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Food safety in Sri Lanka: problems and solutions

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REVIEW ARTICLE

Abstract

There is a growing concern about food safety issues in Sri Lanka with the expansion of the food industry along with urbanisation, increased trade in fresh and processed food, and more consumption of foods of animal origin. Food safety risk management is important for both public health and market development both domestically and internationally. An island nation in an important location, and rich in resources needs to take to essential steps to exploit the export potential of fresh food such as fish, vegetables and fruits, while managing the safety risk of these foods to meet international market requirements. Considerable development has been achieved in fresh and processed fish and fishery products exports along with vegetables, fruits and cereals during the last decade. Especially, fresh and processed fish and fishery products export processors are maintaining higher levels of quality and safety measures consistent with EU regulations and US Food and Drug Administration. Food safety issues remain a challenge to public health. Food borne illnesses show an increasing trend, but still many go unreported and public awareness on food safety and risk management procedures is at a low level in the domestic market. Formulating effective strategy to address food safety is not easy. Establishing food hazard analysis critical control point systems along with an effective national food control system, imposing a Sri Lankan standard for processed food, amending Food Act no. 26 of 1980, harmonisation of food regulations with other countries, and conducting public awareness programmes on food safety issues, would be productive measures in managing food safety risk. Still there are many areas needing improvement. Realistic food hygiene regulations for food handling in small food establishments and restaurants need to be established. Capacity building and technical assistance are required for routine pesticide, mycotoxin and antibiotic residues analysis.

Keywords: food safety, problems, management

1. Introduction

Food safety is a scientific discipline describing handling, preparation, and storage of food in ways that prevent food-borne illness. This includes a number of routines that should be followed to avoid potentially severe health hazards. Food can be contaminated by biological, chemical, or physical hazards. Food hazards leading to health risk can occur in many areas of the food production chain due to contamination or mishandling of foods from farm to retail or household levels. Therefore it is important to carefully control and inspect food production at all possible levels in the food chain in order to prevent food-borne diseases.

As a developing country, food safety issues in Sri Lanka have received much attention with the rapid expansion of food industry, urbanisation, growing mobility of people, and rising population. Many small food outlets and retail food establishments started in the last few years, and the inadequate food safety in these establishments is a significant contributor to the burden of food-borne disease, which must be addressed as the food system develops. In addition, effective quality control systems are needed to meet export market requirements for fresh food products such as fish, fruits and vegetables. Recently, there is a growing concern in Sri Lanka about chemical contamination of food such as from pesticides, toxic heavy metals, and mycotoxins.

Sri Lanka is an island nation and thus has a great potential to expand the fish industry aiming at the export market. Thus, food safety is a significant issue for both public health and for export markets in Sri Lanka. Furthermore, effective food safety programmes are an essential requirement for the booming tourism industry in Sri Lanka. Quality safer foods and drinking water is one of the key requirements for developing tourism. There is an increasing realisation that exports and tourism are critical components in rural economic growth. Thus, food safety has a dual role in poverty alleviation and in market development. The benefits of food safety assurance for export promotion are indeed important, to gain additional exports through access to new markets or the value of avoiding loss of reputation in existing markets.

Formulating a strategy to address public demands for food safety is not simple. However, Sri Lanka has introduced various measures, including the introduction of hazard analysis critical control point (HACCP) systems for fresh and processed food products through the application of ISO 22000 (*SLSI*, 2005), the Sri Lankan standard for manufacture of food products (this standard recommends a code of hygiene practice that should be adopted in the manufacture of processed foods), Food Act no. 26 of 1980 (Parliament of Sri Lanka, 1980) and its amendments in 1991 (The Gazette of the Democratic Socialist Republic of Sri Lanka, 1991), effective national food control system, good management practice for food production factories, public awareness programmes to enhance the knowledge of food safety, training programmes, workshops and mass media campaigns on food safety, harmonisation of food regulations with other countries such as South Asian Association for Regional Cooperation (SAARC) countries. This review aims to discuss the food safety issues, problems and solutions in Sri Lanka.

