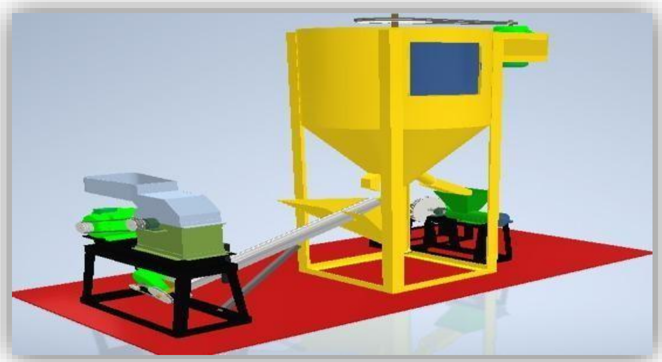
THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

UNDERMINING THE HOME- GROWN TECHNOLOGIES OF PROCESSING AND PRESERVATION: PLAYING POKER WITH FOOD SECURITY

INAUGURAL LECTURE SERIES 205



Delivered by

ENGR. PROF. JOHN ALABA OLUMUREWA

FNIAE, MNSE, MNFIST, MIFEN, MPASAE

B.Sc., M.Sc., PhD (Ibadan)

PROFESSOR OF FOOD AND BIORESOURCE ENGINEERING

Tuesday, 25th August, 2026

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PROLOGUE

I, John Alaba Victor OLUMUREWA from the School of Agriculture and Agricultural Technology, feel highly honored and profoundly grateful to Almighty God—my Creator, Saviour, and Sustainer—for the special grace bestowed upon me to deliver the 205th Inaugural Lecture of this great University, widely acknowledged as Nigeria's leading University of Technology for over a decade.

I stand before this distinguished audience today to share the outcome of my academic journey, discoveries, innovations, and contributions arising from my research activities over the years. These are directed toward addressing one of humanity's greatest challenges—food security. Through research, teaching, and community engagement, I have sought to advance knowledge and develop practical solutions in food processing, preservation, and post-harvest management as pathways to sustainable food security.

This lecture presents the highlights of these efforts and their implications for reducing post-harvest losses, improving food availability, enhancing value addition, and strengthening national food security. It is my hope that the insights shared today will contribute to the ongoing discourse on sustainable agricultural development and inspire greater investment in home-grown technologies for food processing and preservation.

This lecture is the 59th Inaugural Lecture from the School of Agriculture and Agricultural Technology, the seventh from the Department of Food Science and Technology (Table 1), and the first to be delivered from the Food Process Engineering option.

Table 1: Inaugural Lecture Series in the Department of Food Science and Technology

S/N	Inaugural Lecture Series	Lecturer	Title	Date
1.	73th	Prof. T. N. Fagbemi	Food Processing: Guaranteeing Food Nutrition	8th December, 2015
2.	75th	Prof. O.F. Oludahunsi	Food: The Fuel and Vehicle for life	11st March, 2016
3.	10th	Prof. I. B. Oluwalana	"Give Us This Day Our Daily Fruit" Panacea to Wastage, Ageing and Micronutrients Deficiency Diseases	9th October, 2018
4.	120th	Prof. V. N. Enujiugha	Biotechnology for Healthy Nutrition and Productive Lifestyle	10th March, 2020
5.	132th	Prof. O.S. Omoba	Healthy Eating and Human Disease: Dietary Shift in a	3rd August, 2021

			Sustainable Food System	
6.	139th	Prof.M.O. Oluwamukomi	Value Addition: A Sine Qua Non for Sustainable Food and Health Security	16th November, 2021

Do permit me to briefly share my journey into Food and Bio-resource Engineering before delving into the main substance of this lecture, which I believe is both thought-provoking as well as deserving urgent attention from government, stakeholders, and the general public.

My Journey into Engineering: A Calling That Needed No Prophecy

My journey into engineering began during my childhood, driven by curiosity and passion for solving practical problems. My parents could not afford to sponsor my immediate senior sister and me in secondary school at the same time. Hence, after completing my primary education in 1978 at Odo Ijesha, I had to accompany our elder brother to Imesi-Ile to repeat Primary Six at Ijana Methodist Primary School.

At Imesi-Ile, we had only one lantern, one table, and one chair in our household. Having graduated as the best pupil in my previous school, I was determined not to allow my academic performance to decline. This determination led me to begin collecting discarded torchlight batteries (Berec) connecting them to a torch bulb thereby improvising a simple lighting system for reading at night.

By the end of that year, my experiments had advanced to the point where I wired and powered my father's house using a combination of these batteries. Neighbors were amazed and often wondered how our house remained illuminated without a generator. They would be asking questions *'Baba Alaba mo tan generator, ibo ni an ti ri na'* meaning that my father did not put on a generator, where is the light from? Those early experiences convinced and set my mind on fire to become an engineer. Providence further favored me when I became a beneficiary of the first set of students under the free education programme of Uncle Bola Ige. During my secondary school years, particularly in Form Four, I had no teachers for Physics, Chemistry, or Mathematics. Nevertheless, because of my unwavering determination to study engineering, I taught myself using textbooks such as Lambert, Nelkon, Stone and Cozzens, reading them repeatedly four times each from cover to cover. By the grace of God, I obtained distinctions in these subjects.

How I Became a Proud Member of the Food and Bioresource Engineering Family

In 1988, I sat for the Joint Admissions and Matriculation Board (JAMB) examination with Electrical/Electronic Engineering at Obafemi Awolowo University as my first choice and Agricultural Engineering at the University of Ibadan as my second choice. I gained admission into Agricultural Engineering at the University of Ibadan. Initially, I was disappointed, coming from a farming background, I wondered why I should attend a university only to study what I thought was simply farming. Without anyone to guide or encourage me, this misconception negatively affected my academic performance during my first and second years.

Everything changed in my third year when I realized that Agricultural Engineering was much more than farming. Out of curiosity, I approached one of my lecturers, Engineer Ogedengbe and I said '*oga e ti paayan'*, (you have killed somebody) he answered me with a question, '*Famurewa ki lo tun laa se'* (what have we done wrong, again?), I then asked why the programme was called Agricultural Engineering when it involved so much engineering science and technology. That encounter transformed my perspective. Unfortunately, my earlier lack of understanding had already cost me the opportunity of graduating in First Class. Determined to augment my academic laurel, I pursued a Master's degree, and graduated with distinction in 1997. That gave me the opportunity to join the Federal Institute of Industrial Research Oshodi, as a Research Officer I.

Throughout my academic career, food processing has remained my central passion and area of specialization. In my undergraduate days, my research focus was in food processing technology with my undergraduate project on the Development of a General-Purpose Grain Milling Machine. During my Master's programme, I worked on the Construction of a Roller Mill and the Modification of Plate Mill while my doctoral research focused on the production of ready-to-use soy flour. As a Research Officer, I developed a Four-Roller Mill with a Parallelogram Configuration.

Justification for the Title of this Lecture

Madam Vice-Chancellor Ma, for a better understanding of the topic under discussion, it is important to clarify some key concepts embedded in the title of this lecture: *home-grown technologies, food processing and preservation, playing poker, and food security*.

Playing poker:

The expression *playing poker* is used figuratively. In poker, players often conceal their true intentions and circumstances, pretending that everything is under control when significant risks exist beneath the surface. Thus, *playing poker with food security* implies taking dangerous risks with an issue that is too important to be left to chance that is the act of gambling with a nation's food system through neglect, poor policy choices, inadequate investment, or over-reliance on uncertain food sources, thereby exposing citizens to hunger, malnutrition, and food insecurity.

In the Nigerian context, the phrase may be used to express the failure to adequately support local agricultural production, food processing, preservation technologies, and rural infrastructure despite their importance for national food security (World Bank, 2022). Nigeria could be said to be "playing poker with food security" when we all neglect indigenous food processing and preservation technologies while depending heavily on food imports and unstable global food markets. Such actions increase vulnerability to food shortages and price shocks (FAO, 2023; IFPRI, 2022).

Food Security:

The most widely accepted definition provided by the Food and Agriculture Organization (FAO, 2001), states that Food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life. United States Department of Agriculture (USDA) defines food security as 'Access by all people at all times to enough food for an active, healthy life, including the availability of nutritionally adequate and safe foods and the assured ability to acquire such foods in socially acceptable ways' (USDA, 2024).

According to FAO (2008), food security rests on four pillars:

1. **Food Availability** – adequate supply of food.
2. **Food Accessibility** – ability to obtain food.
3. **Food Utilization** – proper biological use of food through adequate diet, water, and healthcare.
4. **Food Stability** – consistent availability and access over time.

Unfortunately, food security remains a major challenge in Nigeria. Recent reports from United Nations indicate that over 35 million Nigerians face the risk of acute hunger due to conflict, climate-related shocks, inflation, and substantial post-harvest losses.
In this lecture, I approach the food insecurity challenge from the perspective of post-harvest losses and the strategic role that home-grown food processing and preservation technologies can play in addressing this important national concern.

