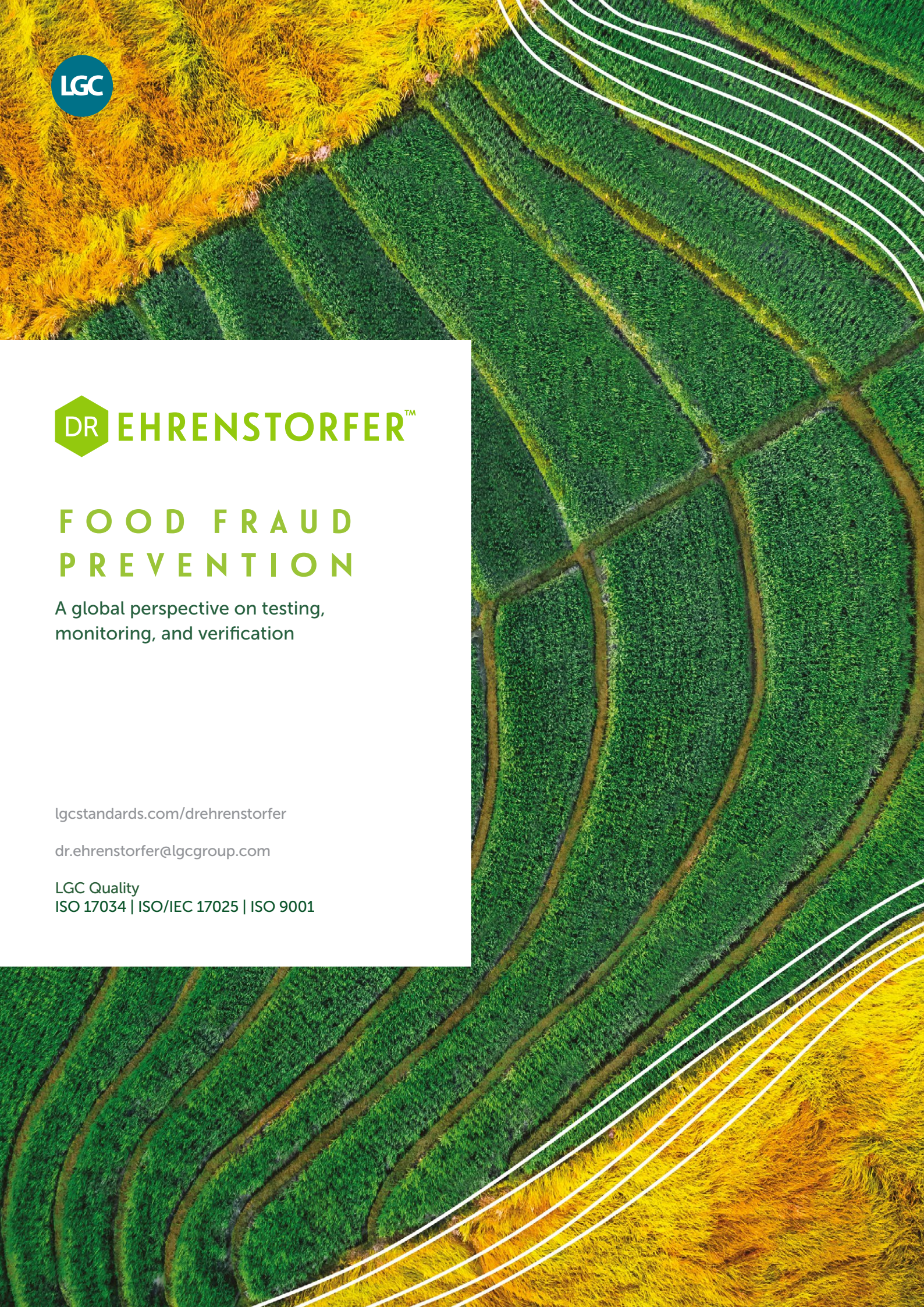

DR EHRENSTORFER™

FOOD FRAUD PREVENTION

A global perspective on testing, monitoring, and verification

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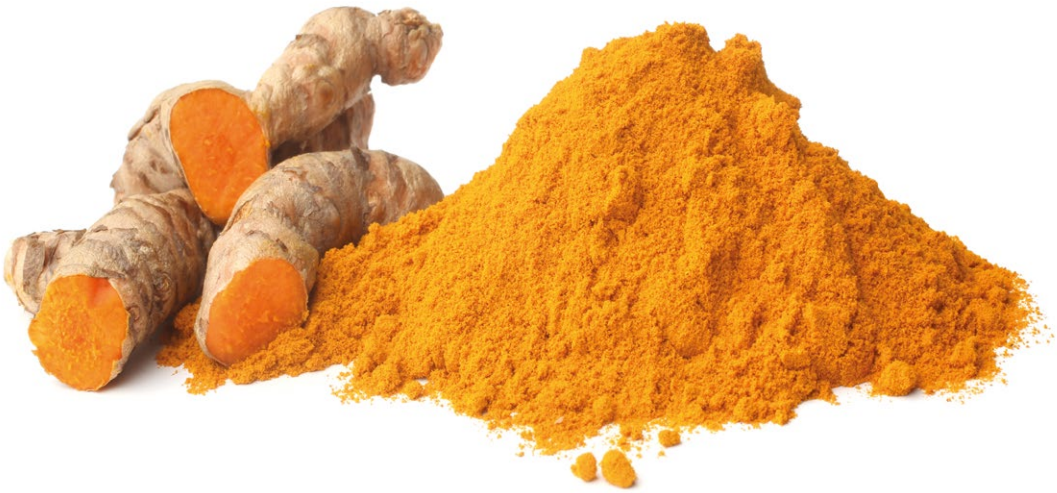
INTRODUCTION

Food fraud – or intentional deception for economic gain using food – has probably occurred since the very start of all commerce. The interdisciplinary focus on food fraud prevention is a newer concept defined in a scholarly sense in 2011 (Spink et al., 2011). When shifting to prevention, there was a need not just to detect food fraud, but also to prevent it by understanding its root causes. Until more formal management systems are adopted, decisions about countermeasures and control systems tend to be one-off, or ad hoc, reactions. But considering all types of food fraud expanded the focus from detecting adulterant substances, or crime-fighting, to a new holistic approach of preventing all fraud acts.

This paper provides insight into how the food authenticity-related concepts of testing, monitoring, and verification can be applied effectively within the overall framework of food fraud prevention.

OVERVIEW OF FOOD FRAUD AND FREVENTION

Three of the four (Sudan dyes in spices, melamine in baby milk and allergens in spices) of the largest food fraud incidents in the last 20 years also had food safety implications so food fraud is a major global public health concern, but prevention topics are still evolving. A first step in facilitating the wider focus on prevention, was reaching a consensus on the definition of food fraud as "an intentional act of deception for economic gain using food." (GFSI, 2017) (Spink et al., 2011)(EC, 2014)(DEFRA, 2014). This definition also enabled clarification of the entire scope of all types of food fraud; including adulterant-substances (dilution, substitution, concealment); unapproved enhancements; mislabeling and misbranding; grey market/ theft/ diversion, tampering; and intellectual property rights counterfeiting. This broad approach to preventing all types of food fraud expands our focus to encompass all products - from raw materials and incoming goods through to finished goods in the marketplace.



