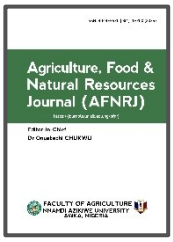
*Agr. Foo. Nat. Res. J. Volume 5, Issue 2, Page: 98-107*

**e-ISSN: 1597-7153 | p-ISSN: 3043-5420**

**Agriculture, Food and Natural Resources Journal**

***The Official Journal of the Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Nigeria***

Journal homepage: https://journals.unizik.edu.ng/afnrj




Review Article

# Food fraud in sub-saharan Africa: awareness, challenges, impacts, and strategies for strengthening food integrity systems

OPEN ACCESS

Paul Abuh OMALE[1,3]*, David Eno ABEL[2], Stephen Owoicho ADAKOLE[1] & Braveson Obiefo UDOJI[3]

[1]*Department of Agricultural and Biosystems Engineering, Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria*
2*Department of Crop Science, Federal University of Agriculture, Zuru, Kebbi State, Nigeria*
[3]*Department of Agricultural and Environmental Engineering, University of Maiduguri, Borno State, Nigeria*

**DOI:** https://doi.org/10.5281/zenodo.23099637

***Editor:*** *Onyekachi CHUKWU, Nnamdi Azikiwe University, NIGERIA*

***Received:*** *July 8, 2026*
***Accepted:*** *September 20, 2026*
***Available online:*** *September 30, 2026*

***Peer-review:*** *Externally peer-reviewed*

**Copyright:** © 2026 Author(s)
*This is an open access article licensed under Creative Commons Attribution 4.0 International License (https://creativecommons.org/licenses/by/4.0/) which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.*

**Conflict of Interest:** *The authors have no conflicts of interest to declare*

***Financial Disclosure:*** *The authors declared that this study has received no financial support.*

**ABSTRACT**

*Food fraud represents a growing global food integrity challenge with significant implications for food safety, public health, and trade, particularly in developing regions such as Africa. This review critically examines food fraud awareness among key stakeholders, challenges hindering effective control, and resulting impacts on African food systems. Recent peer-reviewed literature was synthesized to evaluate consumer awareness, institutional readiness, and industry practices across diverse African contexts. Findings reveal that food fraud awareness remains generally low to moderate and uneven across countries and stakeholder groups. Over a third of Nigerian consumers were unfamiliar with the term "food fraud" (2024), while Ghanaian studies (2022–2023) reported awareness ranging from 46% to over 70%, depending on the issue assessed. Similarly, Ghanaian and Nigerian consumers expressed the highest food fraud concern in a multi-country sub-Saharan African survey (2022–2023), reflecting lower confidence in food safety and quality. Consumers largely associate food fraud with basic adulteration, while complex forms such as species substitution and origin misrepresentation remain poorly understood. Regulatory and institutional responses are constrained by fragmented governance structures, weak enforcement capacity, inadequate laboratory infrastructure, and limited adoption of advanced detection technologies. Food fraud impacts extend beyond economic losses to public health risks, reduced consumer confidence, and barriers to regional and international trade. The review highlights the need for strengthened regulatory frameworks, improved analytical capacity, enhanced consumer education, and digital traceability systems. Regional cooperation and technological innovation are essential for addressing food fraud and safeguarding food integrity and sustainable food systems across Africa.*

**KEYWORDS:** *Consumer awareness, Food authenticity, Food safety, Traceability, Public health*

## INTRODUCTION

Food fraud has become a major global challenge, threatening food safety, public health, consumer confidence, and international trade. It involves the intentional substitution, adulteration, dilution, misrepresentation, or falsification of food products for economic gain (Kyrgiakos *et al*., 2024). Unlike accidental food contamination, food fraud is deliberate and increasingly sophisticated, driven by globalization, complex and opaque supply chains, and the rapid expansion of food markets (Spink *et al*., 2019; Fernando *et al.,* 2025). Consequently, food fraud has emerged as a significant concern for governments, food industries, and consumers worldwide.

Although closely related, the concepts of food fraud, food adulteration, food safety, food authenticity, and food integrity

*Corresponding author: omale.paul@uam.edu.ng

are not synonymous, and precise use of these terms is essential for scholarly analysis. Food integrity is the broadest, overarching concept, encompassing food safety, food quality, food authenticity, and food fraud as interconnected dimensions of a trustworthy food system (Kyrgiakos *et al*., 2024). Food safety refers to the absence of unintended, hazardous contamination — biological, chemical, or physical — that could harm consumers; food safety incidents are typically unintentional. Food fraud, by contrast, is intentional and economically motivated: it is a collective term encompassing the deliberate substitution, addition, tampering, dilution, or misrepresentation of food, ingredients, or packaging, or false or misleading claims made about a product for financial gain (CEN, 2024). Food adulteration is one specific manifestation of food fraud, involving the addition, removal, or replacement of a food's authentic components with inferior, cheaper, or undeclared substances; while most adulteration is fraudulent, not all food fraud takes the form of adulteration, as fraud also includes counterfeiting, diversion, and mislabelling (CEN, 2024). Food authenticity, meanwhile, concerns whether a food product genuinely matches the claims made about its origin, species, ingredients, or production method, and is therefore the positive condition that food fraud undermines (Kyrgiakos *et al*., 2024).

The impacts of food fraud extend beyond economic losses to include serious public health risks arising from undeclared allergens, toxic chemicals, prohibited additives, and inferior ingredients (Sharma *et al*., 2024). High-profile incidents, such as the melamine-adulterated infant formula crisis, have demonstrated the potentially devastating consequences of economically motivated adulteration and highlighted the need for stronger food authenticity systems (Fernando *et al*., 2025). Recent advances in analytical technologies have improved fraud detection, however, preventing food fraud remains challenging because fraudulent practices continue to evolve (Annadurai *et al*., 2024).

