FOOD FRAUD PREVENTION AS AN ACTIVE TOOL IN MEAT INDUSTRY: A CASE STUDY OF POULTRY SLAUGHTERHOUSE

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Abstract

Worldwide latest food fraud incidents have emphasized the need to reinforce food fraud prevention across the global supply chain, which again is essential not just to protect public health, but also to regain weakened consumer trust in foods, in an economic context where entrepreneurs and regulators acknowledge that confidence is the cornerstone of efficient and productive economies. Unfortunately, current food safety and quality management systems were not initially intended to prevent fraud. Prevention of food fraud involves a particular approach: it must take into account vulnerability assessments and formulate a food fraud mitigation plan, that needs to be continuously updated, being correlated with national and international context on this subject and the fact that food fraud typically appears when the opportunity and the motivation of food crime are strong and the probability of being detected as well as the penalties are minimal. The central objective of this paper was to develop a functional analysis tool starting with a pre-existing "NSF Fraud Security Model" version, designed to support the large reputable food retailers and authorities in the prediction of potential for fraudulent activity in a variety of products. This case study, focused on three key strategic elements: the prediction, prevention and management of the food fraud mitigation plan in accordance with Guidelines for Implementation of the GFSI recognized schemes. The outcome of this project is a functioning prototype, a concept built over the past 2 years via collaborative sessions with project team members and tested for input from industry and regulatory representatives. This analysis provides a framework for evaluating the role of science and technology in identification, mitigation, and then prevention.

Key words: fraud, adulteration, vulnerability mitigation plan

Food fraud is a type of criminal activity, regardless of definition, with catastrophic implications for businesses, such as: loss of credibility, loss of customer trust, decline in the market, or termination of contracts for employees. The general implications are similar to other corporate frauds. For the individual businesses, usually the main consequences are social losses, punishments, third party losses (e.g. extra testing), confidence losses, sales losses & over payment, as well as recall losses (Bindt V., 2016).

Due to the cases found, there are a wide range of possible forms of fraud (dilution, substitution, concealment, mislabeling, unapproved enhancements, counterfeiting, grey market production – theft – diversion) as defined in the literature, all of them with one aspect in common: their unpredictable nature. By example, if we take the horsemeat incident as a case, it was seen its significant economic impact due to large product recalls with a severe economic consequence on European beef markets (Moyer D.C. *et al*, 2017).

There is a common perception that food fraud is primarily an external threat to the food supply chain from organized crime groups. While politically convenient, this is in fact more a issue inside the food system itself and includes legal players that take full advantage of criminal opportunities (Lord *et al*, 2017).

Some commodities are closer to food fraud than others. An inventory of records in the three global food fraud datasets for 2008-2013 showed that the six commodity groups most commonly identified were spices and herbs, olive oil, fish, dairy products, meat and other oils and fats (Weesepoel Y.J.A and van Ruth S.M., 2015). This study examines fraud risk through food supply chains and products which have been often documented in inventories of food fraud.

MATERIAL AND METHOD

To update the information for the specific food fraud incidents that have occurred in the food

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supply chain networks linked with meat industry, we assessed 50 key food fraud elements, descriptors for opportunity and motivation, but also and control measures (NSF, 2014; van Ruth, 2018). As a direct result, we toked into consideration the factors mentioned in *table 1*.

Furthermore, all the information found in different blogs, in media, trade associations, research associations, industry network and personal networking was filtered. For the official communication channels, we used: EU RASFF Rapid Alert System for Food and Feed, EFSA European Food Standards Agency, National Competent Authorities for product recall alerts or changes in legislation and guidelines, food fraud known databases, testing laboratory information, commercial trade press, commodity price fluctuations, country risk classification and corruption perceptions index (EMAlert, 2020; EC, 2018; EC, 2019a; GFSI, 2019; SSAFE, 2019; Spink *et al*., 2016, 2017, 2019).

