LIPID BIOCHEMISTRY: PROVIDING NEW INSIGHTS IN OUR ENVIRONMENT

BY

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Mr. Vice-Chancellor;

Fellow Academics;

Distinguished Ladies and Gentlemen:

It is a great honour and pleasure to deliver the 20th inaugural lecture to the distinguished gathering of our University. It is equally a privilege to give an inaugural lecture on Biochemistry, the youngest of all subjects in science. An inaugural lecture in a University is given by a newly appointed Professor to present to the University community his ideas, work on some aspects of his specialization and how he would be able to develop it and the department which he is called upon to lead. Inaugural lecture is a very good tradition; the only problem is that in a multidisciplinary university with numerous faculties, it is not easy at times for the inaugural lecturer to select a subject of interest for all.

Indeed modern day academic inaugural lectures are traceable to the formation of academic societies. For example, on election of an academic into full membership of societies in developed countries, the new member is expected to deliver an augural. Similarly it is well known that for the conferment of Nobel prizes (the acknowledged highest academic honour can receive) the recipient is expected to give an inaugural lecture

Truly Mr. Vice-Chancellor, when in 1998, Prof. I. C. Ononogbu delivered his inaugural lecture, the 11th in our series, he said and I quote "for my postgraduate students, Dr E. C. Onyeneke, Dr). U. Njoku, Mr. F. U. Eneh, and Dr N. B. C. Echeta etc. please keep the flag flying, as I have told you in several

occasions, your song shall be "Animal farm, animal farm, never through me shall thou come to ruin". I will like to come back to the Department of Biochemistry well after my retirement to see that lipids are still alive and well in the Department of Biochemistry where they lecture". Indeed I will like Prof. I. C. Ononogbu to come back well after his retirement to see that lipids are not only alive but most functional.

1.2 My Academic History

Mr. Vice-chancellor, my academic career started in the laboratory of Dr E. O. Alumanah a clinical Biochemist with specialty area in Endocrinology in our Department of Biochemistry. In my graduating year in 1986, I worked closely under his supervision and the title of my project was "Steroid hormones present in the follicular fluid of agama agama lizard. I place a lot of premium on what I learnt under Dr E. O. Alumanah and Dr E. C. Onyeneke. When I came back for my postgraduate study in 1988, I continued in the same laboratory, where I worked on "Serum lipid profile in our sports men and women". Prof. I. C.

Ononogbu and Dr E. C. Onyeneke allowed me free access to their laboratories and academic materials on lipids and lipid related areas. This was a turning point in my academic history. When I graduated in 1990 and registered for the Doctorate degree, Prof I. C. Ononogbu became my supervisor. Permit me to digress a little. I had some early experiences in life that actually convinced me that I was moving at a speed faster than my age. I started primary school at a very tender age of about 4 years, and took the East Central State common entrance examination in Grade 5. I feel bad that I have all academic certificates except the very fundamental and first certificate, the first school leaving certificate. My parents who were teachers and had risen to the rank of Principal of secondary schools, encouraged me to register and participate in the common entrance as an

exposure examination, even though they knew I could pass the entrance examination. When the common entrance examination results came out, they found out that I passed, and they intercepted my result and refused to show or tell me about it. Unfortunately for them, I had developed the attitude and ability of looking at newspapers. On one occasion, I found the common newspaper then the Renaissance unusually big, and I opened the paper only to find out that the common entrance results were published in that volume. I quickly crosschecked and found my name in the list of students admitted to the prestigious Dennis Memorial Grammar School Onitsha.

My joy knew no bounds as I quickly rushed back to inform my parents about the development. I remember that my mum was very happy with the development but was not ready to allow me to go because I was too tender. This situation was so bad that I stopped eating, and my parents had to travel to Egbu to discuss this issue with my late uncle Archbishop B. C. Nwankiti. He advised my parents to allow me to go to secondary school at that very tender age. That gesture remains a memory in my life. My experience at DMGS was very interesting. Equally, my early days in the secondary school, I had the rare and singular privilege of living with my principal, Late Mr. C. O. Agunwa, my father's very good friend. At that very tender age, I was equally a class prefect; this responsibility helped me interact with my classmates especially in doing assignments in science and technical subjects.

When I entered the University in 1982, I was equally one of the youngest in my set. The strain of University education was obviously visible as I hardly could meet up the demands and strain associated with University Education. I thank my classmate and friend Dr B. C. Nwanguma for encouragement those early years during our undergraduate days. When I finished my first degree I tried to study medicine, I didn't know that destiny had another programme for my life. I

reluctantly came back to do a masters degree programme. It was then the practice that postgraduate students be engaged with practical demonstration at all levels in both the Department and Faculty. I was engaged as a part time demonstrator in the Faculty of Biological Sciences and the Department of Biochemistry. I did this assignment with a high sense of responsibility that the lecturers in my Department were very delighted to recommend that I be employed as a staff when a vacancy existed. I thank Prof. L. C. Eze, the Head of Department then. I vividly remember that in one occasion he had this to say. "I am impressed with the manner and method you carry out and discharge your responsibilities".

The period of my graduation coincided with the period when the banking sector was gradually beginning to be very attractive. The banks came to the Universities to recruit staff. I had the opportunity of attending few interviews with some banks, but could not continue the subsequent interviews because I had an offer of Assistant Lecturership position with the Department of Biochemistry. The salary that was offered to me as an Assistant Lecturer was both ludicrous and ridiculous when compared to the offer by the banks, and other sectors. My parents advised that I should accept the offer and use it to do my Ph.D, and promised to supplement my salary. When I had finished the usual documentation and filling my arrival forms, I had series of appointments with my Professor and Ph.D supervisor on possible topics to work on. The two topics he gave to me to look at and study are:

(a) The Standardization of lipid levels in a Nigerian population, which was to take me to all teaching Hospitals in Nigeria; for assay and data collection.

(b) The Rubber seed finding uses for a waste product - Nigeria.

Prof. I. C. Ononogbu gave me 2 weeks to go and think about the two topics. He equally left me with an option of any possible topic of my own. He emphasized

that I had only 2 weeks to finish this assignment, as he was busy trying to write a proposal to IDRC, and part of the proposal requirement was that a postgraduate student would be needed for the study. The two topics had very important derivable benefits and could solve national problems.

