chelating metal ions to prevent the generating of free radicals
- Metabolizing lipid peroxides to non-radical products

5.3 Antimicrobial Compounds from Plants

Plants have an almost limitless ability to synthesis aromatic substances, most of which are phenols or their oxygen-substituted derivatives (Geissman, 1963). Most are secondary metabolites, of which at least 12,000 have been isolated, a number estimated to be less than 10% of the total (Schultes, 1978). In many cases, these substances serve as plant defense mechanisms against predation microorganisms (Adebajo *et al.*, 2006), insects, and herbivores. Some, such as terpenoids, give plants their odors; others (quinones and tannins) are responsible for plant pigments. Many compounds are responsible for plant favor (e.g. the terpenoid capsaicin from chili peppers), and some of the same herbs and spices used by humans to season food yield useful medicinal compounds containing

antimicrobial activity.

5.3.1 Antibacterial Activity of Fresh and Fallen Leaves of *Terminalia catappa* L.

The Indian almond tree, *Terminalia catappa* L. is a Combretaceous plant (tropical almond family). The plant is a large deciduous stately tree, originally from India, growing up to 30m height with a thick broad trunk; the leaves cluster toward the end of the branches with glossy, obovate blades mostly 8-30cm in length and turn red before turning brown and falling (Whistler, 1992). It thrives as an ornamental tree in many tropical cities in the world. It is found in almost every town and village in Southern Nigeria. It is also known as Malabar Almond, Tropical Almond, and Fruit (by some Nigerians).

Indian almond leaves are rich in compounds produced by the tree to protect itself against bacteria, fungi and similar organisms. Compounds found in Indian almond leaves have however been researched for their potential health benefits for the human body. Indian almond has strong antibacterial properties and works against Gram positive and Gram negative microorganisms.

In Nigeria fallen leaves are used as an herb to treat liver diseases. The leaves also have potential in the management of sickle cell disorders. Dried leaves are used for fish pathogen treatment, as an alternative to the use of chemicals and antibiotics. This aroused my interest and I investigated the potential of different methods of extraction of Indian almond, fresh and fallen leaves as an anti-bacterial agent.

Table 12: Review of the quantitative phytochemical screening of fresh and fallen leaves of *Terminalia catappa*

Component	Fresh leaves	Fallen leaves
Alkaloids	Present	Present
Cardiac glycosides	Trace	Abundant
Saponin	High	Absent
Tannin	Present	Present
Flavonoids	Present	Present (contains flavonoids in addition)

(Ladokun and Ojezele, 2011)

Table 13: Antibacterial activity of cold & hot water and ethanol crude extracts of fresh & fallen leaves of *Terminalia catappa*

Terminallia catappa

Extract	*Enterobacter* spp.	*Proteus* spp	*Klebsiella* spp.	*Escherichia* spp.	*Pseudomonas* spp.	*Streptococcus* spp	*Saphylococcus* spp
Cwgl	-	-	-	-	+	-	-
Hwgl	-	-	-	-	-	-	-
Egl	+	-	-	+	+	-	-
Cwfl	-	-	-	-	-	-	-
Hwfl	-	-	-	-	-	-	-
Efl	-	-	-	-	++	-	++

Cwgl-Cold water fresh leaves extract: Hwgl-Hot water fresh leaves extract; Egl-Ethanolic fresh leaves extract: Cwfl-cold water fallen leaves extract: Hwfl-Hot water fallen leaves extract: Efl-Ethanolic fallen leaves extract; - Not Sentivitive: +Sensitive. (Ladokun and Ojezele. 2011).

Table 14: Antibacterial Activity of Selected Antibiotics

ntibiotic	*Enterobacter* spp.	*Proteus* spp	*Klebsiella* spp.	*Escherichia* spp.	*Pseudomonas* spp.	*Streptococcus* spp.	*Saphylococcus* spp
N(10MCG)	-	+	++	-	-	-	-
IP(5MCG)	++	-	-	+	-	-	-
(10MCG)	-	-	-	-	-	-	-
M(25MCG)	-	++		+	-	-	-
N(30MCG)	++	+	-	-	-	-	-
F(20MCG)	-	-	-	-	-	-	-
(100MCG)	-	-	-	-	-	-	-
G(30MCG)	-	+	-	-	-	-	-
B(10MCG)	-	-	-	-	-	-	-
;50MCG)	-	-	-	-	-	-	-

GN-Gentamycin, CIP-Ciprofloxacin, C-Chloramphenicol, AM-Ampicillin, AN-Nalidixic acid, CF-Cefuroxime, N-Nitrofurantoin, AG-Augmentin, NB-Norfloxacin, T-Tetracycline (Ladokun and Ojezele, 2011)

We concluded that a combination of both fresh and fallen leaves be used to broaden the spectrum of activity as observed in our study. Furthermore, alcohol proved to be a better solvent for the extraction of the active components and is advocated for use for the extraction. Our study also revealed that some active components were destroyed by heat. Therefore any method that involves heat during extraction should be avoided.

