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Advancing food processing in Africa: Challenges, innovations and opportunities report on the IUFoST scientific roundtable

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Abstract

This contribution summarizes the outcome of a Scientific Roundtable Discussion webinar, jointly organized by the International Union of Food Science and Technology (IUFoST) and the Association of African Universities (AAU) on the topic of *Advancing Food Processing in Africa*. The event focused on addressing challenges such as post-harvest losses, especially of traditional and indigenous crops, limited infrastructure to scale up traditional processing technologies, difficulties in securing a consistent supply of quality ingredients for the food sector, and the confusion created by some food classification systems. Discussions emphasized the importance of multi-stakeholder collaborations to explore opportunities for value addition to agro-produce in Africa through sustainable and nutrition-focused food processing with retention of bioactive compounds, thereby enhancing food security and economic growth on the continent.

Keywords: Africa; (Traditional) food processing; Smallholder farmers; First mile approach; IUFoST Formulation & Processing Classification Scheme; Valorization; Bioactives.

1. Introduction

The Scientific Roundtable on Advancing Food Processing in Africa: Challenges, Innovations, and Opportunities, jointly organized by the International Union of Food Science and Technology (IUFoST) and the Association of African Universities (AAU), convened a diverse group of distinguished experts, researchers, policymakers, and participants from around the world. Held on January 21, 2025, this webinar explored strategies for scaling up food processing technologies in Africa to enhance food security, economic growth, and sustainability.

It was emphasized that food processing is not merely about transforming farm produce to palatable and shelf-stable products, but also has implications for food safety and public health. For example, it was discussed that African traditional food fermentations improve nutritional quality by increasing the digestibility of proteins and release of bioactive compounds, while improving the bioavailability of minerals and *de novo* synthesis of vitamins (Hotz and Gibson, 2007). Also, some of the microorganisms used in the fermentation process could health-promoting probiotics (Setta et al., 2020). Moreover, lactic acid bacteria of traditional fermentations produce antimicrobials such as lactic acid, propionic acid, diacetyl and bacteriocins, thus improving the safety and extending the shelf life of the product (Mokoena, et al., 2016). A key focus

of these remarks that were given was the importance of traditional fermentation techniques in assuring food security and health. It was explained how these methods help eliminate toxic substances, such as cyanogenic glycosides in cassava, which can otherwise lead to fatal hydrogen cyanide poisoning. Dietary exposure to hydrogen cyanide from cassava products in Africa is well reported in the scientific literature (Padmaja and Steinkraus, 1995; Kobawila, et al., 2005; Nebiyu and Getachew, 2011; Apeh, et al., 2021). To underscore this point, references were made to food safety incidents including cases in Nigeria in 2024 (Azubuike, 2024), and Uganda in 2017 (Alitubeera, et al., 2019), where improper cassava processing resulted in deaths. These incidents, highlight the urgent need for scientific advancements and the scaling up of food processing technologies across the continent.

2. Scaling up traditional food processing technologies in Africa

It was emphasized that the deep cultural and economic significance of traditional food processing, noting that it is an integral part of African heritage and plays a vital role in sustaining local economies (Aworh, 2023). Addressing the challenges in traditional food processing, several key barriers to efficiency were highlighted. For example, many traditional methods rely on manual labour and localized equipment, resulting in inconsistencies in product quality. The lack of mechanization makes large-scale production difficult, limiting the potential for expansion. Additionally, many traditional foods and processing techniques struggle to meet regulatory and health standards, which hinders their acceptance in formal markets (Oguntoyinbo, 2014).

It was further stressed the need to scale up traditional food processing technologies, outlining the numerous benefits of doing so. Enhancing these technologies would significantly improve food security by increasing food availability, creating employment opportunities for young people in food processing industries, and enabling African food products to compete on the continent and in global markets. Strategic approaches to achieving this goal were then outlined. Investment in research and development was highlighted as being crucial for the advancement of food processing technologies, while capacity building through training programmes could empower small-scale processors. Public-private partnerships could attract the necessary investment and ensure market access, while governmental support through policies, tax incentives, and grants would provide the necessary financial and regulatory framework. Collaboration between research institutions and processors was also highlighted as essential for implementing new technologies effectively.

Successful examples of scaling traditional food processing were mentioned, including mechanized cassava processing in Nigeria, which has led to the production of high-quality cassava flour. The expansion of fermented dairy products from Ethiopia into markets beyond Africa, as well as advancements in drying and dehydration methods through the use of solar and hybrid dryers, were also mentioned. Additionally, standardisation of fermentation technologies has been introduced to ensure product consistency and safety.

