defence methods and guidelines, such as TACCP, VACCP, or Carver+Shock, are already available and should be adopted and implemented across the entire food supply chain. This needs to be done in such a way as to have greatest effect, yet simultaneously, minimise the food producers' economic burden. New technology requires extensive testing, within each production system, prior to integration in commercial production lines. EDEN and SNIFFER have provided evidence of the benefits of non-targeted and targeted detection tools but these have only been tested in a limited number of food production systems and with a limited range of pathogens and chemical agents. Researchers should continue to test non-targeted detection systems, as well as targeted detection tools, in a wide range of food matrices and with a wide range of potential biological and chemical contaminants, not just those relevant for food safety incidents or product authentication.

Another stumbling block is that currently food contamination incidents are often only detected once clinical cases are diagnosed in the health system. Unless the perpetrator provides a statement or threat the authorities may not realise that the contamination was carried intentionally. Public health and food testing laboratories may need to provide even higher resolution regarding the genotypes, serovars or chemical composition of the contaminating agents which could be used to not only link outbreaks epidemiologically but also to criminal incidents, like the theft of chemicals and pathogens from laboratories, research and medical centres. It is imperative that health authorities work closely with food safety authorities in suspected outbreaks and that law enforcement agencies are involved as soon as intentional contamination is suspected.

Rapid product recall is another important way in which to prevent distribution of contaminated lots. This can be challenging given that today's legal framework does not require pedigree traceability, there are different national standards and the various tracking systems are not cross-compatible. Policy makers should work together with the food industry to provide a harmonised European standard to ensure cross-compatibility thus helping speed up product recall. Notification and alerting systems for product recall (RASFF, 2015) exist but ensuring sufficient coverage can be difficult. Therefore the industry needs to consider combining current methods of customer communication (loyalty schemes, apps, discount offers, newsletters, and social media accounts) with product safety information, such as product recall (Swinkels *et al.,* 2014) to target only those that have purchased a product in a given timeframe.

Conclusion

Our food supply chain is complex and maintaining food supply chain integrity is especially challenging. However food defence practices can help prevent deliberate contamination, be it motivated by economic, revenge or ideological reasons, and thus build consumer confidence. It is far cheaper to prevent an incident from occurring than dealing with the aftermath of a large foodborne disease outbreak. Food defence should therefore be an integral part of food supply chain integrity and not just an afterthought in the wake of an incident. The detection tools investigated by EDEN and SNIFFER have potential but a wider range of contaminants and food matrices needs to be investigated before these tools could be broadly adopted.

Legend to Figures

Figure 1 showing the triad that contributes to safer food (food security, food safety and food defence) and a comparison of the key differences in principles between food safety (HACCP: Hazard

Analysis and Critical Control Points) and food defence methodology (TACCP: Threat Assessment and Critical Control Points; VACCP: Vulnerability Analysis and Critical Control Points; CARVER+Shock: Criticality, Accessibility, Recuperability, Vulnerability, Effect, Recognizability+ the psychological impact or shock of an attack) in practice (BSI, 2014; Codex, 2003; USDA, 2007; Yoe and Schwarz, 2010).

Figure 2 shows the security cycle for managing an attack on the food supply chain and includes some of the measures that can be carried out at each point in the security cycle (BRC, 2015; BSI, 2014; FDA, 2007).

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