Mr. Vice-Chancellor I opted for the second topic that needed to be well developed - The rubber seed finding uses for a waste product - Nigeria. Using the knowledge of lipid Biochemistry, instrumentation and considering that Biochemistry is an offshoot of organic and physiological chemistry, I investigated the rubber seed, finding uses for a waste product Nigeria, and a host of other tropical plants. I equally did some work using lipid profile to interpret disease conditions and complications, as well as extensive biopharmacological analysis of many plants found in our environment.

This is why I have titled my inaugural lecture

Lipid Biochemistry. Providing New Insights in our Environment.

1.3 Career in the University

Ladies and Gentlemen, I was employed in August 1991 as an Assistant Lecturer. In my early days as a staff, Prof. I. C. Ononogbu called me into his office and had an hour discussion with me. The discussion centred on my career in the University. He ended with this advice, if in 10 years you are not a Professor forget it. I looked at the advice as a Prophesy and I worked very hard to actualize it. Mr. Vice-Chancellor, three years into my career, came the very turbulent period in the history of Nigerian Universities; I am referring to the periods between 1993-1997. There were tremendous crisis in our University here and the Nigerian Universities system in general. There were strikes, sacking of staff and disruption of academic activities. These periods for me was a blessing in disguise, because I capitalized on the instability in the system to do research, I must stress productive research.

Within the said period, I equally lost my job for 9 months during the ASSU National crisis strike of 1995-96. I am referring to the tenure of Prof. U. D. Gomwalk as Sole Administrator. The Dr Nick Inyang, the then Associate Dean. My faculty elected me their Associate Dean to complete that tenure.

My tenure with that of Dr Inyang was very short but most eventful and has always been referred to in the history of our beloved Faculty. It was during this period that my papers left the faculty for the Central Appraisals. By July 2002, I had finished my tenure as Associate Dean, and I proceeded to Michael Okpara University of Agriculture, Umudike for my sabbatical leave. I came back in November 2003 from my sabbatical leave. In 2004, Prof. Gini Mbanefo's, last year as Vice-Chancellor there were series of UAC meetings - one in February, and another in May. As usual I expected that I might be lucky in the University Appraisals Committee meetings, but this did not come. On 25th May, 2004, the Dean, Faculty of Biological Sciences informed me that there would be a meeting of the University Appraisals Committee on 26th May 2004, and the agenda hopefully would be taking final cases only. I was very anxious, as would be expected I did inform my wife about the meeting. We prayed and committed the meeting into God's hand, and equally asked for his special favour. On the morning of 26th May, 2004, we prayed again. During that morning devotion, my little daughter opened my Bible and pointed to a verse. I asked my wife to read that verse. That verse is James 5-16 "Confess your faults one to another, and pray one for another that you may be healed. The effectual fervent prayers of a righteous man availeth much". Mr Vice-Chancellor, ladies and gentlemen, with this Bible reading, I knew that my promotion was on its way. I quickly told my wife that morning before leaving for office that I am leaving as a Doctor, I will come back as a Professor.

My promotion was with a difference. During the meeting, Prof. Gini Mbanefo informed members of the University Appraisals Committee, that my last report came in early hours of that morning and he decided to add it to his list as he didn't want to handover any arrears of professorial promotion to the incoming Vice-Chancellor. The rest of what happened in that meeting was a miracle and I will not go into such unnecessary details today. I thank Prof. Gini Mbanefo, and like I said during a farewell party organized in his honour at the Senior Staff Club University of Nigeria, Nsukka "for me it is a great parting Gift from you Sir". The announcement of my promotion coincided with the end of a tenure, and the beginning of a new administration. In a letter acknowledging receipt of my promotion letter from the University registrar, I wrote. I received this letter with great joy and regard my promotion as a call to greater responsibilities, Mr. Vice-chancellor, indeed since my promotion, it has been call to higher responsibilities. I thank you for giving me the challenges and opportunity to serve, in your administration.

1.4 Biochemistry a Science with a Difference

Biochemistry is an offshoot of organic and physiological chemistry and has a history of only about eight decades. Prof. Augusti, Professor of Biochemistry, University of Maiduguri while delivering his lecture titled Dynamic aspects of Biochemistry in the service of humanity said and I quote "the study of Biochemistry in a developing country suffers from many serious disadvantages - shortage of teachers, laboratory facilities and good libraries. But worse than these are the psychological disadvantages suffered by both staff and students".

Biochemistry as a science is closely related to Medicine, Agriculture and is an integral part of all pure and applied sciences, be it Biotechnology, Environmental Sciences, Molecular Biology, Archaeology, Engineering or

Pharmacy. Biochemical approaches are used for teaching, in experimental design and interpretation of data. The central role of Biochemistry as an important science subject is further explained by the number of Nobel prize winners in science who use Biochemical tools in their research findings. The subject of Biochemistry is so diverse that no single person can claim to be a complete Professor of Biochemistry, Mr. Vice-Chancellor, for me it is wrong to call anybody a Professor of Biochemistry without mentioning his/her specialty area. My specialty area is lipid Biochemistry, and in the next few minutes, I will be discussing lipid Biochemistry and my studies on lipid Biochemistry.

1.5 Lipid Biochemistry - a neglected area

Since in most of my works, I have largely been after lipids or lipid like molecules, it might be necessary to briefly talk about lipids.

Mr. Vice-Chancellor, many scholars have worked and are still working on lipids, but I am afraid that no researcher who had worked or still working on lipids can give an all encompassing definition of lipids. From creation of man, he has always depended on food for his/her existence. Among the major food classes are carbohydrates, protein and lipids referred to as major macromolecules. Prof. I. C. Ononogbu in his inaugural lecture said and I quote "The lipids have always been the most neglected, especially in the underdeveloped and developing countries".

The simplest definition of lipids by most scholars and researchers are biological compounds that are insoluble in water. However, there are many pure synthetic substances which have all the properties of lipids, especially the polar substances, which show variable degrees of solubility.

Some literature may define lipids as simply fats and oils. Today most biomolecules that exert profound biological activities belong to this class of

compounds.

Mr. Vice-Chancellor as my topic refers - Lipid Biochemistry, providing new insights in our environment, I can tell this audience that we see and deal with lipids every day.