Africa is particularly vulnerable to food fraud due to rapid population growth, increasing urbanization, food insecurity, fragmented food supply chains, weak regulatory enforcement, and limited food authentication infrastructure (Onyeaka *et al*., 2024; Fernando *et al*., 2025). These vulnerabilities are compounded by the predominance of informal and unregulated food markets, under-resourced laboratory infrastructure, and limited harmonization of food safety and quality standards across regional economic communities such as ECOWAS and the East African Community. Reported cases across the continent include adulteration of edible oils, dairy products, cereals, spices, honey, meat, fish, beverages, and processed foods. In countries such as Nigeria, Ghana, Kenya, and Tanzania, food fraud has been associated with counterfeit products, adulterated palm oil, recycled cooking oils, contaminated spices, and falsified food labels, posing significant threats to consumer health and market integrity (Soon-Sinclair *et al*., 2023).

Consumer surveys further indicate widespread concern regarding food fraud across sub-Saharan Africa, with many consumers reporting previous experiences of purchasing adulterated or falsely labelled food products (Soon-Sinclair *et al*., 2023). Nevertheless, awareness of food fraud remains relatively low, limiting consumers' ability to identify fraudulent products and increasing their vulnerability to associated health and economic risks (Onyeaka *et al*., 2024).

Despite increasing global attention to food fraud, Africa remains underrepresented in food fraud research. Existing studies are concentrated in only a few countries and are largely based on isolated case reports and regulatory alerts, leaving substantial gaps in understanding the extent, drivers, awareness, and impacts of food fraud across the continent (Tefera & Chekol, 2025). This lack of comprehensive evidence constrains the development of effective policies and intervention strategies for improving food integrity and consumer protection.

Therefore, this study systematically reviews the current state of food fraud in Africa by examining stakeholder awareness, identifying key challenges to food fraud prevention and control, and evaluating its impacts on food safety, public health, and trade. The findings are expected to provide evidence that will support policymakers, regulatory agencies, researchers, and the food industry in strengthening food authenticity systems and enhancing food security across Africa.

## AVAILABLE FOOD FRAUD AWARENESS EVIDENCES FROM SELECTED SUB-SAHARAN AFRICAN COUNTRIES

### Concept of Food Fraud Awareness

Food fraud awareness refers to the extent to which stakeholders recognize, understand, and respond to intentional practices that compromise the authenticity, quality, and integrity of food for economic gain. Unlike general food safety awareness, which focuses primarily on accidental contamination and hygienic practices, food fraud awareness encompasses knowledge of economically motivated adulteration, substitution, dilution, counterfeiting, mislabeling, and falsification throughout the food supply chain (Spink & Moyer, 2011; Spink *et al*., 2019). It also includes the ability to identify vulnerable food products, appreciate the associated health and economic risks, and adopt appropriate preventive or reporting measures.

Food fraud awareness is increasingly recognized as a critical component of food integrity systems because fraudulent practices often exploit information asymmetry between producers, regulators, and consumers. Consequently, awareness influences purchasing behaviour, compliance with food regulations, effectiveness of surveillance programmes, and the overall resilience of food supply chains (Fernando *et al*., 2025). Recent studies have emphasized that improving awareness among all stakeholders is as important as strengthening analytical detection methods because informed

consumers and trained food business operators provide an essential first line of defence against fraudulent practices (Annadurai *et al*., 2024).

Studies such as; Sprink *et al.*, 2019; Costa *et al*., 2024; Charlebois *et al*., 2026; conceptualizes food fraud awareness as a multidimensional construct comprising cognitive, behavioural, and institutional dimensions. The cognitive dimension relates to stakeholders' knowledge of different forms of food fraud, vulnerable commodities, and associated health, economic, and legal consequences. The behavioural dimension reflects the extent to which this knowledge influences purchasing decisions, supplier verification, product authentication, and reporting of suspected fraud. Institutional awareness encompasses the capacity of regulatory agencies, food industries, academic institutions, and professional organizations to recognize emerging fraud risks and implement effective prevention, surveillance, and enforcement strategies (Spink *et al*., 2019; Sharma *et al*., 2024).

Although this conceptual framework is widely accepted, evidence suggests that awareness remains uneven across regions and stakeholder groups. In developed economies, continuous consumer education, mandatory traceability systems, advanced analytical technologies, and strong regulatory oversight have contributed to relatively high awareness of food authenticity issues. Conversely, many developing countries continue to face significant awareness deficits arising from weak regulatory systems, inadequate consumer education, limited laboratory capacity, fragmented food supply chains, and the predominance of informal food markets (Fernando *et al.*, 2025).

These challenges are particularly evident in Africa, where food systems are characterized by rapid urbanization, expanding informal markets, increasing food imports, and limited institutional capacity for food control. Although awareness of food safety has improved across many African countries over the past decade, food fraud remains a relatively unfamiliar concept among many consumers and even some food business operators (Onyeaka *et al.*, 2024). In many instances, consumers readily recognize obvious forms of adulteration, such as dilution of milk or contamination of edible oils, but are less familiar with sophisticated fraudulent practices involving species substitution, counterfeit branding, geographical origin fraud, or ingredient misrepresentation. This discrepancy demonstrates that recognizing isolated fraudulent practices does not necessarily translate into a comprehensive understanding of food fraud as a broader food integrity issue.