5.4 Herbal Medicine

By the World Health Organization estimates (WHO, 2002), increasing population world-wide is depending on herbal medicine as a source of primary health care. Herbal medicine is used by about 60% of the world population both in the developing and in the developed countries where modern medicines are predominantly used (Rickert

et al., 1999; Ogbonnia *et al.*, 2008). The reasons for this, especially in developing nations, include ease and cost of assessing orthodox medicine as well as cost of procuring prescribed medications (Ogbonnia, 2008).

Only a few of the plants/herbs used in herbal medicine have been scientifically validated for the claimed medicinal effects, hence slowing down the pace of drug discovery from such plants. Among the factors responsible for this is the myth surrounding herbal medicine especially in developing nations as well as dosages administered (Sofowora, 1996).

5.4.1 *Viscum album*

Viscum album (mistletoe) is a hemi parasitic shrub, frequently globular in shape. It grows on the branches of other tress, to which it is attached by a swelling called a haustorium. As a hemi-parasite it depends on its host for water and mineral nutrients but it is able to photosynthesize (create its own carbohydrates using sunlight) because it has green leaves and stem (Anthony, 1995). Two prominent types of *V. album*, European and American, contain very similar protein constituents but have different medicinal uses. Both species contain lectins (viscumin/agglutinin), protein toxins, alkaloids and polysaccharides. The lectins are structurally similar to ricin and abrin. According to Franz (1986), the lectins are cytotoxic glycoproteins, they cause cells to agglutinate and inhibit protein synthesis on the ribosomal level. The lectins are dual chain molecules. Chain A inhibits protein synthesis and chain B activates macrophages and releases lymphokines from lymphocytes. Both chains have been reported to inhibit allergen-induced histamine release from leukocytes and collagen-induced serotonin release from platelets (Franz, 1986). According to Bussing and Schietzel, 1999), the amounts and biological activity of *V. album* lectins are dependent on the host tree, manufacturing process and time of harvest.

Ladokun *et al.*, (2015) conducted a study to evaluate the biochemical composition of mistletoe as affected by hosts (Cocoa, Kola and Coffee) tree.

This study showed that phytochemicals such as tannin, flavonoid, alkaloid, phenols are present in mistletoes from cocoa, kola and coffee plant. It was also observed that the mistletoe have an antioxidant effect due to the presence of phenols with the mistletoe from coffee having the highest of 2.50g. The three mistletoes from cocoa, kola and coffee tree contains some toxic component but yet their medicinal function is essential for instance mistletoes tend to boost the body immunity. Moreso, several flavors can be obtained from these mistletoes based on the host as a result of the presence of the flavonoid. Studies have shown that flavonoids prevent the oxidation of low density lipoproteins thereby reducing the risk for the development of atherosclerosis.

Fig 8 below shows the variation in the phytochemicals present in the mistletoes from the different host plants. The host plants seem to confer a difference in the phenol, tannin and saponin contents.

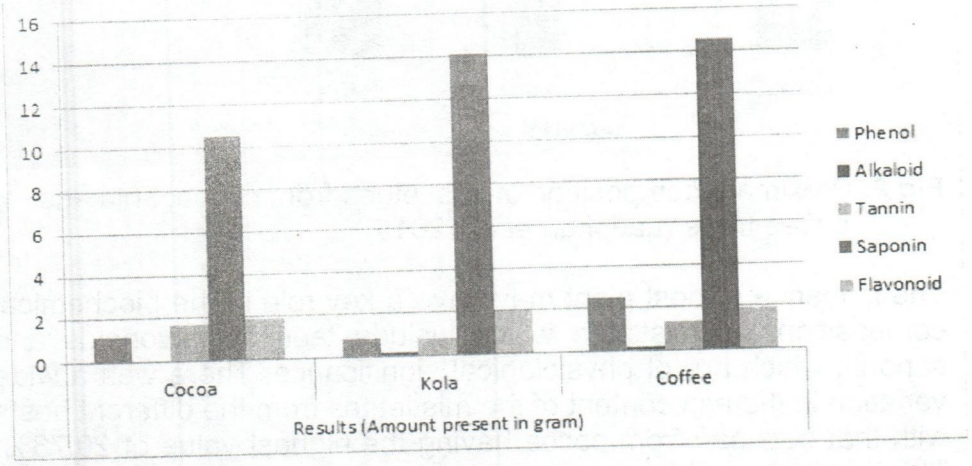


Fig 8: Phytochemical analysis of mistletoe from cocoa, kola and coffee trees.
(Ladokun *et al.*, 2015)

The proximate analysis of the powdered samples of mistletoes from cocoa, kola and coffee trees showed that the samples contain varying

amounts of moisture, ash, crude protein, fat, fibre and carbohydrate. This is shown in the figure below.