2. Food-borne hazards in Sri Lanka

Food borne infection

Food- or water-borne diseases are one of the key issues in food safety assurance in Sri Lanka with increasing incidence levels, partly due to rapid expansion of unsafe retail food establishments over the last few years. Bacterial diarrhoea and hepatitis A, *Salmonella* infections, contamination by *Listeria monocytogenes*, and *Vibrio cholerea* are common sources of food borne disease in Sri Lanka. In a study on the occurrence of *L. monocytogenes* in different market food items, 38% of all tested samples were contaminated with the highest incidence (49%) found among vegetables (Gunesena *et al.*, 1995) (Table 1). Contaminated milk products also posed high risk. Over the last few decades shrimp farming in Sri Lanka has grown significantly as a high income generating agricultural industry. With the growing demand, many shrimp farms were established in coastal areas. Bacteria of the genus *Vibrio* are commonly found in the marine environment, and many of the species are pathogenic to humans causing food-borne disease. Several pathogenic *Vibrio* species have been reported in Sri Lankan shrimp farms (Jayasinghe *et al.*, 2008). Table 2 shows the food poisoning reported by medical officers in Sri Lanka over the last few years and cases reported from Colombo division 2011.

Table 1. Number of food poisoning cases reported by medical officers of health in Sri Lanka (http://www.epid.gov.lk).

Year	Food poisoning cases
2008	1,763
2009	1,103
2010	1,671
2011	1,277

Mycotoxins

Fungal invasion of commodities before and after harvest, and during distribution and storage, is a well-recognised problem throughout the world. This is especially true in tropical countries, where mycotoxin contamination of food supplies remains a major threat. Aflatoxins, mycotoxins which are acutely toxic, immunosuppressive, mutagenic, teratogenic and carcinogenic, are secondary metabolites produced by some species of *Aspergillus*, especially *Aspergillus flavus* and *Aspergillus parasiticus*. Fungal invasion could take place throughout the food chain from farm, storage, and retail establishments affecting yield, quality and nutritional value of the products. In Sri Lanka, contamination by aflatoxin has been reported for rice, maize, copra, peanuts, pulses and minor food items like spices (Bandara *et al.*, 1991a,b; Breckenridge *et al.*, 1986; Dissanayake and Manage, 2009; Samarajeewa and Arseculeratne 1983). Poor pre- and post-harvest practices were the major reason for aflatoxin contamination of rice. Most of the mycotoxins are removed during milling (Takashi *et al.*, 1984). The major factors contributing to the production of mycotoxins are high moisture content, high temperature, and long storage times before drying. According to the estimates of the Food and Agriculture Organization (FAO) 25% of world cereal production is contaminated with mycotoxin (Dowling, 1997). Rice is the staple food for Sri Lankans, thus even low levels of contamination by aflatoxin could pose a health risk as substantial levels of rice is consumed by an average Sri Lankan. Table 3 shows the occurrence of aflatoxin in different food items tested in Sri Lanka. Occurrence of aflatoxin in coconut products, milk products and medicinal plants has been shown to be highly correlated with the prolonged storage time, storage conditions, and lack of

Table. 2. Occurrence of *Listeria monocytogenes* in Sri Lankan food (Gunasena *et al.*, 1995).

Type of food	Number of samples examined	Number and percentage of samples positive with *L. monocytogenes*
Raw chicken (fresh and frozen)	38	13 (34%)
Vegetables		
Green leaves	17	11 (65%)
Cabbage	18	6 (33%)
Lettuce	20	10 (50%)
Milk products		
Processed cheese (local)	2	0
Processed cheese (imported)	2	0
Cottage cheese (local)	1	0
Pasteurised milk	16	5 (31%)
Raw milk	12	3 (25%)
Ice cream (local)	12	4 (33%)
Fresh cream (local)	1	0
Total	139	52 (38%)

Table 3. Aflatoxin contamination in Sri Lankan food commodities.

Food commodity	Toxin level	Reference
Commercially available peanut	moderately contaminated (12.5 µg/kg) to uncontaminated	Dissanayake and Manage (2009)
Parboiled rice	highly contaminated (185 µg/kg AFB_1, 963 µg/kg AFG_1),	Bandara *et al.* (1991a)
Raw milled rice	free of aflatoxins or occurred in less than 10% of tested samples	Bandara *et al.* (1991b)
Coconut products (copra, oil and press cake)	50% of the samples contaminated from medium to high (0.05 to 1 µg/g AFB_1)	Samarajeewa and Arseculeratne (1983)
Medicinal materials	0.5 µg/g AFB_1	Abewickrama and Bean (1991)
Farm gate cow milk	free of contamination or 33% of locally manufactured was contaminated with AFM1 (13.4-84.5 µg/l)	Pathirana *et al.* (2010)

AFB_1 = aflatoxin B_1; AFG_1 = aflatoxin G_1; AFM_1 = aflatoxin M_1.

quality control measures (Samarajeewa and Arseculeratne, 1983). In the processing of commercial parboiled rice, rice is steeped by soaking rice for a certain period of time. In this step ideal conditions are created for the growth of toxigenic *Aspergillus* spp. (Bandara *et al.* 1991a).