Furthermore, awareness varies considerably among stakeholder groups. Consumers primarily rely on visible product characteristics, price, and vendor reputation when assessing authenticity, while food business operators often associate food fraud with regulatory compliance and supply chain management. Regulatory agencies generally possess greater technical knowledge but frequently face resource constraints that limit effective surveillance and enforcement. Academic institutions contribute through research and capacity building; however, translation of scientific knowledge into practical awareness programmes remains limited in many African countries (Fernando *et al*., 2025)

Another important dimension emerging from recent literature is the growing influence of digital communication on food fraud awareness. Social media platforms, mobile authentication technologies, and online consumer networks have substantially increased public access to information regarding counterfeit and adulterated food products. While these technologies enhance information dissemination and consumer engagement, they also facilitate the rapid spread of misinformation, highlighting the need for evidence-based public communication strategies supported by regulatory authorities and scientific institutions (Kyrgiakos *et al*., 2024).

**African Consumer Awareness/Perception of Food Adulteration and Fraud**

Consumer awareness is widely recognized as a key driver of food fraud prevention because informed consumers influence market behaviour through purchasing decisions, demand for transparency, and reporting of suspicious products. Across Africa, however, awareness remains uneven, shaped by disparities in education, income, urbanization, access to information, and regulatory effectiveness (Soon-Sinclair *et al.*, 2023, Onyeaka *et al*., 2024). Although awareness has increased following high-profile food fraud incidents, many consumers still lack a comprehensive understanding of its diverse forms and implications (Table 1).

Evidence shows that most African consumers associate food fraud mainly with visible adulteration or counterfeit products, such as diluted milk, adulterated oils, expired goods, and fake alcoholic beverages. In contrast, more complex forms such as species substitution, origin misrepresentation, ingredient falsification, and document fraud are less understood (Soon-Sinclair *et al*., 2023; Onyeaka *et al*., 2024). This limited perception reduces consumers' ability to detect emerging and sophisticated fraud risks within modern food supply chains. Awareness also varies significantly across demographic groups. Urban consumers generally demonstrate higher awareness due to better access to education, formal retail systems, digital media, and consumer protection campaigns. Rural consumers, by contrast, rely heavily on informal markets where trust-based transactions often replace formal quality assurance systems (Fernando *et al.*, 2025). While this trust may reduce perceived risk, it does not eliminate exposure to fraudulent products introduced earlier in the supply chain.

**Table 1. Empirical studies of African consumer awareness/perception of food adulteration and fraud**

| Country/Region | Study | Sample | Stakeholder | Commodity | Key Finding | Determinant | Limitation |
|---|---|---|---|---|---|---|---|
| Ethiopia (Southern) | Ayza & Yilma (2014) | NS | Consumers | Milk | 95% were aware of milk adulteration | Not tested | Single region/commodity; descriptive |
| Ghana (Volta) | Essuman *et al*. (2022) | 384 | Consumers | Mixed foods | >70% knew about adulteration; smell and price used for detection | Not tested | Single-sex, convenience sample; self-reported |
| Nigeria | Onyeaka *et al*. (2024) | 2,160 | Consumers | Mixed foods | >1/3 did not understand "food fraud" despite recognising some fraud cases | Socio-economic, education, culture, infrastructure | Cross-sectional; self-reported |
| Ethiopia (Borana) | Amenu *et al*. (2024) | 240 | Consumers | Milk | Adulteration suspicion: 73.1% rural vs. 91.7% urban | Rural/urban residence | Small, single-zone sample; suspicion ≠ verified knowledge |
| Ghana, Nigeria, Kenya, South Africa, Tanzania, Cameroon | Soon-Sinclair *et al*. (2023) | 838 | Consumers | Staple/premium foods | 85% were worried/very worried about food fraud; concern differed significantly by country | Country/region; information trust | Uneven country samples; exploratory measure |

*NS = Not specified.*

Educational level remains a strong determinant of awareness, as more educated consumers are better able to interpret food labels, recognize certification marks, and evaluate authenticity claims (Kyrgiakos *et al*., 2024). However, education alone is insufficient, since many fraud types cannot be detected through visual inspection or labeling information. Socioeconomic status further influences consumer behaviour. Higher-income households tend to purchase from supermarkets and certified outlets with better traceability systems, while lower-income consumers prioritize affordability and often rely on informal markets, increasing vulnerability to adulterated products (Ha *et al.*, 2021). This highlights the challenge of aligning food fraud interventions with economic realities in low-income settings.

Regional differences are also evident. Countries such as South Africa, Kenya, Ghana, and Nigeria show relatively higher awareness due to stronger regulatory presence and increased media attention. However, awareness remains concentrated in urban centres, with rural populations still significantly underserved (Onyeaka *et al.*, 2024).

A major concern is the gap between awareness and action. Although many consumers express concern about food fraud, few actively verify product authenticity or report suspected cases due to limited trust in regulatory systems, lack of awareness of reporting channels, and weak enforcement mechanisms (Soon-Sinclair *et al.*, 2023). Digital technologies are beginning to influence awareness through social media, mobile verification systems, and online information sharing. However, their impact is constrained by digital literacy gaps, infrastructure limitations, and unequal access to smartphones. Misinformation on digital platforms also presents new challenges for risk communication (Soon-Sinclair *et al.*, 2023). Overall, consumer awareness in Africa is improving but remains insufficient to effectively deter food fraud. Strengthening education, improving regulatory communication, and integrating digital and community-based awareness strategies are essential to enhance consumer protection and food system integrity.

**Awareness among Food Business Operators**

Food business operators occupy a central position in food supply chains and therefore play a critical role in preventing, detecting, and responding to food fraud. Their level of awareness directly influences supplier selection, raw material verification, implementation of traceability systems, vulnerability assessments, and compliance with food integrity standards (Ha *et al*., 2021; Phan *et al*., 2024).