From Frederic Accum's 1820 volume, 'A Treatise on the Adulteration of Food and Culinary Poisons' we can establish that initial attempts to counter food fraud concentrated on food safety, and substances that created public health harm. (Accum, 1820) Therefore, the original research path started with these food safety problems and then acted to identify and detect the public health issue. Accum – and other early food scientists identified cases of food fraud using improved detection methods but left the task of solving the fundamental problem to 'someone else'.

Management systems and quality management approaches have become increasingly influential, and their emphasis on the importance of prevention, have led to many interdisciplinary projects that concentrated on identifying the root causes of problems. The first presentation of an interdisciplinary food fraud prevention approach was in 'Defining the Public Health Threat of Food Fraud Prevention' in 2011 (Spink et al., 2011). The focus shifted to the identification of root causes and holistically reducing vulnerabilities: for example, a human adversary conducts the food fraud act, so it is logically essential to start with social science, specifically Criminology, to try to understand what drives people to commit food fraud. In a food fraud prevention context, relevant Criminology theories include Rational Choice Theory (a human adversary thinks they can get away with committing the crime) and Routine Activities Theory (crime opportunities are usually found during daily activities), These can then be combined into Situational Crime Prevention (reduce opportunities to commit crime in the physical environment). After focusing on the criminological root cause, additional disciplines such as human behaviour, public policy, standards and certification, packaging, supply chain management, and overall risk management, including COSO (The Committee of Sponsoring Organisations of the Treadway Commission Framework) - based enterprise risk management should be considered. These will contribute insight or countermeasures that can be implemented. (Spink, Working Paper).