- The fats and oil in our food are lipids
- The milk we take contains lipids
- The margarine and butter are lipids
- The yoghurt we take contains lipids
- The soap and cream have lipids
- The nail polish, varnish car and oil paints contain lipids
- The egg has cholesterol - lipids
- The suppository drugs all contain lipids
- The fish we take contain lipids
- The ice cream contains fats and oil - lipids
- The beef, pork, chicken all contain lipids.

Indeed virtually all plants, microorganisms, aquatic animals and terrestrial mammals contain appreciable amounts of lipids.

In more technical term lipids include the more familiar members, the triacylglycerol which is usually referred to as storage fat. This is usually used in living organisms as storage fats and they form sources of energy. The next groups are the structural lipids found in membranes known as glycerophospholipids. Some have the ether linked fatty acids in their structure and are known as plasmalogens. A reasonable quantity of the heart tissues contains this group of lipids.

The platelet activating factors are plasmalogens, which are released from the basophil. They stimulate platelet aggregation and the release of important biological compounds. They exert a variety of effects on tissues and play important roles in inflammation and allergic responses. Another group of lipids are the sphingolipids. These are lipids that contain sphingosine in their structures. They include the cerebrosides, the gangliosides, ceramides and sphingomyelin. These lipids are found in the brain tissues, and they play important roles in the central nervous system as well as in receptor-ligand interactions. They equally play important roles in the determination of human blood groups.

The steroids and their derivatives are another very important lipid class. You are familiar with cholesterol, just as I am equally sure you hear about sex hormones. This belongs to this class. There is yet another important group the lipid soluble vitamins A, D, E & K. These vitamins play important roles in health and disease. Vitamin A is important in vision; vitamin D in bone formation, vitamin E is a fertility vitamin, while vitamin K is important in blood clotting. Apart from these major functions, they have other roles especially in immune reactions.

Mr. Vice-Chancellor, distinguished ladies and gentlemen, it is this diverse group of compounds that I have fooled around with in the past 15 years. **I now wish to recall some of the things I have done with them.**

Extraction. Isolation. Characterization And Uses Of Oil Bearing Seeds In Nigeria

The plant kingdom is an enormous reservoir of vegetable oils, and it is reported to constitute about 60% of all known fats and oil. During my search for new oilseeds to augment the limited vegetable oil resources in Nigeria, I worked with over 30 plants for their oil content possible toxicological, nutritional and industrial uses.

These plants include vegetables, fruits, spices, legumes and seeds. I equally worked on some species of fish. The results obtained from these studies are presented in Table 1:

Table 1: Plants, oil yield and possible applications

S/N	Botanical name	Local name	% yield	Possible uses	References
1.	Colocynthus citrullus	Egusi	50%	Edible oil Industrial oil -Pharmaceutical & nutrition industries	Njoku, O. U. et al, 1994
2.	Monodora myristica	Ehuru	50%	Industrial oil - Pharmaceutical	Njoku, O. U. et al, 1996
3.	Gnetum africanum	Ukazi	3.6%	Nutritional oil ,as emulsifier	Njoku, O.U. etal, 1997
4.	Piper guineense	Uziza	4.8%	Industrial & Pharmaceutical oil	Njoku, O. U. et al,1997
5.	Xylopia aethiopica	Uda	8.5%	"	Njoku O.U. etal 1997
6.	Irvingia gabonensis	Ogbono	54%	Edible oil Industrial oil	Njoku, O.U. and Ugwuanyi J.O. 1997
7.	Theobroma cocoa	Koko	53.5%	Edible oil (infectionaries)	Njoku, O.U. etal 1997
8.	Hibiscus esculentus	Okro	15%	Industrial oil	Njoku, O.U. etal 2002
9.	Hura crepitara	Sand box	54%	Industrial oil	Njoku O. U. et al 1998
10.	Moringa oleifera	Horse radish	20%	Edible oil	Njoku O.U. & Adikwu M.U. 1997
11.	Mucuna bean	Agbara	7.6%	Industrial oil	Njoku O.U. et al, 1997
12.	Vigna unguculata	Akidi-ani	2.6%	,,	,,
13.	Cajanus cajan	Feofeo	1.6%	,,	"
14.	Bambara nut	Okpa	5.0%	,,	"
15.	Pterocarpus santalinoides	Nturukpa	12.8%	Nutritional/Pharmaceutical oil	Njoku O U. etal, 2004

16.	Gongronema latifolium	Utazi	1.2%	Industrial/ Pharmceutical oil	Obasi S.C. etal, 1998
17.	Chrystophyllum albidium	Udara	32%	Industrial oil	Njoku O.U. etal 1999
18.	Atrocarpus altilis	Ukwa	45%	,,	,,
19.	Afzelia Africana	Akparata	16%	Nutritional oil	NjokuO.U..& Eneh F.U. 1999
20.	Detarium microcarpum	Ofo	5%	Nutritional oil	,,
21.	Tetrapleura tetraptera	Uhukuru ho	1.7%	Pharmaceutical oil	NjokuO.U.etal, 1999
22.	Averrhoa carambola	Apple star fruit	52%	Nutritional oil	Njoku O.U. et al 1999
23.	Caesalpina crista	Bondue	10%	Industrial uses	Njoku O.U. et al 1999
24.	Shea butter	Okwuma	51%	Edible/ pharmaceutical fat	Njoku O.U. et al 2000
25.	Pterocarpus	Uha	1.5%	Industrial oil	Okeke E.G. & Njoku O.U. 2001
26.	Ricinodendron heisde'otii		42%	Edible oil	Njoku O.U. et al 2001
27.	Monodora tenuifolia	Ehuru ohia	35%	Pharmaceutical oil	Njoku O.U. et al 2005
28.	Pennisetum purpureum	Achara	1.5%	Edible oil	Njoku O.U. et al 2004
29.	Ocimum gratissiirium	Nchanwu	0.7%	Essential oil Industrial oil	Ijehl.I.etal 2004
30.	Scumber scombrus		10%	Fish oil	Njoku O.U. et al 2005
31.	Trachyrus		17%	Fish oil	Njoku O.U. et al 1996
32.	Rubber seed	Okwe	42%	Industrial oil	Njoku O.U. & Ononogbu I..C. 1998, Njoku O. U.etal.2001

Njoku, O. U. et al, 1994; Njoku, O. U. et al, 1996; Njoku, O. U. et al, 1997; Njoku, O. U. and Adukwu, M. U., 1997; Njoku, O. U. et al, 1997; Njoku, O. U. et al, 1998; Njoku, O. U. and Eneh, F. U., 1999; Njoku, O. U. et al, 1999; Njoku, O. U. et al, 1999; Njoku, O. U. et al, 2000; Njoku, O. U. et al, 2001; Njoku, O. U. et al, 2001; Njoku, O. U. et al, 2004; Njoku, O. U. et al, 2005.

