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QUALITY NUTRIENTS: THE EMBEDDED GLORY, VITALITY AND GOLD IN FOOD CROPS

By

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Professor of Nutritional Biochemistry

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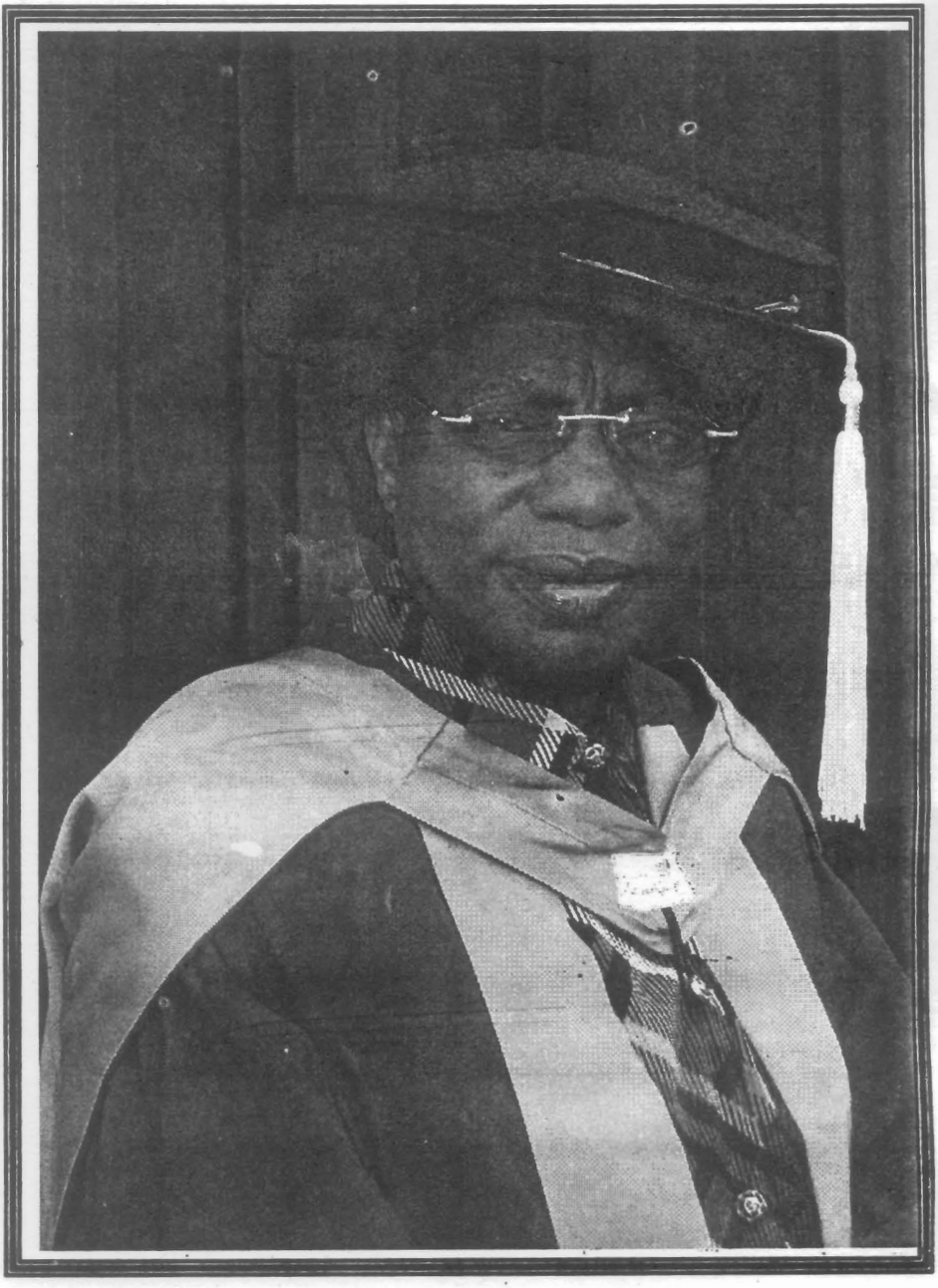

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Mr. Vice Chancellor, Sir
the Principal Officers of the University and
my esteemed guests and audience.

I. Introduction

I stand before this august gathering in total humility and in awe of the Almighty God for making this day a memorable one in my life, when a cherished opportunity has been accorded me by the Senate to deliver the 219th. Inaugural Lecture of the University and the second of its kind from the Institute of Agricultural Research and Training, Moor Plantation, Ibadan. The first was delivered by Professor R.A. Sobulo, a former director of the Institute and of blessed memory.

Mr. Vice-Chancellor Sir, the title of my lecture, **Quality Nutrients: The Embedded Glory, Vitality and Gold in Food Crops**" was borne out of my passion for wellness of the people and, I therefore, use this lecture as a channel to sensitize all and sundry on the need to know your food crops in terms of quality and not only of quantity. The lecture will highlight those entities in some food crops that make them stand out for honour (glory) more than others in terms of their role in human vitality and wealth (gold). The global concern about food shortage leading to hunger and malnutrition is well publicized. It is fairly clear that in order to fight hunger and malnutrition and the consequences that follow, we must now, begin to consider initiatives which do not only place premium on high yielding potentials of crops but directional actions, should now address the dwindling quality of food crops with the attendant negative effects on health.

Recently, it was shown that the nutritional qualities of crops are declining based on the investigation carried out by some researchers in Washington State University (Hero, 2007). The report revealed a decline of 11, 16, 25, 50 percent in iron, copper, zinc and sodium respectively in 63 varieties of wheat harvested between 1842 and 2003. This report sharply registers that the

chemical composition of food crops varieties, is dynamic. In this same report, it was further stated that more slices of bread are now being required to meet the recommended daily amount of nutrients compared with the past, that is, the nutritional quality of food prepared from the wheat had also dwindled with time.

In terms of our knowledge of the "good" and "bad"; "sight" and "taste" decision for choice of food, may not conform to the ethics of healthy eating anymore. Therefore, the food crops must be turned around, subjected to "agricultural surgery" to expose its content, that is, the entities embedded in such crops that need to be identified for their nomination in terms of health and wealth.

II. Nutrients: Types and Functions

(i) Definition

Nutrients are pure chemical compounds or mixture of chemical compounds which exist as dietary constituents and form the building blocks of human body (Lehninger, 1975; Gaman and Sherington, 1977). These chemical compounds are carbohydrates, proteins, fats, minerals, vitamins, and water. They supply energy to drive all the metabolic processes of the body and are required for growth, maintenance, body tissue synthesis and repair, regulation of the body metabolic and detoxification processes. "On a lighter mood now" Tracy Proulx of the Daily Times in Kent County reported in 2007 that Tobe was giving a lecture on nutrition to kids. Tobe was trying to explain that human body is made up of what is consumed. In this attempt, he told the kids "I am made up of food". Then a kid yelled out "you are a chicken". The parents and audience erupted in laughter. Yes, there could have been laughter, but that kid got it right as I will now explain. The chemical compounds, that is, nutrients, are found in the food we eat and the various types of food come from the agricultural system (food crops). The chicken consumes feed that contains carbohydrates, protein, fats, minerals and

vitamins from plants. The chicken is made up of these nutrients. Human beings also consume these same types of nutrients in their daily food system. The nutrients which are required in large amounts (macronutrients) are carbohydrates, proteins, fats, some minerals and water. Others are required in minute quantity (micronutrients) e.g. some minerals e.g. iron (Fe), zinc (Zn), copper (Cu), manganese (Mn),selenium (Se),boron (B) etc and vitamins. A typical composition of the human body weighing 65kg is shown in Table 1

Table 1: Chemical composition of a human body weighing 65kg

Component	Percentage of body weight
Water	61.6
Protein	17.0
Fats	13.8
Minerals	6.1
Carbohydrate	1.5

Source: FAOhttp: #www.fao.doc rep/100o73 E/W 0073 = 04.htm.s

Thus, since chicken is made up of these same compounds (Table 1). Mr. Teacher is a "chicken" in a form while chicken is "Mr. Teacher in another form. The nutrients shown in Table 1 must be supplied daily in the diet for efficient performance of its various functions, such as the ability to learn and work to earn "gold" (wealth).

ii. **Quality Nutrients**: These are nutrients that must be supplied in the daily diet, in the appropriate quantities to sustain the metabolic functions of the body. Their absence or inadequacy in the daily food requirement results into imbalanced nutrition.

Welch and Graham (2004) gave the number of such nutrients as 49. These 49 essential nutrients are shown in Table 2.