Pesticide and heavy metal contamination

Pesticides play an important role in modern agriculture. However, recently increased attention has been focused on chemical residues in food. The presence of residues of pesticides in food can present a health risk. The renal failure disease which is prevalent in the North Central province of Sri Lanka is believed to have a strong link with certain heavy metals contained in agrochemicals. Bandara *et al.* (2011) have reported that chronic renal failure associated with elevated dietary cadmium among Sri Lankan farming communities in the irrigated agricultural area under the river Mahaweli diversion scheme has reached a level of 9,000 patients. Further, they reported that cadmium, derived from contaminated phosphate fertiliser, in irrigation water finds its way into reservoirs, and finally to food, causing chronic renal failure among consumers. It is well established that exposure to high levels of cadmium may cause kidney damage leading to renal failure (Järup and Alfven, 2004). This has raised a serious issue regarding the quality of phosphate fertiliser used in Sri Lanka. In addition to cadmium, it has been reported that certain agrochemicals contained trace amounts of arsenic which also cause serious health problems. Thus, heavy use of agrochemicals for rice farming along with contaminated water could increase the arsenic concentration in paddy soil. The transfer of arsenic from paddy soil to rice is a major exposure route of this highly toxic element to humans. Rice grain baseline levels of As are generally ~10 fold higher than in other cereals (Williams *et al.*, 2007). The measurement

of arsenic content in rice grain is vital to risk assessment. Presence of arsenic in rice grains at a toxic level has been reported in different parts of the world (Batista *et al.*, 2011; Li *et al.*, 2011). However, recent investigations carried out by the Sri Lankan Department of Agriculture and others found that local rice does not contain arsenic.

Artificial fruit ripening chemicals

The fruit and vegetable industry in Sri Lanka is booming with recent growing demand. Toxic and hazardous chemicals such as calcium carbide or ethephon and oxytocin are reportedly being used for artificial ripening of fruits and for increasing the size of fruits and vegetables, respectively. Calcium carbide is said to be carcinogenic. The calcium hydroxide formed during the formation of acetylene contains toxic impurities such as arsenic hydride and phosphoric hydride that consumers may then ingest, harming their health. Banana and mango are the fruits most commonly induced by artificial ripening in Sri Lanka. Bananas which are ripened naturally are dark yellow; there are small black spots around the bananas and the stalks are black. Those which are forced to ripen with carbide are often lemon yellow and their stalks green. Moreover the fruit itself is a clear yellow without any black spots.

3. Managing food quality and safety in Sri Lanka

There is a growing recognition that a farm to table approach is needed to address food safety concerns as many hazards can enter into the food chain at different points causing quality problems. The HACCP system is increasingly used to prevent the contamination of food with different hazards during the food process chain, and is used as the basis for food safety regulation. Although Sri Lanka has developed effective HACCP systems for several food processing factories there are large numbers of small and even large scale food processing factories that have not yet adopted this system. A progressive food safety regulatory system urgently needs to be applied for certain food processing industries, such as rice, vegetables and fruit as their demand and consumption has increased greatly. Issues in domestic food safety can be addressed to a large extent by adopting effective HACCP systems. Mandating HACCP also reduces the cost of regulatory enforcement. Rather than frequent inspection of product or of good manufacturing practices (GMPs), a regulatory agency can review industry records periodically to verify that a HACCP plan is working. One of the key issues in assuring foreign exchange generation from fresh food products is the management of sanitary and quality standards for the export market. Compared to some traditional agricultural products, fresh food products such as meat, fish and vegetables have greater foreign demand and fewer trade barriers. Thus a developing country such as Sri Lanka needs to exploit its fresh food product exports to gain more foreign income. Sri Lanka as an island has a high potential to produce fresh fish for export. With the advancement of quality and sanitary management practices Sri Lanka has been able to find its place in foreign markets for fresh and processed fish and seafood exports. As the first food processing industry in the country which successfully applied HACCP principles in safety and quality management to meet foreign export market it is worth discussing its achievements.

