

Impact of Food Processing on Nutritional Content and National Health

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An Invited Paper Presentation at the 11th Regional Food Science and Technology Summit (ReFoSTS), NIFST East Central Chapter on June 5th, 2025 at Int'l Conference Centre, I.M.T., Enugu

Introduction

Food processing is a critical component of the food value chain, responsible for transforming raw agricultural commodities into consumable, safe, and shelf-stable food products. As technologies advance, food processing not only determines the sensory and microbiological attributes of food but also significantly influences its nutritional quality and health-promoting potential.

Nutritional content refers to the concentration and balance of essential nutrients in food—macronutrients (proteins, carbohydrates, and fats), micronutrients (vitamins and minerals), water, and dietary fiber. These nutrients are vital for physiological functions such as growth, metabolism, immunity, and disease prevention. The method and intensity of processing can either preserve, enhance, or degrade these nutrients.

Beyond essential nutrients, foods also contain bioactive compounds—such as polyphenols, flavonoids, carotenoids, and phytosterols—which, though not classified as essential, play vital roles in chronic disease prevention and overall health. Their significance necessitates careful consideration during processing interventions.

National health encompasses the overall wellness of a country's population, with nutrition being a foundational pillar. In Nigeria, a growing reliance on highly processed, energy-dense but nutrient-poor foods is contributing to a rise in non-communicable diseases (NCDs) such as obesity, hypertension, and diabetes. These trends not only strain the healthcare system but also reduce national productivity.

Food scientists, nutritionists, and policymakers must therefore critically examine how different food processing methods influence nutrient integrity and public health outcomes. This presentation explores the various stages and types of food processing, highlighting their impact on nutritional content and national health in the Nigerian context.

What is Food Processing? An Overview of Key Techniques

Food processing can be defined in multiple ways, depending on context and purpose:

1. "Any deliberate change in a food that occurs before it is available for consumption" (Augustin et al., 2016).
2. "All methods and techniques used by the food, drink and associated industries to turn whole fresh foods into food products" (Monteiro et al., 2010).
3. "Any method used to turn fresh food into food products" (EUFIC, 2022).
4. Food processing also encompasses fortification—adding components such as vitamins and minerals to improve the nutritional quality of food (EUFIC, 2025).

Drawing from these perspectives, food processing may be defined as any physical, chemical, or biological method applied to raw or fresh foods to improve safety, extend shelf life, enhance quality, or increase convenience.

Stages of Food Processing

Food processing generally occurs at three key stages:

- i. **Primary Processing:** Involves the initial handling of raw materials (e.g., cleaning, milling, refrigeration, dehydration). While essential for food safety, nutrient losses—especially of heat- or light-sensitive vitamins—may occur.
- ii. **Secondary Processing:** Converts primary materials into edible forms through cooking, baking, fermenting, etc. This stage often improves digestibility and nutrient bioavailability (e.g., fermentation of cereals).
- iii. **Tertiary Processing:** Involves creating ready-to-eat or convenience foods (e.g., breakfast cereals, infant formula). This stage adds commercial value but may involve significant nutrient modification or dilution.

Food Processing Methods

Food processing in Nigeria can be broadly categorized as:

1. Traditional Food Processing

These are low-cost, culturally rooted methods used in households and small-scale enterprises.

Examples: Drying (sun-dried fish), fermentation (ogi), smoking (meat or fish), salting, boiling.

Features: Labor-intensive, environmentally friendly, may have variable safety/quality depending on hygiene.

2. Modern Food Processing

Industrial-scale techniques using advanced technology for mass production to enhance food safety, extend shelf life, improve quality, and meet large-scale demands.

Examples: Pasteurization, canning, extrusion, freezing, vacuum packaging, fortification.

Features: Higher efficiency, standardized safety and quality, may involve additives, more expensive and technology-dependent.

