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Foodborne diseases and food safety in sub-Saharan Africa: Current situation of three representative countries and policy recommendations for the region

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Abstract

This article examines the current state of food safety preparedness and response in three representative countries in sub-Saharan Africa (SSA): Kenya, Senegal and South Africa. We focus on foodborne diseases associated with the microbial contamination of animal-sourced foods. The results of our analysis indicate that governments in all three countries have official programmes to limit foodborne diseases and mitigate the effects of outbreaks. However, the population in these three countries continues to experience a high burden of foodborne diseases, and knowledge of the specific causes and mitigation of these diseases in SSA is lacking. Furthermore, there is a need for more and better food safety education programming, as we found no study that has collected a representative sample to estimate the level of public awareness of foodborne pathogens in any of the three countries studied. Evidence also suggests that institutional capacity around food safety in both the public and private sectors is insufficient due to limited financial investment and technical capacity. We end by providing suggestions for improving food safety preparedness and response in the region.

Key words: Sub-Saharan Africa; food safety; foodborne illness; regulations; awareness; prevalence; policy recommendations

1. Introduction

The COVID-19 pandemic has emphasised the necessity for ensuring the resilience of local, national and international food supply chains to deliver safe, quality food from farmers to consumers in both times of crisis as well as in "normal" times. Vulnerability to food safety threats is a major problem for the more than one billion people living in sub-Saharan Africa (SSA). The African continent as a whole faces the world's highest foodborne disease burden per capita, with the microbial and chemical contamination of food resulting in an estimated 137 000 deaths and 91 million acute diseases each year (World Health Organization [WHO] 2015).

Although SSA is a large and diverse region, key similarities across countries may serve to uniformly increase food safety threats in the region. First, populations in SSA are growing at an average rate of 2.7% per year (World Bank 2017). This puts tremendous pressure on food systems to meet the increasing demand for safe and nutritious food (Grace *et al*. 2012). Second, many people in SSA live in rural areas and continue to engage in semi-subsistence agriculture, producing foods mainly for their own consumption, with some sales in local markets. In this context, there generally is low awareness and understanding of food safety concerns in these markets, which limits consumers' willingness to pay for safe food and producers' incentives to supply it.

In parallel to those trends, rapid economic growth is occurring in and around urban areas in many parts of SSA. Increased incomes lead to a greater desire for and expenditure on transformed and processed foods and high-quality proteins, including milk, eggs, meat and fish (FAOSTAT 2020). It is an open question whether these high-end value chains can drive the entire market for quality, safe food. But the sustainability of a supply chain that consistently delivers safe food to consumers requires regulations to ensure food safety, and governmental regulatory bodies are often unable to keep up with private sector market development. Without enforceable standards, the nascent supply chains for safe food could be undermined by food safety outbreaks.

The present article examines the state of food safety preparedness and response in SSA, with a focus on foodborne diseases associated with microbial contamination of animal-sourced foods. We begin by discussing the available literature regarding the factors that create these diseases. It should be noted that the microbial contamination of food generally refers to bacterial, fungal, parasitic and other pathogens. To manage the scope of the review, however, we focus primarily on pathogens identified by the World Health Organization (WHO) as major contributors to foodborne diseases in Africa: nontyphoidal *Salmonella enterica*, enteropathogenic *E. coli*, enterotoxigenic *E. coli*, *Campylobacter* spp., the parasites *Taenia solium*, *Ascaris* spp., *Cryptosporidium* spp. and Toxoplasma *gondii* (see WHO (2015) and Arias-Granada *et al*. (2020) for more details about these pathogens).

We then describe the various efforts countries in SSA have or have not made towards preventing foodborne diseases associated with animal-sourced foods. In doing so, we focus our review on three countries: Kenya, Senegal and South Africa. These countries provide geographic coverage of east, west and southern SSA respectively. All are emerging economies; South Africa is the economic engine of the continent, and Kenya and Senegal have GDP per capita around the average of SSA countries (US$1 585). Their urbanisation rates (27% in Kenya, 47% in Senegal and 66% in South Africa) straddle the SSA average of 40% (World Bank 2020). For each of these countries, we briefly discuss (i) key studies documenting major food safety outbreaks, public awareness and challenges, and (ii) official national-level food safety policies.

We end the article by discussing the remaining food safety challenges and opportunities, and provide recommendations for making food systems more resilient so that countries in Africa are better prepared for foodborne disease outbreaks in the future.

