



FOOD FRAUD

UNDERSTANDING THE IMPACT
OF FOOD FRAUD IN ASIA



ABOUT FOOD INDUSTRY ASIA

Food Industry Asia (FIA) is a non-profit organisation that was formed in 2010 to enable major food manufacturers to speak with one voice on complex issues such as health & nutrition, food safety and the harmonisation of standards.

From its base in Singapore, FIA seeks to enhance the industry's role as a trusted partner and collaborator in the development of science-based policy throughout Asia. To do so means acting as a knowledge hub for Asia's national industry associations and affiliated groups, to support with their engagement of public bodies and other stakeholders across the region.

OUR VISION

TO BE A TRUSTED PARTNER FOR
BUSINESSES AND GOVERNMENTS —
BUILDING A VIBRANT FOOD
& BEVERAGE (F&B) INDUSTRY FOR A
HEALTHY AND PROSPEROUS ASIA.

OUR MISSION

TO REPRESENT THE FOOD AND
BEVERAGE INDUSTRY IN ASIA
— PROMOTING A CLIMATE FOR
SUSTAINABLE GROWTH AND SERVING
AS A REGIONAL KNOWLEDGE HUB FOR
SCIENCE-BASED ADVOCACY.

ABOUT THE AUTHOR

Food Industry Asia commissioned Prof Alan Reilly, former Chief Executive of the Food Safety Authority of Ireland (FSAI), to write this report. In 2013, he led the team at the Food Safety Authority of Ireland (FSAI) which uncovered the European-wide horsemeat scandal which resulted in a major restructuring of the official food control system in the European Union and initiatives by the European food industry to strengthen food safety management systems to combat food fraud. He is an Adjunct Professor at the Institute of Food and Health, University College Dublin, Ireland.

CONTENTS

1

INTRODUCTION



pg. **03**

2

WHAT IS FOOD FRAUD

2.1 Types of Food Fraud



pg. **06**



pg. **09**

3

SCALE AND GLOBAL INCIDENCE OF FOOD FRAUD

3.1 Health and Safety implications of food fraud

4

FOOD FRAUD MITIGATION

- 4.1 Vulnerability Analysis
and Critical Control
Point (VACCP) System
- 4.2 Food Fraud
Vulnerability
Assessment (FFVA)
- 4.3 Food Fraud Detection



pg. **15**

EXECUTIVE SUMMARY

Food fraud is committed when food is illegally placed in the market with the intention of deceiving the customer, usually for financial gain. Food fraud can take place at multiple points along the food supply chain. It involves criminal activity that can include mislabelling, substitution, counterfeiting, misbranding, dilution and adulteration of foods. While these types of fraud primarily result in cheating customers, they can also lead to significant food safety risks, compromising consumers' health. Public health is put at risk when foods are adulterated with harmful chemicals or when allergenic or toxic ingredients are illegally used in food manufacture.

The precise scale and nature of food fraud in the wider global food market is largely unknown, however, there is ample evidence from both the scientific press and social/conventional media to highlight a growing problem with serious consequences for the food sector. While there is also an absence of comprehensive, independent data on the scale of food fraud in Asia, the region is at particular risk from food fraud. There is a growing demand for premium quality foods in the region as consumers become more affluent and

trade in e-commerce expands. There is also a growing trend in counterfeiting of middle range foods in Asia, not just premium products, as shown by recent reports of counterfeit food discussed in this report. The impacts of food fraud include loss of consumer confidence in both the food industry and in the effectiveness of government food control programmes. Some high-profile food fraud incidents in the past decade have also damaged national reputations, with unwanted attention focused on the safety, quality and authenticity of all foods exported to the global market.

Combating food fraud requires different tactics to those applied by the food industry to reduce food safety risks associated with microbiological, chemical and physical hazards. Current food safety management systems based upon the Hazard Analysis and Critical Control Point (HACCP) principles are not specifically designed for the identification and prevention of food fraud. Tackling food fraud is a complex task and requires the food industry to develop and implement effective, science-based food traceability systems and improved methods for food authenticity testing.

The food industry also needs to develop and implement systems for food fraud vulnerability assessment to identify potential sources of fraud within their supply chains and to prioritise control measures to minimise the risk of receiving fraudulent or adulterated raw materials or ingredients.

The onus is now on food companies to develop documented systems for Food Fraud Vulnerability Assessment (FFVA) and to implement measures to mitigate the public health, economic and reputational risks that may result from the food fraud. To counter food fraud effectively, the food industry in Asia must expand their food safety management systems to include the process of FFVA. This report discusses the steps that must be taken by food businesses to develop systems to identify, manage, and mitigate fraudulent practices in food trade. Specifically to undertake vulnerability assessments to identify potential sources of food fraud within their supply chains; and to prioritise control measures to minimise the chances of receiving fraudulent or adulterated ingredients, raw materials or products.





1 INTRODUCTION





INTRODUCTION

The precise extent of food fraud in the Asian food industry and in the wider global food market is largely unknown. While the scale of food fraud may be unclear, there is ample evidence from both the scientific press and public media to highlight the serious consequences for the food industry and consumers of foods. Food fraud is not a new phenomenon, some of the earliest food regulations dating back thousands of years targeted such practices as the adulteration of wine and olive oil, dilution of milk, substitution of coffee and tea with a range of adulterants. More recent high profile food fraud incidents have focused the attention of regulators, the food industry and consumers on this criminal practice. The addition of melamine to milk products in 2008 to increase the protein content in China and the European-wide substitution of processing beef with horsemeat in 2013 have highlighted the vulnerability of the global food chain to fraudulent practices. These and other recent incidences of food fraud demonstrate potential public health risks for consumers and reputational and financial risks for the food industry. It is against this background that Food Industry Asia decided to publish this report.