In conclusion, it was emphasized that researchers, policymakers, industry leaders, and traditional food producers work together to scale up food processing technologies while preserving their authenticity and nutritional value. It was emphasized that a collaborative approach is essential for achieving sustainable food systems that benefit both local communities and the broader African economy.

3. Positioning processed and ultra-processed foods in food classification systems-policy and regulatory implications

The significance of food classification systems and their impact on food policy and regulation that support information to the public, whether through food labelling measures or overall consumer awareness initiatives was discussed. It was mentioned that food classification systems include the reliance on the level of processing as one of the parameters to categorize foods accordingly. The intent is to have a classification system addresses nutritional and societal impacts of dietary choices, but also touches on policies and decisions related to the need to address the possible inherent risks of chronic diseases which are associated with food.

The growing influence of food classification systems in shaping food regulatory policies, consumer awareness, and public health initiatives was highlighted, as reported (Moubarac, et al., 2014; Monteiro et al., 2018; Cuj et al., 2021). It was pointed out that while these systems aim to categorize foods based on processing levels (unprocessed or minimally processed foods, processed culinary ingredients, processed foods, and ultra-processed foods), they often oversimplify the complex relationship between food processing and health outcomes, given that the foods are subjected to more than processing but also formulation change, which includes added sugars, fats or salt. A word of caution against the tendency to associate all processed foods with negative health effects was noted, stressing that food processing encompasses a broad range of techniques that improve food safety, shelf life, and nutritional value. Processing includes a wide range of physical, chemical, and biological operations that enhance flavour, texture and even the accessibility to foods, which is crucial in Africa, where food processing is an important contributor to food safety and food security.

The misconceptions about processed foods, such as the belief that all processed foods are unhealthy, was stressed, as well as how such views can hinder the adoption of essential food preservation techniques like freezing and pasteurization. These methods play a crucial role in maintaining food safety and reducing food waste, particularly in regions like Africa where food security remains a pressing issue. Furthermore, the work of the IUFoST task force dedicated to developing a scientifically sound and methodologically robust food classification system was noted along with the importance of collaboration between food science and nutrition experts, citing ongoing partnerships with the International Union of Nutritional Sciences as a key step in ensuring that classification frameworks are well-informed and evidence-based.

The need for continued research and dialogue to refine food classification methodologies, support consumer education, and inform policy decisions such as front-of-pack labelling, marketing restrictions, and food taxation policies was emphasized. IUFoST's commitment to advancing food science for the benefit of global food security and public health was reiterated.

4. 'First mile approach to building a resilient and competitive food processing sector in Africa'

The role of food science and technology in advancing Africa's food processing sector was comprehensively analysed. The importance of integrating traditional knowledge with modern scientific approaches to enhance food security, nutritional quality, and economic opportunities across the continent was also emphasised. The key challenges facing the industry, including inadequate infrastructure, limited access to advanced processing technologies, and the need for regulatory harmonization across African nations

was highlighted. It was stressed that one of the challenges faced by food manufacturers in Africa is the challenge of securing ingredients/raw materials of consistent quality and quantity for their operations. Several examples of case studies across Africa on how the 'first mile approach' could improve the competitiveness and quality of food processing in Africa caried out by UNIDO was presented.

The first-mile approach – a reference to the setting up of produce collection or consolidation points within one mile of farms is an effective strategy used in the agricultural sector to control post-harvest changes to food products and limit product losses was discussed. The first mile approach, originally developed for the transportation/service delivery sector (Strover, 2000), has been applied in other sectors, including agriculture. It is particularly important for small-holder farmers, and works on the principle that a service (e.g., cold storage or drying facilities) will be located in a central location that is within one mile of selected farm locations. The relatively quick access to such facilities, coupled with training to farmers, goes a long way in assuring product quality and preventing or reducing post-harvest losses. The central location of these facilities also means that food manufacturers only need to visit these locations and have access to various products that are grouped, sorted, and processed or packaged based on certain desired criteria.

Several case studies and success stories of the use of the first mile approach in the food processing sector were provided. For example, the installation of a drying facility in an East African country, through the first mile approach, significantly reduced inconsistencies in quality of products supplied to the World Food Program. Other examples mentioned included the training of local farmers and establishment of a first mile locations for vanilla, moringa, and sesame production in Madagascar, Ethiopia, and Sudan respectively. The successes achieved in the aforementioned cases have led to private sector involvement and export of products from those countries. Importantly, when local farmers are given a demonstration of how first mile approaches work and the value it creates for the food supply chain, farmers are often self-motivated to adopt post-harvest practices that assure product quality and maintains the premium status of their produce.