Table 1

The three key elements of the food fraud vulnerability assessment and the meat industry specific associated fraud factors

Key element	Meat industry supply chain
Opportunities	- availability technology and knowledge to adulterate raw materials; - fraud detectability in raw materials; - fraud detectability in final products; - access to production lines / processing activities; - historical evidence of fraud in raw materials; - historical evidence of fraud in final products;
Motivations	- valuable components or attributes; - level of competition branch of industry; - price asymmetries;
Control measures	- integrity screening own employees; - fraud control industry; - national food policy; - law enforcement local chain; - law enforcement chain network;

The second step consisted in establishing the location (a company) and developing of an internal food fraud vulnerability assessment, respective food fraud mitigation plan (through a systematic process). The protocol was developed in an integrated poultry business: farm-slaughterhouse, with a capacity of 10 million-day old chicks / year and a share market in the N-E part of Romania of almost 20%.

For implementation, the frequency of assessment was done 2 times / year in the period 2017-2020 due to some ingredients market fluctuations and active induction of the people. Results were expressed as means from the last 4 Food Fraud Assessments, the steps in this process being:

a) establishing the product fraud assessment team;
b) identification of potential product fraud risk;
c) undertaking the product fraud vulnerability assessment;
d) developing the Product Fraud Mitigation Plan;
e) implementation and monitoring of the Product Fraud Mitigation Plan control measures;
f) review and refinement of the Product Fraud Mitigation Plan;

RESULTS AND DISCUSSIONS

a) The product fraud assessment team [PFAT] included the company employees from purchasing department - directly involved with acquisition of incoming goods and services, logistics management and of technical management – production (process and packaging), maintenance, quality assurance (laboratory and quality technologists). It was implemented through Decision no. 3245 / 13.11.2017, which define the roles and responsibilities of the PFAT, the new creating team having full support of the company's senior management.

b) The identification of potential product fraud risk was done through 2 methodology panels: data gathering from the close meat supply chains (relationship between company and its suppliers) and literature research, all this activity being done to effectively undertake the vulnerability internal assessment process. For this, PFAT had identified first all sources of information and data that relate to the risk factors used within the vulnerability assessment. All information and data sources used to assess the potential of product fraud and other associated information was documented, including the frequency at which the data should be assessed and by whom (e.g. for example, commercial data, such as price and availability were the responsibility of the purchasing department or technical data, such as reports of fraudulent activity and detection methodology developments were activities attributed to the technical departments team members). This initial information was collated in an exhaustive list for all incoming goods (raw materials, ingredients and packaging) and the supplier of each of the

products. Because the company do not have outsourced processes (e.g. packaging, deboning, product transport), this category was not included in the risk assessment.

c) The product fraud vulnerability assessment has identified risk of possible fraudulent activity within the supply chain, identifying the weaknesses, which further were addressed in the Product Fraud Mitigation Plan to minimize the risk of fraud. We considered a number of risk assessments, which followed risk management principles, commonly used within its HACCP study (physical, biological, chemical) and within internal incident management procedure, to establish course of action. The applied method was those of quadratic matrix (Fig. 1), with a defined scale and ranking. The colour of the cells within the product vulnerability risk matrix are indicative of the product risk, namely: orange is considered as high risk, yellow as medium risk and blue would be regarded as low risk.