Mr. Vice-Chancellor, many people in this audience will ask; what new thing did this person do to warrant his promotion. A lot of factors affect oil yield especially the environment. This definitely will affect the physicochemical properties of the oil and fat (Njoku et al, 1997). In my studies, I devoted a lot of time to the lexicological and some nutritional components of the extracted oils. Let me give credit to my older colleagues Prof. Ononogbu, Eka, Umoh, Osagie, Abelu, Odutuga, Nwanze and a host of others, who individually and collectively screened a lot of tropical plants.

In my studies for example it was evident that the vegetables contained varying amounts of oil. Okro *(Hibiscus esculentus)* for a example had an oil yield of about 15% (Njoku et al, *2002), Gongronema latifolium* (utazi), *Gnetum africanium* (ukazi), *Pterocarpus soyauxii* (oha) and *Pennisetum purpureum* (achara) all had low oil yield, {Njoku O.U. et al (2004), Obasi S.C. et al (1998), Okeke E. C. and Njoku O.U. (2004), Njoku O. U. et al (2004)}. The oil extracted from these vegetables had a lot of interesting bioactive compounds as well as antinutrients. The okro - *Hibiscus esculentus* contained a lot of p-carotene and Lecithin. These two important compounds have a lot of nutritional and industrial applications, p-carotene is a precursor of Vitamin A and so is useful in vision, lecithin on the other hand could find important uses in both the food and pharmaceutical industries as an emulsifier or releasing agent as in suppositories.

The oil from okro *{Hibiscus esculentus)* contains gossypol and some cyclopropane fatty acids, which are toxic. Gossypol has been implicated in blindness, and this explains why poorly processed cotton seed oil is very dangerous. Gossypol renders the fat nutritionally unacceptable for edible purposes, and so can only find uses in the industries. One might ask, do we have enough to eat? Yes, okro is a fast growing crop, and the seeds are as numerous as the cotton

seed used in the production of cotton seed oil. A typical example is the Sonola oil sold in the Nigerian market

The ukazi *(Gongronema latifolium),* utazi *(Gnetum af hcanum),* uha (Pterocarpus soyauxii) and achara *(Pennisetum purpureum)* all have low yield of oil. However their oil contain very rich lecithin. Since lecithin is a good emulsifying agent, t reasoned that the creamy nature of soup prepared using these vegetables could be as a result of the lecithin present in the vegetable oil. Lecithin are easily extractable from aqueous solutions. The fatty acid profile of the vegetable oil were of the mixed types - saturated and unsaturated fatty acids. These fatty acids are nutritionally very useful, as they help in a lot of biosynthetic processes taking place in the body. *Afzelia africana* (akparata) and *Deterium microcarpum* (ofo) are thickening agents commonly used in Nigeria. In my study {Njoku O. U. and Eneh F. U. (1999)} we found "that the oil from these seeds was a rich source of phospholipids. This again scientifically explains its traditional role as a thickening agent, since phospholipids are known emulsifying/thickening agents.

In my study on focal spices commonly used in Nigeria, I found that the spices are good sources of lipids. The Monodora species - *Monodora myristica* (ehuru) and *Monodora tenuifolia* (Ehuru ohia) had high lipid content when compared to the other spices - *Piper gwneense* (uziza), *Xylopia aethiopica* (uda), *Tetrapleura tetrapetra* (uhukoruho) and *Occium gatissium* (nchanwu) (Njoku O. U. et al, 1996; Njoku O. U. et al, 1997; Njoku O. U.etal 1999).

The interesting significance of these lipid studies on local spices was the ability of the oil to retain its fragrance for a long period. The fatty acid profile also shows the presence of a lot of essential fatty acids, and in addition the volatile low molecular weight fatty acids. Some of the species *Piper guimeense (uziza), Xylopia*

aethiopica (uda) and *Tetrapleura,* Tetrapetra (uhukoroho) are used in the preparation of restorative sauce after child birth or as a child birth analgesic. The present study gives some scientific basis for their therapeutic roles. The fatty acid content of the spices include arachidonic acid, the precursor of prostaglandins. This tells the entire story, as prostaglandins are important in muscle contraction and relaxation. From the industrial point of view, the oil could serve as a local cheap source of fragrance for the cosmesxs KTdustey.

The *Irvingia gabonensis* (ogbono) has been extensively studied by other workers. In my own study I found out that *Irvingia gabonensis* had high oil yield, consistent with other results. However, the nutritional studies reveal the presence of gum, and lecithin, as well as long chain saturated fatty acids (Njoku O. U. and Ugwuanyi, **J.** O. 1997). The fatty acids could be nutritionally hazardous as they could aggravate coronary heart disease. The thickening of soup prepared from *Irvingia gabonensis* (ogbono) from our studies could be attributed to the fatty acid content on the one hand, and the gum and lecithin on the other. Gums and lecithins are known emulsifying agents. Even though man must die from one condition or the other, I am afraid that he continuous and prolonged eating of ogbono soup could be nutritionally hazardous on the long run because of the nature and type of fatty acids present in ogbono. Nigeria is one of the world's largest producers of melon (egusi), and we find ourselves in the egusi rich belt. Currently (egusi) melon *{Colcynthsu cirtullus)* seed cake and oil are being exploited in the developed countries as a cheap source of protein and oil respectively. In the rural Nigerian society, especially in Igbo land, the Cake is a delicacy. Many creams have been formulated with the melon seed oil and my study reveals that the oil of melon seed has great prospects in nutrition and the pharmaceutical industries (Njoku et al, 1994).

The oil is golden yellow and contains a lot of p-carotene the precursor of vitamin A. This could explain why it is incorporated into a lot of creams and soaps. Vitamin A creams are recommended for very dry skins. I strongly suggest that melon seed oil should be a nutritional supplement like the cod liver oil especially as our lexicological studies reveal no serious toxicity.