The goal is not to catch food fraud but to prevent it from occurring – first, by considering all potential fraud acts and, second, by reducing overall vulnerability or system weaknesses. As tools that help engender trust in global food supply chains, food authenticity testing should be judged not only on the ability to detect fraud but, more importantly, on its contribution to preventing it. So even if an authenticity test is being requested to detect a specific substance, to encourage continued monitoring, the activity should be presented in terms of future prevention goals. There are resources available to help Food Business Operators (FBOs) develop and implement food fraud prevention strategies; many of these resources are signposted in the food fraud prevention section of the open access website (Food Authenticity Network).

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EXTERNAL AND INTERNAL COMPLIANCE REQUIREMENTS

Once the importance of a holistic, preventative approach is understood, the next step necessary is to understand compliance requirements. These requirements set out the details of precisely what must – or should – be done to address food fraud prevention.

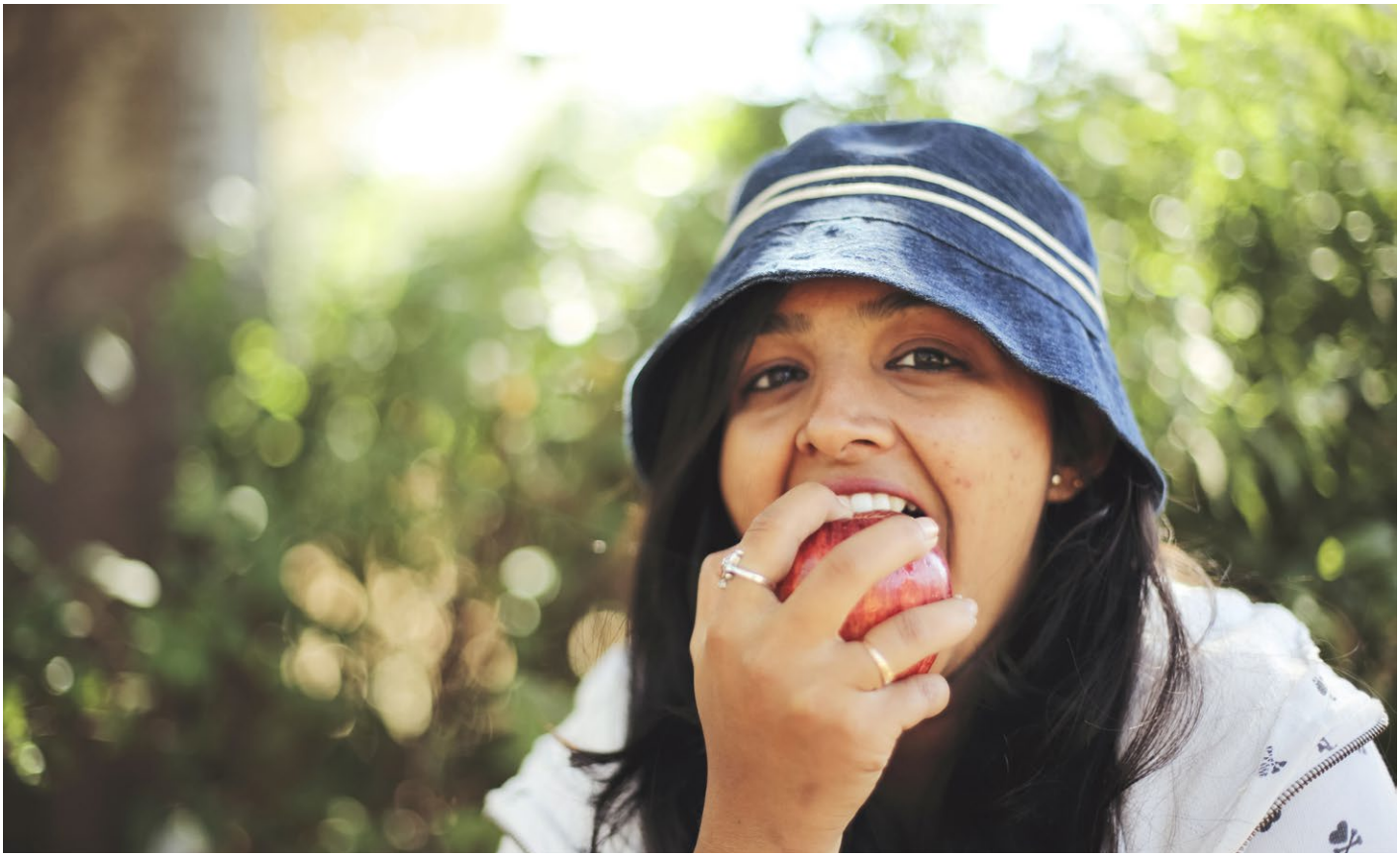
Food laws and regulations usually focus on public health threats, marketing label claims, import or taxation laws, and violations of criminal statutes. Investigating food fraud is usually inherently a lower priority, not least because traditionally, the food fraud acts generally have a lower economic impact than other crimes. Moreover, commonly, most food fraud acts do not present a public health threat even though products and consumers could be vulnerable.