Home-grown Technologies

The term '**home-grown technology'** is often used interchangeably with **indigenous technology**, **local technology**, or **domestically developed technology**. Indigenous (home-grown) technology is the technology developed by local people through the study of existing technologies, adaptation to local environmental conditions, improvements and eventual creation of original innovations suited to local needs (Okafor, *et al*., 2021, Amaechi 2022). Olojuolawe and Osuntuyi (2024**)** viewed home-grown technology as locally developed technological solutions that utilize indigenous knowledge, skills, and resources to address societal challenges and promote sustainable national development.

These are technologies, innovations, machines, processes, or solutions that are developed locally by a country's own people, institutions, researchers, artisans, or industries rather than being imported from other countries. In simple terms, home-grown technology means "technology made at home for local needs."

Home-grown technologies have some importance: reduction of dependence on imports, lower production costs by using locally available materials, creating employment opportunities for local people, promoting food security through technologies suited to local conditions, encouraging innovation and entrepreneurship and saving foreign exchange that would otherwise be spent on imported equipment.

Food Processing and Preservation

Food processing is the application of physical, chemical, and biological operations to transform raw agricultural materials into safe, nutritious, convenient, and acceptable food products while **Food preservation** is the science and technology of preventing or delaying food spoilage through various treatments thereby maintaining safety, nutritional value, and quality while extending shelf life (Rahman, 2007; Fellows, 2017).

Government Policies on Enhancing Home-Grown Technologies in Nigeria

The Nigerian government has introduced several policies and initiatives aimed at promoting indigenous (home-grown) technologies, reducing dependence on imported technologies, encouraging innovation, and strengthening local capacity in science, engineering, agriculture, and manufacturing:

1. National Science, Technology and Innovation Policy (NSTIP) 2022

The National Science, Technology and Innovation Policy (NSTIP) serve as the principal framework for advancing indigenous technology development in Nigeria. The policy emphasizes the promotion of local inventions and innovations, increased local content in industrial processes, technology transfer, and the utilization of Nigerian scientists and engineers in national development projects. It also encourages the use of indigenous languages for disseminating scientific and technological knowledge and supports technology fairs and exhibitions to showcase local innovations (Federal Ministry of Science, Technology and Innovation, 2022).

2. Presidential Executive Order No. 5 of 2018

Executive Order 5, titled *"Planning and Execution of Projects, Promotion of Nigerian Content in Contracts and Science, Engineering and Technology,"* was signed to prioritize Nigerian expertise and locally developed technologies in public procurement. The Order mandates government agencies to give preference to Nigerian firms and professionals in contracts involving science, engineering, and technology. Foreign firms are required to demonstrate clear plans for technology transfer and indigenous capacity development where local expertise is unavailable (Federal Government of Nigeria, 2018).

3. National Agricultural Technology and Innovation Policy (NATIP) 2022–2027

NATIP was developed to transform Nigeria's agricultural sector through innovation and technology adoption. The policy supports the development and dissemination of locally adapted agricultural technologies, encourages collaboration among research institutions, universities, and the private sector, and promotes the commercialization of agricultural innovations (Federal Ministry of Agriculture and Food Security, 2022).

4. Local Content Policies in ICT and Telecommunications The Federal Government, through the National Information Technology Development Agency (NITDA) and the Nigerian Communications Commission (NCC), has developed policies to promote indigenous participation in the ICT sector. These policies encourage the development, production, and patronage of locally produced software, hardware, and digital solutions. They also seek to increase the contribution of indigenous ICT

companies to national development (NITDA, 2019; NCC, 2021).
Nigeria Digital Innovation, Entrepreneurship and Startup Policy
The government introduced the Digital Innovation, Entrepreneurship and Startup Policy to stimulate indigenous technological solutions and support startups. The policy focuses on human capital development, access to funding, infrastructure provision, market creation, and innovation-driven entrepreneurship. It aims to encourage the development of home-grown digital technologies capable of addressing local challenges (NITDA, 2021).

5. Technology Transfer and Indigenous Capacity Development Programmes
The Federal Ministry of Science, Technology and Innovation has established programmes and institutions dedicated to technology acquisition, adaptation, and transfer. These initiatives seek to ensure that imported technologies are domesticated and modified to suit Nigerian conditions while strengthening local technological capabilities (Detail Commercial Solicitors, 2018).

Factors Undermining Indigenous Technologies in Food Processing and Preservation in Nigeria

Indigenous food processing and preservation technologies have played a vital role in ensuring food availability, reducing post-harvest losses, and preserving cultural food heritage in Nigeria. These technologies include drying, smoking, fermentation, salting, roasting, and traditional storage methods. However, despite the importance, several factors have limited their development, efficiency, and widespread adoption:

1. Inadequate Research and Development (R&D)
One major challenge facing indigenous food technologies is the limited investment in research and development. Many traditional processing methods have remained largely unchanged for generations, resulting in low efficiency, poor product quality, and

limited commercialization. The lack of scientific improvement and standardization reduces their competitiveness with modern technologies (Aworh, 2008).

2. Poor Infrastructure

Inadequate infrastructure, particularly unreliable electricity supply, poor road networks, and insufficient water supply, hinders the effective use and modernization of indigenous technologies. Food processors often rely on manual operations, leading to low productivity and high post-harvest losses.

3. Limited Access to Finance

Most indigenous food processors operate at small or household scales and lack access to affordable credit facilities. The inability to secure loans restricts investment in improved equipment, packaging, storage facilities, and product development. Consequently, many processors continue using inefficient traditional methods.

4. Low Level of Education and Technical Skills

The adoption and improvement of indigenous technologies are often constrained by low literacy levels and inadequate technical knowledge among processors. Educational attainment significantly influences technology utilization and innovation in food processing and preservation systems.

5. Competition from Imported and Modern Technologies

The influx of imported food products and modern processing equipment has reduced reliance on traditional technologies. Consumers increasingly prefer products that are attractively packaged, standardized, and perceived as safer, leading to the gradual abandonment of indigenous methods.

6. Poor Government Support and Policy Implementation

Government policies supporting indigenous technology development are often weakly implemented. Limited funding, inadequate extension services, and poor linkage between research institutions and rural processors have slowed technological advancement and commercialization.

7. Weak Documentation and Knowledge Transfer

Much indigenous knowledge is transmitted orally from one generation to another. As older practitioners retire or die, valuable knowledge is often lost because it has not been properly documented. This weakens continuity and innovation within indigenous food technology systems.

The State of Food Processing and Preservation in Nigeria

Food processing and preservation in Nigeria have made significant progress over the years, driven by increasing demand for safe, convenient, and value-added food products. The sector plays a critical role in reducing post-harvest losses, improving food security, creating employment, and supporting industrial development. However, despite these advances, Nigeria continues to face substantial challenges in processing and preserving its agricultural produce effectively.

Overview of the Sector

Nigeria is one of Africa's largest agricultural producers, with major crops including cassava, yam, maize, rice, sorghum, millet, fruits, vegetables, and legumes. The country also produces significant quantities of fish, livestock, and poultry. Nevertheless, a large proportion of these products are consumed fresh or processed using traditional methods, resulting in considerable post-harvest losses (IFT, 2019).

Food processing activities in Nigeria range from small-scale traditional operations such as fermentation, drying, smoking, roasting, and milling to modern industrial processing involving canning, freezing, extrusion, pasteurization, and packaging. Agro-processing industries are increasingly producing products such as flour, starch, vegetable oils, fruit juices, dairy products, noodles, and packaged snacks.

Current Status of Food Preservation

Food preservation remains one of the weakest links in Nigeria's food value chain. The country loses an estimated 30–50% of agricultural produce annually due to inadequate storage, poor transportation systems, insufficient cold-chain facilities, and limited processing capacity. These losses are particularly severe for fruits, vegetables, fish, meat, and dairy products.

According to the Nigerian Stored Products Research Institute (NSPRI) post-harvest losses account for approximately 40% of agricultural output annually, largely due to poor storage conditions and inadequate post-harvest handling practices.

Recent estimates indicate that Nigeria lost between 30 and 40 million metric tonnes of food in 2025, representing economic losses valued between ₦3.5 trillion and ₦5 trillion. These losses are attributed primarily to poor storage facilities, weak logistics systems, and inadequate cold-chain infrastructure.

Major Challenges Facing the Sector

1. Inadequate Storage Infrastructure

The shortage of warehouses, silos, cold rooms, and refrigerated transport systems significantly contributes to food spoilage and waste. Cold-chain facilities remain grossly inadequate for preserving perishable commodities.

2. Poor Electricity Supply

Frequent power outages increase processing costs and hinder the operation of refrigeration, freezing, and other preservation equipment, forcing processors to rely on expensive generators.