Thus, to improve food processing in Africa, small holder farmers are important players that should not be ignored. There is also a need to look at the source of food ingredients and work with local farmers to establish first mile locations to act as collection points for their products, thereby increase the quality and quantities of raw materials, and competitiveness of farm produce.

5. Food processing for nutrition, diet and health, on refining the role of processing in food classification systems

The science-driven approach to food structuring and processing as a crucial enabler of sustainable food production and nutrition was explained. The necessity of understanding food structure at multiple levels, from molecular composition to macroscopic properties, to develop healthier, more efficient, and environmentally friendly food products, as mentioned in Joardder et al. (2017), was also emphasised. In this, three fundamental principles that guide innovations in food processing were outlined. The first was material and process engineering, which focuses on optimizing the conversion of raw materials through physical, chemical, and biological transformations. The second was sustainable food structuring, which leverages advanced technologies to design foods with enhanced nutritional profiles and improved functional properties. While, the third was digitalization and modelling, where computational tools are utilized to enhance process efficiency and predict food behaviour with greater accuracy. There was also a discussion on the transformative potential of alternative proteins, emulsions, and bio-based materials in developing novel food structures. The importance of food classification systems being scientifically grounded, cautioning against oversimplified categorizations that fail to capture the complexities of food processing was emphasized.

Some of the limitations of the NOVA classification system (proposed in Monteiro et al., 2018) were explained. Namely, 1) this system conflates 'formulation' with 'processing', 2) does not quantify the extent to which one might describe a product as being 'formulated' or 'processed', and 3) is based on a weak correlation between consumption of foods in certain NOVA food classes and health risks. The work of the IUFOST Task Force on Food Processing for Nutrition, Diet and Health in developing the IUFoST Formulation & Processing Classification (IF&PC) scheme was discussed. The IUFOST IF&PC scheme has recently been published (Ahrné, et al., 2025).

The key difference between formulation, i.e., systematic selection of relative quantities of ingredients for a food product, and processing, i.e., treatment of a food materials to achieve a desired effect was noted. The IF&PC scheme integrates the impact of formulation on nutrition value, and how this scheme does it was discussed. Case in point, to tease out the impact of formulation, the nutrient-rich food (NRF) index is used and computes the difference between quantities of 'qualifying nutrients' (i.e., those nutrients whose intake are encouraged, e.g., protein, fibre, vitamins, bioactive compounds, etc.), and 'disqualifying nutrients' (i.e., those nutrients whereby excessive intake are discouraged, e.g., sodium, added sugar, saturated fats) expressed as portion base (e.g., per 100 g of food or per kCal or per serve).

The impact of processing uses process analysis methodology, which relies on mass and energy balance entering and exiting a processing system. The changes in the NRF index of a food before and after processing therefore is the impact of processing on that food. The coupling of both parameters yields the food processing and formulation index (FPFI), which is a mathematical equation for the quantitative estimation of how various formulation and processing affects the nutrient value of food.

A classification matrix diagram was used to explain and give scenarios on how FPFI can be used in everyday settings. For example, the fortification of a food product with essential minerals would increase the qualifying nutrient factor in the equation, leading to a positive outcome on the NRF, while added sugars would do the reverse. When this product is then subjected to processing, e.g. thermal processing, any changes in the nutrient content can be reliable quantified to access how the nutrition of the product changed with processing.

There was also elaboration on how the IF&PC system could be extended and applied to consider other areas of interest to consumers such as anti-nutrient contents. With the aid of a classification matrix diagram, the speaker explained how the value of processing in reducing anti-nutrients in food could be quantified using the IF&PC. Other areas of application of this system include sustainability, palatability, safety, convenience, affordability, and digestibility.

The need for interdisciplinary collaboration between food scientists, engineers, industry partners, and policymakers was again noted and stressed. It was also emphasized that innovation in food processing must be driven by scientific research and technological advancements to ensure sustainable and nutrition-focused solutions that address global food challenges. Captured in Figure 1