Large-scale food manufacturers, multinational companies, and export-oriented enterprises generally demonstrate relatively high awareness of food fraud because they operate under stringent national and international regulatory requirements. Many have adopted internationally recognized food safety management systems that incorporate food fraud vulnerability assessments, supplier auditing, ingredient authentication, and risk-based quality assurance programmes. Compliance with standards such as the Global Food Safety Initiative (GFSI) benchmarked schemes, ISO 22000, and Hazard Analysis and Critical Control Point (HACCP) systems has further strengthened awareness of economically motivated adulteration within formal food industries (Fernando *et al.*, 2025). For these organizations, food fraud prevention is driven not only by regulatory compliance but also by the need to protect brand reputation, maintain export market access, and preserve consumer confidence.

In contrast, awareness among small and medium-sized enterprises (SMEs), which dominate Africa's food processing sector, remains comparatively limited. Many SMEs continue to associate food quality primarily with microbiological safety while paying relatively little attention to intentional adulteration or authenticity verification. Limited financial resources, inadequate technical expertise, restricted access to laboratory services, and insufficient regulatory engagement often prevent these enterprises from implementing systematic food fraud prevention measures (Annadurai *et al.*, 2024). Consequently, SMEs may unknowingly introduce fraudulent ingredients into supply chains or become victims of fraud perpetrated by upstream suppliers.

The informal food sector presents an even greater challenge. Informal food vendors, street food operators, market traders, and small household processors account for a substantial proportion of food distribution across Africa but generally operate outside formal regulatory frameworks. Most possess considerable practical knowledge of food quality based on experience and sensory evaluation (Ha *et al.*, 2021); however, relatively few recognize food fraud as a distinct concept encompassing complex forms of adulteration, substitution, and counterfeiting. Their understanding is largely based on observable quality defects rather than systematic food authenticity principles. This distinction is important because sophisticated fraud involving chemical adulteration, species substitution, or falsified documentation often cannot be detected through traditional sensory assessment alone (Onyeaka *et al*., 2024).

Abebe *et al.* (2020) in their study found predominantly export-oriented firms had 5.5× higher odds of implementing ISO 22000 food safety management than domestically-oriented firms; market orientation (export vs. domestic) was a key driver of certification uptake. Onyeaka and Anyogu, (2022) also noted from their study that the bulk of domestic food trade in Africa occurs via informal supply chains characterized by low compliance with international standards and weak regulatory enforcement, contributing to persistent food fraud vulnerability. Businesses supplying formal retail chains, export markets, or institutional buyers are generally more aware of food fraud risks because customers increasingly demand traceability, certification, and documented quality assurance. Conversely, operators serving informal local markets often face intense price competition and weak regulatory oversight, reducing incentives to invest in authenticity verification (Njiru *et al*., 2025). This imbalance contributes to persistent disparities in food fraud awareness throughout African food supply chains and highlights the need for targeted capacity-building programmes for SMEs and informal food enterprises.

Collectively, current evidence demonstrates that awareness among African food business operators remains highly heterogeneous. While significant progress has been achieved within the formal food industry, awareness deficits persist among SMEs and informal sector operators, who collectively account for a large proportion of food production and distribution across the continent. Addressing these disparities will require expanded training programmes, improved access to affordable food authentication technologies, stronger supplier verification systems, and closer collaboration between regulatory agencies, industry associations, and academic institutions (Njiru *et al*., 2025).

**Africa Food Safety Agency, Regulatory and Institutional Awareness**

Regulatory and institutional awareness of food fraud refers to the extent to which government agencies, standards organizations, and related institutions recognize food fraud as a distinct policy and enforcement issue and possess the capacity to respond effectively. Across Africa, institutional awareness has improved in recent years, largely due to increased global attention to food integrity, participation in international food safety networks, and exposure to trade requirements (Table 2). However, this awareness has not consistently translated into effective operational capacity or coordinated enforcement systems (Spink *et al.,* 2019).

**Table 2: Documented Food Fraud Cases and Regulatory Responses in Selected African Countries**

| Country | Commodity | Fraud Type | Detection Method | Health/Economic Impact | Regulatory Response | Reference |
|---|---|---|---|---|---|---|
| Nigeria | Tomato paste | Dilution (below required content) | Lab compositional analysis (NAFDAC/FSAN) | Consumer deception; economic loss | Recall recommendation; 2019 Adulterated Food Regulations | Onyeaka *et al.* (2024), Foods |
| Ghana | Palm oil | Sudan IV dye adulteration | Market surveillance + spectroscopy/chromatography (FDA) | Carcinogenicity risk; trader harm | FDA-Police raids; enhanced surveillance | Nyorkeh *et al.* (2024), Food & Function |
| Kenya | Maize flour | Aflatoxin contamination | Surveillance sampling + ELISA/HPLC | Liver cancer risk; child stunting | KEBS product recalls | Hoffmann *et al.* (2025); Omulo (2021) |
| South Africa | Processed meats | Species substitution/mislabeling | DNA/PCR, ELISA | Religious/ethical violation; economic deception | DTI labelling investigation | Cawthorn *et al.* (2013), Food Control |
| Ethiopia | Milk | Water adulteration | Physicochemical testing | Reduced nutrition; economic loss | Calls for stronger enforcement | Ayza & Yilma(2014), Njiru *et al.* (2025) |

In many African countries, food regulatory systems historically focused on traditional food safety concerns such as microbiological contamination, hygiene, and basic chemical hazards, with limited attention to economically motivated adulteration (Fernando *et al*., 2025). The emergence of food fraud as a distinct regulatory priority is therefore relatively recent. Even where agencies demonstrate conceptual awareness, practical implementation remains constrained by limited resources, fragmented mandates, and weak inter-agency coordination.