Quality and safety measures in fish and seafood industry

The fish and seafood export industry in Sri Lanka has emerged as a dynamic sector providing considerable foreign exchange to the country. It is recognised as a sector with further high potential in exporting both marine and fresh water fish and fishery products to the international market. The value of exports has increased from US$ 103 m in 2005 to US$ 202 m in 2010, an average growth of 15% (MOFA, 2010). The main export destinations are EU, Japan and USA. More than 120 Sri Lankan exporters, including 26 EU-approved export processing establishments, export fish and seafood products to international markets. Figure 1 presents the trends of fish and seafood exports (values in Sri Lankan

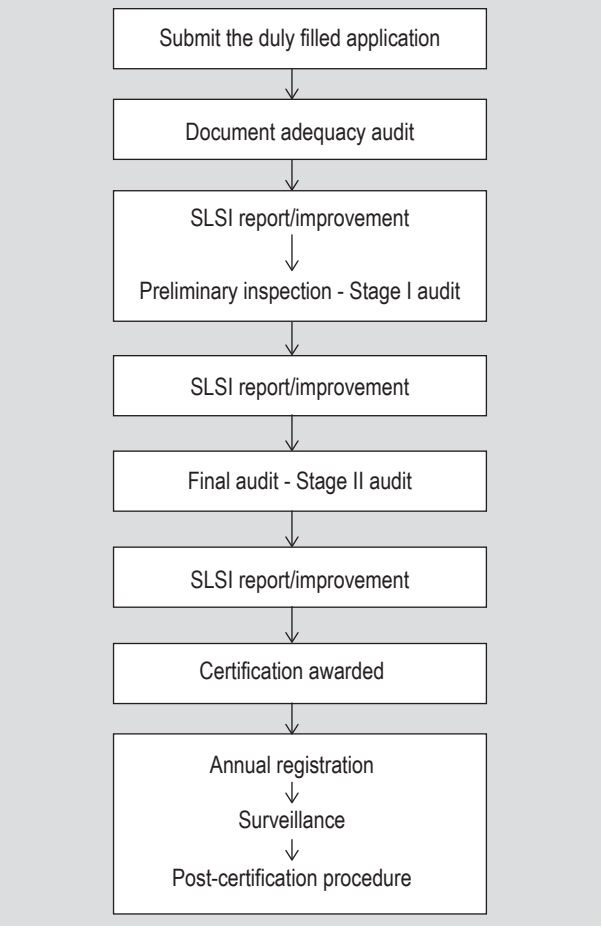

Figure 1. Certificate providing procedure on food safety (http://www.slsi.lk). SLSI = Sri Lanka Standard Institute.

Rupees, millions) of Sri Lanka. The positive increasing trend points to the future prospects of the industry.

Fish quality and safety of the domestic fish market

The domestic fish and seafood market is driven by high income elasticity of demand and competition with the highly regulated, price-sensitive international market. Fish and seafood suffer similar perishability problems and carry potential health risks for consumers, thus necessitating quality assurance systems. On the other hand, the fish and seafood export market is highly restricted and the domestic market is affected by non-quality assured products. Pressures on both demand and supply sides of the international markets provide major incentives throughout the value chain to face the problem of quality management.

Domestic fish supplies depend partially on the harvest of local fishermen who usually fish for a few hours and return to sell the catch on the beach while the fish is still alive or very fresh. Fish harvest of one operating boat does not need a complicated quality assurance system, and local customers looking for fresh fish are accustomed to shop daily from the landing sites or adjacent markets. Often the fish harvest of the local fishery market is in close proximity to the consumer with zero value addition and consumed on the same day.