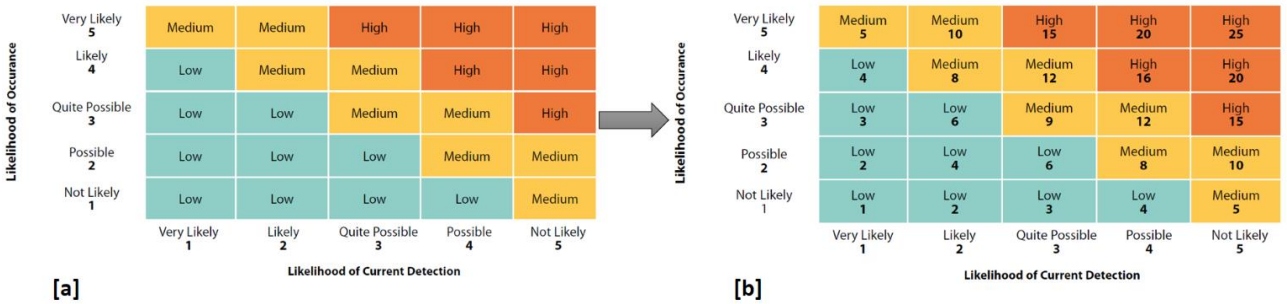

Figure 1 **Product Vulnerability Risk Matrix with Risk Rating for Likelihood of Occurrence and Likelihood of Detection on Axes [a] and Product Risk Rating within the Matrix [b]**

The product risk factors used for the risk rating within the matrix were:

- history of product fraud incidents [number, types and frequency of fraud - the more frequent that a product has food fraud associated with it, the higher the risk];
- economic factors [price - the higher the profit margin the higher the risk; availability of the product - the lower the availability of a product, the higher the risk; availability of adulterant - the high availability and low cost of an adulterant, the higher the risk; price fluctuation];
- ease of fraudulent activity [physical nature of the product - liquid, powder, minced pieces, whole; cost and complexity of fraudulent process - location, processing machinery, costs of production, packaging cost, distribution cost; staff involvement in the fraudulent activity - number, ease of concealment, number of locations; packaging formats];
- supply chain complexity [geographical origin - location of source and length of supply chain; types and number of organizations in the supply chain - manufacture, storage, distribution, agent or broker; number of factories within the supplier organization];
- current control measures for detecting fraud [testing authority - certification bodies, auditing body; testing laboratories and status - accredited / non-accredited; testing methodology - accredited / non-accredited; testing frequency - auditing, product inspection, product testing; cost of testing].

Criteria for supplier vulnerability assessment were: profitability, the risk of detection and ease of fraud, defined as follow:

- economic stability of the supplier and legal entity;
- the business history between the companies, the longer it is, the lower the risk become;
- business relationship: disputes, commercial or technical aspects;
- the frequency of purchasing; if the products are purchased through intermediaries, the risk becomes high;
- quality, transparency and time for delivery; technical information such as specifications, requests for specific information or responses to complaints; an important factor is also the competence of the technical staff, knowledge about food fraud and control measures, efficiency of the quality management system. (the faster the response, the lower the risk);
- obtaining or maintaining a high score for audits, small number of returned products, low number of complaints or small amounts of waste generated during the production process represents a low risk;
- frequency for governmental controls (e.g. higher the level of controls for the products origin and the better relations between governments, the lower is the risk).

A total of 70 suppliers were evaluated, for 14 distinct categories of purchased products, the largest number being attributed to packaging (*table 2*).

Table 2

Food Fraud vulnerability assessment of raw material, auxiliary materials & packaging

PURCHASED PRODUCTS	Total no. of assessed suppliers	RISK OF CONTAMINATION WITH:							Supplier risk class	Product risk class
		1. Allergens	2. Foreign body	3. Biological	4. Chemicals	5. Other species	6. Substitution / fraud	7. Other legislative risks		
Live chickens	5	low	low	low	low	low	low	low	**low**	**low**
Spices	5	medium	medium	low	low	low	medium	low	**low**	**medium**
Additives	8	low	low	low	low	low	low	low	**low**	**low**
Salt	3	low	low	low	low	low	medium	low	**low**	**low**
Sunflower oil	4	low	low	low	low	low	medium	low	**low**	**low**
Packaging (casseroles, foil, bags, cardboard boxes, bamboo sticks, stainless steel sticks, clips)	20	low	low	low	low	low	medium	low	**medium**	**low**
Third-party packaging (plastic containers, pallets, stretch foil)	5	low	low	low	low	low	medium	low	**medium**	**low**
Self-adhesive tape	2	low	low	low	low	low	low	low	**low**	**low**
Labels	2	low	low	low	low	low	low	low	**low**	**low**
Gas mixture	1	low	low	low	low	low	low	low	**low**	**low**
Working tools (knives, gloves)	4	low	low	low	low	low	low	low	**low**	**low**
Equipment (work, protection)	3	low	low	low	low	low	low	low	**low**	**low**
Hygiene substances	5	low	low	low	low	low	low	low	**low**	**low**
Cleaning equipment	3	low	low	low	low	low	low	low	**low**	**low**