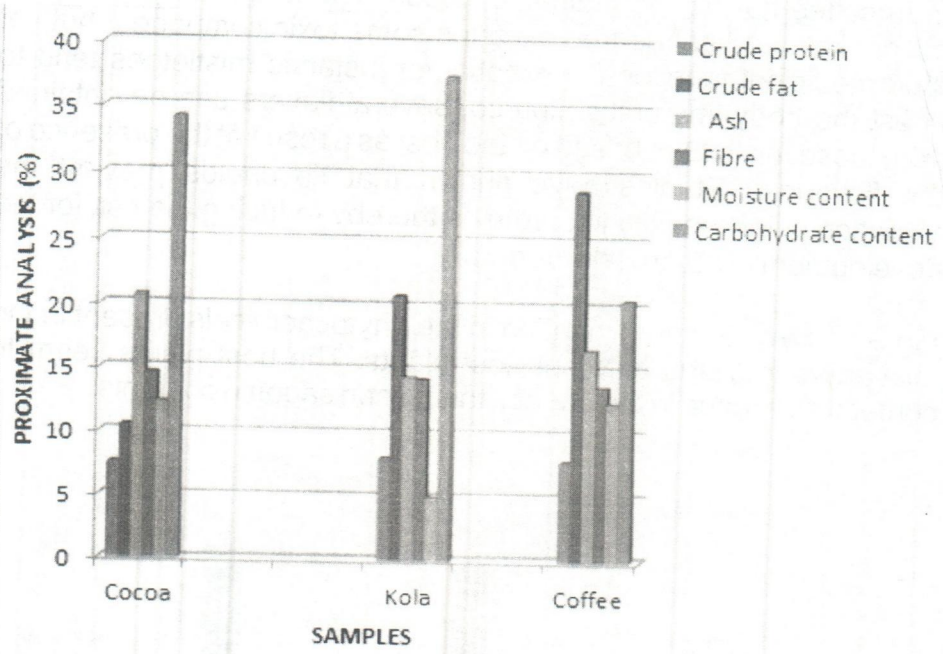


Fig 9: Proximate composition of mistletoes from cocoa, kola and coffee trees (Ladokun *et al.*, 2015)

The influence of host plant may have a key role in the biochemical compositions of mistletoe which include tannins, flavonoids and saponin which are of physiological significance. There was a wide variation in the ash content of the mistletoes from the different hosts with that obtained from cocoa having the highest value of 20.73%. This is indicative of the presence of high amount of inorganic matter.

Blood is a good indicator to determine the health of an organism. It is also a good pathological mirror of the entire body. Cellular component of blood is valuable in immunotoxicology to evaluate the immunotoxic potential of a compound. To this end, haematological parameters are important in establishing the body's functional status as a result of exposure to toxicants (Joshi *et al.*, 2002). The author therefore

studied the acute effects of extracts of mistletoe harvested from three hosts, on haematology of wistar albino rats. The results are presented in the tables below.

It was concluded that it is advisable that the use of this extract in herbal medicine should be with some cautious measures to avoid the risk of anemia in patients treated with the extracts. Also, increase in the WBC count observed in rats administered mistletoe from the three host plants suggests that mistletoe extract contains agents that could stimulate the production of leukocytes, therefore the plant extracts could serve as an immune booster.

5.4.2 Ricinus communis

Diabetes mellitus is a generalized metabolic disturbance that is classically considered to be an endocrinopathy of the pancreas (Jimenz *et al.*, 1986). At the early stage, there is reduced insulin sensitivity, characterized by elevated levels of insulin in the body. It progresses to worsened impairment of insulin secretion. Because insulin is deficient, entry of glucose into the cell is impaired and the principal early symptoms and signs are usually related to metabolic defects (Floyd, 1990). Severe long-time complications can result from unnoticed Type 2 diabetes, including renal failure due to nephropathy, vascular disease (including coronary artery disease), vision damage due to diabetic retinopathy, loss of sensation or pain due to neuropathy, liver damage from non-alcoholic steatohepatitis and heart failure from cardiomyopathy.

The current treatment of the disease includes the use of hypoglycemics (sulfonamides, biguanides, and for Type I diabetes, insulin), hypolipidemics, antihypertensives, hygiene-diet measures and exercises (Menut *et al.*, 1993; CDC, 2004). This management strategy is a lifelong, because it is constraining, cumbersome and expensive therapy. Many people in the developing countries opt for medicinal properties of commonly available plants to fight the disease. Many of such plants lack proper scientific verification of the efficacy.

The author then conducted a study aimed at determining the hypoglycaemic and hypolipidemic potential of the root of castor oil plant, Ricinus communis L on alloxan-induced diabetic wistar rats (Ojezele *et al.*, 2012). This plant is best known for its seed which is the source of castor oil, extensively used as a laxative, purgative, cathartic and demulcent (Greiling & Gressner, 1995). The results are presented in the Tables below.