The purpose of the report is to provide a detailed explanation of the incidence and implications of food fraud for food businesses in Asia and to help food industries anticipate the relative likelihood of fraudulent attacks on the many and varied product lines offered to consumers. To assist food businesses prepare and anticipate for the possibility of food fraud, a mitigation process for incorporation into a food companies' Food Safety Management System is described. This is based on a two stage approach: firstly, to undertake vulnerability assessments to identify potential sources of food fraud within their supply chains; and secondly, to prioritise control measures to minimise the chances of receiving fraudulent or adulterated ingredients, raw materials or products.



2

WHAT IS FOOD FRAUD



Food fraud is committed when food is illegally placed in the market with the intention of deceiving the customer, usually for financial gain¹. More simply, it is the act of defrauding food buyers for economic gain. Essentially food fraud is a criminal activity which involves deception and misrepresentation. It requires a criminal investigatory response, appropriate regulatory provisions and penalties to discourage fraudulent practices in the food chain.

Tackling food fraud requires different tactics to those applied by the food industry to reduce food safety risks associated with microbiological, chemical and physical hazards. Current food safety management systems based upon the Hazard Analysis and Critical Control Point (HACCP) principles are not specifically designed for the identification and prevention of food fraud. These systems focus on the control of hazards posed by natural, accidental or unintentional contamination and are based on the principle that all players in the food chain are honest and do not have criminal intent. The combination of the presumption of honesty and deceitful action to disguise fraudulent activities makes food businesses particularly vulnerable to fraud. In order to combat food fraud, companies in Asia need to carry out food fraud vulnerability assessments and introduce food control measures focusing on supply chains and in-house management systems.

Food fraud can result in significant food safety risks where consumers' health is compromised; it can impact on the nutritional quality of foods, for instance when milk or fruit juices are diluted with water or sugar solutions; it can damage consumer trust in the integrity of the food supply; it can lead to a distortion of the market and disadvantage honest food businesses; it can also result in severe economic consequences for the food industry and damage to national reputations in the global marketplace.

2.1 TYPES OF FOOD FRAUD

There are many categories of food fraud that pose different risks to both the food industry and consumers. Food fraud can take place at multiple points along the food supply chain. The broad categories or types of food fraud include substitution, mislabelling, adulteration, counterfeiting, dilution, concealment and marketing of “grey products”. These are not rigid classifications and overlaps can exist between different categories.

Substitution is a common form of food fraud which involves the substitution of a high-value product with a less expensive or lower quality alternative. This can involve the partial or total substitution of a high value ingredient or product with a cheaper alternative. Key examples of known fraudulent activity involving substitution are replacing extra virgin olive oil with cheaper vegetable oil varieties; substituting wild captured salmon with cheaper farmed species, premier products such as Manuka honey being substituted by low value honey or sugar solutions; and substituting beef with cheaper meat in processed beef products.

Mislabelling includes the fraudulent presentation or description of foods with the intention of defrauding the consumer or evasion of taxes or tariffs. Examples of fraudulent labelling

include false claims based on either the geographic or the varietal origin of products, and false declaration of food production processes. Some common examples are falsely declaring country of origin, misleading consumers as to the variety of rice (Basmati rice), and labelling conventionally produced food as organic. Saffron is a highly valued spice which is used as a colouring and flavouring agent in foods. Much of the saffron which is traded internationally is vulnerable to fraud because of its high price and limited production. A recent study on the authenticity of saffron using a newly developed “chemical fingerprint” method found that over 50% of commercial products tested were fraudulently labelled with respect to country-of-origin labelling².



FOOD LABELLING

Consumers require accurate information so that they can make informed choices about the foods they purchase and eat. Food choices reflect dietary habits and lifestyles, for instance consumers may wish to eat organically produced foods or may wish to avoid certain animal products for religious reasons. It is essential for consumers suffering from food allergies to be provided with precise and accurate information about allergenic ingredients in foods. Food labelling provides the necessary information for consumers to choose one food product over another. To maintain consumers' confidence and trust in the integrity of the food supply, prepacked processed foods must be authentic and accurately labelled.

¹ https://www.fsai.ie/enforcement_audit/food_fraud.html

² <https://www.sciencedaily.com/releases/2016/01/160120113714.htm>

Adulteration is the addition of an undeclared ingredient to foods for fraudulent enhancement of properties. It not only results in reducing product quality but may result in food safety risks for consumers. Examples³ are the addition of melamine to milk to increase the nitrogen levels, the addition of industrial dyes, such as rhodamine B or lead chromate⁴, to ground spices to enhance colour⁵, and the addition of unapproved colouring agents in foods^{6,7}. Adulteration of herbal food supplements with illegal ingredients is a growing problem in e-commerce and internet sales.

Counterfeiting means the production and marketing of fake or imitation food products with the intention to deceive customers. Recent examples of counterfeit food products found on the market in Asia are fake food sauces marketed as popular commercial brands⁸ and fake infant formula sold as a leading commercial infant formula brand⁹.

Dilution of food and drinks is probably one of the oldest forms of food fraud. It is a form of substitution where food and drink are bulked out with cheaper varieties of similar products, for instance the dilution of premium fruit juices with cheaper alternatives, pulp wash, citric acid and sugars. Common examples of this type of food fraud include the addition of cheap cooking oils to premium brands, and the addition of sugar solutions to premium honey varieties.