3. Poor Transportation Networks

Bad roads and inefficient logistics delay the movement of food products from farms to markets and processing centers, increasing spoilage rates and reducing product quality.

- **Government Efforts and Recent Developments** Recognizing the importance of post-harvest management, the Federal Government launched the Nigeria Postharvest Systems Transformation Programme (NiPHaST) in 2025. The initiative focuses on: Household storage technologies, Community warehouses, Cold-room development, Strategic grain silos, Public-private partnerships in food preservation and logistics

The programme aims to reduce post-harvest losses, improve food availability, stabilize prices, and enhance national food security. Additionally, institutions such as the Nigerian Stored Products Research Institute (NSPRI) continue to develop and promote improved storage and preservation technologies for farmers and processors.

Food Engineering

On 21st September 2021, Professor Christopher Akinbile (Dean, SIMME) delivered a thought-provoking presentation in which he explained the concepts of engineering and agricultural engineering and identified food engineering as an important branch of agricultural engineering. This presentation seeks to extend that discourse by examining food engineering in greater detail, highlighting its principles, applications, and contributions to food processing, preservation, quality assurance, and food security.

Food Engineering: Definitions

Food Engineering is a branch of engineering that applies engineering principles, mathematics, physics, chemistry, and biological sciences to the processing, preservation, packaging, storage, distribution, and utilization of food products. It focuses on designing and improving equipment, processes, and systems that transform raw agricultural materials into safe, nutritious, and high-quality foods.

According to Singh and Heldman, food engineering is the application of engineering principles to food materials and food-processing operations in order to produce safe, wholesome, and economically viable food products (Singh and Heldman, 2014).

Similarly, Toledo (2007) defined food engineering as the application of engineering concepts and methods to food and food-processing systems, including the design, operation, and optimization of food manufacturing processes.

According to Institute of Food Technologists (IFT), food engineering involves the development and application of engineering principles for the processing, manufacturing, packaging, storage, and distribution of food products to ensure quality, safety, and efficiency (IFT, 2023).

Food engineering encompasses operations such as heat transfer during pasteurization and sterilization, mass transfer during drying, fluid flow in food processing systems, refrigeration and freezing, food packaging, process control, and equipment design (Singh and Heldman, 2014).

Importance of Food Engineering

- Reduces post-harvest losses
- Improves food safety and quality
- Enhances food preservation and shelf life
- Increases processing efficiency and productivity
- Supports food security through value addition and reduced waste
- Facilitates the development of innovative food products

Different Basic Operations in Food Engineering

Food Engineering is built around **unit operations**, which are the fundamental steps used to transform raw agricultural materials into safe, stable, and marketable food products. Different authors have classified these operations in slightly different ways, although the underlying principles remain similar.

Earle (1983) defined the major unit operations in food processing as: Material and energy balances; Fluid flow; Heat transfer; Drying; Evaporation; Separation processes; Mechanical separations; Size reduction; Mixing; Refrigeration and freezing. These operations form the foundation of food process engineering and are applied in virtually all food industries.

According to Singh and Heldman (2014), food engineering operations are based on engineering principles involving the movement of heat, mass, and momentum. The major operations include: Fluid flow and pumping; Heat processing; Refrigeration and freezing; Evaporation; Drying; Filtration; Centrifugation; Mixing and agitation; Extrusion; Packaging and storage operations

These operations are used to achieve food preservation, quality improvement, and safety (Singh and Heldman, 2008).

Key Areas of Food Engineering

1. **Food Process Engineering** – Design and optimization of food processing operations.
2. **Food Preservation Engineering** – Application of technologies such as drying, freezing, canning, and irradiation.
3. **Food Package Engineering** – Development of packaging materials and systems that extend shelf life.

4 **Post-Harvest Engineering** – Handling, storage, and transportation of agricultural produce.

5 **Process and Systems Engineering** – Automation, instrumentation, and quality control in food industries.

6 **Bioprocess Engineering** – Fermentation and biotechnology applications in food production.

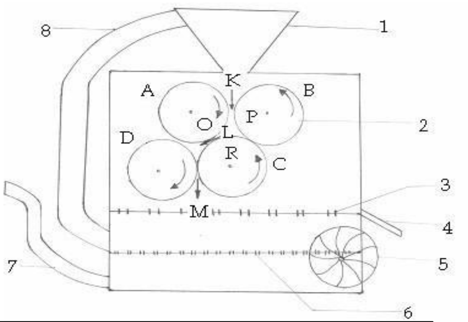
MY CONTRIBUTIONS TO THE ADVANCEMENT OF FOOD ENGINEERING AS A PROFESSION UNDER THE DIFFERENT KEY AREAS

FOOD PROCESS ENGINEERING

Famurewa and Raji (2005**),** evaluated four processing methods—roasting (ROA), extrusion (EXT), boiling and sun drying (BSD), and boiling and oven drying (BOD)— for producing soy flour from the Tax 1448 soybean variety obtained from the International Institute of Tropical Agriculture (IITA) and a mixed variety purchased from the local market. The processed samples were milled into flour and analyzed for protein content, flour yield, and sensory acceptability. Although extrusion produced the highest protein content and acceptability, its flour yield was significantly lower than those of the other methods. In contrast, the boiling and oven-drying (BOD) method produced comparably high protein content and acceptability without significant differences ($p < 0.05$) from extrusion, while maintaining a substantially higher flour yield. Overall, the results identified BOD as the most suitable domestic processing method for producing soy flour with a desirable balance of high protein content, good flour yield, and consumer acceptability.

Ijarotimi and **Famurewa** 2006 used a semi-structured questionnaire to assess mothers' knowledge of the nutritional value and use of soybean in weaning diets. The chemical composition of soybean-fortified *ogi* and *moinmoin* was compared with their traditional counterparts. Soybean supplementation significantly improved the nutritional quality of both products, particularly in protein, fat, energy, calcium, phosphorus, iron, riboflavin, and vitamin A contents, while vitamin C remained negligible. Sensory evaluation showed that *ogi* containing 20% soybean (CSF1) and *moinmoin* containing 25% soybean (CPSF1) were the most acceptable among the fortified samples, with acceptability ratings comparable to the unfortified products. The survey further revealed that most mothers recognized soybean as an excellent source of protein and agreed that it could effectively serve as a protein substitute in complementary (weaning) foods. These findings demonstrate that moderate soybean fortification enhances the nutritional quality of traditional weaning foods without compromising consumer acceptability.

Famurewa, (2007), studied a three-stage roller mill consisting of four cylindrical rollers arranged in a parallelogram configuration. The concept was developed and evaluated for flour production from maize, beans, and soybeans. The first pair of corrugated rollers initiated seed splitting, while the second and third pairs of smooth rollers progressively reduced the particle size. The milled products were separated into chaff, flour, and coarse particles, with the coarse fraction automatically recycled into the hopper for further milling. Performance evaluation under different roller gap settings and feed rates showed that wider roller gaps produced higher throughput, whereas faster feed rates resulted in both higher throughput and finer particle sizes. The mill efficiently produced uniform flour with no material leakage at the roller nip points, demonstrating its capability for effective three-stage size reduction while eliminating the feeding challenges commonly associated with conventional three-high roller mills



Key:
1:Hopper 2: Roller 3: Large aperture sieve 4: Chaff Outlet
5: High Speed Blower
6: Flour size aperture sieve 7: Flour Outlet 8: Returning Duct

Figure 1: Schematic Diagram of the Four Roller Flour Mill

Famurewa and Olusola (2013) reported the design, construction and evaluation of a continuous biomass-fuelled water distiller to provide a low-cost means of producing potable water using renewable biomass as the heat source. The equipment, fabricated from stainless steel in accordance with American Society of Agricultural Engineers (ASAE) standards, was designed for durability, ease of maintenance, user acceptability, and operational versatility. Performance evaluation using well water and two biomass fuels—charcoal and sawdust—showed a production capacity of 461.54 cm^3/h. The estimated fabrication cost of the unit was ₦20,556, while the energy cost of producing one litre of distilled water was ₦43.27 using charcoal and ₦22.44 using sawdust. Corresponding energy requirements were 16.65 kcal/mL and 15.62 kcal/mL, respectively. The results demonstrated that the biomass-fuelled distiller can efficiently produce safe, high-quality distilled water at a relatively low operating cost, with sawdust proving to be the more economical energy source

KEY A – Coal pot ,B – Boiler chamber ,C – Water level regulator ,D – Steam inlet pipe ,E – Condenser ,F – Condensing water outlet pipe ,G – Raw water supply pipe ,H – Distilled water outlet pipe ,I – Distilled collection bottle