**Role of Media, Education, and Digital Technologies**

Media, education systems, and digital technologies play an increasingly important role in shaping food fraud awareness across Africa. Traditional media channels such as radio, television, and print media have historically been the primary sources of food safety information. However, coverage of food fraud tends to be episodic and reactive, often increasing only after major incidents involving counterfeit or adulterated food products (Madjdian *et al.,* 2024).

Radio remains the most influential medium in rural and low-literacy populations due to its accessibility and linguistic diversity. Nevertheless, structured and sustained programming specifically addressing food fraud remains limited in most countries. Television and newspapers, while more common in urban areas, tend to focus on high-profile regulatory actions rather than continuous public education on food authenticity (Oyeaka *et al.*, 2024; Madjdian *et al.,* 2024). Digital media has significantly transformed awareness dynamics in recent years. Social media platforms such as Facebook, WhatsApp, and X (formerly Twitter) have become major channels for rapid dissemination of food safety information. These platforms enable consumers to share experiences, report suspected fraud, and circulate warnings about counterfeit products in real time. However, they also present challenges related to misinformation, unverified claims, and panic-driven responses, which may undermine trust in food systems if not properly managed (Soon-Sinclair *et al*., 2023). Emerging mobile-based technologies are increasingly being deployed to enhance food authenticity awareness. These include SMS verification systems, QR code tracking, and mobile-based product authentication platforms that allow consumers to verify product legitimacy before purchase. While promising, the adoption of these technologies remains uneven due to digital literacy constraints, infrastructure limitations, and affordability barriers, particularly in rural areas (Oyeaka *et al.*, 2024; Madjdian *et al.,* 2024).

Education systems across Africa also play a critical but underutilized role in food fraud awareness. At present, food fraud is rarely included as a standalone topic in primary and secondary school curricula. At tertiary level, awareness is more advanced within food science, nutrition, and agricultural engineering programmes, but integration into broader consumer education remains limited. This lack of structured educational exposure contributes to persistent knowledge gaps among young consumers entering the food market.

Collectively, media, education, and digital technologies represent important but underexploited tools for enhancing

food fraud awareness in Africa. Their effectiveness depends on coordinated communication strategies, integration with regulatory systems, and efforts to bridge the digital divide between urban and rural populations (Soon-Sinclair *et al*., 2023; Karolenko, 2024).

## IMPACT OF FOOD FRAUD ON FOOD SAFETY, PUBLIC HEALTH, AND TRADE IN AFRICA

Food fraud presents wide-ranging consequences that extend beyond economic deception to include significant threats to food safety, public health, and international trade. In Africa, these impacts are particularly severe due to weak regulatory systems, high dependence on informal food markets, and limited analytical capacity for food authentication. Recent evidence shows that food fraud undermines the integrity of food systems, erodes consumer confidence, and exacerbates existing vulnerabilities in food security and nutrition (Sharma *et al*., 2024; Fernando *et al*., 2025).

### Impacts on Food Safety

Food fraud directly compromises food safety when adulterated or misrepresented products contain harmful substances, undeclared additives, or contaminated ingredients. Economically motivated adulteration often introduces chemical hazards such as industrial dyes, unauthorized preservatives, toxic solvents, and substandard substitutes that pose serious risks to consumers (Annadurai *et al*., 2024). In many African contexts, reported cases of adulterated edible oils, contaminated spices, and counterfeit beverages highlight the persistent intersection between fraud and food safety risks.

A major concern is that food fraud is frequently undetected using routine food safety inspections because it is intentional and often designed to evade standard detection methods. Unlike accidental contamination, fraudulent practices are adaptive and evolve in response to regulatory enforcement, making them more difficult to control using conventional food safety frameworks (Brooks *et al.*, 2021). Consequently, food safety systems that focus primarily on microbiological hazards may fail to capture the broader risks posed by fraud-related contamination. In addition, adulteration of staple foods can lead to cumulative exposure to harmful substances, particularly in populations that rely heavily on single food sources. This is especially critical in Africa, where staple foods such as grains, oils, and milk products are widely consumed and often sourced through informal markets with limited quality assurance (Shuping & Lebelo, 2026).

### Public Health Impacts

The public health implications of food fraud are substantial and multidimensional. Consumption of adulterated foods may result in acute poisoning, long-term chronic diseases, nutritional deficiencies, and exposure to carcinogenic compounds. Documented cases globally and within Africa include the use of toxic dyes in spices, dilution of milk with contaminated water, and substitution of animal proteins with undeclared or unsafe alternatives (Sharma *et al*., 2024).

Giannakas & Yiannaka, (2023) emphasize that food fraud is increasingly recognized as a "silent public health threat" because its health effects are often under reported or misdiagnosed as general food borne illnesses. This under reporting is particularly problematic in African settings where surveillance systems for food borne diseases are limited and diagnostic capacity is weak. As a result, the true burden of disease attributable to food fraud is likely underestimated.

Vulnerable populations, including children, pregnant women, and low-income households, are disproportionately affected due to their higher dependence on affordable, informal food markets. In such contexts, food fraud contributes not only to acute health risks but also to long-term nutritional insecurity by reducing food quality and nutrient availability (Fernando *et al.*, 2025). Furthermore, repeated exposure to low-level contaminants from adulterated foods may contribute to chronic health conditions such as liver damage, kidney dysfunction, and endocrine disruption. These long-term effects are rarely captured in routine public health reporting systems, further masking the full impact of food fraud on population health in Africa (Thystrup *et al.*, 2025).