2. Food safety institutional landscape and zoonotic foodborne diseases in Kenya

2.1 Key studies

Kenya has recorded several large foodborne disease outbreaks in recent years. In 2009, a gastroenteritis outbreak was associated with *E. coli* in Madera Kenya (Ochi *et al*. 2017). In 2016, an apparent *E. coli* outbreak in Maru involved over 50 children, resulting in at least two deaths (Daily Nation 2016). In 2014, the Regional Centre of the Centers for Disease Control and Prevention (CDC) in Kenya analysed samples for almost 57 outbreaks and found numerous illnesses associated with *Salmonella enterica*.

Large-scale or longitudinal studies mapping pathogen transmission in different commodities are scarce in Kenya. Some studies have found *Campylobacter* spp., *Salmonella*, *E. coli* and *Toxoplasma gondii* in chickens and poultry products (Dubey *et al*. 2005; Mose *et al*. 2016; Nguyen *et al*. 2016; Paudyal *et al*. 2017; Carron *et al*. 2018; Gahamanyi *et al*. 2020). Food safety issues in many cases are exacerbated by poor storage and handling. Poultry products are often sold in open markets, where ambient temperatures can be high and refrigeration and cold storage are limited (WHO 2012; Carron *et al*. 2018). Contamination also results from poor hygiene practices in small and medium-scale slaughterhouses in Kenya (Carron *et al*. 2017; Wambui *et al*. 2017). The unavailability of gloves and of soap and disposable towels for hand washing, and inadequate cleaning of processing equipment, are common, increasing the risk of carcass contamination and further cross-contamination (Wambui *et al*. 2017). In addition, Carron *et al*. (2017) found low government control and enforcement of hygiene standards by poultry processors of Nairobi.

Despite recurrent outbreaks involving highly-consumed foods, the level of public awareness of foodborne diseases is not well documented in Kenya. To our knowledge, the only two available studies found that approximately half of their respondents (food handlers and smallholder farmers respectively) knew about the causes of foodborne diseases (Kariuki & Orago 2017; Pretari *et al*. 2019).

2.2 National-level food safety policies

The national government of the Republic of Kenya recognised the importance of food safety in the Kenya Health Policy Plan 2014–2030 by way of several policy objectives, including: i) licensing and control of food sold in public spaces, ii) promoting good hygiene and sanitation to control foodborne diseases, and iii) building inter-sectoral collaborations for the regulation of the food industry. The responsibilities for the control of food safety and quality in Kenya are distributed among 12 regulatory ministries and government departments and 20 Acts of Parliament (Ministry of Health, Republic of Kenya 2014). In addition, the National Food Safety Coordination Committee (NFSCC) is an inter-ministerial body that aims to increase awareness of food safety and quality in the country. It is responsible for coordinating all food safety activities.

The National Food and Nutrition Security Policy of Kenya describes the government's aim as being to improve food safety and quality by promoting safe production practices in crops, livestock and fisheries. This is to be accomplished by coordinating and enforcing food labelling, promoting proper handling and food storage, and licensing and regulating producers and vendors (Republic of Kenya 2017).

3. Food safety institutional landscape and zoonotic foodborne diseases in Senegal

3.1 Key studies

Foodborne illnesses are common in Senegal, but not always officially recognised unless they involve outbreaks in large groups of people. In 2016, more than 30 people were hospitalised after consuming contaminated mayonnaise and liver sold by a street vendor in Guédiawaye, a small city outside the capital Dakar (Leral Net 2016). Demoncheaux *et al*. (2012) also reported on a large disease outbreak associated with the consumption of contaminated fish. A 2017 study noted increases in gastrointestinal infections associated with most important religious events in Senegal, possibly linked to the consumption of street food (Hoang *et al*. 2019). In 2018, a popular milk consumed by children in Senegal was contaminated with *Salmonella (*Xinhuanet 2018).

Similar to the situation in Kenya, large-scale studies characterising foodborne pathogen transmission in Senegal are not yet common in the country. A patchwork of studies have examined various

pathogens and commodities, including *Vibrio* spp. in various seafood products (Coly *et al*. 2013), *Salmonella* spp. in beef (Stevens *et al*. 2006; Pouillot *et al*. 2012), *Campylobacter* spp. and *Salmonella* spp. in poultry (Cardinale *et al*. 2004; Garin *et al*. 2012; Pouillot *et al*. 2012), drug-resistant bacteria in chicken (Vounba *et al*. 2019), and the general microbial quality of raw milk (Breurec *et al*. 2010).