Moringa oliefra is another plant I found very interesting working with. It is a promising local source of vegetable oil. The yield is very high (NJoku O. U. and Adikwu M. U., 1997). The fatty acid content is equally very interesting; the oil contains medium chain fatty acids. Toxicological studies carried out show that the oil is safe, and there were no adverse effects on the tissue and organs of experimental animals treated with the oil. There is abundant evidence in literature that shows the oil currently being sourced as an edible vegetable oil in Egypt.

In my study with legumes I found that legumes are not usually good sources of lipids - (fats and oils) however legumes like soyabean and groundnut are very good sources of vegetable oil and remains about the most priced vegetable oil in the world market.

My study on some locally available legumes show that the common legumes mucuna bean (Agbara), Black eyed bean (Akidi-ani), pigeon pea (Feofeo) and Bambara nut (Okpa) have poor oil yield (Njoku et al 1997) but the seed of *Ptrerocarpus santoalinoides* (nturukpa) has high oil yield (Njoku et al, 1998). The oil extractable from the beans contained a lot of antinutrients, as well as very toxic fatty acids - the epoxy, and cyclopropane fatty acids. They render the oil from the legumes unfit for nutritional purposes. The oils could find important uses in the industries especially for soap making and cosmetics.

Shea butter (okwuma) is extensively used in the treatment of inflammation in a local Nigeria setting. In my study on the biochemical constituents of shea

butter fat (okwuma), to see how it helps in the treatment of inflammation, I found that shea butter fat contained a lot of vitamin A and E (Njoku O. U. et al, 2000). These vitamins have been found to aid fat absorption and deposition on the skin. This explains its role in the treatment of inflammations as the fats are easily absorbed into the affected area to release bioactive compounds.

This fat has generally low acceptability as an edible fat especially in the Northern parts of Nigeria where it is used as cooking oil. The reason for its low acceptability is usually the Diack colour. We found out that shea butter contains a lot of unsaponifiable matter. These unsaponifiable matters during cooking forms complexes with other macromolecules such as proteins and carbohydrates. By using both physical and chemical refining processes rendered the oil was nutritionally desirable as most unsaponifiable mater was lost during the process.

Ladies and Gentlemen, for my Ph.D thesis I did a work on 'The cell wall structure and industrial utilization of the oil of para rubber seed in paint manufacture. This study produced a lot of results that have a lot of industrial applications. This topic exposed me to plant anatomy, enzymology and process Biochemistry. Let me digress a little on this topic, when I presented my Ph.D proposal/progress seminar, a lot of my senior colleagues who attended the seminar did not see any serious biochemistry in the topic. At the end of the seminar, it took more than 1 hour for the Departmental Board to accept the proposal as suitable for a Ph.D in Biochemistry. I remember that Professor I. C. Ononogbu spent so much time explaining that the cell wall studies as well as the toxicological aspects of the topic were sufficient Biochemistry. It might interest this audience to know that the stone the builders rejected turned to be the chief corner stone of the house.

Plate I - Rubber pod containing rubber seeds.

Mr. Vice-Chancellor, the studies on rubber seed produced over 30 publications in both local and international Journals on diverse areas of Biochemistry, Enzymology, Nutrition and Toxicology, Lipid Chemistry, Industrial Biochemistry and Synthetic Chemistry.

Table 2: Some rubber tree plantations and their sizes Rubber Estates and Plantations

S/N	Name	Locations	State	Size [hectars]
1.	Erei Rubber Estate	Afikpo	Abia	22
2.	Rubber Research Institute of Nigeria Rubber Estate	Akwete	Abia	2500
3.	Bende Rubber Plantation	Bende	Abia	2
4.	Item Rubber Plantation	Item	Abia	2
5.	Nkpa Rubber Plantation	Nkpa	Abia	1
6.	Asaga-Biakpan Rubber Plantation	Asaga-Biakpan	Abia/akwa Ibom	3
7.	Abam Rubber Plantations	Ndioji & Amaeke Abam	Abia	2822

8.	Umudike Rubber Estate	Umudike-Umuahia	Abia	2
9.	Itu Rubber Plantations	Itu	Akwa Ibom	2
10.	Uga Rubber Plantations	Uga	Anambra	10
11.	Pamol Rubber Estate Oban	Odukpani (Calabar)	Cross River	4500
12.	Oban Rubber Estate	Oban (Calabar)	Cross River	2000
13.	Aaba Rubber Plantations	Asaba	Delta	2000
14.	Ugheli Rubber Plantations	Ugheli	Delta	8000
15.	Uromi Rubber Plantations	Uromi	Delta	2000
16.	Utagbauno Rubber Plantations	Utagbauno (Agbor)	Delta	1700
17.	Warri/Sapele Area Rubber Plantations	Sapele/Warri	Delta	4000
18.	Pamol Rubber Est.	Sapele	Delta	2000
19.	Osse River Rubber Estate	Osse (near Benin City)	Edo	1500
20.	Rubber Research Institute of Nigeria Rubber Estate	lyanomo (Benin City)	Edo	1500
21.	Ukehe Rubber Plantations	Ukehe	Enugu	5
22.	University of Nigeria, Nsukka	Nsukka	Enugu	1
23.	Imo Rubber Estate	Ohaji (Obiti)	Imo	4120
24.	Imo Rubber Estate	Emeabiam	Imo	3100
25.	ADC-Owerri Rubber Estate	Nekede	Imo	1200
26.	Agbala Rubber Estate	Agbala	Imo	100
27.	Obizi Rubber Plantations	Obizi-Mbaise	Imo	50
28.	Nkwere Rubber Plantation	Nkwere	Imo	50
29.	Obowo Rubber Estate	Obowo	Imo	2

30.	llushin Rubber Estate	llushin	Ogun	4400
31.	Araromi Rubber Estate	Araromi-Obu	Ondo	2300
32.	llado Rubber Est.	llado	Ondo	2000
33.	Okitipupap Rubber Plantation	Okitipupa	Ondo	2000
34.	Elele Rubber Plantation	Elele	Rivers	500
				60493

Source: Ononogbu I. C. 1998)

In industrial Biochemistry, I used the oil of Rubber seed to produce Biodiesel. The physicochemical properties of biodiesel produced compared favourably with disel (Ikwuagwu et al., 2000). I equally used the Rubber seed oil to formulate alkyd resin a vehicle for the production of a lot of industrial chemicals - varnish, paints etc.