Plate 1. Set up of the distillation unit during experimentation

The detoxification of two cassava varieties (TMS30572 and TMS98/0581) was investigated by evaluating the effects of drying temperature and air velocity on the cyanide content of dried cassava chips. Total cyanide (HCN) was determined using the alkaline titration method. The results showed that the interaction between cassava variety and air velocity significantly ($P \leq 0.05$) influenced cyanide reduction. Increasing air velocity enhanced cyanide removal at all drying temperatures, while the effectiveness of temperature varied with cassava variety. For TMS30572, the lowest cyanide levels were achieved at a drying temperature of 70°C and an air velocity of 2.75 m/s, whereas for TMS98/0581, optimum detoxification was obtained at 60–70°C and an air velocity of 2.75 m/s. Under these conditions, cyanide concentrations were reduced to well below the recommended safe limits for cassava products. The study demonstrated that optimizing both drying temperature and air velocity is essential for effective detoxification during cassava chip production, highlighting the critical role of air velocity in achieving safe hydrogen cyanide (HCN) levels while preserving product quality (**Famurewa** and Emuekele 2014)

Famurewa et al., (2014) evaluated the influence of drying temperature on the nutritional, physicochemical, and antinutritional properties of cocoyam flour using raw cocoyam (RC) and samples dried at 60 °C (CF1), 70 °C (CF2), and 80 °C (CF3). The dried cocoyam samples were milled into flour and analyzed for proximate composition, functional properties, and antinutritional factors. Drying at 60 °C and 70°C produced flours with significantly lower bulk density, while the sample dried at
70 °C exhibited the highest water absorption capacity and swelling power, indicating superior functional properties. Crude protein content was highest in the flour dried at 60 °C and lowest at 80 °C, whereas crude fat content differed significantly ($p < 0.05$) among the drying treatments. Although drying temperature had no significant effect on the levels of tannins, phytate, oxalate, and saponin, the concentrations of these antinutritional factors remained below acceptable safety limits. The study demonstrated that low-temperature drying (60–70 °C) improves the nutritional and functional quality of cocoyam flour while maintaining safe levels of antinutrients, making it suitable for food processing applications.

Famurewa and Emuekele (2014) investigated the drying kinetics of cassava chips from two improved cassava varieties (TMS30572 and TMS98/0581) using a fluidized bed dryer to identify the most suitable mathematical model for predicting drying behaviour. A 4 × 4 × 2 factorial experiment involving four drying temperatures, four air velocities, and two cassava varieties was conducted with three replications. Fresh cassava tubers were peeled, sliced into chips, and dried under controlled conditions, with weight loss monitored at 20-minute intervals until constant weight was attained. Twelve thin-layer drying models were fitted to the experimental moisture ratio data using nonlinear regression analysis and evaluated based on the coefficient of determination (R^2), reduced chi-square (χ^2), root mean square error (RMSE), and mean bias error (MBE). Among the models tested, the Modified Henderson and Pabis model consistently provided the best fit for both cassava varieties, exhibiting the highest R^2 values and the lowest χ^2, RMSE, and MBE values. The study established the Modified Henderson and Pabis model as the most appropriate model for accurately predicting the drying kinetics of cassava chips in a fluidized bed drying system.

Famurewa et al., (2015) researched into the effects of fruit maturity and drying methods on the quality of breadfruit flour using mature and immature breadfruits dried by sun drying, oven drying, and a biomass-fuelled dryer. The dried samples were milled into flour, reconstituted, and evaluated for proximate composition, texture, antinutritional factors, colour, and sensory acceptability. Sun-dried samples recorded the highest protein content for both mature and immature breadfruits, while oven-dried samples had the highest carbohydrate content. Drying and reconstitution significantly reduced the levels of antinutritional factors, whereas fruit maturity and drying method had little influence on the softness index of the reconstituted flour. Sensory evaluation showed that sun- and oven-dried samples were the most acceptable. However, considering nutritional quality, safety, and processing practicality, biomass drying of mature breadfruit was recommended as the most suitable method because it produced flour with high protein content and low antinutritional factors while avoiding the microbial contamination risks commonly associated with sun drying.


Plate 2a: Biomass fuelled dried breadfruit   2b: Sundried bread fruit

Famurewa et al., (2017), investigated the drying characteristics of unripe plantain slices of 5, 10, and 15 mm thickness in a thin-layer biomass cabinet dryer at drying temperatures ranging from 50 °C to 70 °C. Drying performance was evaluated using charcoal and sawdust as heat sources, with moisture loss monitored at 30-minute intervals until equilibrium moisture content was attained. The results showed that drying rate increased with drying time and temperature, with moisture migration occurring predominantly during the falling-rate period. Equilibrium moisture content was reached after 150, 180, and 240 minutes for 5, 10, and 15 mm slices, respectively, when charcoal was used, and after 120, 240, and 270 minutes, respectively, when sawdust served as the fuel source. The biomass cabinet dryer achieved a maximum overall drying efficiency of 89.67%, demonstrating its effectiveness for drying plantain slices. The study established that slice thickness and fuel type significantly influence drying time and confirmed the suitability of the biomass cabinet dryer as an efficient and sustainable technology for plantain drying.

Famurewa and Begbaaji (2018), studied the drying kinetics of tomato (*Lycopersicon esculentum*) slices using a laboratory-scale air cabinet dryer to identify the mathematical model that best describes the drying process. Fresh tomato slices were dried at temperatures of 40, 50, 60, and 70°C, requiring 18, 15, 11, and 10 hours, respectively, to reach the desired moisture content. Experimental moisture ratio data were fitted to selected thin-layer drying models using nonlinear regression analysis in SigmaPlot 10.0. Model performance was evaluated based on the coefficient of determination (R^2), reduced chi-square (χ^2), and root mean square error (RMSE). Among the models tested, the Two-term Logarithmic model provided the best fit, exhibiting the highest R^2 and the lowest χ^2 and RMSE values. The study therefore established the Two-term Logarithmic model as the most suitable for accurately predicting the drying behaviour of tomato slices under cabinet drying conditions.

Olumurewa and Faboya (2018) investigated the thin-layer drying behaviour of *Irvingia gabonensis* (ogbono) seeds using a cabinet dryer operated at 70 °C to identify the mathematical model that best describes the drying process. Freshly harvested *ogbono* seeds were dried under controlled conditions, with weight measurements taken at one-hour intervals until constant weight was achieved. Moisture ratio data obtained from the drying experiments were fitted to twelve thin-layer drying models and evaluated using the coefficient of determination (R^2), reduced chi-square (χ^2), root mean square error (RMSE), and mean bias error (MBE). Among the models examined, the Modified Henderson and Pabis model provided the best fit, recording the highest R^2 (0.9940) and the lowest χ^2, RMSE, and MBE values. Validation of the model showed excellent agreement between the predicted and experimental results, demonstrating its suitability for accurately predicting the thin-layer hot-air drying characteristics of ogbono seeds.

Famurewa; *et al,* (2019), evaluated the combined effects of osmotic dehydration and smoke drying on the nutritional, oxidative, and mineral quality of *Clarias gariepinus* (African catfish) using two fish size categories (200–450 g and 800–1000 g). Fresh fish were osmotically dehydrated in 20% and 25% sodium chloride solutions at 40°C for 6 hours before smoke drying at 70°C and 150 °C in a sawdust-fuelled smoking kiln. The processed samples were analyzed for proximate composition, lipid oxidation indices, pH, and mineral content. Dual processing significantly ($P < 0.05$) improved product quality by increasing protein and fat contents while substantially reducing moisture compared with the untreated control. Osmotic dehydration and smoke drying also lowered the pH to acceptable levels and produced satisfactory oxidative stability, although free fatty acid and peroxide values increased with drying temperature and duration but remained within acceptable limits. Mineral analysis showed high concentrations of essential minerals, while heavy metals (Cd and Cr) and trace elements (Ni, Mn, and Cu) remained below tolerable limits. Overall, small-sized catfish pretreated with a 20%

sodium chloride solution and smoke-dried at 150 °C produced the best combination of nutritional quality, oxidative stability, and mineral composition, and was therefore recommended as the optimum processing condition.

Olumurewa and Oladele (2020) investigated the production of enriched ready-to-eat snacks from non-wheat composite flour using extrusion technology and blends of yellow maize, defatted soybean flour, and brewers' spent yeast. Four formulations were developed and compared with a commercial wheat-based snack for their functional, proximate, mineral, antioxidant, and sensory properties. The results showed that increasing the proportion of brewers' spent yeast significantly ($p \leq 0.05$) enhanced the protein and carbohydrate contents of the extruded snacks, while higher inclusion of defatted soybean flour improved crude fibre, ash, and fat contents. Defatted soybean supplementation also significantly increased the total phenolic compounds, flavonoids, and ascorbic acid contents, thereby enhancing the antioxidant potential of the products. Sensory evaluation revealed no significant differences ($p > 0.05$) in appearance, taste, aroma, and crispness among the formulated snacks, with the YMDF formulation (35% yellow maize, 10% defatted soybean flour, and 30% brewers' spent yeast) comparing favourably with the commercial wheat-based snack and receiving the highest overall acceptability. The study established that extrusion of locally available cereal-legume-yeast blends can produce nutritionally enriched, antioxidant-rich, and consumer-acceptable ready-to-eat snacks as a viable alternative to conventional wheat-based products.