Concealment is a form of mislabelling or substitution. Examples involve not providing all information regarding foods such as misdescribing the country of origin of food products for financial gain, marketing conventionally produced agricultural products as organic or marketing non-halal meat as halal.

Grey market foods are those foods that are traded which have been legitimately manufactured but are traded illegally. Examples are foods that have been stolen, foods with altered "use by" dates, or "end of

line" or excess production batches. Such products can be produced for marketing in one jurisdiction but they get sold in another, which may occur through on-line sales.

Regardless of the manner in which the food fraud occurs, it is illegal, it can impact negatively on public health and can undermine confidence in the market place. Even if a food fraud scare turns out to be false, it can still impact negatively on brands and trade, with serious consequences for the food industry, in addition to economic, social and environmental costs.



³ <https://onlinelibrary.wiley.com/doi/abs/10.1002/fsn3.127>

⁴ <http://www.astaspice.org/the-american-spice-trade-associations-statement-on-lead-in-turmeric/>

⁵ <http://sggpnews.org.vn/health/hanoi-health-authorities-detect-adulterated-chilli-powder-4349.html>

⁶ <https://foodsafety.suencs.com/?p=5233>

⁷ <http://www.fda.gov/ph/advisories/food/114164-fda-advisory-on-products-positive-on-rhodamine>

⁸ <http://www.bjnews.com.cn/inside/2017/01/16/430772.html>

⁹ <https://www.foodnavigator-asia.com/Article/2016/04/11/Thousands-of-cans-of-Chinese-fake-formula-still->



3 SCALE AND GLOBAL INCIDENCE OF FOOD FRAUD





USE OF UNAPPROVED COLOURS TO ENHANCE VALUE OF SPICES AND OTHER FOODS

The illegal use of industrial dyes to enhance the colour of spices is a major threat to the food industry in Asia. The adulteration of spices with genotoxic industrial dyes, such as Sudan Red, has resulted in product recalls on the international markets and the introduction of regulations requiring certification that chilli products are free from adulteration²⁰. Turmeric from both India and Bangladesh, adulterated with lead chromate used to enhance the yellow colour, has been the subject of major recalls in the United States due to high lead levels²¹. The adulteration of turmeric with lead chromate has also resulted in lead poisoning in children in Bangladesh²². Recent studies in Myanmar have shown that chilli powder on the local market to be adulterated with a range of unapproved colouring agents²³, while shrimp paste was adulterated with Rhodamine B and traditional fermented tea leaf with Auramine O²⁴.

have recently uncovered the use of fake halal labels on chicken products¹⁷ and on prawn crackers. A recent study¹⁸ of labelling non-compliance of imported fishery products carried out by Italian authorities found that 22.5% of products were mislabelled, with the highest rate of mislabelling in products imported from China, Vietnam and Thailand. An investigation of fishery products sold online in China¹⁹, found that 85% of the samples identified by DNA barcoding were mislabelled. The use of industrial or illegal dyes to enhance the colour of foods in local wet markets in Asian countries is also a growing problem.

A number of factors may influence the reporting of food fraud events and can pose challenges in assessing the scale or global incidence. Consumers are often unaware that they have purchased substandard or mislabelled food products as such products may have no immediate health impacts. Food fraud events will generally pass undetected when the consumer does not suffer physical harm. When food businesses suspect or find that they are the victims of food fraud, they may be reluctant to report the event for fear of damaging reputations. Wildly publicised food fraud events can impact food businesses financially, either through loss of revenue or market share. National food authorities may also be reluctant to publicise food fraud events for legal reasons or for fear of encouraging similar practices by other perpetrators.

The cost of food fraud to the food sector globally has been estimated to be in the region of US\$40 billion annually¹⁰. Estimates by the Grocery Manufacturers Association of the United States (USA) show that fraud may cost the global food industry between \$10 billion and \$15 billion annually, affecting approximately 10% of all commercially traded food products¹¹. In March 2017 the results of a joint Europol-INTERPOL¹² operation targeting food fraud and involved 61 countries demonstrated the current global scale of trade in counterfeit and substandard food and drink. The outcome of this investigation led to the seizure 9800 tonnes and over 26.4 million litres of potentially harmful food

and beverages worth an estimated EUR 230 million. Foods ranged from every day products such as alcohol, mineral water, seasoning cubes, seafood and olive oil, to luxury goods like as caviar.

While there is an absence of comprehensive, independent data on the scale of food fraud in Asia, it is a region at particular risk from food fraud. There is a growing demand for premium quality foods in the region as consumers become more affluent and trade in e-commerce expands. There is also a growing trend in counterfeiting of middle range foods in Asia, not just premium products, as shown by recent reports of counterfeit chocolate, spices and chicken stock¹³ where the authorities in China uncovered the large scale counterfeit production of popular brands of sauces and condiments. A recent report from the Ministry of Commerce in China found that nearly 40% of all products on e-commerce sites were fake¹⁴. An analysis of over 1500 media reports on food fraud in China¹⁵ concluded that there are serious food safety concerns across the food chain due to a wide range of fraudulent practices, such as the use of illegal additives, the incorrect use of approved additives, substitution and mislabelling, manufacture of counterfeit and fake foods, dilution and adulteration.