Table15: Effect of 500mg/kg dose of aqueous extract of Ricinus communis (root) on fasting blood glucose concentration of rats

Treatment	Blood glucose concentration (mg/dl								
	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day6	Day 7	% difference
Non diabetic Untreated	81.0±3.0	79.6±4.0	77.5±3.6	78.8±4.2	77.7±3.9	77.7±3.7	78.6±4.1	79.20±4.0	2.22%
Diabetic untreated	548.3±57.5	474.3±22.34	417.3±19.74	503±46.6	508.0±27.2	461.0±57.6	499.0±27.3	500.67±19.06	8.69%
Glibenclamide	316.3±79.9	242.0±100.9	244.7±96.2	137.0±36.5	97.3±14.2	92.0±11.0	96.3±4.1	95.33±4.67	69.87%
Riciinuscommunis	390.0±77.9	290.3±9.5	264.3±25.1	275.0±14.4	245.0±2.9	222.3±12.9	145.0±31.7	148.33±43.59	61.97%

(Mathew *et al.*, 2012)

Table 16: Effect of 500mg/kg dose of aqueous extract of *Ricinus communis* (root) on lipid profile of rats

Treatment	Total cholesterol (TC) mg/dl	Triglyceride m/dl	High density lipoprotein (HDL) (mg/dl)	Low density lipoprotein (LDL) (mg/dl)	LDL/HDL	Coronary risk index (CRI) TC/HDL
Non diabetic Untreated	84.60±0.56	6920±4.50	30.00±0.00	16.00±0.50	0.53±0.00	2.82±0.13
Diabetic untreated	95.67±2.85	166.00±54.37	26.67±3.33	43.33±7.69[2]	1.62±0.17[2]	3.69±0.41
Glibenclamide	73.33±1.76[1]	64.33±1.20[1]	27.33±4.06	17.67±5.61[1]	0.41±0.26[1]	2.80±0.38
Riciinus communis	77.33±1.45[1]	76.00±4.62[1]	32.00±1.15	30.00±1.15[1]	0.93±0.00[1]	2.42±0.04[1]

Superscripted items indicate statistically significant difference (<0.05) exist between mean values of each group compared with diabetic untreated (1) and glibenclamide (2) groups. (Mathew *et al.*, 2012)

Table 17: Phytochemical analysis of *Ricinus communis* (root)

Plant	Method/Reagent		
Cardenolides	Dragendorff's	Meyer's	Wagner's
	+	-	-
	Keller-killiani	Keddle	
	+	-	
Anthraquinones	±		
Saponin	+		
Tannins	+		

(Mathew *et al.*, 2012)

+ ---------- present

- ---------- absent

± ---------- trace

Anthraquinones derivatives have been found to play an important role in the treatment of tumors, diabetes, ulcer and cancer (Rajendran & Gnanarel, 2007). The hypoglycaemic effect observed in the diabetic rats administered *Ricinus communis* extract could be as a result of the anthraquinone.

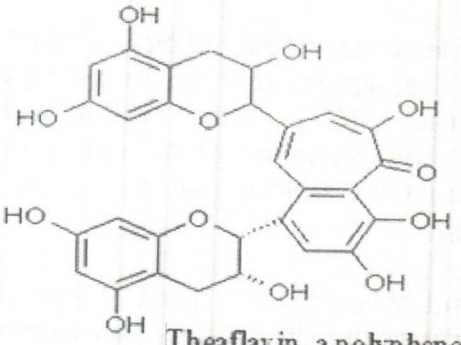
Flavonoids and tannins are phenolic compounds and plant phenolics are a major group of compounds that act as primary antioxidants or free radical scavengers (Polterait, 1997). Since diabetes and oxidative stress are interrelated, the presence of phenolics (e.g. tannin) in Ricinus communis could be factors that enhanced its hypoglycaemic effect in diabetic rats.

The biochemistry of the movement of lipids in the blood stream and the factors that increase lipid deposition in arteries is extremely complex. As far as cholesterol is concerned, the two lipoproteins most concerned with its transport are the high density lipoproteins (HDL) and the low density lipoproteins (LDL). LDL transports cholesterol to the cells where it is deposited even though it may not be required and is therefore associated with atherosclerosis. HDL on the other hand, transports cholesterol to the liver where it can be removed from the body (Allan *et al.*, 2007). Normally, it is found that high cholesterol levels are associated with high LDL levels, but having a high HDL may compensate for this.

Thomas (Thomas, 2003) showed a strong relationship between high level of total cholesterol concentration in the blood and cardiovascular disorder. Furthermore diabetics have an increased risk of coronary disorder (Stratton *et al.*, 2000; Davis *et al.*, 2001). This may offer an explanation for the high coronary index (tendency to cause cardiovascular disorder) observed in the diabetic rats administered the extract. The lipid profile of rats administered the extract showed relatively cholesterol and low density lipoprotein which are factors that may lower development of artherosclerosis.

VI. FORWARD LOOKING

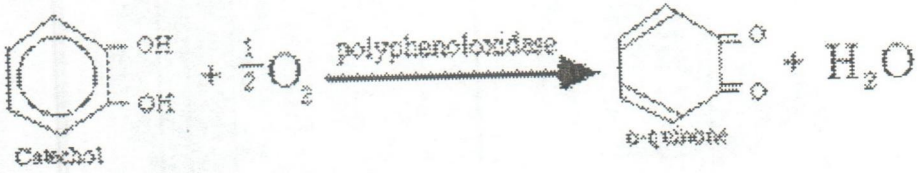
The author has done some work on a variety of tropical plants, which were investigated nutritionally including quantification of nutrients/antinutrients and bioavailability. In addition to many essential nutritional components, plants contain phenolic substances, a large and heterogeneous group of biologically active non-nutrients (Schahidi and Naczk, 1995). The most abundant polyphenols are the flavonoids