Famurewa et al., (2021), examined **t**he effects of traditional, mechanical, and chemical extraction methods on the yield and quality of coconut oil. The extracted oils were evaluated for yield, proximate composition, microbial quality, and selected physical and chemical properties using standard analytical methods. The results showed that extraction method had a significant influence on both oil yield and quality. Chemical extraction using *n*-hexane produced the highest oil yield (82.7%), followed by mechanical extraction (72.9%), while the traditional method recorded the lowest yield (61.3%). Despite these differences, the quality characteristics of the oils obtained from all three methods were within acceptable standards for edible vegetable oils, and all samples were free of cholesterol. The study demonstrated that mechanical extraction offers a practical balance between oil yield and product quality, while chemical extraction maximizes oil recovery. These findings provide valuable information for improving coconut oil processing, increasing the utilization and economic value of coconut, and guiding food scientists, food engineers, and agricultural engineers in selecting appropriate oil extraction technologies.

Further study on utilization of underutilized legumes by examining the effects of extrusion temperature on the nutritional and functional properties of low-glycemic composite breakfast flakes produced from maize, plantain, and germinated jack-bean flours were presented. Composite flour blends were optimized using Response Surface Methodology (RSM) based on glycemic response and resistant starch content, resulting in two selected formulations: Sample A (60% maize, 15.5% plantain, and 24.5% jack-bean flour) and Sample B (75% maize, 10% plantain, and 15% jack-bean flour). The blends were extruded at 100, 120, and 140°C and evaluated for proximate composition and functional properties. Increasing extrusion temperature significantly reduced moisture and carbohydrate contents while enhancing protein, ash, and crude fibre levels, indicating improved nutritional quality. Bulk density increased with extrusion temperature, suggesting greater product compaction and reduced porosity. The study established that extrusion temperature is a critical factor influencing the quality of composite breakfast flakes and recommended a moderate extrusion temperature of 120°C as the optimum processing condition to achieve a desirable balance between nutritional composition and functional characteristics while producing flakes with a low glycemic profile **(Olumurewa et al;** 2026)

Plate3a: Extrusion of flakes from Plantain, Jackbean and Maize flour

Plate3b: Extruded flakes from Jackbean, Plantain and Maize flour

FOOD PRESERVATION ENGINEERING

Famurewa (2009), investigated the effects of different drying methods on the nutritional and sensory quality of leafy vegetables using cabinet drying at 40, 50, and 60 °C, sun drying, and kiln drying at 95 °C. Fresh and dried samples were evaluated for sensory attributes, proximate composition, mineral content, and vitamin composition using standard analytical methods. The fresh leaves were found to be rich in protein (32.71%) and ascorbic acid (51.98%). Among the drying methods evaluated, cabinet drying at 50 °C was the most effective, preserving the sensory characteristics of the fresh leaves while maintaining proximate composition, mineral content, and vitamin C without significant losses compared with the other drying methods. The study therefore established cabinet drying at 50 °C as the optimum drying condition for producing high-quality dried leafy vegetables with maximum nutrient retention and desirable sensory attributes.

Famurewa and Raji (2011), further investigated into the effects of roasting, oven drying, and sun drying on the nutritional quality and consumer acceptability of soy flour produced from Tax 1485 and mixed soybean varieties. Soybean samples processed by each drying method were milled into flour and used to produce composite bread containing 5% soy flour and 95% wheat flour for sensory evaluation, while the flour samples were analysed for proximate composition. The results showed that oven drying produced the highest consumer acceptability for both Tax 1485 (58%) and the mixed variety (64%). Oven-dried samples also recorded the highest protein contents (40.54% and 33.70% for Tax 1485 and the mixed variety, respectively), although the differences were not statistically significant. In contrast, prolonged drying during sun drying and excessive heat during roasting reduced both protein retention and product acceptability. The study therefore established oven drying at a moderate temperature of 60°C as the most suitable processing method for producing soy flour with superior nutritional quality and sensory acceptability for use in composite bread production.

Famurewa and Raji (2011), examined the effects of different drying methods on the quality of osmotically dehydrated tomato, following pretreatment in a 40°Brix sucrose–salt solution for four hours. The pretreated tomato samples were dried using sun drying, solar cabinet drying, hot-air cabinet drying, and oven drying, and subsequently evaluated for proximate composition, vitamin C retention, and colour characteristics. The results showed that drying method significantly influenced the nutritional and quality attributes of the dried tomato. Although all drying methods reduced vitamin C content compared with the fresh samples, sun drying and solar cabinet drying retained higher vitamin C levels and better preserved the characteristic red pigmentation of the tomato. Proximate analysis further indicated that these two drying methods produced products with superior nutritional quality compared with hot-air cabinet and oven drying.

Overall, the study established that solar cabinet drying and sun drying are the most suitable methods for processing osmotically dehydrated tomato, as they ensure better retention of nutrients and colour, resulting in higher-quality dried tomato products.

Famurewa et al., (2011), studied the effects of sample preparation and drying method on the nutritional composition and volatile oil content of ginger using sliced and grated ginger subjected to sun drying and oven drying at 50 °C. The dried samples were milled into powder and analyzed for proximate composition, mineral content, and volatile oil using standard analytical methods. The results showed that drying method and sample form significantly ($p < 0.05$) influenced the nutritional and quality attributes of ginger powder. Oven drying generally retained more nutrients than sun drying, while the dried samples contained appreciable amounts of calcium and magnesium, with relatively low levels of iron and zinc. Among all the treatments, sliced ginger dried in the oven at 50 °C recorded the highest volatile oil content as well as superior protein, calcium, and magnesium levels. The study therefore established that slicing followed by oven drying at 50 °C is the most suitable processing method for producing high-quality ginger powder with enhanced nutritional value and maximum retention of volatile oil.

Famurewa and Olarewaju (2013), evaluated the nutritional and physicochemical properties of dried palm oil mill effluent (POME) obtained from pressing and water displacement extraction methods to assess its potential as a feed ingredient. Fresh effluent samples collected from a small-scale palm oil processing plant were concentrated into slurry, dried in a cabinet dryer at 70 °C, milled, and analyzed for proximate composition, mineral content, physicochemical properties, and antinutritional factors using standard analytical methods. The results showed that both samples were good sources of protein (17.54–17.81%), while the water displacement effluent (PEW) contained higher concentrations of potassium, phosphorus, and copper than the pressing effluent (PEP). Although PEW exhibited a higher peroxide value, indicating greater susceptibility to oxidative deterioration, it also possessed superior fat and mineral contents. The low iodine values of both samples suggested low levels of polyunsaturated fatty acids. Overall, the study demonstrated that dried palm oil mill effluent, particularly that was obtained through the water displacement method, has considerable potential as an alternative ingredient for fish feed production because of its favourable protein, fat, and mineral composition. Furthermore, the subsequent heat treatment during feed manufacture is expected to reduce microbial load and phytate content, thereby enhancing the safety and nutritional value of the feed (Plates 4a, 4b and 4c)



Plate 4a. Raw POME   Plate4b. Dried POME   Plate 4c. Milled POME after Pressing

Adejumo et al; (2023), also evaluated the thin-layer drying behaviour of cassava mash from three improved cassava varieties (TMS 96/1414, TMS 92/0326, and TMS 01/1368) in a hybrid solar dryer operated at 50°C and an air velocity of 2.5 m/s to identify the most suitable mathematical model for predicting the drying process. Seventeen thin-layer drying models were fitted to the experimental drying data and evaluated using standard goodness-of-fit criteria, while effective moisture diffusivity and activation energy were determined from Fick’s diffusion equation. The results showed that the Two-Term Exponential model consistently provided the best fit for the drying behaviour of all three cassava varieties. The effective moisture diffusivity ranged from 6.72×10^{-9} to 7.21×10^{-8} m²/s, while the activation energy was estimated at 36.82 kJ/mol. The study established the Two-Term Exponential model as the most appropriate for predicting the thin-layer drying kinetics of cassava mash in a hybrid solar dryer and provided useful drying parameters for the design, optimization, and efficient operation of cassava drying systems (Plate 5)