Table 2: The 49 essential nutrients for sustaining human

Water and energy	Water and Carbohydrates
Protein and amino acids	Histidine, Isoleucine, Leucine, Methionine, Phenylalanine, Threonine, Tryptophan, Valine
Lipids-fat (fatty acids)	Linoleic acid and Linolenic acid
Macro-elements	Na, K, Ca, Mg, S, P, CI
Micro-elements	Fe, Zn, Cu, Mn, I, F, B, Se, mo, Ni
Vitamins	A, D, E, K, C (ascorbic acid), B_1 (thiamin), B_2 (riboflavin), B_3 (pantothenic acid), niacin, B_6 (pyridoxal)

Many metabolic disorders manifesting in sickness, malnutrition, chronic diseases, impaired development in children and reduced productivity in adults have been linked with inadequate consumption of even one of these quality nutrients (Branca and Ferrai, 2002; Golden, 1991; Grantham-Mc Gregor and Ani 1999; Ramakrishman *et. al.* 1991). The Recommended nutrients intakes for males, females and children have been reported in literature (FAO/WHO, 2000).

The major nutrients shown in Table 2 can each be broken into their various subunits. For example, protein molecule is built from their components of amino acids (a.as). There are 20 a.as and 9 of them are termed essential because they cannot be synthesized by the body tissue and must be supplied by food protein, in adequate amounts and proportions. The non-essential a.as can be synthesized in the tissues and need not be supplied. Thus a quality protein must be able to supply the essential a.as. Tissue protein synthesis requires that all the amino acids must be in their various specific locations and in the appropriate quantity. If an a.a. is missing, misplaced, under supplied, proper protein synthesis will

not occur. With this, the basis for linking inadequate consumption of quality protein to the spread of diseases and various metabolic disorders is understood. Hormones, enzymes, antibodies and components for tissue growth, maintenance and repair are all protein based. The need for quality nutrients for the sustenance of human health can be visualized in the context of the composition of the human body as was shown in Table 1. For example, the body is made up of 1.5% carbohydrate and you now supply this nutrient in an amount below the required level, it will not function accurately and may breakdown completely. Similarly if you try to overload it with this nutrient by consuming too much of starchy staples as it is in the developing countries, the outcome is the disruption in carbohydrate metabolism and catastrophic imbalanced nutrition. The effects of dietary inadequacy or excess of quality nutrients in terms of human diseases and incapacitation in the normal living processes, have been reported in literature (Champe and Harvey, 1994).

Water is required in all the metabolic system of the body.

III. Origin and sources of nutrients

(i) Divine existence of nutrients

At creation, before man was made, God had also created man's source of food **(Gen.1:11 KJV)** "And God said, let the earth bring forth grass, the herb yielding seed, the fruit seed is in itself, upon the earth and it was so". Later, after the man had been created, God now declared to the man that the plants created were for his food. "And God said, Behold I have given you every herb bearing seed which is upon the surface of all the earth, every tree yielding seed, to you it shall be for meat (food) **(Gen 1:29 KJV)**. These sources of food sustained man for his various activities (vitality), meaning that man's requirement of the daily allowance of nutrients would have been met, even as of that

time. So the divine source of quality nutrients from food crops for man is ensured as manifested by his survival.

(ii) **Historical Existence of Nutrients**

As far back as 475 BC (New World Encyclopedia) – Anaxagoras found out that the food taken by human goes into the human body by a process of absorption. This idea led him to state that the human body contained "homeomerics" i.e. generative components. He then deduced the existence of nutrients in the human body, the nutrients he takes, the nutrients he is made of, and the nutrients found from the break down components of the body. Remember our "Mr. Teacher, you are chicken"

(iii). **Biochemical origin and source**

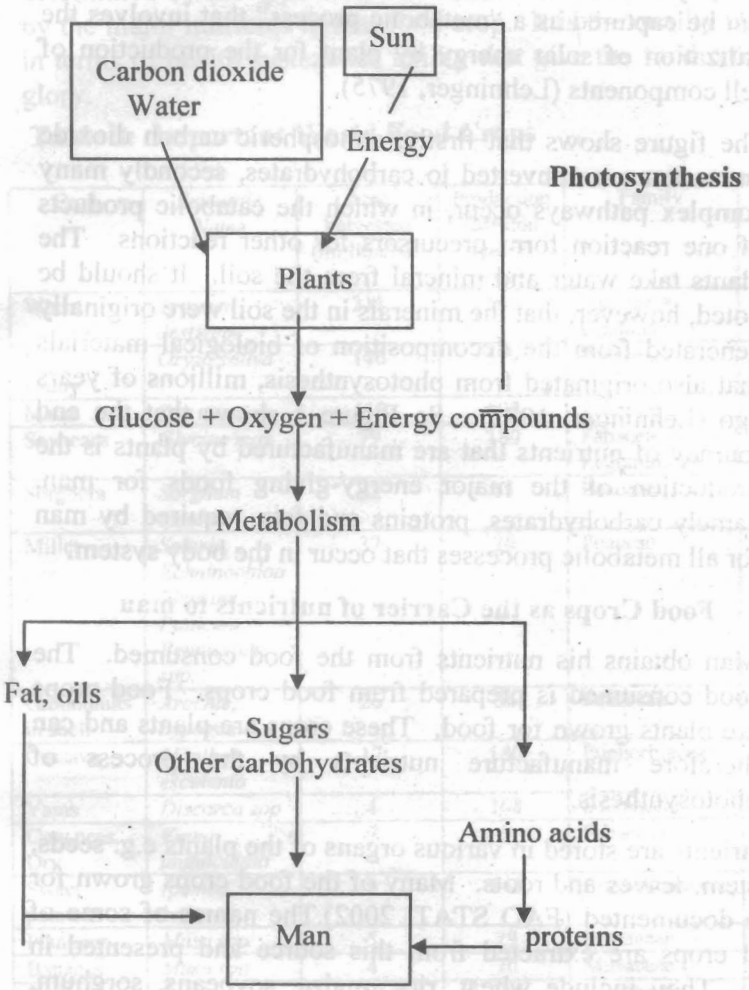


Figure 1: Diagrammatic representation of the source and passage of nutrients from plants to man. (From Ensminger, *et. al.* 1994)

The above diagram shows a pathway named photosynthesis. The simplest definition of photosynthesis can be captured as a "metabolic process" that involves the utilization of solar energy by plant for the production of cell components (Lehninger, 1975).

The figure shows that firstly, atmospheric carbon dioxide and water are converted to carbohydrates, secondly many complex pathways occur, in which the catabolic products of one reaction form precursors for other reactions. The plants take water and mineral from the soil. It should be noted, however, that the minerals in the soil were originally generated from the decomposition of biological materials that also originated from photosynthesis, millions of years ago (Lehninger, 1975). So Figure 1 shows that the end journey of nutrients that are manufactured by plants is the production of the major energy-giving foods for man, namely carbohydrates, proteins and fats, required by man for all metabolic processes that occur in the body system.

(iv) **Food Crops as the Carrier of nutrients to man**

Man obtains his nutrients from the food consumed. The food consumed is prepared from food crops. Food crops are plants grown for food. These crops are plants and can therefore manufacture nutrients by the process of photosynthesis.

The nutrients are stored in various organs of the plants e.g. seeds, tubers, stem, leaves and roots. Many of the food crops grown for food are documented (FAO STAT, 2002).The names of some of the food crops are extracted from this source and presented in Table 3. They include wheat, rice, maize, soybeans, sorghum, groundnuts, cassava, yam etc.

From these food crops, man and animals are able to meet their nutrients requirement directly or indirectly. The major type of nutrients obtained from a particular crop depicts its emblem of

glory (whether they are essential or non- essential nutrients). Whether a food crop is more glorious than another crop can be determined by the type of metabolic functions that are performed by the major nutrients in that food crop. It is the quality nutrients, in terms of health sustenance ability that give the food crops their glory.

Table 3: Important World Food Crops

Crop	*Scientific Name*	Area harvested (million/ha.)	Production (Million metric tons)	Family	Annual or Perennial
Wheat	*Triticum aestivum*	211	568	Poaceae = Graminae	Annual
Rice, Paddy	*Oryza sativa*	146	579	Poaeceae	Annual
Maize	*Zea mays*	139	602	Poaeceae	Annual
Soybeans	*Glycine max*	79	180	Fabaceae = Leguminosae	Annual
Sorghum	*Sorghum bicolox*	42	55	Poaceae	Annual
Millet	*Setaria, Echninochloa Eleusine, Panicum Pennisetum spp.*	37	26	Poaceae	Annual
Groundnuts in shell	*Arachic, hypogea*	26	34	Fabaceae	Annual
Cassava	*Manihot esculenta*	17	180	Euphorbiaceae	Perennial
Yams	*Discorca spp*	4	108	Solanaceae	Annual
Cow peas, Dry	*Vigna unguiculata*	9	3	Fabaceae	Annual
Sweet potatoes	*Ipomea batatas*	9	141	Convolvulaceae	Annual
Plantains	*Musa spp.*	5	29	Musaceae	Perennial
Bananas	*Musa spp*	4	70	Musaceae	Perennias
Potatoes	*Solunum tuberosum*	19	308	Solanaceae	Annual

The glory of each food crop is shown in Table 4 with most notable quality nutrients in such food crop topping the list in the column of emblem of glory. The entities of glories in the legumes are protein and heart-friendly oil, in cereals they are proteins, heart-friendly oil and good starch, in tubers they are starch and carbohydrates and in vegetables and fruits they are vitamins, minerals, phytonutrients and fibers.