Food supplements, especially products sold online and via internet sales are frequently mislabelled or contain ingredients not included on the label¹⁶. The halal food markets in Indonesia and Malaysia are under threat from the marketing of non-halal products as halal. The Malaysian authorities

10 <https://www.singaporebusiness.com/2016/keeping-an-eye-on-food-fraud-in-asia.html>

11 <https://fas.org/sqp/crs/misc/R43358.pdf>

12 <https://www.europol.europa.eu/newsroom/news/eur-230-million-worth-of-fake-food-and-beverages-seized-in-global-opson-operation-targeting-food-fraud>

13 <https://www.foodfraudadvisors.com/trends-and-developments-in-food-fraud-2017/>

14 <https://www.techinasia.com/40-chinas-ecommerce-products-fakes-government-report>

15 <https://www.sciencedirect.com/science/article/pii/S0956713516301098?via%3Dihub>

16 <https://www.fda.gov/forconsumers/protectyourself/healthfraud/ucm255499.htm>

17 <http://www.malaysiadigest.com/news/652631-major-chicken-tofu-processing-company-caught-using-fake-halal-logos.html>

18 <https://www.sciencedirect.com/science/article/pii/S0956713517301822?via%3Dihub>

19 <https://www.sciencedirect.com/science/article/pii/S0956713516303176?via%3Dihub>

20 <http://foodsafety.suencs.com/?p=5233>

21 <http://www.foodqualityandsafety.com/article/the-cumin-scandal-accidental-or-fraudulent/>

22 <http://www.biomedcentral.com/1741-7015/11/222>

23 <https://doi.org/10.1016/j.trstmh.2010.10.002>

24 <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0625&from=EN>

3.1 HEALTH AND SAFETY IMPLICATIONS OF FOOD FRAUD

Although many of the food fraud incidents reported globally do not pose an immediate risk to public health, some cases have resulted in actual or potential harm to consumers' health. Public health is put at risk when foods are adulterated with harmful chemicals or illegal ingredients for commercial gain. Examples of such practices in Asia are the addition of melamine to dairy products to increase the nitrogen content and the use of toxic industrial dyes, such as lead chromate or Sudan red to ground spices for enhancing the colour. Turmeric, chilli powder and paprika originating in Asia have all been the subject of international food recalls because of adulteration with harmful chemicals. Traditional foods, such as shrimp paste, pickled tea leaves, bean curd and ground spices have been the subject of food alerts and recalls in a number of Asia countries due to the presence of potentially carcinogenic illegal colours, Rhodamine B, Auramine O and methyl yellow. The import of certain brands of cooking oils from Thailand and Malaysia have been banned in Myanmar because of the presence of illegal colouring agents²⁵.

Risks to public health are also associated with the bulking out or adulteration of ground spices and chopped herbs with cheap plant material that may expose consumers to unlabelled allergens. One of the largest recalls of food resulted from the adulteration of cumin and cumin-containing foods with undeclared peanuts²⁶. Adulteration of food supplements with contaminants, fillers and unapproved ingredients also poses serious risks to public health²⁷.

BULKING OUT OF HERBS AND SPICES

Substitution of expensive herbs and spices with inferior plant material is a major challenge for the food industry because of the difficulties of detection and the expense of using advance analytical methods. Chopping and grinding of dried herbs and spices make these products an easy target for adulteration as processing will change the physical distinguishing characteristics, making adulteration difficult to detect. Recent studies in the UK²⁸ and Australia²⁹ found oregano on retail sale to be adulterated with myrtle, sumac and olive leaves. In one of the largest food recalls in the United States, ground cumin and products containing ground cumin were found to be adulterated with undeclared peanut protein causing a major allergy scare³⁰. Saffron, one of the most expensive spices in the world has also been the target of adulteration with inferior plant material and the addition of unapproved colouring agents³¹.

25 <http://www.sda.gov.cn/WS01/CL0782/169500.html>

26 <https://www.foodengineeringmag.com/articles/95205-vaccp-haccp-for-vulnerability-assessments#Tools>

27 <http://www.ssafefood.org/our-projects/?proj=365>


28 <https://www.pwc.nl/en/industries/agrifood/ssafe-food-fraud-tool.html>

29 <https://doi.org/10.1016/j.foodcont.2017.08.020>

30 <https://doi.org/10.1016/j.foodcont.2017.05.019>

31 <https://www.foodfraudadvisors.com/vulnerability-assessment-tools/>





In Asia there are major food safety concerns associated with the substitution of commercial fish species with toxic varieties. Naturally toxic fish species which cause serious forms of food poisoning and which can sometimes cause fatalities include some species of puffer fish, scombroid fish, escolar or oilfish, and ciguatoxic fish species. Over the past number of years, there have reports of fatalities associated the consumption of puffer fish in Bangladesh resulting from unscrupulous marketing of toxic fish in communities which would have no knowledge about the risks to health from puffer fish, resulting in three outbreaks with 141 cases of illness and 17 deaths³². Public health is also put at risk when farmed species from polluted watercourses are substituted for marine fish. Residues of antibiotics in farmed species may also pose a risk to consumer health, emphasising the link between species authentication and food safety.

FISH FRAUD IN ASIA

Seafood fraud is committed when seafood is deliberately placed on the market, for financial gain, with the intention of deceiving the customer. There are many different types of seafood fraud which can take place at multiple points along the seafood supply chain. The most common type of fish fraud involves intentional mislabelling and species substitution. To a lesser extent fraud occurs when seafood is over-glazing or over breaded, leading to consumer deception regarding the nature of fishery products. Undeclared use of water binding agents is also a fraudulent practice that leads to increasing the weight of products and selling additional water substituted for fish. While seafood fraud is not a new problem, the number of reported cases and incidences in recent years, particularly in Asia, shows an increasing trend in the worldwide scale of species substitution and mislabelling. The seafood chain is particularly vulnerable as demonstrated by an investigation into food fraud carried out across 57 countries and coordinated by INTERPOL-EUROPOL in 2015³³. Seafood was identified as the third highest risk category of foods with the potential for fraud. In 2013, the European Parliament identified seafood as the second

most likely category of food traded internationally at risk of fraud³⁴.