Plate 5: Drying process in the hybrid solar dryer

POST HARVEST ENGINEERING

Famurewa et al., (2011), studied the moisture adsorption characteristics of *pupuru* flour, a fermented cassava product, at 27 °C using the static gravimetric method to evaluate its storage stability under tropical conditions. Samples produced by toasting, smoking, and oven drying were equilibrated at water activity levels ranging from 0.1 to 0.6, and the equilibrium moisture content (EMC) data were fitted to four sorption models: Henderson, Chung–Pfost, Oswin, and Caurie. Model performance was assessed using the coefficient of determination (R^2), with values ranging from 0.881 to 0.993. The Henderson and Oswin models provided the best fit for describing the moisture sorption behaviour of *pupuru* flour. Sorption isotherm analysis further revealed that toasted *pupuru* flour exhibited lower equilibrium moisture content at low water activity but greater moisture adsorption capacity at higher water activity than the smoked and oven-dried samples. The study established that the Henderson and Oswin models are reliable for predicting the moisture sorption behaviour and storage stability of *pupuru* flour and demonstrated that toasted *pupuru* offers superior storage stability under the high-humidity conditions prevalent in tropical environments (Plates 6a and 6b)

Plate 6a: Oven dried pupuru

Plate 6b: Smoked-dried pupuru after 3 days

Famurewa and Onigbinde (2014**),** studied the effects of storage conditions on the functional and pasting properties of *lafun* flour using low- and high-density polyethylene packaging materials under relative humidities of 30%, 40%, and 50% and storage temperatures of 20, 30, and 40 °C. Equilibrium moisture content was established using controlled humidity environments before the samples were evaluated for pasting characteristics with a Rapid Visco Analyser and functional properties using standard analytical methods. The results showed that storage conditions significantly influenced the pasting and functional properties of the flour. Peak viscosity, trough viscosity, final viscosity, setback viscosity, water absorption capacity, oil absorption capacity, and bulk density varied considerably with storage temperature, relative humidity, and packaging material. Among the storage conditions evaluated, *lafun* flour packaged in high-density polyethylene and stored at 20 °C and 30% relative humidity exhibited the highest peak viscosity and superior cooking quality. The study therefore established that proper packaging combined with low storage temperature and low relative humidity is essential for preserving the functional quality and processing characteristics of *lafun* flour during storage.

Akise et al; (2016), examined the effects of processing and storage conditions on the fatty acid composition of smoked *Clarias gariepinus* over a six-week storage period. Fresh fish samples were either stored frozen at −6 °C or smoked at 70 °C to equilibrium moisture content before being stored under either frozen conditions (−6 °C) or a continuous heated environment (40 ± 4°C). Samples were analysed weekly to monitor changes in fatty acid composition. The results showed that palmitic acid (C16:0), oleic acid (C18:1), and docosahexaenoic acid (DHA, C22:6) were the predominant saturated, monounsaturated, and polyunsaturated fatty acids, respectively. Although storage resulted in progressive reductions in the beneficial omega-3 fatty acids, smoked fish stored under frozen conditions exhibited the least decline in the omega-3/omega-6 fatty acid ratio compared with fresh frozen fish and smoked fish stored in a heated environment. The study therefore established that freezing smoked fish is the most effective storage method for preserving its essential fatty acid profile and maintaining its nutritional quality over extended storage.

Famurewa and Oladejo (2016), investigated the moisture adsorption characteristics of *Tacca* starch packaged in low-density polyethylene (LDP), high-density polyethylene (HDP), and plastic containers were investigated under tropical storage conditions. Controlled water activity levels (0.10–0.80) were established at ambient temperature using concentrated sulphuric acid solutions, and the resulting equilibrium moisture data were fitted to seven widely used food sorption models, namely GAB, Oswin, Modified Oswin, BET, Halsey, Smith, and Henderson. The adsorption isotherms exhibited the characteristic sigmoidal pattern typical of starchy food materials and were influenced by storage temperature. Model evaluation showed that the Modified Oswin model best described the sorption behaviour of *Tacca* starch packaged in high-density polyethylene, whereas the Oswin model provided the best fit for samples packaged in low-density polyethylene and plastic containers. The study established that the Modified Oswin and Oswin models are reliable tools for predicting the moisture adsorption behaviour of *Tacca* starch and can be used to optimize packaging selection and storage conditions for improved shelf stability under tropical environments.

In 2019, **Famurewa** and Oladejo, continued their study on moisture adsorption characteristics of *Tacca* starch at 20, 30, and 40 °C using the static gravimetric method to evaluate its storage behaviour under varying environmental conditions. Equilibrium moisture content (EMC) data were obtained at water activity levels ranging from 0.1 to 0.8 and fitted to seven sorption models, namely GAB, Oswin, Modified Oswin, BET, Halsey, Smith, and Henderson. Model performance was assessed using the coefficient of determination (R^2), which ranged from 0.7654 to 0.9999. Among the models evaluated, the GAB and Oswin models provided the best fit for describing the moisture sorption behaviour of *Tacca* starch across the temperatures studied. The sorption isotherms further showed that samples stored at 40°C attained the lowest equilibrium moisture contents, indicating improved storage stability under tropical conditions. The study therefore established the GAB model as the most suitable for predicting the moisture adsorption behaviour of *Tacca* starch and confirmed its suitability for storage in tropical environments (**Famurewa** and Oladejo, 2019).

Olumurewa et al; (2019) investigated the moisture adsorption characteristics of cocoyam flour to determine its storage behaviour under tropical conditions. Fresh cocoyam corms were peeled, washed, sliced, oven-dried, milled into flour, and subjected to adsorption isotherm studies using the static gravimetric method. Equilibrium moisture content (EMC) was determined at temperatures of 20, 30, and 40°C and water activity (aw) levels ranging from 0.10 to 0.80, established with different concentrations of sulphuric acid (H_2SO_4). The experimental data were fitted to six widely used sorption models: GAB, BET, Oswin, Modified Oswin, Halsey, and Smith. The adsorption isotherms exhibited the characteristic sigmoidal shape typical of starchy food materials and were significantly influenced by temperature. Among the models evaluated, the Modified Oswin model provided the best fit for describing the moisture sorption behaviour of cocoyam flour. The study established the Modified Oswin model as a reliable tool for predicting the equilibrium moisture content of cocoyam flour and provided valuable information for optimizing its packaging, storage, and shelf-life under tropical environmental conditions.

Daramola *et al*., (2020) reported the design and construction of a novel fish smoking kiln that was constructed to utilize agricultural residues, including sawdust, palm kernel shell, and rice bran, as alternative energy sources to conventional charcoal for fish smoking. The kiln, with a capacity of 40 kg of fish per batch, incorporated six drying trays and 36 fish hooks, while a rotary wheel-and-axle mechanism ensured uniform heat distribution through conduction and convection. Performance evaluation showed that the kiln achieved an energy efficiency of 69.4% and required approximately 10 hours to smoke fish at temperatures ranging from 60 to 120 °C, depending on the fuel used. The calorific values of the agricultural wastes ranged from 16.2 MJ/kg for palm kernel shell to 30 MJ/kg for charcoal. Sawdust and rice bran produced drying rates and smoked fish quality comparable to those obtained with charcoal, whereas palm kernel shell exhibited the lowest drying rate. The study demonstrated that agricultural wastes, particularly sawdust and rice bran, are effective and sustainable alternatives to charcoal for fish smoking, providing comparable product quality while promoting the utilization of renewable biomass resources (Figure 2)

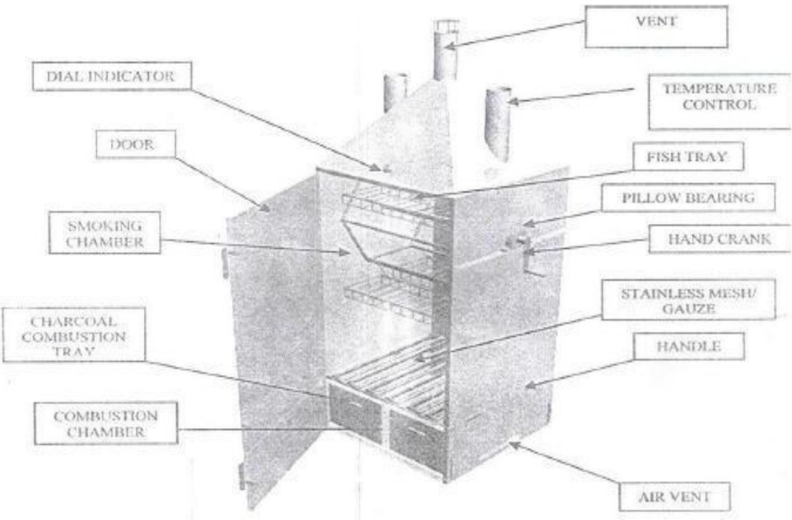


Fig. 2: FUTA Model of Rotary Fish Smoking Kiln

The performance of four evaporative cooling systems fitted with charcoal, coconut husk, jute, and sponge gourd cooling pads was evaluated for the short-term storage of *Corchorus olitorius* (jute) leaves. The hexagonal wooden coolers incorporated a water circulation system and a fan to maintain continuous evaporative cooling. Freshly harvested leaves were stored for eight days and periodically assessed for physiological weight loss, proximate composition, mineral content, and microbial quality. The evaporative coolers maintained temperatures between 12 and 22 °C and relative humidity of 79–99%, thereby creating favourable storage conditions. Storage period and cooling pad type significantly influenced the postharvest quality of the leaves. Physiological weight loss increased with storage time, but the sponge gourd cooling pad consistently recorded the lowest weight loss, indicating superior moisture retention. The apparent increases in protein, carbohydrate, fat, fibre, and ash contents were attributed to moisture loss during storage, while microbial populations, including heterotrophic bacteria, yeasts, and fungi, declined progressively. Overall, the evaporative cooling systems effectively extended the shelf life of the vegetables, reduced microbial deterioration, and preserved their nutritional quality. Among the cooling pads evaluated, sponge gourd proved to be the most effective and is recommended as a low-cost, sustainable technology for reducing postharvest losses of leafy vegetables (Plates 7 a-d) **Olumurewa *et al*; (2023)**