Regulations that focus on food safety and public health threats are generally based on hazard analysis and prevention, and they are applicable, directly, or indirectly to food fraud, since usually all sources of a public health hazard need to be assessed and managed. Although this is a dynamic environment, with Codex Alimentarius (CODEX) and European Committee for Standardization (CEN) actively developing consensus definitions for food fraud and related terms, currently, food codes or standards, such as the aforementioned or the International Organization for Standardization (ISO), have few resources that explicitly mention food fraud, and there are often no prescribed requirements (e.g., specific types of tests or countermeasures).

In this context, the most impactful recent breakthrough for food fraud prevention was the widespread adoption of the 2018 Global Food Safety Initiative (GFSI) system standards. GFSI is the benchmark for food safety management system standards (including Food Safety Certification System 22000 (FSSC), the Safe Quality Food Programme (SQF), British Retail Consortium Global Standards (BRCGS), and the International Featured Standards (IFS)). The GFSI membership equates to over 65% of the world food trade, and therefore the benchmark has become a de facto requirement for conducting food commerce.

> GFSI recognised that food fraud could be a root cause of a food safety incident, (GFSI, 2014) and included all types of food fraud and all products within its scope. Essentially a quality management system focuses on root causes to reduce vulnerabilities and requires companies to:
>
> - Conduct a food fraud vulnerability assessment and then,
> - Implement a food fraud prevention strategy that is then,
> - Integrated into its food safety management system. (GFSI, 2018)

GFSI sets broad, high-level principles that allow food companies to refine and implement compliance journeys – an approach that also takes the varied nature of risks and supply chains into account. There is now a near-universal requirement to assess and prevent food fraud, and the scope of prevention requirements usually covers all types of fraud and food products.



THE ROLE OF TESTING AND AUTHENTICITY

Food authenticity testing is the most complex scientific task in food fraud prevention. The nature of foods and products is so varied that it is often very difficult to detect adulterant-substances or fraudulently sourced materials. While broadly focused approaches such as non-targeted testing or next-generation sequencing are significant advances, there remains the question of 'What are you looking for?' Levels for Thresholds of Concern (TOC) are required but often not available against a background of a few Thresholds of Regulation (TOR) in the food authenticity arena.

> Food authenticity testing is complex and there is frequently a need for analytical scientists to provide more than just a 'Yes/No' answer for the presence or absence of an analyte. Partnership working between laboratories and FBOs will lead to the implementation of a more robust food authenticity testing regime that is more likely to be valued by all stakeholders.

Also, there is a challenge of the 'Threshold of Detection' and quantitation, especially in a blended food product after changes that occur during processing. There may also be no need for parts per million or parts per billion level testing: in some cases, the Threshold of Concern may be one per cent, as was agreed in the 2013 horsemeat incident as the action limit for enforcement. (UK Parliament, 2020).