Table 4: Food crops and their emblem of Glory

Classes of food crops	**Examples**	**Emblem of Glory**
Legumes especially	Soybean and cowpea	**Proteins and Oil** of high nutritional value. **High level of Lysine**
Cereals	Maize, sorghum, wheat, rice and millet	**Protein and oil** of High nutritional value, **Methionine, Starch.**
Root and Stem tubers	Cassava, yam, potatoes	**Starch, Carbohydrates** minerals,vitaminC(from potatoes).
Vegetables	*Celosia, Amaranthus spp Telfaria spp,Celosia spp etc*	**Vitamins,Phytonutrients Fibers.**
Fruits	Pawpaw, pineapple, guava. Mangoes,oranges etc.	**Vitamins, Phytonutrients,fibers.**

Maize and Soybean as crops of glory

In this lecture, I chose to illustrate the ability of quality nutrients to bestow glories on certain food crops using soybean and maize because of their nutritional significance and their usage in my research work.

(a) Soybean

Soybean (*Glycine max*) is a crop of glory based on the quantity and nutritional qualities of its proteins (40%) and oil (21%), its role in the sustenance of good health, restoration from malnutrition state and popularity in human nutrition (Kawamura and Tada,1967). It is not surprising then when soybean is given the following accolades as:-

A golden bean , miracle bean, crop of the planet (Singh, 1987).

The "Cow of China", the "preserver of Chinese race" (Shurtleft and Aoyagi, 2004). Soybean is also called the peacock of the protein bean of the field, the golden egg, the Cinderella crop of the nation and the meat that grows on the field (Ogunseitan, 1989). It stands out for quality nutrients both by its ability to sustain vitality and attract gold via its contents of all the essential a.as, especially, a high level of lysine, high quality protein (Weingartner,1987) and its diversified utilization potentials as it will be shown in this lecture.

(b) Maize

Maize *(Zea mays L.)* also referred to as corn ranked third amongst the World largest grain crops (FAO, 1990). In Nigeria, the estimated harvested land areas had increased from 1.5 to 5.0 million hectares (1961-2006) while production for the same period increased from 0.9 to 6.0 million tones (FAO, 2008). The nutritional characteristics of maize oil include its content of high level of linoleic acid (essential fatty acid) which gives the oil the biochemical ability to reduce serum cholesterol (dangerous link with coronary heart disease)(Berkhout,1968). A few attributes of the glory in maize include its recognition as:-

an inexpensive and nutritious food that helps to sustain growing population, (Brader, 1993).

- an engine of economic development (Brader, 1993).
- a giant raw material in industries (Fakorede, 1993).
- a hunger-quenching crop (Ezekwe, 1993; Obi, 1991).
- a miracle seed for Nigeria agricultural development (Adenola and Akinwumi, 1993).
- a magic plant in agriculture (Obi, 1991).
- a versatile ingredient in dietary and industrial uses (Brader, 1993; Fakorede, 1993; Obi, 1991).
- a goddess (Chicomecoat) that was worshipped in the pre-Columbia Civilization because of its nutritional importance (Valiant, 1962).
- the Nigerian "mouth organ" (as a result of the way it is being eaten on the cob with two hands moving from the right to the left and vice-versa.).

(v) **Unearthing the embedded glory in food crops.**

It is very vital to know the food crops by their nutrient contents. Food crops must be subjected to analytical process that will expose the glory (quality nutrients) or dishonour (anti- nutrients) contained in each part of the crop in order to classify such nutrients into types in terms of quantity and nutritional value. The nutritional status of a people and some causes of endemic diseases can be assessed through reliable information of the chemical composition of the types of food consumed and crops used to produce such food. The results of a report by Akindahunsi *et. al.* (1993) corroborate this fact. The report showed positive relationship between the occurrence of endemic goiter and high consumption of cassava products

with a low protein intake. Therefore, the nutrients composition of food crops and their products are vital determinants of the role of such crops in human nutrition and health. Scientists must have to play a role of establishing which crops, at what stage from the farm gate and in what processed form for the palate, would these crops give maximum quality nutrients to the consumer for nutritional advantage.

IV. Maximizing quality nutrients in food crops.

(i) Chemical composition of food crops

Researchers' role in ensuring optimum nutrients availability in food crops involves the identification of various types of nutrients contained in the crops through analytical procedures. The harvested crops are separated into their component parts. For example, *Amaranthus* plants are separated into leaves, leaf stalk, stem and root for analysis. Foods prepared from crops are also subjected to similar analytical procedure to determine the nutrients contained in the food. The agricultural practices involved in planting to harvesting, have various effects on the nutrient composition of the crops. Similarly, the methods of processing of crops to food could also affect the nutrients level of the food. Using concerted efforts by scientists in various disciplines, the knowledge of the nutrients composition of food crops and products could be used to control, reduce and eradicate some diseases associated with deficiencies in the dietary intake of specific nutrients. The choice of crops and food types for optimum quality nutrients intake is very relevant for good health.

The Institute of Agricultural Research and Training gives priority to demand-driven research in line with Government's Policy on food security and improved nutritional status of her people. Part of my area of research focus on the commonly eaten vegetables, was *ab initio* suggested by late Professor A.A. Adegbola, a renowned scholar and teacher of this great University.

This research idea had been nurtured and its execution in advanced progress before the National Horticultural Research Institute Ibadan was created for vegetable research. What a great vision of the late erudite scholar. The studies covered effects of varieties, age at harvest, and season of harvest on the nutrients composition of some important vegetables. (Omueti, 1977; 1980; 1982). Four *Celosia spp.* and four *Amaranthus spp.* were used in the investigation. Similar results obtained on the two vegetables showed that for higher nutritional qualities, vegetables should be harvested between 5 and 7 weeks after sowing (WAS) at which periods, protein on dry weight basis(DWB) and vitamin C (DWB) were highest (Table 5) for *Celosia spp,* and (Table 6) for *Amaranthus spp.*

Table 5: Effects of age on nutrient contents of *Celosia* (av. of 4 cultivars)

Harvests period	Crude fiber content %	Crude protein content (%)	Total crude protein yield (g/m^2)	Vitamin C (mg/100g	Vitamin C (mg/100g M)
H_1	11.7	31.3	19.9	20.8	290
H_2	13.2	29.0	19.0	52.0	1168
H_3	13.6	26.0	46.6	54.5	495
H_4	12.7	25.7	61.5	46.2	371
H_5	12.0	25.2	80.2	43.1	367
H_6	13.3	25.9	91.3	50.8	415
SE	0.27	0.54	4.2	1.7	27.4

H_1, H_2, H_3, H4 denote 5, 7, 9, 11 weeks after sowing. SE=Standard Errors of the means.

Table 6: Effects of age, irrespective of cultivars on yield, some yield components and nutrient content of *Amaranthus spp*. Harvest means (Rainy season).

Harvests	Marketable yield t/ha.	Edible yield t/ha	Leaf/Stea m Ratio	Leaf yield Kg/ha.	Percent D.M.	Percent crude Protein	Crude Protein Yield kg.ha DM	Total Vitamin C me/ 100g F.W.	Total Vitamin C me/100g D.M.
H^1	15.96^c	6.65^b	0.91^a	639.95^b	9.76^c	29.74^a	189.73^b	40.06^d	410.38^d
H^2	40.67^b	12.55^a	0.50^b	759.48^b	6.01^d	25.39^b	193.88^b	62.99^c	1062.92^a
H^3	53.88^a	14.87^a	0.35^{bc}	1947.56^a	12.88^b	20.40^c	389.97^a	83.63^b	653.35^b
H^4	59.58^a	12.99^a	0.29^c	2230.51^a	17.26^a	19.49^c	432.31^a	94.02^a	547.41^c

a,b,c,etc. Means within the same vertical column bearing the same superscripts are not significantly different ($P < 0.05$) H_1, H_2, H_3, H4 denote 5, 7, 9, 11 weeks after sowing.

Table 7: Nutrient contents of four *Celosia* cultivars (av. of 6 ages)

Cultivars	Crude fiber contents (%)	Crude protein content (%)	Total crude protein yield (g/m2)	Vitamin C (mg/100g FW)	Vitamin C (mg/100g DM)
V_1	14.2	26.4	682	44.7	582
V_2	10.3	28.1	278	49.3	453
V_3	13.0	26.6	594	43.5	522
V_4	13.4	27.3	570	41.4	522
SE	0.22	0.44	4.4	1.4	22.4

V_1, V_2, V_3 V_4 denote Large and green, Narrow and green, Narrow and red, Large and red, *Celosia spp.* respectively.