Aspect	Traditional Processing	Modern Processing
Technology	Low-tech/manual	High-tech/machine-driven
Scale	Household/local	Industrial/global
Cost	Low	High initial investment
Shelf Life	Short to moderate	Extended
Control	Variable	Regulated and standardized
Nutritional Impact	Nutrient retention varies	Can enhance or degrade nutrients

Effects of Food Processing on Nutritional Content

Positive Impacts

1. **Fortification and Enrichment:** This improves the nutritional quality of foods by adding essential nutrients lost during processing or not present naturally (e.g., iodized salt, iron-fortified cereals).
2. **Enhanced Bioavailability:** Processing can break down anti-nutritional factors or complex structures, making nutrients easier for the body to absorb (e.g., **Fermentation of legumes** reduces phytates, enhancing iron and zinc absorption while **cooking tomatoes** increases bioavailability of lycopene - a powerful antioxidant which has been linked to a reduced risk of prostate cancer).
3. **Nutrient Preservation:** Techniques like freezing or vacuum packing help retain vitamins.
4. **Functional Foods:** Incorporation of probiotics or omega-3s for targeted health benefits.
5. **Food Safety:** Thermal processing reduces microbial risk, making food safer and reducing disease-related malnutrition (e.g., **pasteurization of milk** prevents diseases like tuberculosis and improves public health outcomes).

6. **Improved Digestibility:** Heat processing enhances digestibility of proteins and complex carbohydrates (e.g., **cooking legumes** like beans makes protein more digestible and reduces flatulence-causing compounds).

Negative Impacts

1. **Loss of Heat-Sensitive Nutrients:** High temperatures during cooking, canning, or pasteurization can destroy vitamins. E.g., Vitamin C and B-complex vitamins.
2. **Destruction of Enzymes and Bioactive compounds:** Processing may inactivate beneficial enzymes and bioactive compounds. E.g., myrosinase in cruciferous vegetables, an enzyme essential for activating cancer-fighting compounds is destroyed by cooking.
3. **Loss of Dietary Fiber:** Refining processes strip bran and germ. E.g., **white rice and white flour** lose most of their fibre, bran, and germ during milling.
4. **Nutrient Dilution:** Processed foods may have added sugars, starches, and fats that lower the nutrient density. E.g., **instant noodles** and **sugary breakfast cereals** may provide calories with minimal vitamins and minerals.
5. **Formation of Harmful Compounds:** Some methods (e.g., frying or smoking) can produce toxic compounds. E.g., acrylamide in fried snacks; **nitrosamines** can form in cured meats and are linked to cancer risk.
6. **Overconsumption Risks:** Excess sodium, sugars, and unhealthy fats are commonly added in some processed foods. E.g., **canned soups, processed meats, and snack foods** can lead to high **salt intake**, increasing the risk of hypertension.
7. **Loss of Nutrient Interactions:** The natural balance between nutrients in whole foods may be altered or lost. E.g., whole fruits provide fiber, vitamins, and phytochemicals together; **fruit juice** removes fiber and can cause rapid sugar absorption.

Nigeria: Traditional and Emerging Practices

In Nigeria, food processing is predominantly traditional, relying on time-tested, low-cost techniques such as fermentation, drying, boiling, and frying. These methods are culturally rooted and essential for enhancing food preservation, reducing toxic compounds, and improving digestibility.

1. Cassava-Based Products

Traditional processing into gari, fufu, and lafun helps detoxify cassava. The traditional processing sequence typically involves peeling, grating, fermenting, pressing, and toasting/garrifying. While fermentation effectively reduces toxic cyanogenic glycosides, thermal processing during toasting leads to the loss of heat-sensitive nutrients such as vitamin C and some B-complex vitamins (Fellows, 2009; FAO, 2001).

2. Cereal-Based Foods

Cereal products like *ogi* (fermented maize or sorghum gruel) undergo soaking, fermentation, and milling. These processes improve mineral bioavailability by reducing antinutritional factors like phytates and tannins (Mensah and Tomkins, 2003). However, protein losses and microbial contamination may occur if hygienic practices are not adequately followed.