Technically, food safety testing does not test if the food is 'safe.' Instead, analysis is targeted at 20 or so chemicals or organisms that are known to cause public health harm. For example, probably the most significant of all recent food fraud acts occurred when the melamine molecule was added to infant formula to deceive protein tests and caused the death of six babies and illness in about 300,000 others due to kidney damage. Melamine is rich in nitrogen, and relatively cheap. Adding it to sub-standard or watered-down milk makes the milk's protein content appear higher. Standard quality tests estimate protein content by measuring the concentration of nitrogen. From a laboratory testing perspective, there was no reason to prioritize monitoring for melamine as, at that time, it was not a well known food safety or food fraud problem. It is therefore not practical or economically viable to look for 'any adulterant-substance that could cause a problem.'

Throughout history, food fraud has a pattern of reoccurring periodically, so it would be sensible to consider this fact to identify system weaknesses that present a fraud opportunity when developing food authenticity testing regimes as part of a food fraud prevention strategy. For example, considering where melamine has been used in food previously would lead one to the discovery that in 2007, pet food that was manufactured in China and distributed in North America was contaminated with melamine and caused the deaths of over 1000 household pets. In this vein, consideration could also be given to which other chemicals or actions could deceive protein tests (when the content of one component, such as a protein, establishes the price per kilogram of a product, the higher the protein content, the more valuable the product). Beyond protein tests, we could review how value-added products are measured and consider potential fraud opportunities; this type of focus could also indicate that species swapping in ground meat might represent a similar fraud opportunity such as the substitution of beef meat with horsemeat that was discovered in January 2013 when beef prices were very high. After testing for melamine-type chemicals, a criminology intelligence analysis review would have recommended scrutiny of other areas, such as animal species tests.

Food authenticity testing plays a critical role in food fraud prevention but there are inherent complexities involved in predicting which adulterants could be used by fraudsters or the type of food fraud they will commit. This means that starting with vulnerability assessments and an understanding of fraud opportunities that exist within a business and/its supply chains will help make testing and monitoring plans more efficient and effective.

HOW LABORATORY PARTNERS CAN SUPPORT FBOS IN FOOD FRAUD PREVENTION

Laboratories can either adopt a reactionary approach to offering food authenticity testing services i.e., waiting for a request for a specific product or service – a situation that usually occurs following an incident such as the melamine or species swapping examples above. Once the incident passes, the testing is often stopped – since the emergency has passed, and there is a perception that detection tests are no longer needed. Or laboratories can adopt a partnership approach whereby they discuss the requirements of the FBO and offer them a testing programme that identifies and suggests solutions to relevant, specific fraud opportunities identified in their vulnerability assessment. When the food fraud opportunities and their potential impacts are understood by the FBO, delivering a comprehensive food fraud prevention programme can be achieved using a strategic approach. When there is a strategic plan to identify new fraud acts and implement prevention, a food authenticity testing regime usually becomes a permanent part of the monitoring process.

Food authenticity laboratories must first understand the FBO's overall food fraud prevention strategy. This starts with understanding the unique vulnerability of the FBO's supply chain and then the specific details of the relevant fraud opportunities. By working together, both the laboratory and FBO can more efficiently and effectively address the goals to detect, deter, and, more importantly, prevent food fraud. The proposal for a testing programme should explain how the product or service meets that priority. The proposal should include the recommended test and method (including its strengths and weaknesses), as well as the frequency and site of the test.

Food authenticity testing is complex and laboratories working in partnership with FBOs to understand the fraud opportunities relevant to their business, will lead to the implementation of a more robust food authenticity testing regime that is fit for the FBO's purpose, and thus, is more likely to be valued by all stakeholders.

It is also important to recognise that FBOs no longer have to work in isolation, in the UK, the Food Industry Intelligence Network (fiin) allows food businesses to collaborate to enhance supply chain assurance by sharing the data from their analytical testing regimes, which is collected, collated and analysed by fiin. The information and intelligence gained from the collective data (Over 50,000 authenticity tests conducted and pooled for intelligence sharing every year) analysis is shared with all member FBOs enabling them to adjust their future testing regime accordingly.