There were also varietal differences in their level of protein and vitamin C. This investigation reveals that the buyers and consumers may not be able to obtain vegetables with the highest nutritional quality since the grower and seller often opt for maximum profit by selling vegetables at higher marketable stages 9 to 11 WAS. In this case availability of quality nutrients is hampered by the necessity for higher profit margin as against consideration for availability of quality nutrients in the diet. The improved and most attractive varieties of *Celosia* V_1 gave lower level of protein than the unattractive narrow-leaved variety V_2 (Table 7). Thus the consumer who has no knowledge about these differences opts for "sight" choice that gives less nutritional quality, hence the significance of the knowledge of nutrients composition is re- affirmed.

Except for the protein content, all other yield and nutrients components were generally low in the dry season production of the vegetables, meaning that consumers get less quality nutrients in the dry season (Omueti, 1977). The levels of macro and micro elements in the *Celosia spp* was also investigated (Omueti, 1982).

Significant differences were observed between varieties and stages of harvest. Higher level of calcium, phosphorus and potassium were observed in the vegetables harvested between 5 and 7 WAS (Table 8).

Table 8: Effects of age on elemental nutrients, averages of four Celosia cultivars

Elemental nutrients	Weeks after sowing						
	5	7	9	11	13	15	SE of means
Magnesium (%)	1.35	1.19	1.13	1.28	1.40	1.43	0.053
Calcium (%)	2.48	2.67	2.41	2.21	2.00	2.21	0.171
Phosphorus (%)	0.42	0.31	0.31	0.25	0.26	0.25	0.013
Sodium (ppm)	422	458	468	444	446	478	20
Potassium (%)	5.1	4.2	4.2	4.4	4.4	4.7	0.17
Iron (ppm)	558	545	650	638	583	696	28.0
Copper (ppm)	15.4	13.4	13.4	28.4	21.7	11.5	1.52
Manganese (ppm)	187	418	101	617	572	740	38.8
Zinc (ppm)	108	131	151	174	109	128	8.2

Other minerals namely, magnesium and manganese slightly increased with age to 15 WAS. To utilize this vegetable for iron rich diet, 9 to 15 WAS would be the best period for its harvest.

(ii) **Efficient Utilization of quality nutrients for food products of high nutritional value.**

The utilization of crops is linked with nutrition and health by way of the food consumed. Through the utilization of food

crops, the quality nutrients (embedded glory) of the crop can be transferred to man through his dietary intake. Efficient utilization of food crops to maximize the quality nutrients contents of such crops for man's food is not only ensuring food security but quality life.

In this area, Mr. Vice-Chancellor, Sir, I made some modest contributions using my knowledge of applied nutritional biochemistry. I capitalized on the occurrence of the quality nutrients in maize and soybean. The most important nutrients in question are protein and the essential a.as lysine in soybean and methionine in maize (Bressani, 1981; Omueti and Morton, 1996 a,b) and the polyunsaturated fatty acids in both crops. Maize and soybean will complement each other to give a blend of high nutritional value (Bressani, 1981). My foray into this area of investigation began in King's College, London while visiting as a fellow of Ian Smith, Royal Society, London. Here I sought to evolve a low cost but efficient method of utilization of food crops for increased quality nutrients in food. The combination of maize and soybean in various ratio with other crops was extruded to produce ready-to-eat protein snack "soyaabari snack sticks" (Omueti and Morton, 1996a). Different extrudates (Picture1) were obtained and were compared with a London market snack (Bombay Mix) (MS) (No.11 in Picture1).

Picture 1

There were significant differences in the acceptability of the extrudates and the soya-abari snack sticks were more acceptable than MS. The chemical composition of the various extrudates is presented in Table 9. In general quality nutrients namely high level of protein

Table 9: Chemical composition of representative extruded soya-maize products (soyaabari snacks sticks)

	Extrusion number				Market Snack
	5	8	12	15	
Protein (%)	22.75^{b}	20.13^{c}	19.91^{c}	24.06^{a}	17.94^{d}
Crude fat (%)	9.2^{b}	14.2^{a}	9.0^{b}	2.9^{c}	NA
Available CHO (%)	25.8^{c}	40.3^{a}	37.8^{b}	38.5^{a}	NA
Crude fiber (%)	4.5^{b}	1.7^{b}	1.6^{b}	1.1^{c}	3.5^{a}
Total ash (%)	4.0^{a}	2.1c	3.5^{b}	3.6^{b}	3.3^{b}
Energy (kcal/g)	4.54^{b}	4.4^{b}	4.86^{a}	4.03^{c}	NA
Available lysine (g/16gN)	4.3^{a}	4.0^{b}	4.0^{b}	3.2^{c}	NA
In vitro digestibility (%)	84.7^{d}	85.7^{c}	87.6^{a}	86.4^{b}	NA

Where letters following means within a\horizontal line differ, mean differ significantly ($P > 0.05$)

and the essential a.as, healthy fat, energy, minerals and vitamins have been desirably incorporated into the various snacks. The consumers of these extrudates receive vitality from the quality nutrients obtained from the products as evidenced by the level of digestibilities of the extrudates, (84-87%). This work was one of the very first extrusion work to produce traditional snacks by extrusion using maize and soybean with the Nigerian local ingredients namely plantain, banana and pepper. The publication of this work was widely accepted as requests for reprints came in from many countries across the globe. The health implication of these findings is that these products are suitably adapted to combating Protein Energy Malnutrition (PEM). Furthermore, extrusion has been used here, to provide cheap method for increasing quality nutrients in man's diet for vitality.

Mr. Vice-Chancellor Sir, my second point of call while still in King's College London was the attempt made to improve the protein level of the customarily eaten Nigerian abari known by many names in the country. It is known as *abari, sapala, tepotiyo* in Yoruba speaking areas, *ekpan akpapa* in Efik, *okpa* in Ibo and *Okwoka* in some Ishan speaking areas of Edo State. This shows that this meal is widely consumed in the country. Maize flour was made from Nigerian yellow maize (IAR&T). Various ratios of maize to soybean flour varying from 100:0 to 40:60 were utilized (Omueti and Morton, 1996b) to produce soyaabari shown in Picture 2. The soybean supplemented abari samples were found to be superior to the unsupplemented abari (Picture 2) in terms of quality nutrients namely; protein, overall balance of a.as, available lysine, good fat and protein digestibility (Tables 10 & 11).

Picture 2

Table 10. Nutritional characteristics of soyaabari g 100^{-1}g DM basis

Blends	Ration of maize to soyaflour	% Crude protein	Crude fat %	Total ash %	Available CHO %	GE g (Kcal)
Ao	100.0	9.43^{a}	22.22^{a}	4.16	44.01^{a}	4.93^{e}
A1	90.10	12.02^{f}	24.78^{f}	4.22	34.41^{b}	5.27^{d}
A2	80.20	15.06^{c}	26.40^{c}	4.46	26.4^{c}	5.60^{c}
A3	70.30	19.07^{d}	28.04^{d}	4.78	23.5^{d}	5.70^{b}
A4	60.40	22.32^{c}	30.07^{c}	4.95	20.42^{c}	5.90^{a}
A5	50.50	24.54^{b}	31.88^{b}	5.27	20.00^{c}	5.99^{a}
A6	40.60	29.34^{a}	36.17^{a}	5.83	16.4^{f}	6.02^{a}
SE	-	0.223	0.336	-	0.326	0.091
Soya flour (SN)[a]	0.100	48.25	26.96	6.8	11.30	5.69

*Soy flour produced from processed and oven dried soybean seeds. Where letters following means within a column differ, means differ significantly (P = 0.05)

Table 11. Amino acid composition of supplemented abari (maize meal) aag/16 gN

Amino acid	Blends								
	Yellow maize	Maize meal							
		A_o	A_1	A_2	A_3	A_4	A_5	A_6	SN
Aspartic acid	6.5	5.4	7.0	9.4	11.9	13.2	16.2	24.0	14.2
Glutamic acid	20.6	18.9	19.2	23.5	26.2	30.4	35.4	38.8	27.9
Serine	5.7	4.6	4.7	5.5	5.7	6.1	7.9	11.2	7.1
Histidine	3.5	2.0	2.6	2.7	2.8	2.8	2.9	4.9	2.9
Glycine	2.9	2.9	3.4	4.0	4.3	5.7	6.2	10.9	5.6
Threnine	3.9	4.2	3.7	4.4	4.9	5.8	7.2	8.8	4.3
Arginine	3.7	4.3	6.9	5.9	7.0	9.0	10.0	18.2	7.8
Alanine	7.4	7.7	6.4	6.0	5.9	6.5	8.3	10.2	5.9
Tyrosine	4.2	3.1	3.4	4.1	4.4	5.7	8.7	8.7	4.8
Valine	5.2	3.2	3.2	3.4	3.5	3.6	3.8	5.5	2.6
Phenylalonine	5.8	3.3	3.8	5.0	5.7	5.7	10.5	14.7	5.9
Isoleucine	6.7	3.0	2.9	3.0	3.1	4.3	8.3	10.9	3.6
Leucine	14.6	11.7	10.5	9.7	10.2	11.8	16.9	20.9	11.4
Lysine	3.1	2.7	3.2	4.7	5.6	5.8	6.0	6.4	7.8
Available lysine	2.6d	2.2^{h}	2.57^{g}	3.8^{e}	4.2^{e}	4.9^{d}	5.1^{c}	5.1^{b}	5.7
In vitro digestibility	-	74.6^{d}	80.98^{c}	81.71^{c}	85.48^{b}	84.27^{b}	88.78^{a}	90.92^{a}	81.5

*See Table 1 for description of blends and SN. Where letters following means in horizontal columns differ, means

The 30% and 40% blends are suitable for combating PEM.