Investigations in Asia using DNA barcoding have also reported incidences of mislabelling of seafood. In a pioneering forensic seafood survey conducted in Malaysia in 2016³⁵, 16% of raw, frozen or commercially processed seafood were found to be mislabelled. Studies in China using DNA barcoding have also revealed widespread mislabelling of seafood on the national market^{36, 37}. A study on the authenticity of fish maws (dried, salted swim bladders) on the Chinese market found that 53.2% were mislabelled and commercial species substituted with low value species³⁸. Similarly, an investigation of the authenticity of seafood imported into Taiwan showed that 70% of samples were mislabelled³⁹. A recent study⁴⁰ of labelling non-compliance of imported fishery products carried out by Italian authorities found that 22.5% of products were mislabelled. The highest level of mislabelling was found in cephalopod based products (43.8%) followed by crustaceans (17%) and fish (14%), with the highest rate of mislabelling in products imported from China, Vietnam and Thailand. All of these data point to a serious problem with seafood fraud in the global food marketing chain.

³² <https://www.foodfraudadvisors.com/vulnerability-assessment-methods/>

³³ www.fdf.org.uk/food-authenticity.aspx

³⁴ <https://www.sciencedirect.com/science/article/pii/S0308814617309688?via%3Dihub>

³⁵ http://www.ypbsystems.com/technology/forensic_covert_tracer.php

³⁶ <http://thinfilm.no/solutions-nfc-solutions/>

³⁷ <http://www.foodanddrinkbusiness.com.au/news/traceability-key-in-infant-formula-export>

³⁸ <https://pdfs.semanticscholar.org/24cd/eb7d7421012c2fdd362b8e2816c105b7071f.pdf>

³⁹ <https://hbr.org/2017/01/the-truth-about-blockchain>

⁴⁰ <http://www-03.ibm.com/press/us/en/pressrelease/53487.wss>



4

FOOD FRAUD MITIGATION





FOOD FRAUD AND THE BRC GLOBAL STANDARD FOOD SAFETY (ISSUE 7)

This internationally recognised food safety standard was updated in 2015 to include a framework to assist food manufacturers to put systems in place to reduce exposure to food fraud and to manage product authenticity to meet customer requirements. The standard defines a vulnerability assessment as a “documented risk assessment designed to identify potential sources of food fraud within the supply chain and to prioritise control measures to minimise the chances of receiving fraudulent or adulterated raw materials”.

Clause 5.4.2 of the Standard requires that “the vulnerability assessment shall be kept under review to reflect changing economic circumstances and market intelligence which may alter the potential risk; and that it be formally review annually”.

WHY THE FOOD INDUSTRY IN ASIA NEEDS TO RESPOND

Food fraud presents major challenges for the food industry in Asia to protect brands and reputations, and to minimise risks for consumers. To counter food fraud effectively, the food industry must expand their food safety management systems to include the process of Food Fraud Vulnerability Assessment (FFVA). Food fraud is an issue which was until recently not part of a company’s food safety management system. The onus is now on food companies to develop documented systems for FFVA and to implement measures to mitigate the public health, economic and reputational risks that may result from the food fraud.

While it makes eminent sense to protect brands and reputations, and the health of consumers of their food products, there are a number of other drivers demanding that the food industry focus on mitigation measures. These relate to private sector food standards such as the Food Safety System Certification (FSSC) 22000 which is equivalent to ISO 22000, the standards of the Global Food Safety Initiative (GFSI) and the British Retail Consortium (BRC) global standard for

food safety. Compliance with these standards is usually a prerequisite for trading in international markets. For instance, from January 2018, in order to be certified against FSSC 22000 it will be mandatory for food companies to introduce a system of FFVA and to have a food fraud prevention strategy in place. The latest issue of the BRC Global Food Safety Standard (Issue 7) requires food companies to have “systems in place to reduce exposure to food fraud and to manage product authenticity to meet customer requirements”.

Following the European horsemeat scandal of 2013, food regulations in many countries have been strengthened to include provisions for food fraud prevention and mitigation. Food companies in Asia wishing to export to international markets will need to demonstrate that their food safety standards are equivalent to those of importing countries. For instance, the European Union food control regulations⁴¹ have been revised to require food control authorities to “identify possible intentional violations of the rules perpetrated through fraudulent or deceptive practices” and to include “financial penalties applicable to violations of the rules perpetrated through fraudulent or

deceptive practices to be sufficiently deterrent and set at a level which seeks to exceed the undue advantage for the perpetrator resulting from those practices”. Stricter regulations and controls have also been put in place in the USA with the introduction of the new Food Safety Modernization Act (FSMA). In China a revised Chinese Food Safety Law has been introduced and government agencies responsible for food safety restructured to streamline food control. In 2017, China has also introduced new draft regulations concerning the scope and legal liabilities for food fraud activities⁴².

