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Prevention of Food Fraud in Egypt: Policy Implementation Challenges and The Way Forward

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PREVENTION OF FOOD FRAUD IN EGYPT: POLICY IMPLEMENTATION CHALLENGES AND THE WAY FORWARD

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Abstract

Prevention and control of food fraud is now an emerging policy goal for different governments. Food fraud is intentionally adulterating food intended for personal gain and deceiving consumers. Adulterated food continues to be a significant threat to Egypt's food sector because of its negative impact on the food industry's reputation. Additionally, it jeopardizes the success of initiatives to increase investment, tourism, and exports in Egypt. Addressing fraud is, by definition, the most challenging food control system form because it directly addresses a personal stake benefiting from fraud behavior. In light of the importance of food fraud prevention as an emerging policy, this research aims to answer the question: How is the government of Egypt's policy working to prevent food fraud, and to what extent is it effective? The study primarily understands food fraud policies in Egypt, explores the current legal and regulatory framework used to deal with food fraud violations in Egypt, and covers the entire food production chain "from farm to fork." The research also explores the main challenges facing the government to mitigate the problem, the recent and ongoing reforms that the government did to overcome the obstacles, and the new reforms that are happening or need to happen to reduce the problem. A qualitative approach is adopted. Thirteen in-depth interviews were conducted with different food fraud prevention policymakers and implementers from the competent authorities involved. The analysis revealed specific challenges and gaps in the food fraud laws and regulations, food fraud control management system, inspection services, laboratory services, education, and communication. In conclusion, the research introduces a comprehensive set of recommendations that Egypt can apply to strengthen its legal and regulatory framework and improve its policy implementation to fight food fraud in identified areas, including the updating of food fraud laws and regulations, strengthening the food fraud control management system, promoting inspection services, expanding laboratory services, and promoting information, education, and communication.

Dedication

I dedicate this thesis to the memory of my cherished grandmother, who played a crucial role in shaping my life and instilling my values. Her constant source of inspiration, unwavering love, wisdom, and guidance will forever remain in my heart, and I am forever grateful for the time we spent together.

And to my mother, who always supported and encouraged me. I am truly indebted to her and will always appreciate what she has done for me.

And to consumers who have been victimized by food fraud, a deceptive and unethical practice that risks their health and trust. Through this work, I hope to shed light on the complex nature of food fraud and provide recommendations for its prevention and detection. May this knowledge empower consumers to make informed choices and demand greater transparency and accountability in the food industry.

Acknowledgment

Coming from a pharmaceutical science background, for me, social science was challenging but eye-opening. I express my immense gratitude that goes beyond the boundaries of academia to Prof. Laila El Baradei, my advisor, for her guidance, insightful advice, and invaluable constructive criticism throughout this project. Additionally, I always extend my sincere appreciation for her kindness and patience.

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I would like to take this moment to convey my heartfelt appreciation to my colleagues at AUC and NFSA, those who have assisted me during the past two years of my academic journey. Your support has been invaluable, and I am deeply grateful for it. Without your help, this journey would have been significantly more challenging, and I appreciate you more than words can express.

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I express my heartfelt appreciation to my parents for their unwavering support, not just during this year but throughout my entire life. None of my achievements would have been possible without their presence in my life, and I am forever grateful for everything they have done for me. Moreover, I am deeply grateful for their belief in me and, most importantly, for their unconditional love.

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Contents

List of tables

List of figures

List of Acronyms

AAC-FF	Administrative Assistance and Cooperation System for Food Fraud
COVID-19	Corona Virus Disease
DEFRA	Department of the Environment Food and Rural Affairs
DG SANTE	Directorate-General for Health and Food Safety
EC	European Commission
EMA	Economically Motivated Adulteration
FAN	Food Authenticity Network
FAO	Food and Agriculture Organization
FBO	Food Business Operators
FDA	Food and Drug Administration
FSA	Food Standards Agency
FFIM	Food Fraud Implementation Method
FSS	Food Standards Scotland
GFSI	Global Food Safety Initiative
GIS	Geographical Information System
IFPRI	International Food Policy Research Institute
NFSA	National Food Safety Authority
NRZ-Authent	Nationales Referenz Zentrum für Authentizität
OLAF	European Anti-Fraud Office
RASFF	Rapid Alerts for Safety of Food and Feed
SFCIU	Scottish Food Crime & Incidents Unit
SMEs	Small and Medium-sized Enterprises
JRC	Joint Research Center
WHO	World Health Organization