We were not oblivious of the anti-nutritional factors in soybean. The level of anti-nutrients was significantly reduced by extrusion process, heat treatment and by the pre-treatment of the soybean with 0.5% sodium bicarbonate or trona (sodium sesquicarbonate) (kaun) (Omueti *et. al.* 1992). All the treatments removed significant proportions of the undesirable oligosaccharides thus making the flour to have high protein digestibility and attribute desired for health and vitality.

Home-level protein-supplementation of the locally produced egbado maize kokoro was carried out (Omueti, 1999) to develop soyakokoro shown in Picture 3. Increased protein level without any adverse effects on the acceptability of the protein-improved kokoro was achieved (Table 12).

Table 12. Protein Content of Soya kokoro

Treatment	Maize to Soya Ratio	Using Soy flour % CP	Using Okara % CP
M	1:0	1.8c	8.0c
N	2:1	13.78ab	12.91b
O	1:1	17.06ab	14.22b
P	1:2	20.35a	18.61a

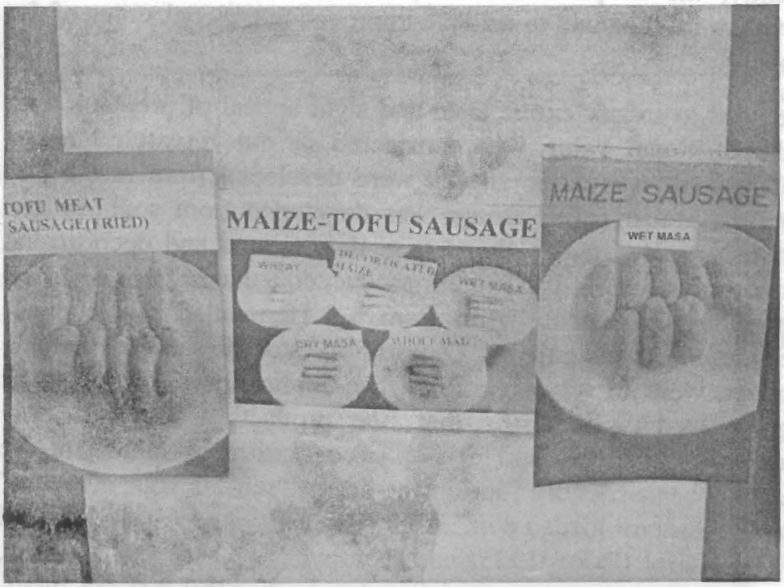
Means followed by the same letter within the same column are not significantly different at ($P<0.05$) CP = Crude Protein

Picture3

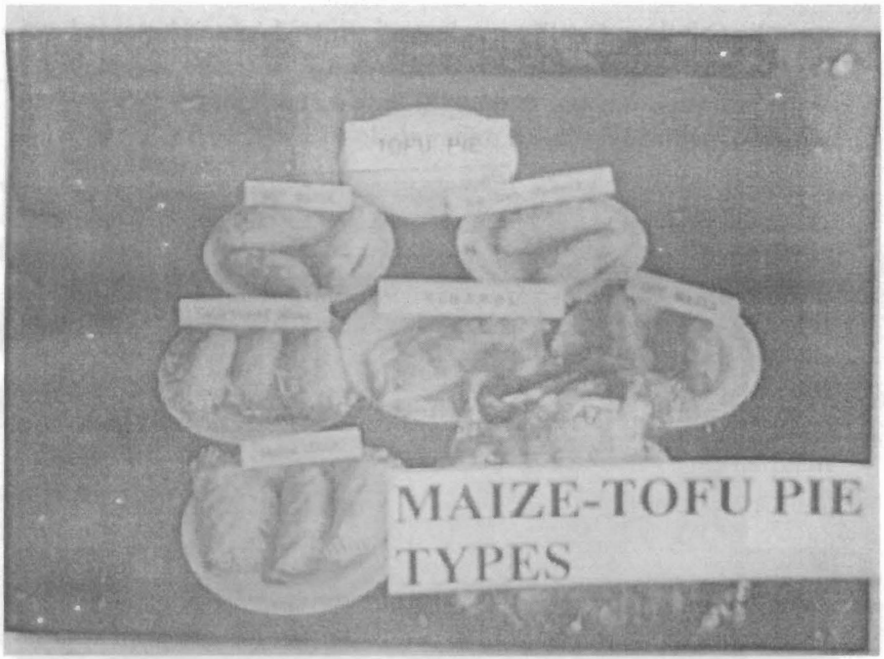
Indeed the supplemented kokoro was significantly more acceptable than the unsupplemented sample. Considering how kokoro snack has spread extensively from Ogun State to the neighboring states

recently, the adoption of this product for consumption would provide a fast channel to achieve improved nutritional status of the people.

The need to satisfy exotic taste and sight appeal of products with high nutritional value was considered in our research. Many protein-improved exotic snacks were developed from maize and soybean. Maize-Tofu Sausage was developed from soybean and variously treated maize flours (e.g. lime treated and decorticated maize grains). Tofu is a protein product coagulated from soy milk using the supernatant liquid from ogi (fermented maize meal) preparation, as coagulant. Digestibility studies showed that the products were all very digestible. The implication of the results as regards healthy eating is that, the products would not only contribute cheap protein for improved nutritional status but are found as heart-friendly food in the era of "run for your dear life" from cholesterol loaded diet. Plant products are considered devoid of cholesterol (Pyke, 1975) and in this case maize and soybean, being rich in polyunsaturated fatty acids (healthy fat) are heart-friendly. The attractive imitated shape of meat sausage achieved in Maize-Tofu-Sausage (Picture 4), would enhance its appeal to both children and adults. This attempt was considered to be a successful method to combat malnutrition in the society, especially among children.



Similar success was achiev **Picture 4** evelopment of Maize-Tofu Pie (Omueti *et. al.*, 2006) from maize and Tofu (Picture5).

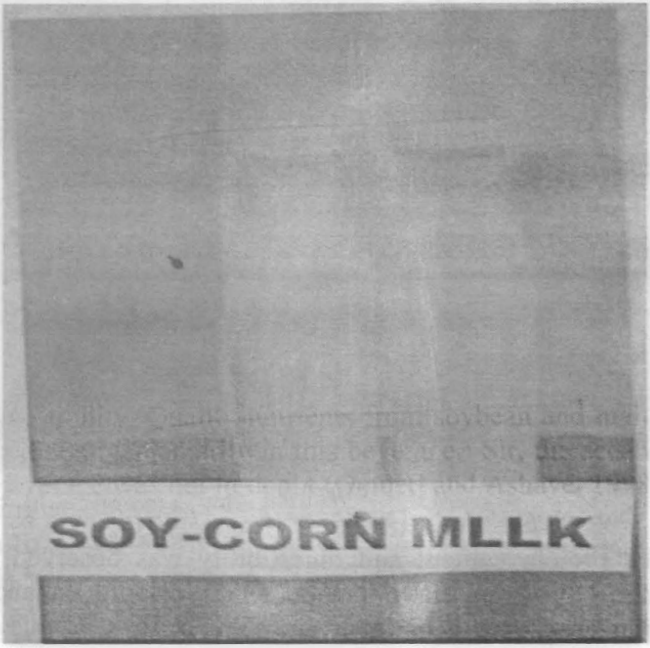


Picture 5

Increased protein content and digestibility was observed. The adoption of these protein improved snacks would enhance the dietary intake of quality nutrients and the nutritional status of the people that would consume the products especially in the scenario of low dietary intake of protein (Oguntona, 1998) and rampant occurrence of PEM in Nigeria (Maziya – Dixon *et. al.* 2004).