### Economic Impacts

Food fraud generates significant economic losses across the entire food supply chain. At the global level, food fraud is estimated to cost the food industry tens of billions of dollars annually through direct losses, recalls, litigation, and reputational damage (Spink *et al*., 2019). In Africa, although precise estimates are limited due to weak reporting systems, the economic burden is believed to be substantial, particularly for smallholder farmers, food processors, and informal traders.

One of the key economic consequences is market distortion. Fraudulent products sold at lower prices undermine fair competition by disadvantaging legitimate producers who adhere to quality standards. This creates an uneven playing field where unethical operators gain short-term financial advantage, discouraging investment in quality assurance systems (Brooks *et al.*, 2021). Additionally, food fraud increases transaction costs across supply chains. Companies and regulatory agencies must invest in testing, certification, auditing, and traceability systems to mitigate fraud risks. These costs are often passed on to consumers, indirectly increasing food prices and exacerbating food insecurity in low-income populations (Sharma *et al.*, 2024). At the agricultural level, farmers may also suffer income losses when counterfeit inputs such as seeds, fertilizers, or agrochemicals enter the market. Such fraud undermines productivity and reduces trust in agricultural input systems, further weakening rural livelihoods.

### Impacts on Trade and Market Access

Food fraud significantly affects both domestic and international trade by undermining confidence in the authenticity and safety

of exported food products. Countries with weak food control systems may face trade restrictions, rejection of exports, and reputational damage in global markets. This is particularly relevant for African countries that rely on agricultural exports such as cocoa, coffee, fish, spices, and horticultural products (Kareem *et al*., 2023).

International trading partners increasingly require strict compliance with food authenticity and traceability standards. Failure to meet these requirements can result in border rejections and trade bans, which have long-term implications for national economies (Fernando *et al*., 2025). For example, incidents of contamination or adulteration can trigger heightened inspection requirements, increase the cost of exports and reduce competitiveness.

Within regional African markets, food fraud also undermines trade integration efforts. The African Continental Free Trade Area (AfCFTA) aims to promote intra-African trade; however, persistent food fraud challenges may hinder harmonization of standards and reduce trust between trading partners. Without robust harmonized food control systems, cross-border trade remains vulnerable to fraudulent practices that distort market efficiency (AfFSA, 2026).

**Impact on Consumer Confidence and Food Systems Integrity**

Beyond direct health and economic effects, food fraud significantly erodes consumer trust in food systems. When consumers lose confidence in the authenticity of food products, they may shift purchasing behaviour, avoid certain food categories, or rely on informal verification methods that are not scientifically reliable (Charlebois *et al*., 2016; Costa *et al*., 2024)).

Low consumer confidence can also weaken compliance with regulatory systems, particularly when enforcement is perceived as ineffective. Over time, this undermines the legitimacy of food control institutions and reduces the effectiveness of public health interventions (Giannakas & Yiannaka, 2023). In Africa, where informal markets dominate food distribution, maintaining consumer trust is essential for food system stability. Persistent exposure to fraud risks without adequate regulatory response may therefore have long-term consequences for food system resilience (Onyeaka *et al.*, 2026).

**Synthesis of Impacts**

Overall, food fraud in Africa represents a multidimensional threat that simultaneously affects food safety, public health, economic stability, and trade performance. The interplay between these impacts highlights the systemic nature of food fraud, which cannot be addressed through isolated interventions. Instead, integrated approaches involving regulatory strengthening, technological innovation, consumer education, and regional cooperation are required to mitigate its effects and protect African food systems.

## CHALLENGES

The key challenge is the uneven distribution of technical expertise within regulatory institutions. While senior officials engaged in international trade and Codex Alimentarius processes often demonstrate high awareness of food fraud concepts, frontline inspectors and laboratory personnel frequently lack specialized training in authenticity testing and fraud detection methodologies (Annadurai *et al*., 2024). This gap creates a disconnect between policy-level awareness and field-level implementation capacity.

Institutional awareness is further weakened by limited surveillance infrastructure and inadequate data systems. Many food control agencies lack integrated databases for tracking food fraud incidents, identifying recurring offenders, or monitoring trends across supply chains. As a result, institutional responses tend to be reactive, triggered by public complaints or media reports rather than proactive risk-based monitoring systems (Sharma *et al*., 2024).

At the regional level, awareness is improving through initiatives led by organizations such as the African Union, FAO, and WHO, which promote harmonized food control systems and risk-based inspection frameworks. However, implementation across regional economic communities remains inconsistent, and cross-border information sharing on food fraud incidents is still limited. This fragmentation reduces the ability of institutions to respond effectively to transnational fraud networks operating across African food systems.

Overall, while institutional awareness of food fraud in Africa is increasing, it remains constrained by capacity limitations, weak coordination mechanisms, and insufficient integration of fraud-specific considerations into national food control systems.

## CONCLUSION AND RECOMMENDATIONS

Food fraud is a growing threat to food safety, public health, and trade in Africa. This review shows that although awareness is increasing, it remains uneven across consumers, food business operators, and regulatory institutions. Weak regulatory systems, fragmented supply chains, and limited technical capacity continue to enable fraudulent practices. The impacts are significant, ranging from health risks and economic losses to reduced consumer trust and trade barriers. A coordinated and system-wide approach is therefore essential to effectively address food fraud in Africa.

Food fraud legislation should be strengthened with clear definitions and enforcement mechanisms. Laboratory and analytical capacity must be improved through investment in modern detection technologies and staff training. Digital traceability systems, including blockchain and QR-based tools, should be adopted to enhance transparency. Consumer and industry awareness programs should be expanded, particularly for SMEs and informal operators. Regional collaboration under frameworks such as AfCFTA should be strengthened to address cross-border fraud. Finally, more research and innovation are

needed to develop affordable, context-specific solutions for African food systems.