Control methods - risk assessment	Risk class legend		
1. - 6. = Technical specification (including specification for allergen cross contamination); Qualitative reception; Suppliers test reports; Internal laboratory analysis according to self-control plan; Supplier technological flow chart assessment; **7.** = International and European law context & incidents that were appearing on the official sources of information.			
	low	medium	high
	Questionnaire	Quality certificate & 1 audit each 2 years	Audit each year

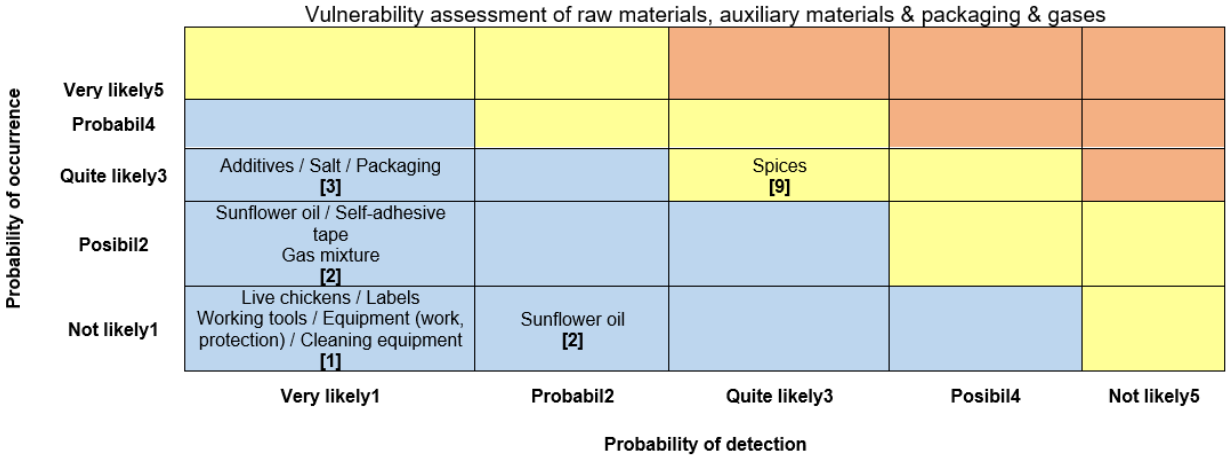

Figure 2 **Company Product Vulnerability Risk Matrix with Risk Rating for Likelihood of Occurrence and Likelihood of Detection on Axes [a] and Product Risk Rating within the Matrix [b]**

By product risk assessment, it can be seen that only in case of spices exist a medium risk for aduleration, especialy due to the: worldwide cases no., supply chain complexity, and easy of fraudulent activity, completed by the risk of contamination with allergens, foreign bodies and /or be substituted.

Although in case of salt and additives the risk was medium, due to the internal control measures and suppliers – company relation, bought remained low. Figure 2 represent the overall imagine of company Product Food Fraud Assessment, this being within Table 2 by product and supplier risk vulnerability with the afferent Mitigation Foo fraud Plan.

By supplier risk assessment, packaging suppliers were evaluated as medium risk, especially due to the new technologies that are now enhanced in some particularly cases (e.g. 100% biodegradable) or due to the complexity of chain, from producer of granules to the company (final client).

Table 3 defines the measures and controls that are required to be in place to mitigate the risks identified in the Product Fraud Vulnerability Assessment, especially for spices (overall high risk) and packaging materials.