Standards imposed on producers exert strong pressure to upgrade, and stimulate the emergence of an improved support system. Effective operation of fish value chain regimes and quality assurance system for fish markets must be applied from the beginning of production to marketing. The Sri Lankan government has tried to streamline its fish and seafood regulatory and inspection systems through the Quality Control division of the Ministry of Fisheries and Aquatic Resources (MOFA) which has formally become the sole authority for fish safety issues. However, MOFA does not have the capacity to control fishermen at the production level or at remote landing sites. Export processors, who rely on supplies from local fishermen, strictly follow international standards at receiving points. The safety of seafood products varies considerably and is influenced by a number of factors such as origin of the fish, microbiological ecology of the product, handling and processing practices and preparation before consumption. In general, receiving point temperature should be 4 °C, and zero levels of histamine may be present for export processing of many pelagic species. Only the fishermen who supply to export processors, and the export processors themselves, are following stringent quality procedures.

The government's weak enforcement of quality and safety measures on fishermen and producers has led to the formation of fisheries cooperatives or fishermen-driven societies to enhance the quality of supply. Other parts of the value chain are still lacking meaningful coordination. Traders and logistic providers lack in collective action and coordination is sporadic. Most of the ports, harbours, and landing sites have cold storage facilities developed, which could if followed up with enhanced subsequent handling, ensure the quality of fish and seafood distributed even in the domestic market. In particular, retailers and fishmongers lack modern facilities to ensure the quality of operation of their businesses on a daily basis.

The emergence and immense growth of retail chains and the booming tourism industry has created further local niche markets with specific customer preferences requiring some form of quality assurance. Retail chains show an upward trend in fish retailing based on fresh, ready-to-cook and ready-to-eat fishery products. Fresh and semi-processed products available on the market are lacking in proper labelling and identification systems. Processed products, especially cans and vacuum packs are labelled but follow minimum certification procedures. Traditional fish processing techniques are widely employed in dry fish processing, resulting in poor quality and high levels of post-harvest losses.

Quality standard of fish and seafood export industry

The Sri Lankan fish and seafood industry is an example of how essentially forced compliance with EU and United States Food and Drug Administration (FDA) regulations can drive innovation and improvements in the value chain to make an industry competitive enough for export markets. The EU ranks as Sri Lanka's biggest importer for fish and seafood exports. In a study of 32 EU-approved Sri Lankan fish and seafood processing establishments, high commitment was found to adoption of international market regulation (De Silva and Bjorndal, 2011) (Figure 2).

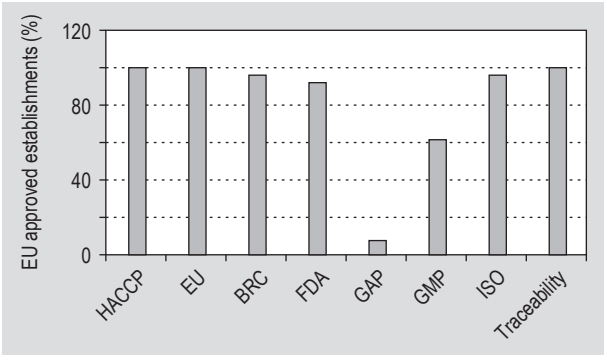

Figure 2. Commitment on international market regulations (percentage of EU approved establishments) (De Silva and Bjorndal, 2011). HACCP = hazard analysis critical control point; EU = European approval; BRC = British Retail Consortium; FDA = US Food and Drug Administration; GAP = good agricultural/ fish farming practices; GMP = good manufacturing practices; ISO = International Organization for Standardization series 9000, 14000 and 22000.

Key international market regulations considered were HACCP, European approval, British Retail Consortium (BRC), FDA, good agricultural/fish farming practices, GMP, ISO series (9000, 14000, 22000; *SLSI, 2004, 2005, 2009*) and traceability. Of the sample, all respondents were supported by HACCP, EU and traceability certifications and the majority maintained BRC, FDA and ISO series (9000, 14000 and 22000) certifications.

The EU is Sri Lanka's dominant trading partner for fish and fisheries product exports, which bring in an income of 22 billion Sri Lankan rupees annually. However, lapses in compliance with EU regulations and high incidences of illegal, unreported and unregulated fishing in Sri Lanka caused the EU to issue a 'yellow card' warning over seafood importation. After active steps to eradicate illegal fishing, and with Sri Lanka's compliance with international fisheries regulations rising over three years from 10 to 47%, a return to 'green card' status was announced effective June 2013 (Asia News Network, 2013). Fish and seafood supplies are still mostly extracted from wild populations and the contribution of aquaculture or inland fisheries is at very low levels. There are specific safety aspects associated with capture fishery in the high seas, and intensive husbandry in aquaculture poses new and increased risks. It is imperative that the HACCP principles are extended beyond the factory-gate and applied throughout the total food production chain from harvest to the consumers' plate (Huss *et al.*, 2003).