Beverages with quality nutrients, if adopted for consumption, would constitute fast channels to enhancing intake of quality nutrients. In this wise, Mr. Vice Chancellor, Sir, a beverage named "Soy-Corn milk" was developed from fresh-green maize and soybean cotyledons (Omueti and Ashaye, 1998; Omueti *et. al.* 2000). Nutritional evaluation studies showed that this beverage compared favourably with casein in terms of biological value, net protein utilization, and protein efficiency ratio and *in-*

vitro digestibility. Quality nutrients from soybean and maize have combined complementarily in this beverage. Sir, the acceptability of the beverage was not in doubt (Omueti and Ashaye, 1998) when compared with soymilk.



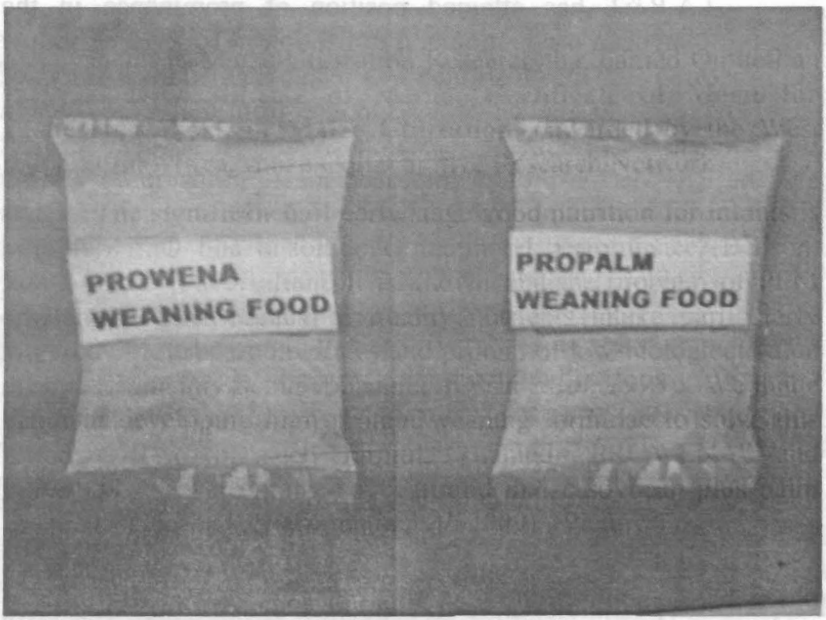
Picture 6

The beverage (Picture 6) is an option for increasing the dietary intake of quality nutrients as a means for combating PEM. Thus, vitality can be sustained on this nutritive product.

Only some of my work on soybean-maize utilization work can be mentioned here, but the modest contribution to improved maize utilization is also reported in a book titled "Nutritionally Improved Maize Foods, Recipe Book" (Omueti, 1998a). The generous funding by the Regional Research Projects on Maize and Cassava (RRPMC) is greatly appreciated for the success and

achievement in Maize Utilization Research that earned Omueti an International Certificate of Merit; **"Certificate of Merit for Pioneering Work in Maize Utilization"**, awarded by the West and Central Africa Maize Collaborative Research Network.

The significance of early stage good nutrition for infants is considered very basic for good adulthood performance (Benson, 2008, Hedley *et. al.* 2004).It is known that the problem of PEM results from inadequacy of quality nutrients intake particularly when low- level carbohydrates and protein of low-biological value are predominantly being consumed (Ossai *et. al. 1998*). We made effort in developing high protein weaning formulae to solve this problem. Two of such formulae named "PROWENA" and "PROPALM" were maize-soybean and maize-soybean plus palm oil blends respectively (Omueti *et. al.* 2009), (Picture 7).



Picture 7

The chemical composition of the weaning formulae revealed adequacy of protein and minerals in supporting good nutrition when compared with the FAO standard.

IV. Quality Nutrients as a source of vitality in man

The vitality- giving ability of quality nutrients in some food crops had been demonstrated in the nutritional studies on food crops such as soybean, soybean-maize blends or soybean-maize and other crops combinations (Omueti *et. al.* 2000 ; Omole *et. al.* 2005 and Omueti *et. al.*, 2006). In all of these reports it was shown that protein digestibilities, weight gain, feed intake, protein efficiency ratio, biological value and net protein utilization (Rat feeding studies) increased when rats were fed with the soybean-maize blends.

I.A.R&T has attained position of prominence in the history of soybean production and utilization in Nigeria. The low key research in the Institute was catapulted into history of excellence due to the generous funding from IDRC – Canada International Development Research Centre on soybean project and the RRPMC on protein improved maize utilization. Vitality was restored into malnourished children fed with soybean products in Kersey Children's Home in Ogbomosho and Oni Memorial Children Hospital, Ibadan (IAR&T Reports, 1984; 1985; 1986; Weingartner, 1987). In these locations, malnourished infants who are unable to consume solids were placed on diets of soymilk which was followed by traditional foods supplemented with soybean fractions as were previously described (Omueti and Ogundipe, 1994; Omueti *et. al.* 2000; Omueti, 2000). By virtue of the quality nutrients embedded in soybean e.g. generous level of essential amino acids especially lysine, tryptophan and threonine, soybean is indeed a premier food crop in proffering solutions to the problems of malnutrition in Nigeria. Furthermore, the virility of soybean products as sources of health and vitality can be enhanced when combined with cereals especially maize as shown in our modest work. In a blend of soybean and cereal e.g. maize, the

lysine from soybean complements its deficiency in the cereals while methinoine acts vice-versa in soybean (Bressani, 1981; Omueti and Morton 1996a, b; Omueti,. 2000; Omueti, *et.al.*2000).In this regard the achievements of the team comprising Mr Afolabi (late),Prof. Oyekan, Dr.(Mrs) Ogundipe, Dr (Mrs) Osho , Prof.(Mrs) Obatolu, Dr. Ashaye and Mr.Ajomale (late) are worthy of note.

Thus what the Chinese had known to be a vitality-giving food crop for centuries back is now in nutritional focus in Nigeria. Lo, a young man with percipient abilities saved lives in Hongkong (Shurtleff and Aoyagi, 2004). Today, in Nigeria, through the soybean joint projects; malnourished children were restored to wellness in all areas of soybean promotion to the public (IAR&T; 1984; 1985 and1986 Reports).

V. Quality Nutrients: Wealth of the Nation (Gold)

Productivity of a nation leads to her economic growth and development. Only a healthy body can be productive. A healthy body can only be sustained by an adequate intake of quality nutrients. The intake of health - friendly nutrients from infancy through adolescence affects the learning capacity and alertness of an individual. Learning cuts across basic educational training, apprenticeship, artisanship and trading abilities of people. A well alert and educated individual would strive to achieve self-sufficiency in basic necessities and would have a propensity to improve his or her lot financially. This is an index of productivity, self development and integral part of national development. Some reports had established that childhood's good nutrition and health determine adulthood productivity especially in developing countries (Benson, 2008; World Bank, 1993; Hedley *et. al.* 2004).

My modest contributions to utilization work on maize and soybean and other ingredients in diversified blends, had produced over 201 maize forms which can be commercialized at Small and Medium Enterprises for job and wealth creation. Summary proof is given on Table 13, (Omueti, 1998).

Table 13. **Diversified and soy- protein – enhanced maize based products**

Abari forms	=	22
Kokoro forms (snacks)	=	90
Extruded ready to eat snacks	=	28
Maize-Tofu pie forms	=	34
Maize- Tofu Sausage forms	=	6
Weaning formulae (from maize and Soy blends)	=	20
Maize soybean based beverages	=	9
Total		209

A Summary from Omueti; (1994), (RRPMC project); Omueti, (1998a, b).

From the above Table, the large number of quality products from maize-soybean blends is available to break monotony at the family tables. Similarly, over 201 maize based products are not imagination but are real and vital in our efforts to widen the utilization base of maize and soybean to suit all classes, income level categories, adults, school children and children at weaning ages. The nutritional qualities of some of these products have been shown in this lecture and through their usages, malnutrition, in all categories, resulting from deficiencies and inadequacies in the dietary intake of quality nutrients can be reduced or eliminated.

At this juncture, I would like to remind this august audience of the significance of maize-soybean blends in human vitality. The most limiting a.as in the diet of people especially in the developing countries is lysine and is contributed by soybean (legume) while methionine and other sulphur amino acids are contributed by maize (cereal). Other essential amino acids, vitamins, minerals,

phytonutrients which are quality nutrients, feature generously in the blends. All these blends were promoted both in the urban and rural sectors through RRPMC funding with evidence for a virile small scale enterprises which can be used as sources of income (Omueti, 1994). Adoption of these simple technologies for diversified usage of quality nutrients can result into generation of additional income in the family, thus leading to wealth.