Table 3: Formulation of Modified Alkyd Resin from Rubber Seed Oil

Ingredient	**Sample 1**	**Sample III**
	Medium chain alkyd resin	Long chain alkyd resin
Rubber seed oil	50	66.7
Phthalic anhydride	30	22.2
Polyol	19.6	12.7
Sodium thiosulphate (modifier)	0.2	0.2
Reaction condition		
Time of cooking	120 minutes	120 minutes
Temperature	240-2600-0	240-260°C
Acid value of alkyd resin	8.0	8.0

Source: Njoku O.U. and Ononugbu, I.C. 1995

I formulated wood finish using the modified rubber seed oil alkyd resin. The next Table shows the formulation of Wood Finish using the modified alkyd resin.

Table 4: Formulation of Wood Finish using Modified rubber seed oil alkyd resin

Recipe	Quantity
Alkyd resin	17.8
Solvent (white spirit)	7.0
Lead napthenate	0.1
Colbalt napthenate	0.1

Source: Njoku 0. U. et al 1996

Mr. Vice-Chancellor, the technology has long been transferred to local industries in Nigeria.

In another study to optimize the rubber seed for oil extraction, a process technology for the optimization of the seed to obtain good oil for industrial purposes was designed (Njoku O. U. et al, 1996). This process involves inactivation of the lipase enzyme as well as removal of cyanide from the Rubber seed. Table V shows CN removal from rubber seed.

Table 5: CN removal (%) from Rubber seed during oven drying

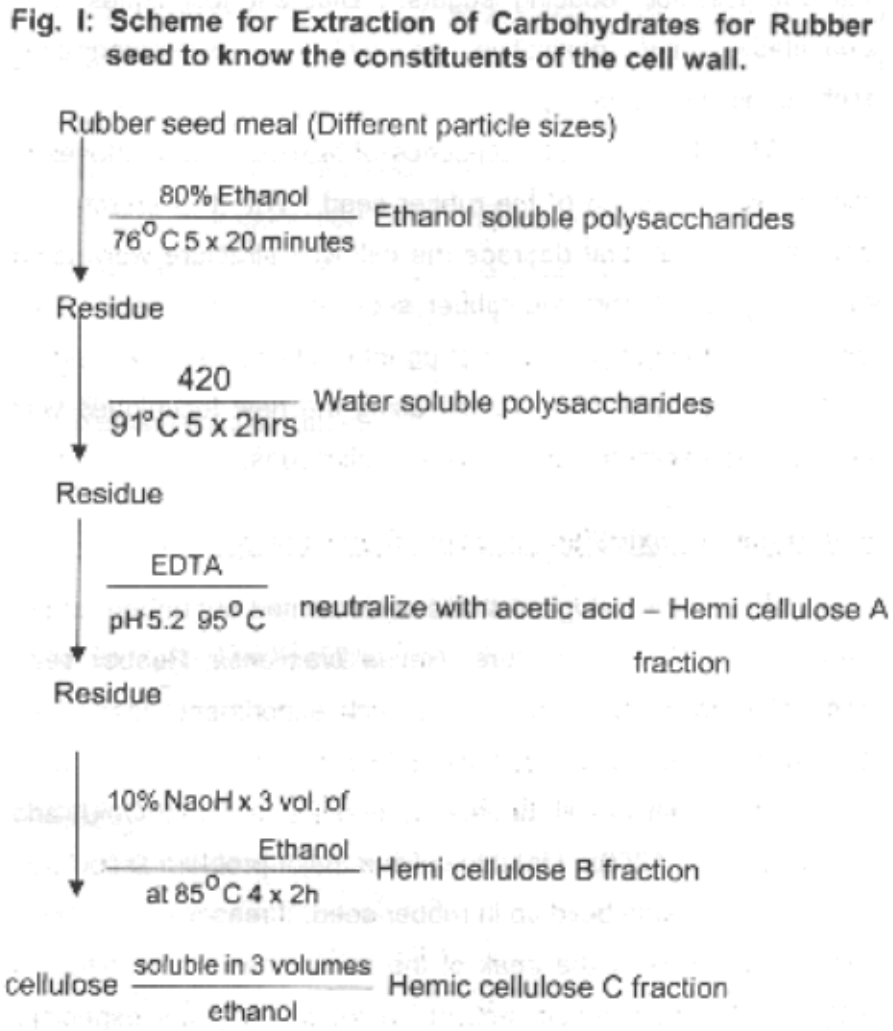
Time Min	60 °C	90 °C	123°C	150°C	180°C	Mean ± S.D
30	8.50	21.78	23.71	31.98	28.12	22.82 ± 8.93
60	15.90	24.63	30.69	35.63	33.63	28.03 ± 7.90
90	21.77	25.73	33.81	35.73	34.73	30.36 ± 6.23
120	24.82	28.03	34.91	36.65	37.94	32.47 ± 5.74
150	25.18	35.37	35.01	38.12	42.00	35.14±6.23
180	28.13	40.04	38.57	38.68	43.63	37.81 ± 5.79

Source: Okafor et al, 2005

In the optimization study to extract oil from rubber seed in-depth knowledge of the cell wall structure of the Rubber seed was. used in the process technology for the extraction of oil.

First the knowledge of the cell wall constituents was studied. Fig. I shows the scheme.

Fig. I: Scheme for Extraction of Carbohydrates for Rubber seed to know the constituents of the cell wall.



The fractions were hydrolyzed with 1 N N2304 and boiled at 100°C for 16 hours. This was followed by neutralization with Barium carbonate. The neutralized solution was treated with ion-exchanger resin. The hydroxylate obtained was concentrated and used to test for reducing sugars. Different techniques both quantitative, and qualitative as well as chromatographic techniques were employed.

The study revealed presence of hexoses and pentoses in the cell wall structure of the rubber seed. With this knowledge, specific enzymes that degrade the cell wall structure were used for extracting oil from the rubber seed, by enzyme assisted oil extraction techniques. I will not go into details. However the oil yield and quality of oil extracted using the new techniques was high and had tremendous industrial applications.