Plate 7: (a) (b) (c) (d)

(a) Evaporative cooler with charcoal pad (b) Evaporative cooler with coconut husk pad (c)Evaporative cooler with sponge pad (d) Evaporative cooler with jute pad

BIOPROCESS ENGINEERING

Famurewa and Babatola (2011), investigated the effect of slurry dilution ratio on biogas production from composite cow, pig, and poultry wastes under mesophilic anaerobic digestion conditions. Three 5-L laboratory digesters were charged with 3.9 kg of slurry prepared at total solids concentrations of 5%, 15%, and 25%, respectively, and monitored for 26 days. The results showed that the digester containing 25% total solids produced the highest cumulative biogas yield of 1.6 L, whereas digesters with 5% and 15% total solids generated only 0.10 L and 0.15 L, respectively. Biogas production in the 5% and 15% treatments ceased after the second day because the solid particles settled out of the slurry, thereby limiting microbial activity. In contrast, the 25% total solids slurry maintained sustained digestion, with the heat generated during active biogas production causing a gradual increase in digester temperature until the twenty-sixth day, after which the temperature declined toward ambient conditions as gas production subsided. The study established that a slurry containing 25% total solids provides the optimum dilution ratio for efficient biogas generation from mixed livestock wastes, whereas lower total solids concentrations result in excessive dilution, solid separation, and poor biogas production.

Alao et al., (2017), studied live fresh *Clarias gariepinus* that were sourced locally, stunned, de-gutted, washed thoroughly with water and cut into pieces of 3 cm length each. Parts of the pieces were dried in the oven for comparison; other portion was smoked with biogas while the rest were used as control. Proximate, mineral, sensory and microbial analyses were carried out on the biogas-smoked and oven dried fish to compare the effect of heat source on the quality. *Clarias gariepinus* dried in the oven gave the highest value of protein (39.88), fat (22.47) and ash content (11.73) and was statistically different from that smoked with biogas and the fresh fish. However, proximate value of fish biogas-smoked (protein 37.83, fat 19.50, ash 8.69) conforms to minimum standard. The observation was similar for mineral content of the oven-dried and biogas-smoked (Na 118.76; K 20.56; Ca 54.63) pieces. The microbial loads of the biogas-smoked pieces (TCB 1.71 x 107, mould 1.25 x 107) were lower than the required minimum values. The sensory evaluation of the biogas smoked pieces was satisfactory (Plates 8 a and b)

Plate 8 (a) Biogas **(b)** fresh *Clarias gariepinus*

Alabi et al; (2022), evaluated the cytotoxic and genotoxic effects of aqueous crude leaf extracts of *P. nigrescens* using the *Allium cepa* root meristem assay, while the volatile organic compounds (VOCs) present in the extract were identified by gas chromatography–mass spectrometry (GC–MS). The extract was prepared with tap water to simulate the traditional method commonly used in Nigeria. Onion bulbs were exposed to extract concentrations ranging from 1% to 50%, with tap water and 10 ppm lead nitrate serving as the negative and positive controls, respectively. The results revealed a concentration-dependent and statistically significant ($p < 0.05$) inhibition of root growth at concentrations between 5% and 50%, indicating cytotoxicity. Significant genotoxic effects were also observed at 10% and 20% concentrations, as evidenced by chromosomal abnormalities including chromosome fragments, disturbed spindle formation, delayed chromosomes, and chromosome stickiness. GC–MS analysis identified 14 volatile organic compounds, with 1,2-benzenediol, 4H-pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl, and 5-hydroxymethylfurfural considered the major contributors to the observed cytogenotoxic effects. The study therefore established that aqueous crude leaf extracts of *P. nigrescens* exhibit cytotoxic and genotoxic properties at high concentrations and should be consumed with caution (Plate 9)

Plate 9: Fresh leaves of *Parquetina nigrescen*

Alabi, et al (2023) studied the cytogenotoxic potential of aqueous leaf extracts of *N. laevis* using both prokaryotic and eukaryotic bioassays. Mutagenicity with the Ames *Salmonella* fluctuation test (TA98 and TA100 strains of *Salmonella typhimurium*) and the SOS Chromotest using *Escherichia coli* PQ37, while cytotoxicity and genotoxicity were assessed using the *Allium cepa* root assay. Volatile organic compounds (VOCs) were identified by gas chromatography–mass spectrometry (GC–MS), and phytochemical screening was also conducted. The Ames test confirmed that the extract was mutagenic, whereas the SOS Chromotest demonstrated slightly greater sensitivity in detecting both mutagenicity and genotoxicity. In the *Allium cepa* assay, the extract produced a significant ($p < 0.05$) concentration-dependent inhibition of root growth from 5% to 50%, with complete inhibition of cell division observed at the 50% concentration. Chromosomal aberrations also increased significantly ($p < 0.05$) between 5% and 20% extract concentrations, indicating marked genotoxicity. The observed mutagenic and cytogenotoxic effects were attributed to the presence of volatile organic compounds, including 1,2,3-benzenetriol, 1,2-benzenediol, and 5-hydroxymethylfurfural, together with alkaloids detected in the extract. The study therefore established that aqueous leaf extracts of *N. laevis* possess significant cytotoxic, genotoxic, and mutagenic properties, even at relatively low concentrations, and should be consumed with caution (Plate 10)

Plate 10: Fresh leaves of *Newbouldia laevis*

Alabi, et al.,(2024) examined the reproductive toxicity of five commercially available sachet water brands in Nigeria using murine sperm count and sperm abnormality assays. Male mice were allowed unrestricted access to the sachet waters for 35 days, after which reproductive, biochemical, and toxicological parameters were assessed. Hormonal analyses included follicle-stimulating hormone (FSH), luteinizing hormone (LH), and total testosterone (TT), while oxidative stress and liver function were evaluated through the activities of catalase (CAT), superoxide dismutase (SOD), alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP). Heavy metal concentrations and physicochemical properties of the sachet waters were also determined. The results revealed that concentrations of arsenic (As), chromium (Cr), and cadmium (Cd) in some of the sachet water samples exceeded the permissible limits established by regulatory agencies. Health risk assessment further showed that the total carcinogenic risk (TCR) and total hazard quotient (THQ) values for both adults and children exceeded acceptable thresholds, indicating significant carcinogenic and non-carcinogenic health risks. Exposure to the sachet waters caused a significant ($p < 0.05$) increase in sperm abnormalities, a reduction in sperm count, and alterations in reproductive hormone levels and biochemical enzyme activities. The study therefore established that some commercially available sachet waters contain contaminants capable of inducing reproductive toxicity and associated health risks, highlighting the need for stricter regulatory surveillance and improved quality control to safeguard public health

Oladele, et al., (2026) studied the effect of selected plant additives on biogas production during anaerobic digestion of cow dung using four 25-L laboratory bioreactors. Three digesters were supplemented with 50 g each of powdered *Azadirachta indica* (neem), *Curcuma longa* (turmeric), and *Carica papaya* (papaya), while a fourth digester containing only cow dung served as the control. Biogas production and microbial populations were monitored over a 30-day digestion period. The results showed that supplementation with plant powders significantly ($p < 0.05$) enhanced biogas production compared with the control. The neem-treated digester produced the highest cumulative biogas yield (0.63 ± 0.03 kg), followed by papaya (0.29 ± 0.09 kg), turmeric (0.25 ± 0.06 kg), and the control (0.17 ± 0.03 kg). A similar trend was observed in microbial populations, with the neem treatment recording the highest bacterial count, followed by papaya, turmeric, and the control. The predominant microbial species identified included *Bacillus*, *Pseudomonas*, *Methanobacterium*, *Lactobacillus*, and *Escherichia coli*. The study established that the addition of plant powders, particularly neem, stimulates microbial activity and significantly improves biogas yield during the anaerobic digestion of cow dung, thereby offering a simple and sustainable strategy for enhancing biogas production.