The decisions of the PFAT were dependent on the evidence reviewed and may lead into the future to changes in policy in relation to supply of spices and “sensitive packaging”, while in the

meantime is maintain current specified control measures.

Table 3

Food Fraud Vulnerability Assessment and Mitigation Plan

Raw materials, ingredients, auxiliary materials	Product Risk class	Supplier Risk class	Risk class	Current control measures- level	Team decision
Live chickens	1	1	1	Low risk	Accepted suppliers
Spices	9	3	27	High risk	Accepted suppliers
Additives	3	2	6	Low risk	Accepted suppliers
Salt	3	2	6	Low risk	Accepted suppliers
Sunflower oil	2	2	4	Low risk	Accepted suppliers
Packaging	3	3	9	Medium risk	Accepted suppliers
Self-adhesive tape	2	2	4	Low risk	Accepted suppliers
Labels	1	2	1	Low risk	Accepted suppliers
Gas mixture	2	2	4	Low risk	Accepted suppliers
Working tools (knives, gloves)	1	1	1	Low risk	Accepted suppliers
Equipment (work, protection)	1	3	3	Low risk	Accepted suppliers
Hygiene substances	2	3	6	Low risk	Accepted suppliers
Cleaning equipment	1	2	2	Low risk	Accepted suppliers
Control measures: - selection and evaluation of suppliers of raw materials, ingredients, packaging and auxiliary materials in accordance with POP-BON-3.2 doc. - request to suppliers for providing the following documentation for the delivered live chickens: declarations of conformity, veterinary certificate for transported live chickens, test reports issued by accredited laboratories; - request to suppliers for providing the following documentation for the delivered packaging's: declarations of conformity, declarations of components migration reports / certification made in oily environment in accordance with E.U. Reg. 10/2011. - quality control of one day old chicks [e.g. anamnesis, state of vivacity] and ingredients / auxiliary materials in conformity with IM-BON-01 doc. and compliance with E.U. regulations and technical specifications for: live chickens ST-P-01 / salt ST-SI-01 / sunflower oil ST-U -01 / spices ST-C-01 / packaging's ST-A-01; monitoring of it in doc. FL-BON-06; - spices and packaging material (bags, casseroles, foils) quality control for the microbiological characteristics in the internal laboratory, recorded in FL-BON-07/09 and FL-M-110 doc. in accordance with IM-BON-01 doc; - verification of gas content in the final product in accordance with FL-BON-109 doc. - respecting the annual control program for laboratory analysis of the receipt micro components in accordance with auto control program; - employees training on how to perform the reception;					

As result of this active Food Fraud Assessment, company high management, with direct implication and supervision of PFAT had decide a systematic approach for Mitigation plan, as follows:

- selection and evaluation of suppliers of raw materials, ingredients, packaging and auxiliary materials in accordance with POP-BON-3.2 doc. minimum 2 times / year, especially for those which have high Risk Class (e.g.: spices, packaging materials);
- increasing the frequency for test reports provided by the suppliers of used packaging's (in accordance with Annex III of Regulation 10 / 2011).
- including in the annual auto control program of tests for origin and type of species at all ingredients and / or suppliers with High Risk Class;
- starting to collaborate with a third-party service supplier for acquisition process improvement, especially for the large quantities of imported ingredients and additives;

Until the next Food Fraud Vulnerability Assessment, PFAT decided to increase analytical surveillance from suppliers by use of accredited laboratories test report at each reception for spices. For maintain the required level of control measures the company established a frequency of 2 times / year for formal review of Product Fraud Mitigation Plan or when different changes appear.

CONCLUSIONS

The outcome of this project is a functioning prototype, a concept built over the past 2 years via collaborative sessions with project team members and tested for input from industry and regulatory representatives. This analysis provides a framework for evaluating the role of science and technology in identification, mitigation, and then prevention.

The efficiency of this functional tools will be evaluated at the end of each year, in the management review meeting, in accordance with national and international context of food fraud worldwide.

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