



Contents lists available at ScienceDirect

Trends in Food Science & Technology

journal homepage: <http://www.journals.elsevier.com/trends-in-food-science-and-technology>

Food fraud prevention shifts the food risk focus to vulnerability

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ARTICLE INFO

Article history:

Received 28 October 2016

Received in revised form

19 January 2017

Accepted 13 February 2017

Available online 27 February 2017

Keywords:

Food fraud

Economically motivated adulteration

Vulnerability

Assessment

Crime

Food safety

ABSTRACT

Background: Food fraud – including the sub-category of economically motivated adulteration – is illegal intentional deception for economic gain using food. The types of food fraud include adulterant-substances (adulteration), substitution, dilution, stolen goods, tampering, diversion and gray market product, smuggling, unauthorized product or unauthorized re-filling, misrepresentation or mislabeling, and intellectual property rights counterfeiting. Key events include Sudan Red colorant, melamine in infant formula and pet foods, species swapping of fish, counterfeit branded chocolate, and horsemeat in packages labeled as beef. While most food fraud events do not have an immediate hazard, the food supply is vulnerable. The issue involves intelligent human adversaries, so the response is uniquely complex regarding mitigation and prevention.

Scope and approach: This commentary provides insight on the unpredictability and potential economic gain to fraudsters; and presents food fraud as an emerging, unique and autonomous food research area. The need to assess a food fraud event shifts the focus from the traditional internal process controls and human health risk assessment to prevention and vulnerability reduction. The goal is not to catch food fraud but to prevent the event from ever occurring – food fraud prevention.

Key Findings and Conclusions: Often, traditional food safety or food defense countermeasures and assessment methods are ill-fitting tools for the unique food fraud prevention goals. To address the root cause of fraud, food science and technology research should expand to include social science, criminology, and business decision-making. This commentary provides insight that a shift from “risk” “mitigation” to “vulnerability” “prevention” is necessary for food fraud prevention. We provide clarity on important terms, which include event, incident, hazard, crisis, and threat.

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1. Introduction

Food fraud events – illegal intentional deception for economic gain using food - can occur in all stages of the supply chain and often cross international borders (Everstine, Spink, & Kennedy, 2013; Moore, Spink, & Lipp, 2012). Under certain circumstances, food fraud can have significant health and economic implications, but not always. In recent years, illegally added horsemeat to beef products created economic and consumer confidence crises across Europe (EC, 2015). Prior to detection, no one except the fraudsters knew that the less expensive horsemeat was in the beef product. While the horsemeat is clearly an

illegally added “adulterant-substance,” there was no identified public health hazard. Yet this event had a massive economic impact: widespread product recalls and costly authenticity testing, and the effective halting of almost all ground beef sales in the United Kingdom and across Europe.

In another food fraud event,¹ several multinational food service companies were victims of an alleged date-code tampering scheme that led to the distribution and sale of illegal expired meat (Premanandh, 2013; EC, 2015). There was technically no “adulterant-substance” in this event, and numerous tests confirmed that there was no public health hazard. Nonetheless, this event had a

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¹ This study uses the term ISO 31000 Risk Management term “event.” Later the terms will be reviewed in more detail including “incident,” “threat,” and “hazard.” This is not in conflict with other laws, regulations, standards and certifications. For additional comments about following ISO 31000 see Leitch (2010) and Purdy (2010).

massive economic impact; as after the discovery of the false expiration dates, several multi-national restaurants had no meat product to sell in several countries. Due to this event, one of the victims of fraud, McDonald's Corporation, was estimated to have had a stock price drop of more than \$500 million on the day the event was reported, and a monthly global sales loss of over \$40 million² (Forbes, 2014; Jargon, 2014).

Both events highlight the failure of traditional food safety and food defense systems and processes to address food fraud vulnerability. The deception in food fraud cases can be adulterant-substances (adulteration), substitution, dilution, stolen goods, tampering (including date-code tampering), diversion and gray market product (e.g. product sold outside its intended supply chain or market), smuggling, unauthorized product or unauthorized re-filling, misrepresentation or mislabeling, and intellectual property rights counterfeiting (Spink & Moyer, 2011; DEFRA, 2014; EC, 2014; GFSI, 2014). To successfully commit these acts, the fraudsters are clandestine, stealthy, diligent in seeking opportunities, often well-funded, and patient in waiting for fraud opportunities. A great challenge is that food fraud acts occur outside the authorized supply chain, and often do not involve adding a monitored substance (an adulterant or contaminant that is monitored). Additionally, fraudsters usually demonstrate technological expertise and actively seek to avoid detection (Primrose, Woolfe, & Rollinson, 2010).

Although food fraud prevention is emerging as a unique food research area due to the unpredictability and potential economic gain to fraudsters, food fraud events are not new. From thousands of years ago, there is evidence of fraudulence involving French wine and olive oil deceptively represented as Roman Empire products (Fortin, 2009). Many of the earliest food laws in the 1500s were created to address food fraud such as the Reinheitsgebot related Food Purity Laws (Fortin, 2009). There are also reports of laws to address fraudulent acts during the Chinese Zhou Dynasty, which spanned from 1056 to 256 BCE (Wu et al., 2017, p. 1).