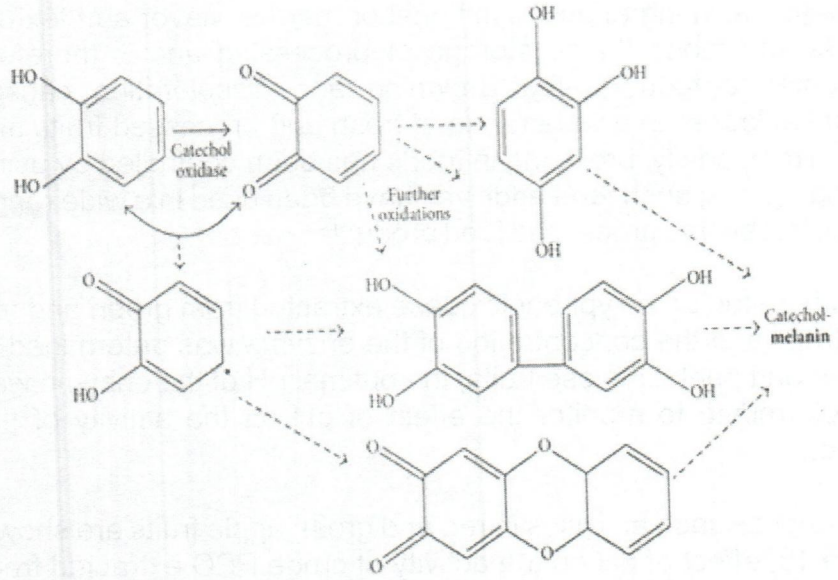


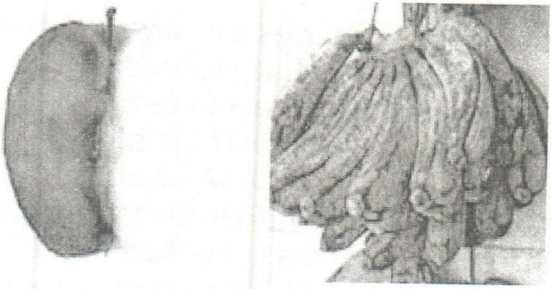
Theaflavin, a polyphenol in tea

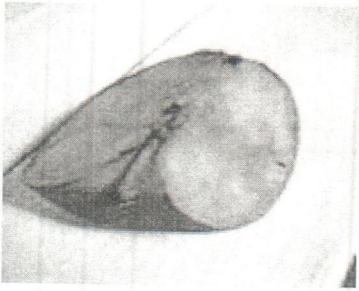
Polyphenols in vegetables, fruits and teas can prevent degenerative diseases including cancers through antioxidative action and/or the modulation of several protein functions. Polyphenol oxidases are a widespread group of enzymes found in plants, fungi, bacteria, and animals. In plants, these enzymes are usually found in the chloroplasts, although they can be released from this compartment during ripening or senescence.

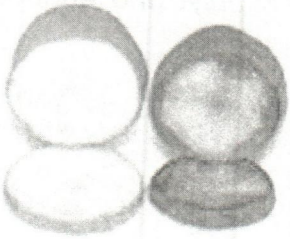
Polyphenol oxidase (PPO) causes oxidative browning in many food products (Ming, *et al.,* 2014). Enzymatic browning is a significant problem in a number of fruits and vegetables resulting in discoloration of fruits and vegetables. This occurs as a result of conversion of phenolic compounds to *o*-quinones which subsequently polymerize to be a brown or dark pigment. Polyphenol oxidase has received much attention from researchers in the field of plant physiology and food science because of its involvement in adverse browning of plant products *(Ruhiye and Maurice, 2003*).











Enzymatic browning affects nutritional properties, flavor and texture of foods and feeds during storage or processing and is therefore detrimental to food quality. Browning and discoloration causes substantial losses in a wide range of fresh and processed fruits and tubers. Traditionally, browning in foods has been controlled by using sulfating agents; such food additives have been used in a wide range of fresh, frozen and processed food products.

The author studied polyphenoloxidase extracted from green and red apple fruits and the concentration of the enzyme was determined in the flesh and peels of these fruits, the optimal pH of the enzyme was also determined to monitor the effect of pH on the activity of the enzyme.

Polyphenol oxidase activities in red and green apple fruits are shown in Table 18, effect of pH on the activity of crude PPO extracted from green apple peels is depicted in figure 10, effect of pH on the activity of crude PPO extracted from green apple flesh is depicted in Fig. 11, effect of pH on the activity of crude PPO extracted from red apple peels is depicted in Fig. 12 and the effect of pH on the activity of crude PPO extracted from red apple flesh is depicted in Fig. 13.