CHAPTER ONE: INTRODUCTION

1.1. Introduction

Prevention and control of food fraud is now an emerging policy goal for different governments (Spink et al., 2016 b; Robson et al., 2021). Food fraud refers to the intentional adulteration of food intended for personal gain and deceiving consumers. It is also known as economically motivated adulteration. Preventing and controlling food fraud is crucial because it may directly jeopardize the health of customers and consumers (Spink & Moyer, 2011). Spink & Moyer (2011: 1) defined food fraud as: "the deliberate and intentional substitution, addition, tampering or misrepresentation of food, food ingredients, or food packaging, or false or misleading statement made about a product, for economic gain." Food fraud policy is at the intersection between food crime and food safety. The government, local authorities, and industry are responsible for preventing food fraud.

Globalization and technological development have changed the pattern of food fraud in the food supply chains. The modern food supply chain has more opportunities for fraudsters. For example, importing food from another country and declaring it originated in Egypt before selling it elsewhere is much easier. Traders grow their profits by substituting expensive food ingredients with relatively cheap ingredients. The most popular example of food adulteration/substitution is the horsemeat scandal that shocked the UK in 2013, in which beef meat contained horse meat that was not declared on the label (de Castella & Wheeler, 2013). Moreover, other ingredients, such as myrtle leaves in oregano, were detected in around one in four samples in the UK (Galvin-King et al., 2018). These examples raised concerns about the legitimacy of what we sell and consume. However, they just represent the tip of the iceberg.

Food fraud has raised different questions related to economic injustice and public health (Smith et al., 2017). Food fraud is not only about health; it is also about economics and society. The profits from food fraud are similar to cocaine trafficking, with fewer risks (Shears, 2010). It is considered a white-collar crime. White-collar crime refers to lucrative and indirectly violent crime in which fraud is committed by the business. This crime is characterized by the violation of confidence and does not depend on the application of violence. Obtaining or avoiding losing money is the motivation behind this crime. It is not a victimless crime, as the company or businesses can lose their reputation because of fraud (Cliff & Desilets, 2014). Moreover, it may cause immeasurable damage to the economy and destroy consumers' confidence. Yet, it is difficult to measure the actual cost of food fraud because it is difficult to measure the actual size of food fraud that happened in the supply chain (Reynolds, 2008).

Food fraud is not a new phenomenon. Food fraud is as old as trade. During the Middle Ages, for instance, expensive imported spices to Europe were mixed with cheap substitutes (Laura, 2014). In the United States, an investigation conducted by Oceana, a marine conservation group, revealed that forty-three percent of the salmon tested were mislabeled, and in restaurants, diners were three times more likely to be misled than shoppers in grocery stores (Warner, 2015, p. 1)." From December 2014 to January 2015, Interpol and Europol initiated an investigation in 47 countries. They seized thousands of tons of adulterated food from different countries, including 35 tons of counterfeit butter from Egypt (Oaklander, 2015). Yet, it is difficult to measure or capture the entire fraud happening in the food supply chain.

To the list of "Most Adulterated Foods," the 2022 data has recently been published according to the Food Fraud Database (Fig 1 & 2). Food Fraud Database is a searchable collection of food fraud records to support the Global Food Safety Initiative (GFSI) and its required

vulnerability assessments. The GFSI was started in 2000 as “a non-profit foundation with the mission of providing continuous improvement in the food safety management systems to ensure confidence in the delivery of safe food to consumers worldwide” (Soares, 2017, P:1).