'PLAYING POKER' WITH FOOD SECURITY: WHY NIGERIA MUST STOP GAMBLING WITH HER FUTURE

Having carefully examined the concepts of food engineering, food security, food processing and preservation, home-grown technologies, renewable energy, and the body of research that my colleagues, students, and I have pursued over the years, one fundamental question remains unanswered:

If solutions abound within our universities and research institutes, why does food insecurity continue to threaten millions of Nigerians?

This question has occupied my mind throughout my academic career. My answer is simple but profound: **Nigeria is playing poker with food security.** The title of this inaugural lecture is not intended as a political slogan or a sensational metaphor. It is an evidence-based description of a national reality.

Poker as earlier defined, is a game characterized by uncertainty, calculated risks, bluffing, and high stakes. Players may appear confident while concealing weak hands, hoping that fortune will eventually favour them. Sadly, this is analogous to Nigeria's approach to food security. We continue to make declarations without corresponding actions; formulate impressive policies without sustained implementation; celebrate scientific breakthroughs without commercializing them; and acknowledge the importance of indigenous technologies while continuing to depend overwhelmingly on imported solutions. In effect, we are wagering with the food security of over 230 million Nigerians.

Government: Strong Policies, Weak Implementation

Successive Nigerian governments have demonstrated that they understand the strategic importance of agriculture and food security. Since independence, numerous agricultural policies and programmes—including the National Accelerated Food Production Programme, Operation Feed the Nation, the Green Revolution Programme, the Agricultural Transformation Agenda, the Agriculture Promotion Policy, and the National Food Security Programme—have sought to increase food production, reduce post-harvest losses, promote mechanization, encourage value addition, and improve rural livelihoods (Federal Ministry of Agriculture and Rural Development [FMARD], 2016; World Bank, 2022).

Yet, despite these laudable initiatives, implementation has often been inconsistent. Political transitions have frequently interrupted programmes before they mature. Funding for research institutions remains inadequate. Agricultural extension services are weak, while commercialization pathways linking universities to industries are underdeveloped. Consequently, many excellent research outputs remain confined to laboratories, conference proceedings, and journal publications instead of being transformed into technologies that improve farmers' productivity and processors' efficiency (UNESCO, 2021; World Bank, 2022). Policies alone cannot guarantee food security. Implementation is what feeds nations.

The Citizenry: Our Silent Contribution to the Problem

If government has paid lip service to food policies, society has often paid insufficient attention to home-grown technologies. One of the greatest obstacles confronting Nigerian innovation is not merely inadequate funding but inadequate confidence. We celebrate imported technologies while questioning locally developed alternatives. Equipment fabricated abroad is frequently assumed to be superior before any objective comparison is made. Entrepreneurs readily invest millions of naira importing foreign machinery but hesitate to collaborate with Nigerian universities to improve locally developed prototypes. Financial institutions perceive indigenous technologies as high-risk investments, while consumers often equate foreign products with higher quality.

This mindset creates a vicious cycle. Low patronage discourages commercialization; limited commercialization reduces industrial confidence; weak industrial confidence discourages investment; and inadequate investment slows technological advancement.

Ironically, the very countries whose technologies we import became technological leaders because they consistently invested in, patronized, refined, and improved their own indigenous innovations.

My Research Journey: Evidence that Solutions Already Exist

Throughout my academic career in Food Engineering, my research has consistently sought practical solutions to Nigeria's food security challenges. My research group has worked on improving food processing technologies, reducing post-harvest losses, developing indigenous food processing equipment and food systems, advancing biomass utilization, promoting value addition to agricultural produce, and enhancing food preservation techniques suitable for Nigerian conditions.

These studies have generated practical technologies capable of improving processing efficiency, reducing energy consumption, minimizing losses, enhancing food quality, creating employment opportunities, and increasing farmers' incomes. The challenge, therefore, has never been the absence of knowledge. The challenge has been the absence of sustained commitment to deploying that knowledge. Indeed, Nigerian universities are not suffering from an innovation deficit. Nigeria is suffering from an implementation deficit.

The Greatest Gamble:

Every abandoned prototype…
Every locally fabricated machine gathering dust…
Every postgraduate thesis that ends on a library shelf…
Every indigenous technology ignored because it bears the label "Made in Nigeria"…
Every policy launched with fanfare but abandoned midway…
Every processing facility without reliable electricity…
Every farmer who loses produce because appropriate preservation technologies remain inaccessible……**represents another hand of poker played with Nigeria's food security**.

And unlike poker, where losses affect only the players, the consequences of this gamble are borne by millions of innocent Nigerians through hunger, malnutrition, unemployment, food inflation, poverty, and increasing dependence on food imports.

From Gambling to Nation Building

Fortunately, this lecture need not end in failure of the system, Nigeria possesses fertile land, abundant renewable energy resources, vibrant entrepreneurs, dedicated researchers, innovative students, resilient farmers, and one of Africa’s largest scientific communities. What remains is the collective resolve to transform knowledge into national prosperity.

Government must move beyond policy formulation to consistent implementation. Funding for research and development must increase. University–industry collaboration must become institutionalized. Indigenous technologies should be deliberately prioritized in public procurement where they meet required standards. Technology incubation centres should be strengthened, while private investors should regard universities as partners in innovation rather than mere teaching institutions.

Industries must recognize that investment in Nigerian technologies is an investment in Nigeria’s economic future. Financial institutions should develop innovation-friendly financing mechanisms for indigenous technological enterprises. Our universities must continue producing researches that solve real societal problems while strengthening commercialization efforts. Most importantly, Nigerians themselves must regain confidence in Nigerian ingenuity.

My Closing Submission

As I conclude this lecture, permit me to submit that **food security is not won on farms alone. It is won in research laboratories, engineering workshops, policy chambers, classrooms, industries, financial institutions, and ultimately in the collective mindset of a nation.**

My life's work has convinced me that Nigeria already possesses many of the scientific and engineering solutions required to transform its food system. Our greatest challenge is not discovering new knowledge. It is **deploying the knowledge we already possess.**

Therefore, I leave this distinguished audience with a simple but urgent proposition:

Nigeria must stop 'playing poker' with food security issues but rather 'invest boldly in our scientists, trust our engineers, empower our farmers, commercialize our research, patronize our home-grown technologies, and implement our policies with consistency and courage'. Only then shall we transform food security from a national aspiration into a national reality.

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First and foremost, I bow in profound gratitude to the Almighty God—the Alpha and the Omega, the Fountain of all wisdom, knowledge, and understanding. Every milestone of my life and career bears unmistakable testimony to His unfailing grace, abundant mercy, and steadfast love. I stand today on this distinguished podium to deliver an Inaugural Lecture, it is not by human strength, intellectual prowess, or personal merit, but by His divine favour and sustaining hand. As the Holy Scriptures declare, *"By the grace of God I am what I am"* (1 Corinthians 15:10), Through countless challenges, uncertainties, and triumphs, He has remained my Refuge, my Strength, and my ever-present Help. In moments when the journey appeared impossible, He made a way where there seemed to be none, faithfully

fulfilling His promises.Every honour I have received, every accomplishment I have attained, and every opportunity to serve in scholarship and humanity belong ultimately to Him. For *"Every good and perfect gift is from above"* (James 1:17

Madam Vice-Chancellor Ma, kindly permit me to pay glowing tribute to my beloved parents of blessed memory, my late father, Pa Kehinde Amos Famurewa, and my late mother, Princess Monisola Grace Famurewa. When I was barely six years old, the duo looked into my eyes and assured me that my education would never be cut short—that you would support me to the highest level possible. You were determined that your children would never endure the hardships and missed opportunities that life had imposed on you. That promise became your life's mission, and you pursued it with unwavering commitment, sacrifice, and unconditional love. Though you are no longer with us physically, I believe that you are rejoicing in Paradise today as you witness the fruits of your labour. Today's honour is a testimony to your sacrifices, your prayers, your discipline, and your steadfast belief in the transforming power of education. Whatever I have become and whatever I have achieved are deeply rooted in the solid foundation you laid. May your gentle souls continue to rest in perfect peace, and may your legacy of love, sacrifice, and godly values remain evergreen in our family. Thank you, Daddy and Mummy. This day belongs to you as much as it belongs to me. Also, to my other parents, late Pa Samuel Olasuji Olojo and Mrs Elizabeth Yemi Olojo, thank you greatly for adopting me as your eldest son. I have no iota of regret for being part of the family.

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Madam Vice-Chancellor ma, I humbly seek your kind permission to conclude mine with the spirit of gratitude. I **return all glory, honour, and adoration to the Almighty God, whose unfailing grace has made this day possible; "*Oba k'E je kaye gbe mi yile*".** With your permission, Ma, I offer my sacrifice of praise with obeisance to God

To God alone be all the glory.

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