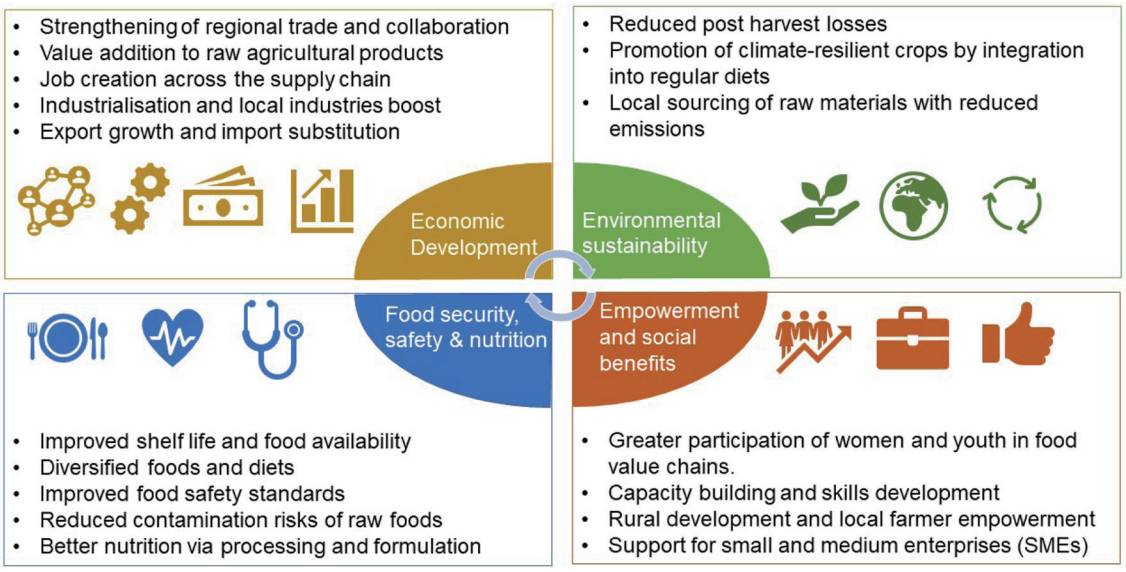

Figure 1. Some benefits of advancing food processing in Africa.

is a schematic showing some benefits of food processing and the interdependence among them.

6. Questions and answers

6.1. Technology communication and intellectual property in scaling up traditional food processing

Questions were asked about the technological advancements that have been made in the food processing area and what effective mechanisms there are to inform smallholder farmers of these. Additionally, a question was posed on how Intellectual Property (IP) rights are handled when scaling up traditional technologies. In response, it was proposed to establish technological incubation centres in rural areas to enhance knowledge transfer. The role of educational institutions including universities, was also noted, particularly in modifying curricula to incorporate entrepreneurship training, which would empower young graduates, even those outside food science disciplines, to engage in food processing. Short-term micro-credential courses were suggested as a means of equipping interested graduates with relevant skills.

Addressing the financial constraints of scaling up, the need for government and financial institutions to provide credit facilities to local food producers was mentioned. Encouraging investment in food processing by young entrepreneurs was also identified as a critical step toward sustainable growth. Regarding Intellectual Property, it was clarified that IP tools allow businesses to safeguard their innovations in the food industry. It was advised that innovators to file patents for their unique creations to establish ownership and secure their rights over the resulting benefits.

6.2. Sustainability of communal dryers and the role of hydroponics in Africa

The communal use of dryers in the first mile location was questioned as to how shared facilities were maintained and managed, to ensure sustainability. It was explained that communal dryers were not provided as donations but were granted to producer associations that co-invested in the purchase. Governance structures were established before the assets were acquired, and business plans were developed to ensure the facilities' long-term sustainability. The operational model included a pay-per-use system, ensuring that maintenance costs were covered. Typically, these facilities were handed over to cooperatives that were already engaged in commercial activities, such as aggregation and market supply.

Drawing from experience in Ethiopia, it was elaborated that capacity-building efforts before asset acquisition was necessary. When working with women's cooperatives, for example, knowledge-sharing programs were implemented by taking these women to learn from successful cooperatives, particularly in the coffee sector. This hands-on exposure ensured that beneficiaries understood management and operational aspects before receiving new infrastructure. It was further emphasized that capacity-building need to precede infrastructure provision, for sustainability.

The role of hydroponics in Africa's food industry was another topic of interest. On that topic, its potential was noted but it was stressed the need for gradual introduction through demonstration projects. An example was cited where solar pumping technology was introduced to Sudanese farmers in the sesame production trade. Initially hesitant, the farmers only adopted the technology after witnessing it in operation. It was noted that universities play a critical role in demonstrating new technologies, bridging the gap between research and practical applications. The need for financial support to help researchers take their innovations beyond academic institutions and into commercial markets was emphasized. It was proposed that governments and private sector partnerships should provide funding and policy support to facilitate technology transfer. Finally, the importance of linking smallholder farmers and SMEs with private sector players was highlighted, to ensure successful commercialization of research-based innovations.

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