⁴¹ <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32005D0402&from=EN>

⁴² <https://doi.org/10.1177/0033354917700109>

TABLE 1: FOOD FRAUD MITIGATION REQUIREMENTS OF BRC GLOBAL STANDARD FOOD SAFETY ISSUE 7

Fundamental Requirements	Detailed Requirements (Clauses)	Requirements related to Food Fraud
1.1 Senior Management Commitment and Continual Improvement	1.1.6 The company's senior management shall have a system in place to ensure that the site is kept informed of and reviews:	<ul style="list-style-type: none"> • New risks to authenticity of raw materials
3.5 Supplier and Raw Material Approval and Performance Monitoring	3.5.1.1 The company shall undertake a documented risk assessment of each raw material or group of raw materials including packaging to identify risks to product safety, legality and safety. They shall take into account the potential for:	<ul style="list-style-type: none"> • Substitution or Fraud
5.4 Product Authenticity, Claims and Chain of Custody (While this is not specified as a Fundamental requirement, it is requirement) Systems shall be in place to minimise the risk of purchasing fraudulent or substituted food raw materials and to ensure that all product descriptions and claims are legal, accurate and verified.	5.4.1 The company shall have processes in place to access information on historical and developing threats to the supply chain which may present a risk of adulteration or substitution of raw materials. Such information may come from:	<ul style="list-style-type: none"> • Trade associations • Government sources • Private resource centres
	5.4.2 A documented vulnerability assessment shall be carried out on all food raw materials or groups of raw materials to assess the potential risk of adulteration or substitution. This shall take into account:	<ul style="list-style-type: none"> • historical evidence of substitution or adulteration; • economic factors that may make adulteration or substitution more attractive; • ease of access to raw materials through the supply chain; • sophistication of routine testing to identify adulterants; • nature of raw materials
	5.4.3 Where raw materials are identified as being at particular risk of adulteration or substitution appropriate assurance and/or testing processes shall be in place to reduce the risk.	



4.1 VULNERABILITY ANALYSIS AND CRITICAL CONTROL POINT (VACCP) SYSTEM

One of the major advances in recent years in reducing risks associated with unsafe food has been the development and implementation by the food industry of food safety management systems based on the Hazard Analysis and Critical Control Point (HACCP) principles. This has allowed the food industry to be proactive in identifying hazards associated with their operations and to introduce control and prevention strategies to minimise risks associated with chemical, microbiological or physical hazards.

Recent food fraud global events demonstrate that there is a need for the food sector to expand this risk-based approach to protecting the integrity of the food chain by minimising vulnerability to fraud and mitigating the consequences. The same basic principles of risk assessment that apply to HACCP can be incorporated into the Vulnerability Analysis and Critical Control Point (VACCP)⁴³ system. Using this approach, a food business can develop fully documented procedures to identify and mitigate risks of food fraud in their supply chains. Typical stages in a VACCP system are:

- Drawing up a complete list of ingredients and materials used in the manufacturing process;
- Identifying the potential forms of fraud that ingredients and materials may be subjected to;
- Evaluating the risk of occurrence of fraudulent practices;
- Identifying and implementing control measures;
- Recording and reviewing findings.



4.2 FOOD FRAUD VULNERABILITY ASSESSMENT (FFVA)

In order to combat food fraud, food companies need to establish evidence-based mitigation measures based on risk assessment and vulnerability analysis. The simplest and most straightforward approach is for food companies to adopt a two stage approach: firstly to undertake vulnerability assessments to identify potential sources of food fraud within their supply chains; and secondly, to prioritise control measures to minimise the chances of receiving fraudulent or adulterated ingredients, raw materials or products and to address vulnerabilities within the business, its facilities or processes. The successful implementation of FFVA requires involvement from multidisciplinary teams with a broad range of competencies. Quality control departments usually take the lead but will need support of senior management, technical, legal, procurement and human resources groups.

UNITED STATES PHARMACOPEIAL CONVENTION (UPC) INITIATIVES ON FOOD FRAUD

The United States Pharmacopeial Convention (UPC) is a membership-based organisation that provides advice and training for food businesses on how to develop and implement food fraud mitigation strategies. An innovative aspect of the work of the USP has been the development of a Food Fraud Database⁴⁴ that consists of continuously updated data on thousands of ingredients and related records gathered from scientific literature, media publications, regulatory reports, judicial records, and trade associations from around the world. The USP also provides Food Fraud Mitigation Services⁴⁵ to assist food businesses identify vulnerabilities in ingredient supply chains and to implement control measures to combat food fraud. The tools developed by the USP allow food manufacturers to be confident that the ingredients they produce, procure, and use are authentic and of sufficient purity and quality to safeguard consumers' health. UPC's Food Chemicals Codex and Food Ingredient Reference Materials provides reliable resource materials for food businesses to verify the authenticity, quality, and purity of food ingredients used in food manufacture.

Guidelines for conducting FFVA have been developed and published by a number of organisations. These take the form of Food Fraud Vulnerability Assessment Tools (FFVAT) which are user friendly Excel Spreadsheets which guide the user to complete a questionnaire to assess vulnerabilities and how robust a company's control measures are. Once the questionnaire is completed, the FFVAT will provide an automatic report detailing the level of risk to food fraud.

A comprehensive FFVA Tool was developed by SSAFE⁴⁶ in collaboration with nine different multinational companies, the Wageningen University and Research Centre and VU University Amsterdam published as a free downloadable App⁴⁷. This Tool allows food companies to self-assess their businesses and provides a series of 50 questions for a detailed analysis of three key elements: Opportunities, Motivations, and Control Measures. These elements are subdivided into technical opportunities, opportunities in time and place, economic drivers,

culture and behaviour, technical control measures, and managerial control measures. Detailed analysis of how this FFVAT was successfully used to assess the vulnerability to fraud in the fish, meat, milk, olive oil, organic bananas, and spice supply chains have been published^{48,49}. The conclusion of these studies was that the fraud vulnerability appeared highest for the spice chain, which was followed by the olive oil, meat, fish, milk and organic banana chains, with wholesale and traders being most vulnerable, followed by retailers and processors.