Although Sri Lankan fish and seafood exporters have targeted high-value European, USA and Japanese markets, these markets are both highly regulated and have highly price sensitive consumers. The current economic crisis worsens the situation and limits the returns for exporters. On the other hand, growing and relatively prosperous economies of Russia, China, Singapore, and Korea are demanding fish and seafood products more than ever before, with rising demand for healthy food options. Regulatory and quality requirements of these markets are comparatively low compared to Western markets. This represents a useful additional avenue for market development for additional flexibility.

Under the Fisheries and Aquatic Resources Act no. 2 of 1996, the following regulations have been enacted to maintain higher quality standards in fishery products: fish processing establishments regulations 2003; fish products (export) regulations; with amendments to cover drinking water standards, to cover additives, to cover aquaculture management (disease control), to cover aquaculture (monitoring of residues).

Imposing standards and inspection

Sri Lanka Standards Institution (Colombo, Sri Lanka) is the key institute which provides certification and training programmes on food safety for food producers in collaboration with RvA Netherlands (Utrecht, the Netherlands), which assists in the accreditation process. A certificate holder develops and maintains its food safety assurance programme based on the internationally accepted principles of ISO 22000 and SLS 1266 (*SLSI* , 2011). The certification procedure is shown in Figure 1.

National food control system

There must be an effective national food control system to ensure that the consumer receives safe foods after the long journey from farm to fork. In Sri Lanka this system has been established under the Ministry of Healthcare and Nutrition, and Uva Wellassa Development (FAO/WHO, 2004). The director general of health services is the chief food authority and also the chairman of the Food Advisory Committee (FAC) established in terms of the Food Act no. 26 of 1980. The FAC comprises 19 members. They represent various stake-holders in food safety from government departments/ ministries as well as trade and consumers. With current developments, Sri Lanka has taken steps to review the Food Act no. 26 of 1980 and its subsequent amendment (in 1991) and several regulations published under the Food Act, and also to draft a number of new regulations relating to food safety areas not previously covered. Implementation of the Consumer Protection Authority Act of 2001 and the Drugs and Cosmetic Act of 1980 further strengthened the national food control system in Sri Lanka.

Harmonisation

With globalisation growing use of process standards for food safety, and the resulting difficulties in determining equivalence across countries for food safety, add complexity. Thus, developing a common set of legal and management guidelines to enable easy acceptance of quality and safety standards among governments and world-wide companies is the best solution. Sri Lanka is a member country of SAARC and harmonisation of food safety regulations among SAARC countries was initiated in 1998 by the FAO in collaboration with India. Sri Lanka is also actively collaborating with FAO in the current process of harmonisation of food regulations in the SAARC region. Sri Lanka has taken actions to revise the existing food regulations according to guidelines of the Codex Alimentarius Commission, with the assistance of local consultants, in order to strengthen the country's food regulation system (FAO/WHO, 2004).

4. Conclusions

Although Sri Lanka has established several effective measures to ensure that consumers receive safer foods there is still much work remaining to be done to fully address certain food safety issues. Capacity building and technical assistance are urgently required to prevent contamination of food with pesticide residues, mycotoxins and antibiotic residues in the supply chain. Rice, the staple food for Sri Lankans, needs management under HACCP principles in order to eliminate mycotoxins and pesticide residues in processed rice. More government and public intervention is required to minimise poor food processing, manufacturing, handling and sanitation practices, particularly in the area of fruit ripening and handling. Effective food regulations and proper sanitary inspections and quality assurance need to be adopted for small-scale food establishments such as food outlets and small restaurants to minimise food-borne infections. To ameliorate the acute shortage of properly trained personnel such as food inspectors, analytical chemists and microbiologists, it is important to implement further training initiatives in collaboration with international organisations such as FAO. There is also a need for more provincial food laboratories. Resources must be moved towards the most important sources of risk with consolidated authority that can address the food system from farm to table. More public awareness programmes about food safety and sanitation are needed where both commercial stakeholders and consumers need to be involved.

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