Since PPO is involved in enzymatic browning, this phenomenon can be prevented by inhibiting the enzyme's activity. Concentration is one of the factors that affect enzyme's activity. The concentration of the enzyme in the flesh compared to the peels of the apples revealed that the enzyme's activity was lower in the green apple flesh than the peel but higher in red apple flesh than in the peel, this result was confirmed by the rate of browning reaction observed during peeling. The red apple flesh had the highest PPO activity of 2.65; this high PPO activity could be responsible for the rapid change in coloration observed in the red apple flesh during peeling. The activity of the enzyme in the green apple peel was 2.15; the activity in the green apple flesh was 1.3 while the enzyme's activity in the red apple peel was 0.75.

pH is another factor which affects the rate of an enzyme catalyzed reaction. The changes in ionization of prototropic groups in the active site of an enzyme at lower acid and higher alkali pH values may prevent proper conformation of the active site, binding of substrates, and/or catalysis of the reaction (Whitaker, 1994). An optimum pH is the pH at which an enzyme shows its maximum activity. Therefore for any enzyme, when the $[H^+]$ concentration of the reaction medium is increased above or decreased below the optimum pH, the activity tends to decrease. From the result obtained in this study, the optimum pH for crude PPO extracted from the green apple peel, green apple flesh, red apple peel and red apple flesh were 7.6, 6.4, 8.4 and 8.0 respectively as depicted in figures 10-13 below.

Table 18: Polyphenol oxidase activity in red and green apple fruits

Samples	PPO Activities ($\mu molmin^{-1}cm^{-3}$)
Green apple peels	2.15
Green apple flesh	1.30
Red apple peels	0.75
Red apple flesh	2.65

Ladokun and Arojojoye, 2016

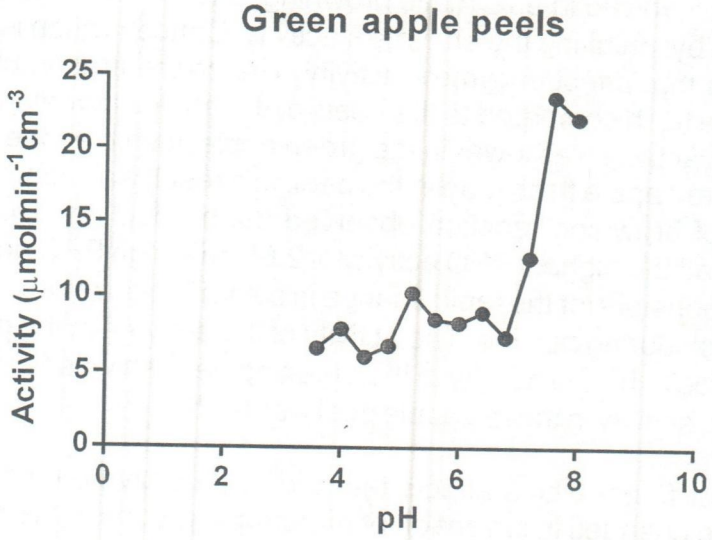


Fig 10: Activity of crude PPO extracted from green apple peels (*Malus domestica*) against pH (Ladokun and Arojojoye, 2016)

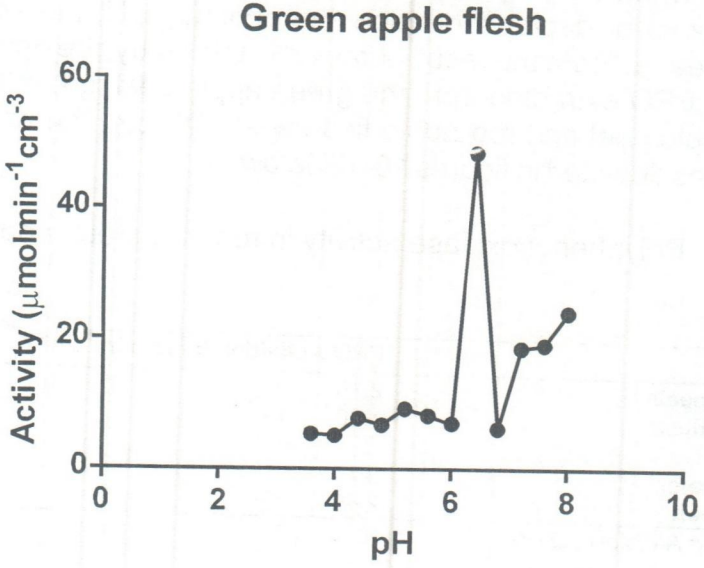


Fig 11: Activity of crude PPO extracted from green apple flesh (*Malus domestica*) against pH (Ladokun and Arojojoye, 2016)

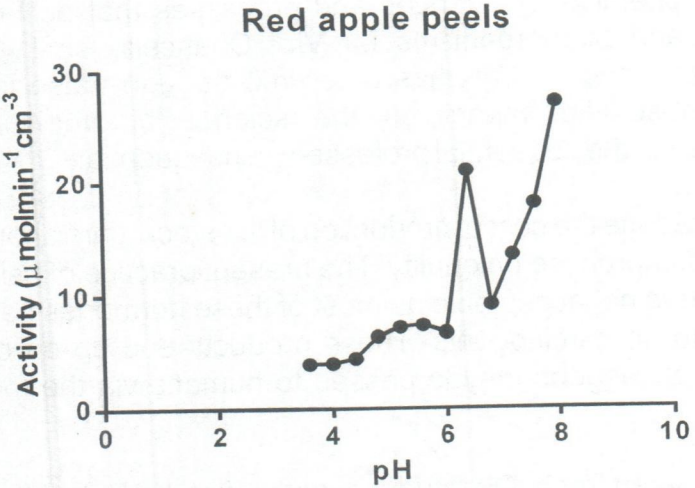


Fig 12: Activity of crude PPO extracted from red apple peels (*Malus domestica*) against pH (Ladokun and Arojojoye, 2016)