The nation itself can boost her sources of wealth by capitalizing on the experience of South America that was able to penetrate the North American and European countries with calcium enriched maize tortilla to earn foreign exchange. The modern world scouts for health and non-cholesterol products. The extruded soybean, maize, plantain based snacks which were developed in my work and assessed acceptable by Britons in London can be commercialized and perfected for external trading as heart-friendly snacks, for the wealth of the nation.

VI. The constraints to adequate intake of quality nutrients.

There are many constraints to adequate intake of quality nutrients but I will just mention a few.

(i). Dwindling quality in Rural Agriculture

There is sufficient evidence to prove that agricultural systems are gradually failing to provide quality nutrients especially in the developing countries where micronutrient malnutrition is rampant (Mason and Gracia, 1993; WHO, 2002). Furthermore hunger stricken people are reported to be in large number in the rural areas (Cleaver, 2007). The Minister, Federal Ministry of Agriculture and Water Resources, Dr Abba Ruma said "the food insecurity and malnutrition was as a result of the poor performance of agriculture sector" (Godwin, 2008). Mr. Vice Chancellor Sir, if the rural sector, where the food is produced is the hungriest sector, it can be inferred that the type of food crops being produced have failed to supply adequate quantities of quality nutrients that can support healthy lives (Graham *et. al.*, 2001; McGuire, 1993). The

dwindling level of some micro-nutrients such as Iron and zinc (mean for iron, 19.6mg g^{-1} and mean for zinc 19.8mg g^{-1}) in maize kernels has been observed in the data collected by CIMMYT (Banziger and Long,2000). In IITA Nigeria (S.O.Okeh, unpublished data) there had been some reference as regards low content of iron and zinc in maize (in the range of Fe 15.5 – 19.1 mg g^{-1} and 16.5 – 20.5 mg g^{1-} for zinc) grown in several agro-ecological zones in West Africa. It is evident that the levels of these important micronutrients must be improved to obtain enhanced nutritional quality of this important staple for the resource-poor people in the affected region. Without the improvement of these quality nutrients in the maize staples, meals prepared from them will be deficient in the said nutrients. Such a situation might result in increased morbidity and mortality rates, diminished livelihoods, deficient learning ability, development and growth in infants and children previously reported (Caballero, 2002; WHO, 1999).

(ii.) **Low level of awareness of the importance of quality nutrients production and intake.**

In the various sectors of community life, many consume food without giving cognizance to what kind of nutrients are present in such food nor in the food crops utilized in the preparation of the meals. There is no gainsaying that there are ignorance and nonchalance of people about what they and their entire families consume in terms of the presence and absence of quality nutrients and the ensuing consequences as a result of inadequacies of such nutrients in their diet. Is it not a case of an execrable ignorance of the significance of quality nutrients intake, when an obese individual still sits in local "bukataria" or restaurant consuming only two balls of fufu or pounded yam, or amala but full plate of cow leg (bokoto), divers entrails (abodi, liver, kidney), the sure source of bad cholesterol and fat? In addition, he requests for many pieces of red meat (later to be oxidized to produce free radicals, which could trigger cancer cells

formation) and on top of these, no green vegetables are served fresh except over cooked vegetables. This is an alarming health suicide attempt. Farmers' knowledge about quality agriculture *vis-à-vis* quality food crops is in the low ebb. Modern and productive agriculture and the technologies generated from them are not adequately transferred to depict the enormous role of quality nutrients in the production of seedlings with required vigour (based in quality nutrients) for improved yields of quality food crops. If the Extension Agents are not adequately knowledgeable about quality nutrients, their role in the agricultural systems and the utilization of such crops for quality nutritional status, it will become difficult for such agents to transfer the information on the role of quality nutrients to their clientele.

How would the resource-poor farmer and an average consumer without some level of education grasp my sermon of today? Going further into the individual family, do the heads and mothers of the families even care to get involved in dogging the family food from the kitchen, as to know whether it is dud in quality nutrients? A lack of awareness of what you take and what would be the role of that food in your metabolic system is a great constraint in the dietary intake of quality nutrients. It is vital to monitor the general nutritional status of the family all the time. This can be achieved by having some ideas about the composition of foods and that of the crops used to produce the food. Such monitoring requires a bifocal approach. One approach is based on researching into food crops to provide data information about the nutrients composition of crops and food (by the scientists), followed by the efficient transfer of this information, using simple and clear methods, to the appropriate centre of "catch". The second method of approach is dependent on the level of education of both the transferors and the recipients of such information to yield positive results.

I have made my modest contributions as regards the above two approaches firstly, by research results on the chemical composition of some food crops and the foods made from them,

secondly, by demonstrating the use of the crops for quality foods and thirdly, by on- the field demonstration work as means of transfer of the technologies of usage of quality nutrients to achieve improved nutritional status to our targets- groups.

Nutritional research on food composition is progressing in Nigeria but the commensurate level of transfer and receipt of the information about findings are still not adequate. Thus, the intake of quality nutrients is adversely affected resulting in the poor level of the people's nutritional status, increased incidents of diseases and low national development.

(iii) **Agricultural diversity**

Decreased agricultural diversity with respect to plants is described by a situation in which there is lack of variety of food crops grown by farmers and households. Such limitation also leads to decreased dietary diversity. The larger population in the developing countries is limited to just energy staples which contribute little or no quality nutrients in adequate amount for human nutrition (John, 2001). Inability to juggle between the growing of crops and their usage for food, so as to achieve biochemical and nutritional complementarities, often result into inadequacy of quality nutrients intake (Ekesa, *et. al. 2008)*. For a healthy and productive life, crops and food diversity is very pertinent. Enrichment of consumers' diet is achieved through the diverse contributions of quality nutrients from various types of crops and foods prepared from them.

(iv) **Poverty**

A healthy nation becomes a wealthy nation. With a low purchasing power, there is bound to be a low capacity to purchase quality foods with quality nutrients. When hunger sets in, a man lacks the capacity to work due to weakness ensuing from illness and diseases. It is actually a vicious circle of no quality food, no healthy living, resulting into inability to earn a living to combat

poverty. Thus, poverty is a constraint to dietary intake of quality nutrients.

(v) **Unsustainable agricultural policies**

This country has witnessed many promises on boosting agriculture. Year in year out, there has been low level of agricultural funding coupled with slow pace in implementation to the extent that research in agricultural production, utilization and extension services had to be detrimentally compromised. With such a situation, there would always be a lack of efficient agricultural production, resulting in dwindling output of food crops, earning and purchasing power, followed by poverty; it is a case of inadequacy in supply of food crops to meet the quality nutrients dietary requirements for the population. The vision of government has centered only the foreseeing events and not deeply rooted in the insight of the issues, neither is direction made proactive. Such a scenario has consequently led to failure and fruitlessness in quality food and nutrients security.

VIII. Enhancing the dietary intake of quality nutrients.

(i) **Holistic attention**

A synergy of approach that will involve policy makers, community based organizations, non-governmental organizations (NGOs), consumers, researchers, resource - poor farmers, women and youth, must be put in place to formulate initiatives that would enhance the dietary intake of quality nutrients.

(ii) **Advocacy**

Public awareness on the importance of quality nutrients is at a low level in most developing countries. It is essential to create awareness on what we eat and what would be the end of the journey as regards one's health. It is the right of an individual to be able to identify quality crops and food prepared from them in such a way as to sustain healthy life. Farmers' knowledge about

the significance of quality crops should receive urgent attention of the policy makers so as to encourage farmers to produce such crops. This will ensure good nutrition. Farmers must be trained to ask questions from the extension agents whether the crops they are to grow will contribute positively to their health.

(ii) **Education/Training**

The level of education whether formal or informal of stake- holders as regards the significance of quality nutrients security must be

complemented with the understanding, interpretation and application of sustainable agricultural technologies. Such technologies should translate to agricultural production in terms of increased quality food crops, their appropriate processing and utilization for high nutritional status of the people. Women being the chief educators in the family (Falusi, 2007) must be made relevant in advocacy for improved intake of quality nutrients to eliminate malnutrition. From women to children, who would be the leaders of tomorrow, the campaign, knowledge and ability to evaluate the table food setting, for quality health would enhance the national development. Planning policies that can eliminate debacles in the education of the young people and invigorate high standard of University Education that covers all facets of human endeavor must be pursued with zeal and good conscience of the planners. If this can be achieved, a population of healthy young men and adults will emerge to be used for the national growth and development of our country.

(iii) **Eradication of poverty**

In this aspect, I am glad to observe that the government has taken giant strides to tackle this problem. One of the many initiatives of the government is on food security. The Ministry of Youths' Development must be commended for the initiative put in place to train youths, males and females to become educated farmers, who in the very near future can fit into the models presented in this lecture. The youths, after being trained will know

their "onions" in modern and productive agriculture. These youths had been sponsored for 2- weeks vocational training organized by the I. A. R & T., of this University. Some of the advantages accruing from these training workshops will be, increased ability for self- employment towards wealth and self-sufficiency. Considering the number of youth involved in the training, this initiative has only covered a tip of the iceberg. This area of intervention must be made to accommodate many youths in the country for these vocational training, focusing on the key areas of productive agriculture. The three tiers of Government should evolve interventions that will produce modern farmers for productive agriculture.