**Acknowledgments**

The authors sincerely appreciate the management of Joseph Sarwuan Tarka University (JOSTUM), Makurdi, through the Department of Agricultural and Biosystems Engineering, College of Engineering for providing access to essential academic resources and information through the College and University Library at no cost. This support greatly facilitated the literature review and completion of this research. We are grateful for the University's continued commitment to supporting academic research and scholarship.

**Authors' Contributions**

PAO brought the idea and reviewed the first draft of the manuscript. SOA searched for literature and wrote the first draft of the manuscript. DEA managed the literature searches. BOU reviewed the manuscript and funded the paper writing

**Ethical Statement**

Not applicable

**AI Declaration Statement**

The authors declare that ChatGPT and Grammarly were used for improving the manuscript structure and for language editing/grammar correction, respectively. All outputs were critically reviewed, verified, and approved by the authors, who accept full responsibility for the content of the manuscript.

**REFERENCES**

Abebe, G. K., Bahn, R. A., Chalak, A., & Yehya, A. A. K. (2020). Drivers for the implementation of market-ased food safety management systems: Evidence from Lebanon. *Food Science & Nutrition*, 8(1), 539–549. https://doi.org/10.1002/fsn3.1394

Amenu, K., Shibiru, A., Kumbe, A., Konyole, S. O., Jaleta, M. B., & Tiki, W. (2024). Perceptions of rural and urban residents in Borana pastoral and agro-pastoral areas in Ethiopia related to milk adulteration. *BMC Nutrition*, 10, 66. https://doi.org/10.1186/s40795-024-00876-4

Annadurai, V., Dar, O. I., Liu, Z., & Jia, A. Q. (2024). Advanced detection tools in food fraud: A systematic review for holistic and rational detection methods based on research and patents. *Food Chemistry, 448*, 139078. https://doi.org/10.1016/j.foodchem.2024.139078

Ayalew, A., Kareem, F. O., & Grace, D. (2023). *A paradigm shift in food safety for Africa*. International Livestock Research Institute (ILRI) & AKADEMIYA2063. https://hdl.handle.net/10568/126767

Ayza, A., & Yilma, Z. (2014). Patterns of milk and milk products adulteration in Boditti town and its surrounding, South Ethiopia. *Scholars Journal of Agriculture and Sciences*, 4(10), 512–516.

Brooks, C., Parr, L., Smith, J. M., Buchanan, D., Snioch, D., & Hebishy, E. (2021). A review of food fraud and food authenticity across the food supply chain. *Food Control, 130*,108171. https://doi.org/10.1016/j.foodcont.2021.108171

Cawthorn, D.-M., Steinman, H. A., & Hoffman, L. C. (2013). A high incidence of species substitution and mislabelling detected in meat products sold in South Africa. *Food Control*, 32(2), 440–449. https://doi.org/10.1016/j.foodcont.2012.12.036

CEN (European Committee for Standardization). (2024). BS N17972:2024-Food authenticity- Food authenticity and fraud-Concepts, terms and definitions.

Charlebois, S., Schwab, A., Henn, R., & Huck, C. W. (2016). Food fraud: An exploratory study for measuring consumer perception towards mislabeled food products and influence on self- authentication intentions. *Trends in Food Science & Technology*, 50, 211–218. https://doi.org/10.1016/j.tifs.2016.02.003

Costa, M. J., Sousa, I., Moura, A. P., Teixeira, J. A., & Cunha, L. M. (2024). Food Fraud Conceptualization: An Exploratory Study with Portuguese Consumers. *Journal of Food Protection*, 87(7), 100301. https://doi.org/10.1016/j.jfp.2024.100301

Essential Guide to Africa Food Safety Agency (AfFSA) Compliance in 2026 and Beyond." *Food Systems Africa*, 2026. https://foodsystems.africa/affsa-compliance/

Essuman, E. K., Teye, E., Dadzie, R. G., & Sam-Amoah, L. K. (2022). Consumers' knowledge of food adulteration and commonly used methods of detection. *Journal of Food Quality*, 2022, 2421050. https://doi.org/10.1155/2022/2421050

Fernando, I., Fei, J., Cahoon, S., & Close, D. C. (2024). Emerging technologies and systems to mitigate food fraud in supply chains. *Critical Reviews in Food Science and Nutrition, 64*(18), 6261–6285. https://doi.org/10.1080/10408398.2024.2405840

Giannakas, K., & Yiannaka, A. (2023). Food fraud: Causes, consequences, and deterrence strategies. *Annual Review of Resource Economics, 15*, 85–104. https://doi.org/10.1146/annurev-resource-101422-013027

Ha, T. M., Shakur, S., & Pham Do, K. H. (2021). Food risk in consumers' eye and their consumption responses: Evidence from Hanoi survey. *Journal of Asian Business and Economic Studies*, 28(2), 86–100. https://doi.org/10.1108/JABES-12-2019-0126

Hoffmann V, Ndisio B, Barasa A, Okoth S, Murphy M (2025) Aflatoxin contamination of maize flour in Kenya: Results from multi-city, multi-round surveillance. PLoS One 20(11): e0336687. https://doi.org/10.1371/journal.pone.0336687

Kamilaris, A., Fonts, A., & Prenafeta-Boldú, F. X. (2019). The rise of blockchain technology in agriculture and food supply chains. *Computers and Electronics in Agriculture, 162*, 725–743. https://doi.org/10.1016/j.compag.2019.05.043

Karolenko, C. (2024, April 30). Hashtags and Hazards: The Dubious Influence of Social Media Trends on Food Safety. *Food Safety Magazine*. https://www.food-safety.com/articles/9434-hashtags-and-hazards-the-dubious-influence-of-social-media-trends-on-food-safety