3. Street Foods

Street foods such as fried yam, *puff-puff*, *akara*, and *suya* are widely consumed in urban settings due to their affordability and convenience. These foods are often prepared using deep-frying methods with reused oil, which may generate harmful compounds like acrylamide. Additionally, the high fat and salt content of these foods raises concerns over their long-term health effects.

Implications for National Health

The nature and extent of food processing in Nigeria have far-reaching implications for public health. As the country continues to rely heavily on traditional processing methods with an increasing adoption of modern techniques at the industrial level, the outcomes on nutritional well-

being and disease patterns are becoming more pronounced. These outcomes are shaped by how processing affects nutrient preservation, dietary patterns, and food safety, ultimately influencing national health indicators.

1. Contribution to Nutrient Deficiencies or Excesses

Food processing can either support or hinder adequate nutrient intake. Traditional methods such as fermentation and drying enhance the bioavailability and preservation of micronutrients, but may also lead to losses—especially of heat-sensitive vitamins like vitamin C and thiamine. For example, during the toasting of gari or boiling of vegetables, water-soluble vitamins may be significantly reduced.

On the other hand, some industrially processed (modern) foods in Nigeria are refined to the extent that they lose much of their original nutrient content. The increased consumption of products such as white bread, refined cereals, sweetened beverages, and instant noodles—often with little or no fortification—contributes to nutrient dilution. This dual scenario has led to both micronutrient deficiencies (especially iron, vitamin A, and zinc) and excess intake of calories, sugar, and sodium, depending on socioeconomic status and access.

2. Role in the Rise of Non-Communicable Diseases

The increasing consumption of tertiary processed foods in Nigeria is contributing to a shift from traditional diets rich in whole grains, legumes, and vegetables to energy-dense, nutrient-poor diets. Street foods and processed snacks, though culturally popular and affordable, are often high in salt, sugar, and saturated fats. This dietary transition has been linked to the rising incidence of non-communicable diseases (NCDs) such as obesity, hypertension, and type 2 diabetes, particularly in urban populations.

In many cases, the appeal of convenience, affordability, and taste in processed foods overshadows their potential health risks, especially when consumed frequently and in large quantities. Without adequate consumer awareness and regulatory control, the burden of diet-related diseases is likely to grow.

3. Influence on Food Security and Dietary Diversity

Food processing plays a vital role in improving food security in Nigeria by reducing post-harvest losses and extending the availability of seasonal crops. Traditional processing techniques like drying and smoking enable rural households to store food for long periods, while modern technologies such as canning and refrigeration help extend shelf life and improve distribution. However, reliance on a narrow range of highly processed foods, especially in urban areas, can diminish dietary diversity. When processed foods made from refined wheat, rice, or maize become staple components of the diet, they often displace more diverse, nutrient-rich traditional foods. This has implications for the adequacy of micronutrient intake and overall dietary quality.

4. Public Health Burden and Healthcare Costs

The nutritional consequences of food processing contribute significantly to Nigeria's double burden of malnutrition—where undernutrition coexists with rising levels of overweight and diet-related diseases. In rural communities, undernutrition is often linked to monotonous diets centered around overprocessed staples with limited nutrient value. In contrast, in urban areas, excessive intake of calorie-rich processed foods is driving an increase in NCDs.

The resulting health challenges place pressure on an already strained healthcare system. Costs associated with treating chronic conditions like hypertension and diabetes are rising, both at household and national levels. Poor nutritional status also reduces productivity, impairs cognitive development, and increases absenteeism from school and work, all of which have long-term socioeconomic implications.

Current Strategies and Interventions

The Nigerian food system is undergoing rapid transformation due to urbanization, population growth, and changing dietary habits. While food processing plays a critical role in ensuring food availability and reducing post-harvest losses, it also poses challenges to public health when not aligned with nutrition objectives. In response, several strategies and interventions have been introduced to ensure food processing supports national health and nutritional security.

1. Nutrition-Sensitive Innovations

In Nigeria, nutrition-sensitive food processing focuses on developing affordable, culturally acceptable, and nutrient-rich food products, particularly for vulnerable populations such as children, pregnant women, and internally displaced persons (IDPs).