(iv) **Plant breeding**

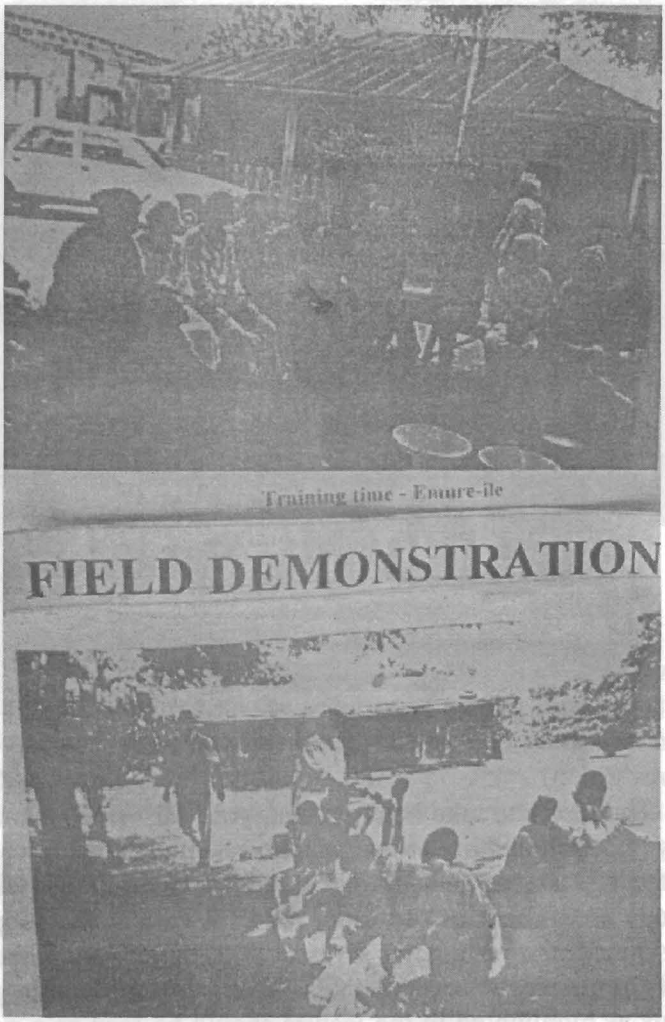
The plant breeders are stake- holders in this matter. Research efforts should be geared toward producing varieties of crops with improved level of quality nutrients. I.A.R&T is poised to have breakthrough in the breeding of Quality Protein Maize (QPM), (Olakojo *et. al.*, 2008). These varieties when released would be nutritionally sufficient for weaning food for babies because of the incorporation of all the essential a.as in such varieties, especially, a high level of lysine. Joint cultivars evaluation for nutrients composition of food crops by the breeders and biochemists have yielded information that identified cultivars of high nutritional qualities in cowpea (Omueti and Singh,1987) and in *Solanum* species (Omueti and Omidiji,1996).

(v) **School lunch policy**

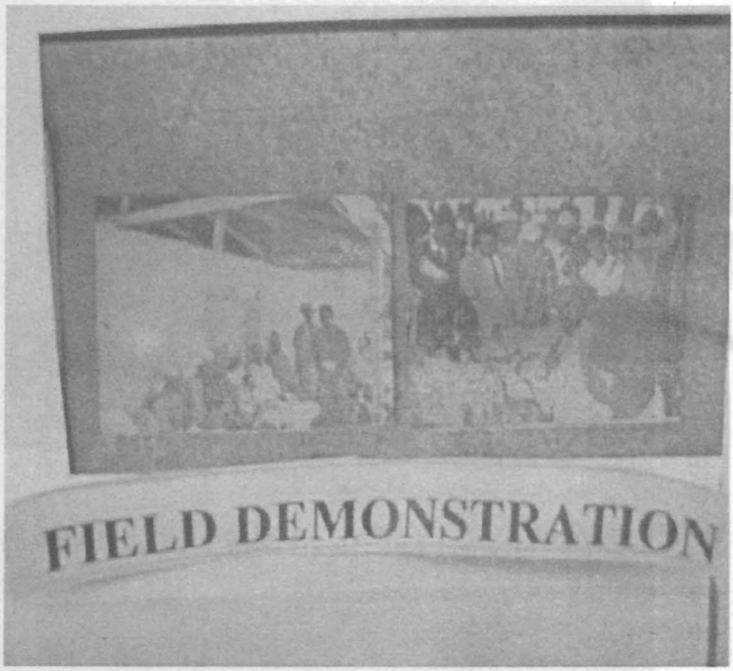
A policy that will entrench school lunch in primary and secondary schools is a way to boost quality nutrients intake in the growing ages where it will be utilized for metabolic processes that will ensure healthy growth of children, catalyze learning capacity and virile academic performance of the children. A lunch of high nutritional quality thus served would have been prepared from quality crops from where the quality nutrients will be released into foods prepared from them for consumption.

IX. Conclusion

Mr. Vice-Chancellor Sir, in this lecture, I have attempted to draw the attention of my august audience to the fact that, we all have to utilize nutritionally viable crops for the food we consume, to get our recommended daily allowance of quality nutrients, needed for healthy living. It is also shown in this lecture that nutritionally enhanced dietary intake of quality nutrients can also be achieved through diversified utilization of various crops with high level of quality nutrients for food products. In this aspect, soybean and maize featured as crops of glory in my research. Furthermore if these nutrients dense food types are not promoted to the populace, there will be no positive results in the areas of health and wealth. In I.A.R& T., a team approach was utilized to train-the – trainers, the technologies for the production and usage of most of the protein-improved food products developed in I.A.R&T. The appropriate technologies are transferred with directions for profitable income generation activities using surplus produce. Two of the outings for the promotion of products, to women leaders and to elites in workshops are shown in Pictures 8and 9.

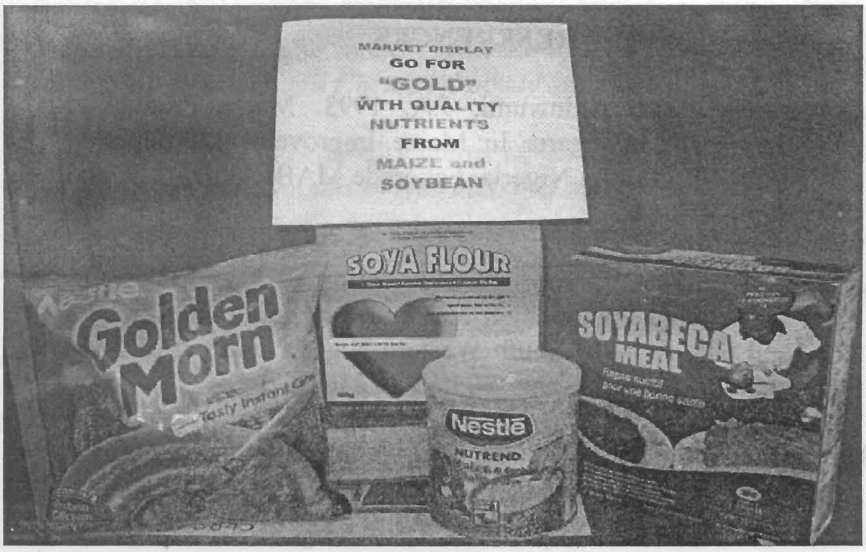


Picture 8



Picture 9

The nexus to take home is that, you, Mr. Vice-Chancellor, Sir, my poor self and my esteemed audience must now move away from the attitude of just sitting at tables to eat food with no conscious assessment of the food, for their role in the supply of quality nutrients for quality lives. A general idea about the contents of the meals served at tables in terms of the health- giving nutrients as highlighted in the lecture should be seen as a right of an individual. Here lie the needs for formal or informal education for all, on the production and usage of quality food crops that will supply quality nutrients for healthy living.



Picture 10

Mr. Vice-Chancellor Sir, the prosperity (health and wealth) of a nation is anchored on the security of quality food crops, their embedded glory (quality nutrients), vitality and gold. The market for soy flour and soybean-maize based products (rich sources of protein, energy, minerals and fiber) shown in Picture 10 is attesting to the fact that quality nutrients are making gold in the market in Nigeria. Let us" **go"** for quality nutrients from quality crops to obtain **QUALITY LIFE and GOLD.**

I salute I.A.R.&T, the backbone of my academic achievements, my co- researchers and dedicated laboratory team. My siblings and extended family, I love you the more. To God, who has made this occasion a reality as regards my silent desire to give an inaugural lecture in this University, I give Him all the Glory, Honour and multitude of Praises.

I thank you all, for listening.

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