Food Fraud Vulnerability Assessment Tools have also been developed and published by the Food Fraud Advisors (a private consultancy)⁵⁰. These are inter-active Excel Spreadsheets and are designed to allow food businesses assess the vulnerability of their raw materials, products and processes to food fraud. These have been designed to meet their requirements of the GFSI and BRC Food Safety Standard. Two vulnerability assessment methods are provided⁵¹.

⁴⁴ http://www.myanmarhsrj.com/file/display_fulltext.php?articleid=Reg-000058&issue=2&vol=27

⁴⁵ http://www2.irrawaddy.com/article.php?art_id=15791

⁴⁶ <https://www.sciencedirect.com/science/article/pii/S030881461630680X?via%3Dihub>

⁴⁷ <https://www.choice.com.au/food-and-drink/groceries/herbs-and-spices/articles/oregano-fraud#worldwide>

⁴⁸ https://www.foodsafety.gov/recalls/recent/cuminrecalls.html#_Recalled_Products

⁴⁹ <https://www.sciencedirect.com/science/article/pii/S0956713517302979?via%3Dihub>

⁵⁰ https://www.europol.europa.eu/sites/default/files/documents/report_opson_v.pdf

⁵¹ <http://www.europarl.europa.eu/Methods>



3. ASSESSING AND PRIORITISING FINDINGS

Once a food company has assessed the likelihood of food fraud occurring and understands the impacts of food fraud on consumers and a company's brand, the next steps are to develop a framework to prioritise strategies for preventing fraud and mitigating the risks in the event of fraud occurring. Activities include ensuring robust supplier approval and auditing systems are in place; different groupings in a company, such as technical, legal and procurement work closely together; the company's financial targets are linked to food safety and quality goals which are adequately resourced and mutual trust and respect for all employees is integrated into the food safety culture.

4. CREATING A PLAN OF ACTION

A company's plan of action should include measures to address all risks and opportunities for food fraud. It should identify staff with specific responsibilities and should be endorsed by senior management. The plan of action should be based on a FFVA and include supplier approval protocols, supplier audit and verification schemes, food fraud sampling and detection systems, and systematic record keeping and documentation of the food fraud mitigation programme. The plan of action should be fully integrated with the company's food safety management system and corporate governance.

5. IMPLEMENT, TRACK, REVIEW AND COMMUNICATE

FFVA is a dynamic process and the plan of action needs to be kept under constant review for relevance and effectiveness. Sources of ingredients and suppliers can change and external environments, such as adverse weather, animal or plant disease and political factors, can all impact on the potential for food fraud. Horizon scanning and monitoring external environmental factors are integral components of a FFVA. Both internal and external communications are also a dynamic part of the overall FFVA.

The Food and Drink Federation⁵² has published guidance for the food businesses on food authenticity and protecting food businesses from fraud. The guidance provides a step-by-step process to assist businesses in developing vulnerability assessments and identifying and managing supply chain authenticity risks. The process recommended by the Food and Drink Federation in their guidance "Food Authenticity: Five steps to help protect your business from food fraud" are:

1. MAPPING THE SUPPLY CHAIN

A key aspect of protecting a company's brand is to ensure the integrity of its supply chain. Detailed information is required on all links of the supply chain, including raw materials, ingredients, products, storage and transport, in order to assess vulnerability to fraud. Knowing and trusting suppliers is key, in addition to reducing the number of unknown middlemen and brokers. Every food business should have a supplier approval procedure in place as part of managing procurement. The supplier approval process should be based on risk categorisation. Some of the factors which should be taken into account are the degree of confidence in management, supplier audit history, and provision of authenticity documentation for ingredients and products (certificates of analysis).

2. IDENTIFY IMPACTS, RISKS AND OPPORTUNITIES

When conducting a FFVA it is essential to evaluate the potential opportunities and impacts of fraudulent activities in a

company's supply chain. For instance, what is the risk of receiving adulterated ingredients? Liquids are easily diluted with cheaper alternatives, ground spices and herbs are more susceptible to substitution than whole raw material. How complex will it be to carry out authenticity testing of raw materials? In assessing opportunities for fraud food companies should conduct "what if" scenario planning taking into account such factors as the consequences of what would happen if raw materials are in short supply due to adverse weather events or political instability in countries of origin. Once vulnerabilities have been identified, risks and impacts should be assessed according to likelihood of occurrence, likelihood of detection and severity of occurrence. Reviewing factors in the food chain that are likely to encourage or motivate people to commit food fraud is an important part of this exercise.

In order to reduce opportunities for fraud during processing and manufacture, all food companies require staff vetting procedures, robust food safety management systems based on HACCP principles, full traceability, authenticity testing, monitoring and surveillance programmes. Reviewing the culture of a food business is also an important aspect of evaluating opportunities and motivations for fraud. For instance, setting unrealistic economic or financial targets may encourage employees to commit fraud. Promoting a food safety culture and setting high ethical performance standards are all part of protecting a food company from opportunities for fraud.

⁵² <https://doi.org/10.1016/j.foodcont.2015.11.042>

4.3

FOOD FRAUD DETECTION

One of the greatest challenges for food companies in Asia in respect to the mitigation of food fraud is detection. Increasingly sophisticated methods of food fraud employed by food fraudsters requires food companies and regulators to keep abreast and stay one step ahead of perpetrators. The verification of current food traceability parameters, such as authenticity of ingredients, legal food labelling, food production methods and country of origin declaration all require the development and introduction of new laboratory analytical methods. New anti-counterfeit forensic detection systems are under development by the food industry which will assist in combating sophisticated food fraudsters.