Kyrgiakos, L. S., Hazimeh, M., Vasileiou, M., & Tzora, A. (2024). The food fraud landscape: A brief review of food safety and authenticity. *Proceedings, 94*(1), 6. https://doi.org/10.3390/proceedings2024094006

Madjdian, D. S., van Asseldonk, M., Talsma, E. F., Amenu, K., Gemeda, B. A., Girma, S., Roesel, K., Grace, D., Knight-Jones, T. J. D., & de Vet, E. (2024). Impact of a mass-media consumer awareness campaign on food safety behavior and behavioral determinants among women in Dire Dawa and Harar, Ethiopia. *Food Control*, 163, 110509. https://doi.org/10.1016/j.foodcont.2024.110509

Mphaga, K. V., Moyo, D., & Rathebe, P. C. (2024). Food safety and control systems in South Africa: A critical review. *BMC Public Health, 24*, Article 1123. https://doi.org/10.1186/s12889-024-1123-x

Njiru, J. M., Njeru, E., Kang'iri, J., Lunani, I., Rotich, H., Muriira, G., Tombito, C., & Nyaboga, E. N. (2025). Food fraud in selected sub-Saharan Africa countries: a wake-up call to national regulatory bodies to support enforcement and food safety. *Frontiers in Food Science and Technology*, 5, 1499271. https://doi.org/10.3389/frfst.2025.1499271

Nnaji, N. D., Onyeaka, H., Ughamba, K. T., Ononugbo, C. M., Olovo, C. V., & Mazi, I. M. (2025). *Chemical Toxicants Used for Food Preservation in Africa: Is it a Case of Ignorance or Food Fraud? A Review.* Health Science Reports, 8(4), e70333. https://doi.org/10.1002/hsr2.70333

Nyorkeh, R., Teye, E., Essuman, E. K., Haughey, S. A., Logan, N., & Elliott, C. T. (2024). 18 year analysis of RASFF notifications on Sudan dye adulterated cases in palm oil (2004 to 2022) and the principles of the technique for its detection. *Food & Function*. Royal Society of Chemistry. https://doi.org/10.1039/D3FB00190C

Onyeaka, H., Anyogu, A., Odeyemi, O. A., Ukwuru, M. U., Eze, U., Isaac-Bamgboye, F. J., Anumudu, C. K., Akinwunmi, O. O., Sotayo, O. P., & Jeff-Agboola, Y. A. (2024). Navigating food fraud: Asurvey of Nigerian consumer knowledge and attitudes. *Foods*, 13(20), 3270. https://doi.org/10.3390/foods13203270

Onyeaka, H., Kahu,J.C., Nwajagu, I.U., Okoye, I.U.,Umar, A.T., Okotie, H.O. & Ogun, S.O. (2026). Advancing safe, culturally relevant nutrition in Africa: Digital health, innovation and regulation, Food and Humanity, 6,101210, https://doi.org/10.1016/j.foohum.2026.101210.

Phan, U. T. X., Tran, C. T. T., & Nguyen, N. M. T. (2024). Socioeconomic constraints on low-income individuals' perceptions toward food safety. *Journal of Sensory Studies*, 39(3), e12918. https://doi.org/10.1111/joss.12918

Poláková, K., Bobková, A., Demianová, A., Bobko, M., Jurčaga, L., Mesárošová, A., Čapla, J., Timoracká, I., Lidiková, J., & Čeryová, N. (2024). Adulteration in food industry in 2023 – Overview. *Journal of Microbiology, Biotechnology and Food Sciences*, 13(6), e11048. https://doi.org/10.55251/jmbfs.11048

Robson, K., Dean, M., Haughey, S., & Elliott, C. (2021). Food fraud terminology and mitigation strategies. *Food Control, 120*, 107516. https://doi.org/10.1016/j.foodcont.2020.107516

Sharma, R., Nath, P. C., Lodh, B. K., Mukherjee, J., Mahata, N., Gopikrishna, K., Tiwari, O. N., & Bhunia, B. (2024). Rapid and sensitive approaches for detecting food fraud: A review on prospects and challenges. *Food Chemistry*, 454, 139817. https://doi.org/10.1016/j.foodchem.2024.139817

Shuping, L. S., & Lebelo, K. (2026). Food fraud implications and regulatory challenges in South Africa: A review. *Foods, 15*(8), 1282. https://doi.org/10.3390/foods15081282

Soon-Sinclair, J. M., Imathiu, S., Obadina, A. O., Dongho Dongmo, F. F., Kamgain, A. D. T., Moholisa, E., Saba, C. K. S., Walekhwa, A. W., Hunga, H., & Kussaga, J. (2023). How worried are you about food fraud? A preliminary multi-country study among consumers in selected sub-Saharan African countries. *Foods*, 12(19), 3627. https://doi.org/10.3390/foods12193627

Spink, J., Embarek, P. B., Savelli, C. J., & Bradshaw, A. (2019). Global perspectives on food fraud: Results from a WHO survey of members of the International Food Safety Authorities Network (INFOSAN). *npj Science of Food, 3*, Article 12. https://doi.org/10.1038/s41538-019-0044-x

Tefera, T., & Chekol, Y. (2025). Food fraud research in Africa: A systematic review of prevalence, detection methods and research gaps. *Food Control. (Update the bibliographic details if you are citing the final published version.)*

Thystrup, C., Ogunbiyi, T., & Hald, T. (2025). Applying a systems thinking approach to evaluating the effectiveness of Africa's foodborne disease surveillance systems. *Communications Medicine*, 5, 397. https://doi.org/10.1038/s43856-025-01115-y