Nutritional & Toxicological Studies on Rubber Seed & Oil

A lot of toxicological studies was carried out on the rubber seed and oil. From literature, *Hevea brasilensis* Rubber seed contains a lot of cyanide. In one such experiment, linamarase extracted from cassava was used to treat the seed and oil, I found out that the level of CM' decreased drastically (Njoku 0. U. and Ononogbu 1. C. 1996). I tried to solve a major problem associated with CM' and lipase build up in rubber seed. I reasoned that since rubber seed falls at the peak of the rainy season, imbibition of water by the seed could activate a lot of enzymes especially lipase and linamarase. During the August break, we plucked Rubber seeds from the trees and dried them at 60°C for 48 hrs. This process inactivated the enzymes and rendered the seed industrially viable (Njoku O. U. et al, 1997). We suggested that harvesting the seeds during the August break and drying could be useful if the seeds will be used for oil extraction. The cake that comes from the oil mills could have some industrial uses. The seed cake after extraction is rich in fibre, protein and calcium and very low levels of phytate. Our collaborative studies with a mill meal yielded good results. There was increase in egg yield and the eggs had very hard shells from feed formulated with 10% supplementation of rubber seed defatted cake.

Similarly in the food industry, we tried solving some problems especially

yam processing Rubber seed was used to isolate lipoxygenase employed in the processing of yam cubes. The lipoxygenase isolated from the rubber seed meaningfully reduced browning in yam cubes (Anokwolu et at 2005). This could solve the major problem associated with packaging of yam flour. In another study, the lipase extracted from rubber seed was used to produce stable emulsions, which could be of value in the confectionary industry.

Mr. Vice-Chancellor, the study on rubber seed has been rewarding both academically and financially. In 1997, the Third World Academy of Sciences/Nigerian Academy of Sciences awarded to me a special prize - The 1st best young scientist in Nigeria. The occasion was well celebrated and was given international publicity.

In the citation read during the award, the Honorary Secretary of the Nigerian Academy of Sciences said and I quote "Dr Njoku's Ph.D Thesis titled the cell wall structure and the industrial utilization of the oil of para rubber in paint manufacture was so rich and of strategic importance that it attracted a grant from the IDRC Canada. The research was adjudged to be the best postgraduate work conducted in the Faculty of Biological Sciences, University of Nigeria, Nsukka in 1994 and consequently earned Dr Njoku the Faculty Postgraduate prize for the year. The

research has not only yielded a rich harvest of scholarly publications, but made a scientific breakthrough in its production of oil from rubber seed, which has been found suitable for the alkyd resin industry in Nigeria. Dr Njoku has as much academic as well as industrial experience, an asset, which is of vital importance in enhancing the marketability of his useful research results. He has had training stints locally and abroad particularly at the Pos Pilot Plant University of Saskatchewan Saskatoon, Canada. Dr Njoku represents the new breed of young Nigerian scholars who have refused to be intimidated and daunted by the problems besetting the Nigerian academic system. For this we salute his courage, ingenuity, foresight, perseverance and his determination to explore an uncharted territory".

Mr. Vice-Chancellor, I have remained focused, and have refused to be intimidated and daunted by the problems besetting the Nigerian academic system. I came back from that trip and decided to explore another uncharted territory - Biopharmacology, using my lipid experience. In collaboration with my colleagues in Microbiology, Pharmacology, Pharmaceutical Microbiology and Pharmacognosy, I tried to study the possible antimicrobial activities of most of my lipid extracts. Table 6 shows the result of my lipid antimicrobial study.

Table 6: The results of my Antimicrobial Studies

Extract	Bacillus subtilis	E. coli	P. mirabilis	S. aureau	S. foaccalis	P. aeruginoosa	T. rubrum	T. mentagrophytes	E. floccolum	C. albicans	A. niger	B. baptoporus	T. torosuran	S. typhi
Local Nigerian soap (Black soap				+			+	+	+	+				
Hura crepitan	+	+		+		+					+			
Baphia nitida		+		+	+	+	+		+	+		+		
Cassia alata		+		+	+	+	+		+	-		+		
Fibus exasperate		+		+	-	+	-		+	-		+		
Gosypium aboreum		+		+	+	+	+		+			+		
Trema guineensis		+		+						+			+	+
Morinda lucida		-		-			+			+			+	-
Tetrapleura tetraptera	+	+		+		+					+			
Monodora tenuifolia	+	+		+		+					+			

Interestingly, many of the lipid extracts had antimicrobial activities (Njoku O. U. et al, 1998; Njoku O. U. et *al,,* 1999). A work I cherish and find most useful is the study we carried out using black soap. Black soap is a local soap prepared from ash and palm oil. We found from our studies that the black soap had tremendous antimicrobial activities against most pathogenic fungi (Iroegbu C. U. and Njoku O. U., 1998). We recommend the use of trie black soap in the treatment of fungal infections in the rural areas of Nigeria.

Mr. Vice-ChanceHor, I did not completely leave my training in Medical Biochemistry, I equally did some studies on lipids in malaria and sickle cell anaemia. Most disease conditions lead to alteration in the lipid composition of the membrane. Professor E.A.C. Nwanze, Professor of Biochemistry at the University of Benin, Benin City, in his inaugural lecture titled 'Lipid Biochemistry providing new insights into disease' had this to say, one of the problems one encounters in research in medical biochemistry, especially when dealing with living human beings, is the guaranteed availability of samples. Consent may not be forthcoming and even when it is, there is the ethics committee to satisfy. This had remained a problem in clinical studies. The sickle cetl patients worked with showed a lot of interesting results that could clinically explain many deformities noticed in sickle cell patients.

The lipid profile showed very low levels of cholesterol. This could explain the hormonal complications associated with sickle cell anaemia, as well as fragility of the red blood cells (Njoku O. U. et al, 1995; Njoku O. U. et at, 1999). I had earlier recommended for a dose graded cholesterol therapy in sickle cell diseases at the early stage of life to improve hormonal balance and possibly help maintain the integrity of the red blood cells. In another study on human malaria, I found out that vitamin A plays important roles in malaria, Vitamin A has been found to aggravate the effects of malaria. I recommended ia that study, that vitamin A status be included as part of the assay in malaria therapy (Njoku 0. U. et al, 1995).

I equally studied the lipid lowering effects of some plants, The aqueous extracts of many common edible plants - especially utazi and uvara chamae had lipid lowering activities, especially cholesterol (Obasi et al, 1997; Obasi et al, 1998). In my study on the effect of neem extract commonly called Dogonyaro, a common plant used in the treatment of malaria. I found that neem plant lowers

lipid levels, and also provided a lot of antioxidants to patients who take the decotition (Njoku 0. U. et al, 2001). The continued use of these plants in ethnomedicine is encouraged, however toxicity studies must ascertain the side effects. There is a lot of controversy on fish diet as a good therapy in the management of lipid disorders.