DNA barcoding is a valuable innovative analytical technique for authentication of both foods of plant and animal origin and is particularly useful in those industries which are vulnerable for mislabelling and substitution. This technology was used by the Food Safety Authority of Ireland to uncover the European horsemeat scandal in 2013. DNA barcoding based on short sequences from the mitochondrial cytochrome oxidase subunit 1 (CO1) region has been used for fish speciation which is difficult, if not impossible when the head, scales and fins are removed during processing. Laboratory certification, based on DNA technologies, is now a requirement for trading meat products in Europe. Barcoding in addition to geochemical signatures can be used to identify country of origin in combatting food fraud⁵³.

One of the new anti-fraud technologies include the use of invisible particles that can be mixed in printing ink for food labels, plastic food containers or caps of bottles and can be detected using dedicated scanners⁵⁴. New anti-counterfeit measure also include the use of radio-frequency identification (RFID) technology which allow food companies to track products from the factory to the retail store. This technology is growing in use in the

wine and spirits industries. RFID tags are incorporated into bottle caps which can be rapidly detected using a handheld scanner. Novel traceability technologies also include the use of hologram authentication technologies. Some of these new anti-fraud detection systems are being investigated for use in tracking halal foods by Malaysia and Brunei authorities, to address concerns of Muslim consumers over counterfeit halal food.



⁵³ <https://doi.org/10.1016/j.foodcont.2015.08.028>

⁵⁴ <https://doi.org/10.1016/j.marpol.2016.02.024>



A novel anti-fraud technology which is under development for premium food products is based on Apps for mobile phones and near field communication (NFC)⁵⁵ which uses thin, flexible tags which are integrated packaged foods. These identification tags are encoded into food packaging which readily identifies tampering or counterfeiting. Another example of an innovative traceability technology has been developed which allows Chinese consumers to quickly check the authenticity and provenance of infant formula products using smartphones⁵⁶.

In addition to advanced technologies for detection of food fraud, more sophisticated systems for improving traceability of foods and food ingredients from “farm to fork” are required to combat food fraud. For small food companies it is relatively simple to maintain “one up – one down” traceability records but for larger food business operators involved in regional or global food trade the situation is more complex. Managing and retrieving large volumes of data on suppliers, ingredients, processes, and distribution networks requires IT solutions. Generating traceability records during a food recall or withdrawal is extremely

challenging when large volumes of products with multiple ingredients have to be identified and removed from the market. Technologies such as blockchain have the potential for assisting food businesses to improve traceability. Blockchain is a permanent digital ledger where all blocks can be linked to lead to fully integrated tracking. Feng (2016)⁵⁷ proposed to establish an agrifood supply chain traceability system based on RFID and blockchain technology for helping Chinese agri-food markets to enhance their food safety and quality. A recent analysis in the Harvard Business Review⁵⁸ of the use of blockchain technology suggests that while it has potential it will take time to fully develop as a useful tool for supply chain management in the food sector. However, the use of blockchain in the food sector is rapidly developing. The Blockchain Food Safety Alliance⁵⁹ was established in 2017 as a collaboration to enhance food tracking, traceability and safety in China for achieving greater transparency across the food supply chain. Some of the major food retailers are also investing in this technology as a means to increase transparency and improve trust and consumer confidence.

55 <https://doi.org/10.1016/j.foodcont.2015.02.033>

56 <https://doi.org/10.1016/j.foodcont.2016.01.034>

57 <https://doi.org/10.1016/j.foodcont.2017.03.056>

58 <http://www.foodfraud.org/>

59 <http://www.usp.org/foods/food-fraud-mitigation-services>

CONCLUSION

Placing fraudulent food on the market for economic gain is probably one of the oldest forms of criminal activity associated with the food chain. While imitation may be the sincerest form of flattery, for some food companies counterfeit products can damage brands and put reputations at risk. The food market in Asia is at particular risk of food fraud as consumers in the region become more affluent and the demand for premium quality foods grows and trade in e-commerce expands. Cognisant of these trends, Food Industry Asia has commissioned this report to highlight the potential risks to public health and food industry reputations. Food Industry Asia will continue to work with its partners in national industry associations and other regional groups, to support the development of science-based mitigation strategies to combat food fraud.



ABBREVIATIONS

ASEAN	Association of Southeast Asian Nations
BRC	British Retail Consortium
CAC	Codex Alimentarius Commission
DNA	Deoxyribonucleic Acid
CO1	Cytochrome Oxidase Subunit 1
EC	European Commission
EU	European Union
EUROPOL	European Union Agency for Law Enforcement Cooperation
FAO	Food and Agriculture Organization of the United Nations
FIA	Food Industry Asia
FFVA	Food Fraud Vulnerability Assessment
FFVAT	Food Fraud Vulnerability Assessment Tool

FSAI	Food Safety Authority of Ireland
FSMA	Food Safety Modernization Act
FSSC	Food Safety System Certification
GFSI	Global Food Safety Initiative
HACCP	Hazard Analysis and Critical Control Point
ISO	International Organization for Standardization
INTERPOL	International Criminal Police Organization
RFID	Radio Frequency Identification
VACCP	Vulnerability Analysis and Critical Control Point System
USFDA	United States Food and Drug Administration
USP	US Pharmacopeial Convention
WHO	World Health Organization



Food Industry Asia (FIA)

1 Scotts Road
Shaw Centre #19-07/08
Singapore 228208

E: info@foodindustry.asia

T: (+65) 6235 3854