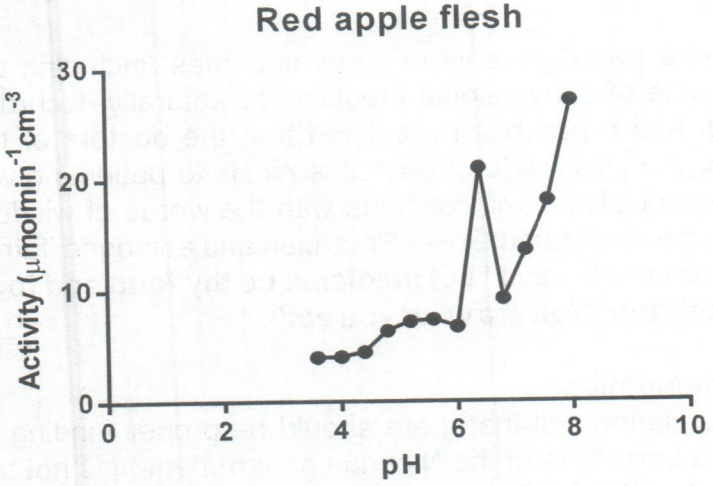


Fig 13: Activity of crude PPO extracted from red apple flesh (*Malus domestica*) against pH (Ladokun and Arojojoye, 2016)

VII. CONCLUDING REMARKS AND RECOMMENDATIONS

7.1 Conclusion

One of the definitions puts Biochemistry as a field of science concerned with chemical substances and processes that occur in plants, animals, and microorganisms. Mr. Vice-Chancellor sir, I wish to submit that my random walk has taken me through those little things, with not-so-little impact on the science of Nutritional Biochemistry, hence the sequential professedly unsequential.

In an attempt to reduce the cost of production of livestock, care should be taken not to compromise on quality. The present practice of using growth hormones is not acceptable as most of these hormones have been recorded to be carcinogenic. These products end up on our tables and the carcinogens maybe passed to humans via the food chain.

Fruits are better eaten fresh. Our study revealed that the Polyphenol oxidase is still active even at lower temperatures. To prevent browning (and the accompanying degradation of nutritional quality), it is therefore recommended not to store fruit in a refrigerator for too long before consumption.

There has been a paradigm shift in many countries (including the USA) from the use of conventional medicine to naturally-occurring phytochemicals and it has been predicted that the doctors of the future will prescribe pills made of phytochemicals to patients given their beneficial principles. I will conclude with the words of wisdom from Hippocrates a celebrated Greek Physician and adjudged 'father of Western medicine' who said **"Let medicine be thy food and food be thy medicine" and "You are what you eat".**

7.2 Recommendations

I want to give a clarion call that there should be proper funding of education by the three tiers of the Nigerian government. It is not too late to embrace the UNESCO's recommendation of allocating 26% of the annual national budget to education; there lies the magic for our quest to join the league of 20 advanced economies in the year 2020

which is just by the corner.
For researchers working in the field of natural product, I encourage you to dig deeper. While the use of extracts may provide some preliminary information on the therapeutic use of a plant, it is only isolated and well-characterized compounds that can be useful in investigating and understanding the underlying pharmacological basis of action of these plants. Hence, multi-disciplinary approach involving Biochemists, Chemists, Pharmacognosists, Toxicologists, Pharmacologists and Microbiologists is highly needed at this time.

To my dear colleagues, it is highly imperative that we should do away with 'survival' research and go beyond mere publishing only for the purpose of promotion. Rather, we should be engaged in cutting-edge research, highly competitive proposals that can attract international grants to do globally-relevant research. It is only by engaging in this kind of research that the gown can effectively impact the town.

ACKNOWLEDGEMENTS

Mr. Vice Chancellor sir, for this cause I bow before the Father of light, the Creator of the ends of the earth, the Holy One of Israel. He is the Lifter up of my head, the Ever Present Help, the One who causes me to triumph in every situation and make manifest the savour of His knowledge in every place. Glory be to His Holy name.

I am highly indebted to my late parents Chief Moses Itanola and Mrs Winifred Mobola Okunola for giving me the right and complete training, which has stood me in good stead, both in my career and other areas of human endeavor. How I wish you were here today to see what your baby has become, but God knows best. Continue to rest in the bosom of our Lord. To my brothers and sisters, and their spouses, I say a big thank you for your wonderful support.