Awareness of foodborne diseases among the general Senegalese population is not well documented. One study conducted focus groups with mothers and found that they had some level of awareness of the health risks associated with animal-sourced foods and the importance of hygiene or preventative practices, such as washing the food and proper cooking procedures (Traoré *et al*. 2018). Two additional studies found that less than one-third of smallholder farmers were aware of foodborne diseases and food contamination associated with aflatoxins and bacteria (Arias-Granada *et al*. 2021; Bauchet *et al*. 2021).

3.2 National-level food safety policies

The Senegalese government has recently set up three key initiatives to improve food safety. First, it established a national surveillance and an early warning system in 2015 with the support of the Food and Agriculture Organization of the United Nations (FAO) and the Grand Duchy of Luxembourg. Second, the Ministry of Health and Social Action of Senegal recently developed and launched the National Strategy on Food Safety in Senegal (SNSAR) (Conseil National de Sécurité Alimentaire 2015). The document serves as the framework for a food safety system that aims to ensure the quality of the food supply in the country. It is expected that this policy will facilitate the coordination of efforts among different ministries, the private sector, and consumer associations to reduce diseases associated with poor quality food. The policy will also make it possible to have a risk assessment and risk management system (Leral Net 2017).

Finally, the SNSAR document mentions the lack of proper sanitary conditions in small local agri-food companies supported by public institutions and the need to improve the quality of the food they produce. This policy also underscores the importance of improving animal health through epidemiological surveillance, allocating more resources to vaccination campaigns, and improving training in animal health and animal husbandry professionals (Conseil National de Sécurité Alimentaire 2015).

4. Food safety institutional landscape and zoonotic foodborne diseases in South Africa

4.1 Key studies

Despite its growing economy, South Africa faces challenges with foodborne diseases. An outbreak associated with a processed meat known as *polony* that was linked to *Listeria* resulted in 1 000 deaths in 2017/2018 (Chutel 2018; WHO 2018). *Salmonella* outbreaks have also been reported in different regions of the country, including North West province in 2016 and KwaZulu-Natal province in 2018 (Herriman 2018; Motladiile *et al*. 2019).

Food safety issues in South Africa have been the focus of a larger number of studies than in Kenya and Senegal. Various studies in South Africa have identified several pathogens in many common animals and meats (chicken, swine, goats, cattle, mutton). Studies examining parasites have identified *Taenia solium* (a pork tapeworm), *Toxoplasma gondii* and *Cryptosporidium* spp. (Samra *et al*. 2007; Krecek *et al*. 2008; Ndou 2013; Hammond-Aryee *et al*. 2015; Joseph *et al*. 2015; Samra *et al*. 2016; Syakalima *et al*. 2016; Samie *et al*. 2017; Tsotetsi-Khambule *et al*. 2017; Tagwireyi *et al*. 2019). Bacterial foodborne pathogens, namely *Campylobacter*, *E. coli*, *Salmonella*, and *Listeria* spp., are also widely present in animals and animal-sourced foods in South Africa (Igwaran & Okoh 2020).

As in other countries, key points of contamination include improper slaughtering, including traditional slaughtering practices, and hygiene practices (Qekwana *et al*. 2014, 2017; Rani *et al*. 2017; Jaja *et al*. 2018; Tatsing Foka & Ateba 2019). In addition, pathogens such as multidrug resistant strains of *Enterococcu*s spp. emerge in feedlots (Tatsing Foka & Ateba 2019).

In general, the published evidence suggests that South African consumers have low levels of awareness regarding the risks of foodborne diseases, and few know about legislation on the issue of food safety (Asiegbu *et al*. 2016; Lumka *et al*. 2017; Mkhungo *et al*. 2018; Katiyo *et al*. 2019; Sithole *et al*. 2020). Studies have also documented that food vendors lack knowledge and do not implement proper food safety practices (Oguttu *et al*. 2014). Similar low levels of awareness were found among handlers and managers in schools, hospitals and hotels (Sibanyoni & Tabit 2019; Sibanyoni *et al*. 2017).

4.2 National-level food safety policies

The Meat Safety Act of 2000 drives the Republic of South Africa's approach to reducing foodborne diseases from animal-sourced foods. The South African Department of Health imposes hygiene requirements for food premises and transport, with the focus on reducing food safety risks. Some gaps still exist, however, as programmes such as Food Safety Management Systems (FSMS) and Hazard Analysis and Critical Control Points (HACCP) are not required by law to be implemented in food service businesses (Griffith *et al*. 2017).