In my study to ascertain the real lipid content of fresh ice fish sold in Nigerian markets, I found out that the ice fish had high levels of Triacylglycerol, cholesterol and phospholipids. This suggests that the common saying that fish is better than meat could be specie dependent. However, the possible build up of lipids in the ice fish studied could be as a result of storage and other environmental factors. In general the preferred fish is the fresh fish, which is a good source of both omega 3 and 6 fatty acids (Njoku O. U. et al, 2005). Omega 3 and 6 fatty acids have been found to reduce platelet and leucocyte reactivity and may reduce blood pressure.

Research in Nigeria Universities

Mr. Vice-Chancellor, there are many Departments of Biochemistry in Nigeria, our Department here has been a feeder Department to these Universities and our Department of Biochemisty has continued to be a leading Biochemistry Department in Nigeria, but like many Inaugural lectures in Biochemistry had said, lack of chemicals, equipment and books, together with breakdown in electricity and depletion of already existing equipment has adversely affected the level of research input and quality of research in our Biochemistry Departments. Thankfully, the current intervention by the Federal Government is beginning to redress this situation, provided our Heads of Biochemistry and other science based Departments in Nigeria will judiciously use the funds for the purpose for which they have been appropriated.

In conclusion, Mr. Vice-Chancellor in one of the congratulatory cards I received shortly after my promotion, it reads, "I sincerely thank God for his continuous blessings and mercies on you. I therefore join you, your family and admirers to count your blessings. The conferment of the professorship you recently got is only one of such blessings. More are still to come. Remain a great achiever; I greatly admire your numerous God-given qualities including your transparent honesty, hard work, gentleness, humility and God fearingness. It is never difficult to approach Prof. Njoku, because he is always there to help, to listen and to advise. Bravo a million times, a man of good moral.

Mr. Vice-chancellor, this aspect covers all I intend to do in a Department, I am meant to lead and I leave this charge to my fellow professors and future professors.

Mr. Vice-chancellor, distinguished ladies & gentlemen, permit me now to show appreciation to a lot of people who I met on their way up - First, I want to thank my first teachers, my parents, Rufus and Virgy Njoku, parents per excellence, they taught me those things Abraham Lincoln told his son's teacher.

I thank my siblings, Ogugua, Adaugo and Amanze, I remember with thanksgiving to God the gift of Chukwuemeka to the Njoku's family, we know that he is sleeping and some day we shall meet again to part no more.

I thank my beloved wife Ugochi, I have come to accept that no man should count his blessings till he is married. Ugochi has been a special gift from God to me. I thank my lovely children Adanze, Obioma Jr. and Chioma.

I cannot continue this thank you, without remembering my teachers, past and present. I thank them very sincerely, but I must thank in a special way, Dr. E. O. Alumanah and Prof. I. C. Ononogbu who collectively helped me to rediscover my

talent.

I thank my numerous collaborators, especially those here today with me. I remember also with thanksgiving to God, late Dr. Bosah Okide, who did my ever first serious research with on melon seed.

Finally, to my numerous students and colleagues, I say thank you; you have been a wonderful group to work with. And my friends in the Senate Ceremonials Committee, I lack words to thank you for your support and encouragement these many years, I have worked for and with you.

Let me end by saying a big thank you to Sir Prof & Lady O. C. Nwankiti. They showed a lot of kindness to me all through my days as a student.

Mr. Vice-Chancellor, distinguished Professors and members of Senate, my colleagues, friends and well wishers, ladies and gentlemen.

Thank you for listening.

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INAUGURAL LECTURES

IN UNIVERSITY OF NIGERIA, NSUKKA

1. ***Prof. K.Nzimiro-1976***
   Title: *The Crisis in the Social Sciences The Nigerian Situation*

2. ***Prof. Chika Okonjo -1976***
   Title: *Economic Science, Imperialism and Nigerian Development*

3. ***Prof. K.S. Hegde, Vet. Medicine -1977 Title:***

4. ***Prof. D.I. Nwoga -1977***
   Title: *Visions Alternatives: Literary Studies in a Transitional Culture*

5. ***Prof. J.A. Umeh -1977***
   Title: *Land Policies and Compulsory Acquisition of Private land for Public Purposes in Nigeria.*

6. ***Prof. D.C. Nwafo -1984***
Title: *The Surgeon as an academic*

7. ***Prof. G.E.K. Ofomata -1985***
Title: *Soil Erosion in Nigeria: The views of a Geomorphologist.*

8. ***Prof. E.U. Odigboh -1985***
Title: *Mechanization of cassava production andprocessing: A Decade of Design and Development*

9. ***Prof. R.O. Ohuche 1986***
Title: *Discovering what Learners have attained in Mathematics*

10. ***Prof. S.C. Ohaegbulam-1986***
Title: *Brain surgery: A luxury in a Developing Country like Nigeria*

11. **Prof. I.C., Ononogbu**
Title: Lipids: Your Friend and Foe

12. **Prof. V.F. Harbor-Peters - 2001**
Title: Unmasking some Aversive Aspects of Schools Mathematics and Strategies for averting them.

13. **Prof. P.O. Esedebe - 2003**
Title: Reflections on History, Nation Building and the University of Nigeria.

14. **Prof. E.P. Nwabueze - 2005**
Title: In the Spirit ofThespis: The Theatre Arts and National Integration.

15. **Prof. I.U. Obi - 2006**
Title: What have I done as an Agricultural Scientist?
(Achievement, Problems and Solution Proposals)

16. **Prof. P.A. Nwathukwu - 2006**
Title: A Journey through the Uncharted Terrain of Igbo Linguistics

17. **Rev. Fr. Prof.** A.N. **Akwanya -** 2007
Title: English Language learning in Nigeria: In search of an enabling principle.

18. Prof. T. Uzodinma Nwala - 2007

Title: The Otonti Nduka Mandate: From Tradition to Modernity

19. Prof. J.A. Ibemesi - June 2007

Title: From studies in Polymers and Vegetable oils to Sanitization of the Academic System

20. Prof. Obi U. Njoku - June 2007

Title: Lipid Biochemistry: Providing New Insights in our Environment.