My special gratitude to all my mentors starting with Professor Olumide Odeleye Tewe, for the training, counsel, guidance, support and encouragement. I appreciate deeply my lecturers in the department of Animal Science, University of Ibadan. I acknowledge also the support of Professor Israel Rozenboim of the Hebrew University of Jerusalem, Israel. To my teachers at Bodija International School, St Teresa's College and St Annes' School, I say a big thank you.

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To my immediate family I say a big thank you. My 'soldiers' Toluwanimi and Oluwatomilola you have given me reasons to be eternally grateful to God. I appreciate your love and support, I love you so much. Precious you are a darling. You will all fulfill destiny and accomplish God's purpose for your lives. You will be greater than me in Jesus' mighty name. Amen.

Now unto the King Eternal, Immortal, Invisible the only Wise God, the only Potentate, the First and the Last, the Alpha and Omega, my Helper and Pillar of Support. By Him I have run through several troops and by Him I have leaped over the wall. He made me a fruitful bough by the well with branches running over the wall. Yea my bow abides in strength and the arms of my hands have been made strong by the hands of the Almighty. To Him alone be the Glory, the Honour, the Power, the Might, the Victory and the Majesty for ever and ever.

Mr. Vice-Chancellor distinguished ladies and gentlemen "Hitherto the Lord has helped me (Ebenezer)". I thank you all.

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BIODATA OF REVEREND PROFESSOR OLUSOLA ABIOLA LADOKUN

Olusola Abiola Ladokun was born in Ibadan, Oyo State to the family of Late Chief Moses Itanola and late Mrs Winifred 'Mobola Okunola. After her primary education, she attended St Teresa's College, Ibadan, where she obtained the West African School Certificate. She had her A' Levels at St Anne's School Molete, Ibadan. She later proceeded to the University of Ibadan to study Agricultural Biochemistry and Nutrition. After the compulsory NYSC, she returned to the University for Postgraduate Studies. She successfully defended her PhD thesis in 2003.

Her academic career started at the University of Ibadan in 1998 as Graduate Assistant. She joined the services of Lead City University as a Lecturer II in 2005. She rose steadily and consistently through the ranks of the promotion ladder of the University. On the 5th of November, 2015 she was appointed a Professor of Nutritional Biochemistry.

After her PhD in 2003, she proceeded to the Hebrew University of Jerusalem, Israel for a short postgraduate course. On her return, she joined the services of this great citadel of learning as the pioneer lecturer of the department of Biochemistry.

She has held several administrative positions including: the first Sub Dean of the then Faculty of Information Technology and Applied Sciences (2005-2014), Head of Biochemistry Department (2010-2011), Faculty representative on Board of Postgraduate School (2007 to date), Departmental Curriculum Coordinator (2005-2009), Member Committee on Examination Malpractice (2007), Member Departmental Research Committee (2009 to date), Member University Research Committee (2009-2014), Dean, Faculty of Sciences (2014 to date), Director, International Degree Foundation (2014 to date). She is also the President Ibadan Club of Business and Professional Women (BPW) an Affiliate of Business and Professional Women International (BPWI) (2010 to date) and on the international scene, Member Standing Committee on Health BPWI.

An effective and innovative researcher, supervisor and mentor, she has supervised numerous BSc students' projects in Biochemistry. She has to her credit several articles in both local and international journals, chapters in books and conference proceedings. She is a recipient of a couple of international Fellowships and Grants including: EMBL Advanced Training Grant Heidelberg Germany (October, 2011), Chinese Academy of Sciences (2010) Travel Grant to attend the TWOWS Fourth General Assembly and International Conference, Beijing, China, Islamic Development Bank (2007) Travel Grant to attend the 8th African Crop Science Society Conference held at Minia University, El-Minia, Egypt, MASHAV Scholarship Award (2004), sponsored by The Ministry of Foreign Affairs, Israel to mention a few.

Under her leadership the Faculty of Sciences held the first International Conference in October, 2016. The conference was very successful in terms of participation and attendance. She has also set up a research group in the faculty that works directly with the Chancellor, Prof G.B Ogunmola. Since assumption of office as Dean, the Faculty of Sciences has had two Faculty Lectures, several Departmental Lectures and a general Staff Training.

Redeemed by grace, she is the Provost of Image of Christ Theological Seminary, Akure. She was recently ordained as a Reverend. She is married and blessed with two wonderful boys.

NATIONAL ANTHEM

Arise, O compatriots
Nigeria's call obey
To serve our fatherland
With love and strength and faith
The labour of our heroes' past
Shall never be in vain
To serve with heart and might
One nation bound in freedom
Peace and unity

O God of creation
Direct our noble cause
Guide thou our leaders right
Help our youths the truth to know
In love and honesty to grow
And living just and true
Great lofty heights attain
To build a nation where peace
And justice shall reign

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Lead City University
The cradle of great leaders
Where hopes and dreams are given life
And drive for great attainment
With motivation and inspiration
We're dedicated, educated
Extending peace and joy
From different cultures, beautiful picture
Lead City University

We are the leaders
The light of our great nation
Diversified yet one great vision
With knowledge for self-reliance
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We're dedicated, educated
Extending peace and love
Our voices together, beautiful harmony
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