- Promotion of the use of local crops (e.g., orange-fleshed sweet potato, moringa) in complementary foods.
- Some Small and Medium Enterprises (SMEs) fortify traditional snacks with nutrient-rich ingredients.
- Promotion of low-heat, nutrient-retentive techniques. E.g., simple interventions like **solar drying, minimal heat application, and improved packaging** help reduce post-processing nutrient loss while ensuring food safety.

2. Food Labeling and Regulation

Nigeria has made efforts to develop food safety and labeling regulations, although enforcement remains limited.

- i. **NAFDAC Regulations:** The **National Agency for Food and Drug Administration and Control (NAFDAC)** mandates nutrition labeling on packaged foods and regulates the use of additives, though compliance is inconsistent across markets.
- ii. **Fortification Initiatives:** Under the **National Food Fortification Programme**, staple foods such as **wheat flour, sugar, and vegetable oil** are fortified with **vitamin A, iron, and zinc**. These efforts are coordinated by the **Federal Ministry of Health, NAFDAC, and private sector partners**.

Challenges: Many processed foods in open markets are unlabeled, and a significant proportion of consumers lack the literacy or awareness to interpret nutrition information effectively.

3. Public Awareness and Education

Nutrition-related public health campaigns in Nigeria are essential for correcting misconceptions about processed foods and guiding healthier consumption patterns.

- i. **Community-Level Sensitization:** Health extension workers, particularly under the **Primary Health Care (PHC)** system, often provide community education on **infant and young child feeding (IYCF)** and the dangers of excessive consumption of fried snacks and sugary beverages.
- ii. **Media Outreach:** Initiatives like the **"Eat Healthy, Live Long"** campaign and nutrition radio jingles sponsored by **UNICEF, FMOH, and local NGOs** have been used to discourage high intake of processed and ultra-processed foods.
- iii. **School-Based Programs:** School feeding programs and nutrition clubs in secondary schools are increasingly being used to promote the consumption of indigenous, minimally processed foods such as **moi-moi, beans, plantain, and vegetables**.

4. Professional and Policy Engagement

Tackling the double burden of malnutrition in Nigeria requires coordinated efforts among food scientists, public health professionals, and policymakers.

- i. **Food Technologists:** Nigerian universities and research institutes (e.g., **Federal Institute of Industrial Research Oshodi – FIIRO**) have developed locally adaptable technologies for producing nutritious snacks, weaning foods, and shelf-stable products using indigenous raw materials.

- ii. **Nutritionists and Dietitians:** Through platforms like the **Nutrition Society of Nigeria (NSN)**, professionals are advocating for evidence-based dietary guidelines and nutrition-sensitive food systems.
- iii. **Policy Frameworks:** The **National Policy on Food and Nutrition (2021)** and the **National Strategic Plan of Action for Nutrition (2014–2019)** outline multisectoral approaches to improving nutrition, including integrating nutrition objectives into agricultural and food industry policies.
- iv. **Public-Private Partnerships:** Collaborative efforts involving SMEs, development partners, and government agencies are being leveraged to scale up production of fortified and processed foods that meet both safety and nutritional standards.

Recommendations

1. **Promote Minimally Processed, Nutrient-Dense Foods:** Scale up traditional and innovative methods that preserve nutrients.
2. **Encourage Product Reformulation:** Reduce salt, sugar, and trans fats in processed foods.
3. **Strengthen Food Regulations:** Improve food labeling and enforce standards.
4. **Invest in Research and Development:** Enhance local processing technologies and encourage public-private partnerships.

Conclusion

Food processing in Nigeria serves as both a solution and a challenge. When aligned with health objectives, it supports food security, dietary diversity, and public well-being. However, when dominated by nutrient-poor formulations and inadequate oversight, it contributes to the rise in diet-related diseases. A strategic focus on nutrition-sensitive processing, effective regulation, and public awareness will ensure that food processing remains a driver of improved national health outcomes.