There are also a wide range of activities that support the food fraud prevention efforts, such as the UK Government funded review of Global Food Fraud Definitions undertaken by the Food Authenticity Network (FAN). This work has been a resource for global activities such as the Codex Alimentarius (CODEX) electronic Work Group on Food Fraud prevention and the European Committee for Standardization (CEN) food authenticity projects and work groups.

Definitions of terms

There are several types of fundamental food risks (Spink et al., 2011)

Food quality	Food safety	Food fraud	Food defense
Unintentional act with no health hazard	Unintentional act with a health hazard	An intentional act of deception with the goal of personal economic gain, including avoidance of a financial loss	Intentional action with the intent to cause harm that is economic, public health, or terror

There are also related terms such as:

- **Food integrity:** "can be seen as ensuring that food which is offered for sale or sold is not only safe and of nature, substance, and quality expected by the purchaser but also captures other aspects of food production, such as the way it has been sourced, procured and distributed and being honest about those elements to consumers." (DEFRA, 2014)
- **Food authenticity:** "is about ensuring that food offered for sale or sold is of nature, substance, and quality expected by the purchaser." (DEFRA, 2014)
- **Food crime:** there are two definitions, the first of which is "any crime that occurs using food" and the second, a "serious food fraud incident."(van Ruth et al., 2017) The National Food Crime Unit defines food crime as serious fraud and related criminality in food supply chains.
- **Economically motivated adulteration** (US FDA defined "substance" intentionally added for "economic gain." (FDA, 2009).

In recognition that the lack of consensus can be a potential barrier in the international trade of food, both Codex and CEN are currently standardising definitions for food fraud and related terms.

ABOUT DR. EHRENSTORFER

Since 1975, Dr. Ehrenstorfer™ has led the way in producing pesticide reference standards. Today, as part of the LGC Group, our portfolio has expanded to adapt to changing regulations and technology and the requirement for reliable reference materials for food and environmental analysis. Supporting science for a safer world.
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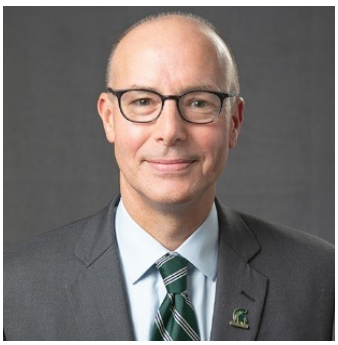
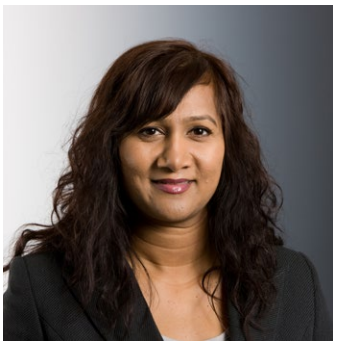
Dr. John W Spink is the Director and Lead Instructor for the Food Fraud Prevention Academy. Also, he is an Assistant Professor in the Department of Supply Chain Management (SCM) in the Eli Broad College of Business at Michigan State University (MSU). His food fraud prevention research focus is on policy and strategy to understand and prevent these supply chain disruptions and to implement procurement best practices. He is widely published in leading academic journals and has helped lead national and global regulatory and standards activity. More recently his teaching and research has expanded to supply chain disruption management and procurement best practices.
For more information visit: www.FoodFraudMOOC.com



Dr John W Spink

REVIEWED BY SELVARANI ELAHI MBE, UK DEPUTY GOVERNMENT CHEMIST

Selvarani is the UK Deputy Government Chemist and Executive Director of the Food Authenticity Network FAN at LGC. Selvarani has over 30 years' experience in the analysis of food and agriculture samples and working with the UK Government to input into standards, regulation and policy to ensure that they are based on sound measurement science. Selvarani is the UK co-Chair for a Codex working group that is developing definitions for food fraud. Selvarani led the creation of FAN, an open access website that is now the world's premier source of food authenticity methods and food fraud mitigation information, helping to build more resilient global food supply chains. Selvarani is a Fellow of the RSC and IFST, and in 2020, she was awarded an MBE for services to food measurement science.



Selvarani Elahi MBE

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