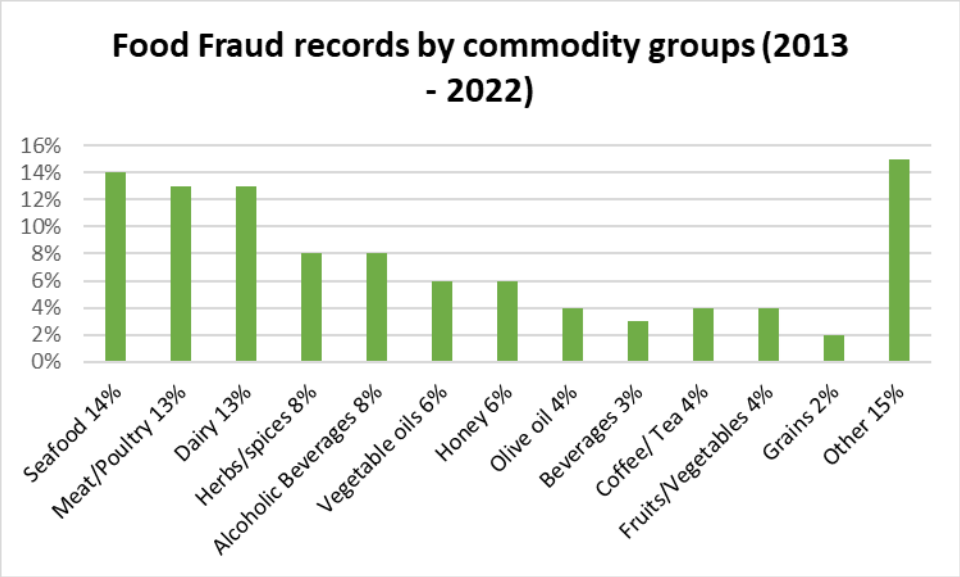

Figure 1. Food Fraud Records – Commodity groups (2013 – 2022).

Source: Adapted from Elahi (2023), based on FoodChain ID food fraud database.

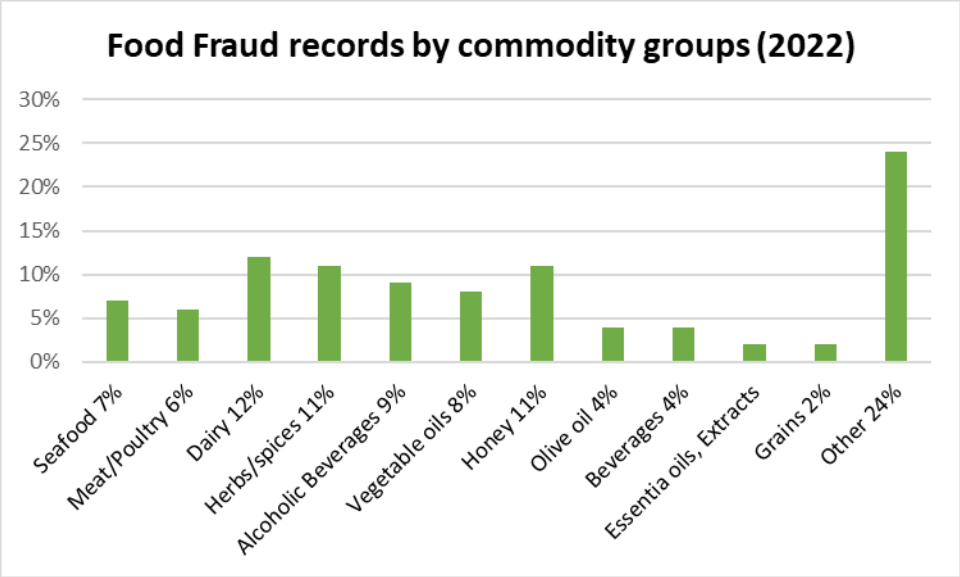

Figure 2. Food Fraud Records – Commodity groups (2022).