Along the timeline of history, food fraud events have probably not increased per consumer; but globalization and industrialization have amplified the scope and scale of each event. Due to globalization of production and distribution, modern food fraud events could be massive in scale and have regional or global impact. For example, the 2007 melamine events in infant formula and pet food from China had an international scope; whereas in time past, food products would largely not have been distributed outside their neighborhood, city, valley, province or country.

2. A new paradigm for managing food fraud risk

Addressing food fraud has led to a shift in focus from mitigation to prevention. Prevention and mitigation try to accomplish the control but from different directions. Mitigation assumes the event will frequently occur, so we try to mitigate or reduce the negative consequence. Prevention assumes that the root cause of the event could be eliminated or at least greatly reduced in likelihood of occurrence. Food fraud vulnerabilities may have never occurred before, may never occur again, or may be a potential opportunity that never leads to an actual food fraud event. For efficient management, this nature of food fraud necessitates a shift of the focus of countermeasures and control systems from intervention and response to prevention.

² McDonald's market capitalization is approximately \$90 billion and an approximately 0.5–1% one day drop in stock price would be a loss of \$450–900 million of value; their annual sales are approximately \$27.5 billion so one month loss of 2% is \$45 million.

Table 1
Summary of Terms with a statement of occurrence, harm and intentional.

Term	Occurred	Hazard or Crisis	Intentional
Event	Yes	Maybe	Maybe
Incident	Yes	Yes	Maybe
Hazard	No	Yes	Not usually for Food
Crisis	Yes	Yes	Maybe
Threat	No	Yes	Usually for Food
Vulnerability	No	Maybe	No
Risk	Maybe	Maybe	Maybe

There are many instances where – even in laws or regulations – the most basic and fundamental terms are not defined explicitly or included in a glossary. Where there were discrepancies in terminology, this study follows the International Standards Organization (ISO) practices (ISO, 2007; 2007a, 2007b). Usually discrepancies are variations of common terms applied to a specific product or application such as the US FDA food laws defining a “hazard” as “any biological, chemical (including radiological), or physical agent that has the potential to cause illness or injury.”³

The things that could, are likely to, or have happened are defined as an event or a crisis. An **event** is essentially something that occurs (Table 1) (ISO, 2002; CNSI, 2010; Merriam-Webster, 2004). There is no evaluation yet of the change in the consequence. A type of event is an **incident** that has occurred and evaluated and that could have a negative consequence (DHS, 2008; ANSI, 2009; CNSI, 2010). Also, a **hazard** is an event that has not occurred and could cause harm if not addressed (ISO, 2007b; PAS 96, 2014, NRC, 1996; 21 CFR, Merriam-Webster, 2004) – this includes damaging potential (ISO, 2007b). For food this is often applied to unintentional events that have potential to harm. A **crisis** is an event that has occurred – or is occurring – that has a confirmed harm (ANSI, 2009) – this includes imminent hazard (21 CFR), attack, emergency (ISO, 2007b; 21 CFR, FDA, 2016), disaster, etc.

The assessment of the thing that happens is expressed as risk or threat. **Risk** is an uncertainty of an outcome that is assessed in terms of likelihood and consequence (ISO, 2007a; NIST, 2002; CNSI, 2010; DHS, 2013). Often the consequence is sub-divided to other factors such as onset, severity, or other. Risk is based on factors of the probability of the threat and the susceptibility from vulnerability (NRC, 2009). In other applications it is an unwanted outcome (DHS, 2008, Codex Alimentarius, 2014, 21 CFR 50 (A) (.3)(k), Merriam-Webster, 2004). A **threat** is the cause of an unwanted event that includes generally known variables or attributes of the source of the negative consequence (“threat source”) (ISO, 2012; ISO 2002; 21 CFR 121, ANSI, 2009; PAS 96, 2014, FSMA, 2016; NIST, 2002; CNSI, 2010; UNODC, 2010; DHS, 2013) – this includes incident, hazard, damaging potential, etc. In crime and security science this is often a person(s) who have the intent and capability to cause harm. This is often applied to intentional acts with the intent to harm. The result of a threat assessment is usually a quantitative probability that the event to occur – but not an assessment of the consequence.

Vulnerability is a weakness or flaw that creates opportunities for undesirable events related to the system (“system design”) (ISO, 2007a; ISO 2002; ISO, 2012; DHS, 2013; NIST, 2011; CNSI, 2010; NRC, 2009; COSO 2014; Merriam-Webster, 2004). The result of a vulnerability assessment is usually a qualitative statement of the susceptibility of the system – this influence the likelihood (NRC, 2009). FSMA uses the term vulnerability

³ The summary definitions are based on extensive review of a wide-range of sources summarized and referenced in the supplemental materials.

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