Nevertheless, the government of South Africa is focused sharply on food safety, with increased regulation of food handling and processing, sales, and food exports. In 2014, the Department of Agriculture, Forestry and Fisheries pledged to focus more on food and nutrition security risk management, which includes stability of the food supply and general food safety (South Africa Department of Agriculture, Forestry and Fisheries 2014). Currently, the Director of Veterinary Services of South Africa oversees the importation of meat products in line with the Meat Safety Act of 2000, but only approves meats processed in abattoirs and slaughterhouses approved by the Directorate, which some argue could have better hygiene management systems (Govender 2013).

5. Conclusions and policy recommendations

Our synthesis of the literature on food contamination by key zoonotic foodborne pathogens and the regulatory frameworks tasked with improving food safety in three countries in sub-Saharan Africa (Kenya, Senegal and South Africa) reveals four key findings.

First, our review confirms that populations in SSA experience a high burden of foodborne diseases. Our analysis documented contaminations from animal-sourced foods, but other foods also contribute to this burden (WHO 2015). Safety from contamination is a largely unobservable food attribute (Fafchamps *et al*. 2008; Kadjo *et al*. 2020; Prieto *et al*. 2021), and many households in SSA either produce their own food or buy it in informal and unregulated markets, giving rise to a "lemons market", where low-quality food predominates (Akerlof 1970). An important priority for extension programmes in SSA should therefore be to include and diffuse guidelines to improve production and farming practices among smallholder farmers to reduce food contamination and improve quality in informal markets.

Second, government policies are another key component of effective food safety improvements due to the failure of markets alone to promote safe foods. Governments' responses to food safety issues in SSA are increasing and improving. The results of our analysis indicate that the governments of all three countries have official programmes to limit foodborne diseases and mitigate the effects of outbreaks, although these are not enforced strictly or are outdated in some cases. Governments should

deploy strategies to improve the monitoring and enforcement of existing food safety regulations in informal food markets. Investments in physical infrastructure will also facilitate better safety practices. Specific investments include the adequate supply of water, toilets, handwashing facilities and waste-removal systems. Markets should be inspected and cleaned regularly, and live animals and raw foods of animal origin must be separated from other types of food, such as ready-to-eat and fresh produce (WHO 2012). In addition, efforts to prevent and respond to food safety outbreaks by international agencies and the private sector still remain insufficient. This is due to a combination of a lack of financial resources and incentives, fragmented food control systems, and a lack of technical capacity (WHO 2012). Moreover, international aid to improve food safety has been geared towards export-oriented products. For instance, less than 5% of internationally-funded projects have sought to address microbiological hazards affecting local consumers and that are commonly found in animal-source foods (GFSP 2019). Governments and international donors should coordinate efforts to prioritise interventions that tackle foodborne diseases affecting African people.

Third, researchers' and governments' understanding of the specific causes of foodborne diseases in SSA is lacking. This makes it difficult to develop targeted interventions to prevent and mitigate them. The evidence on the presence of pathogens in foods is fragmented and often limited to large-scale commercial operations. Consequently, governments and international donors should invest in projects that aim to identify risks in critical value chains and pilot solutions tailored to the African context, where most of locally produced food will not meet international safety standards.

Fourth, we found no study that collected a representative sample to estimate the level of public awareness of zoonotic foodborne pathogens in any of the three countries studied. Given the unobservability of threats, raising awareness is both critically necessary and poses a challenge to improving the functioning of informal food markets and increase the production, trade and consumption of safe foods. Policymakers in SSA should consider implementing public information campaigns in both rural and urban areas to raise awareness of food safety issues. Providing information about food safety is a key component of approaches to increase the quality of foods produced by smallholder farmers (Bauchet *et al*. 2021; Magnan *et al*. 2021), as well as consumers' willingness to pay for safer foods (De Groote *et al*. 2016; Nindi *et al*. 2021). Increased awareness will empower African consumers to demand safer food and pay price premiums to foster better production practices. Furthermore, gender-sensitive approaches that recognise the significant and unique contributions of women to agricultural production, animal husbandry, post-harvest food processing and cooking are particularly promising. Furthermore, the identification, testing and scaling up of adapted, low-cost technological solutions to improve food safety can have large influences on the quality of foods produced and sold.

Finally, the COVID-19 pandemic has shown acutely the need for local, regional, national and international institutions to coordinate and cooperate. Such coordination is essential to ensure that all stakeholders are prepared and have the resources available to detect and mitigate the effects of food safety threats in the future, before they become devastating to health and economic well-being.

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