Source: Adapted from Elahi (2023), based on the FoodChain ID food fraud database.

Figure (2) depicts the prevalence of food fraud in various food categories, highlighting the risks and challenges facing the food sector. The most fundamental result that emerges from the data in Figure (2) is that the most adulterated food commodities in 2022 were dairy products, herbs/spices, and honey, with a prevalence of 12%, 11%, and 11%, respectively. This highlights the need for robust regulatory frameworks and effective enforcement mechanisms to ensure the authenticity and integrity of these products. In comparison, the analysis of the most adulterated food data over the period from 2013 to 2022 revealed that seafood, dairy, and meat/poultry were the most adulterated foods, with a prevalence of 14%, 13%, and 13%, respectively (Figure 1). This is alarming because these food products are essential in the diets of many people and are consumed by significant populations globally. Furthermore, the prevalence of fraud in herbs/spices, coffee/tea, and fruits/vegetables emphasizes the need for comprehensive regulatory frameworks and effective enforcement mechanisms to ensure the authenticity and integrity of these products.

1.2. Research problem

No country has immunity against food fraud (Sadiku et al., 2020; Onyeaka et al., 2022). This illegal behavior erodes people's confidence in government, destroys business reputation, and corrodes government legitimacy by making food policies and health policies less effective. Food fraud is known to weaken the government's ability to support the growth of the food system in a way that benefits all citizens. Food fraud is considered one of the most important issues associated with the importance of increasing internal and external trade flow and protecting people's health (Spink & Moyer, 2011). Fraud in the global food supply chain is becoming increasingly ubiquitous due to the enormous profit that fraudsters are making from this crime. While the intentional adulteration of fraud may pose a health threat to consumers, the Egyptian food control system suffers from many challenges, making it relatively inefficient to fight against the innovative tools of fraudsters in a globalized complex food supply chain (Onyeaka et al., 2022).

The Egyptian government put food safety-related issues a priority on their policy agenda by deciding to establish the National Food Safety Authority in 2017. However, several food fraud incidents continue to occur. Earlier in 2023, the incident of the counterfeit Nescafe coffee packs has drawn attention. In February 2023, law enforcement officials discovered and shut down an informal factory, operating under the name of food and beverage juggernaut Nestlé, that was manufacturing fake versions of Nescafe coffee items. Five million counterfeit Nescafe packs and a total of three tons of raw ingredients were discovered during a plant search. The fraudulent coffee packs were said to include ceramic powder instead of creamer, which caused the issue to be brought up in the national parliament (Food Business Africa, 2023).

Given that there are still many challenges that the food fraud control system encounters in curbing food fraud in Egypt, different aspects will be analyzed to explore whether the current food

control system provides an adequate safeguard against food fraud. This research is carried out by using in-depth analysis to explore how the government of Egypt's policy works to prevent food fraud, what the main challenges facing the government in controlling food fraud, and how to tackle these challenges.

1.3. Research objectives

Food fraud is an old problem in both developed and less-developed countries. Since the food sector in Egypt is crucial for international trade, exports, and tourism, not sufficiently dealing with fraud would undermine the Egyptian position as a reliable supplier of food products internationally. In light of the importance of food safety and food fraud as an emerging policy, this research aims to analyze food fraud policies, explore the current legal and regulatory framework that is used to deal with food fraud violations in Egypt that covers the entire food production chain "from farm to fork," the main challenges that are facing the government to mitigate the problem, and the recent and ongoing reforms that the authorities did to overcome the challenges.

The current research is filling a gap in the literature by tackling the issue of food fraud and how the Egyptian government currently deals with it. This study may help policymakers develop a better understanding of the problem and help them develop an effective system to combat food fraud in a globalized food supply chain.

This research is needed to support the decision-makers with interventions to the challenges they face to mitigate food fraud. Since the food sector in Egypt is crucial for international trade, exports, and tourism, not sufficiently dealing with fraud would undermine the Egyptian position as a reliable supplier of food products internationally. Food fraud policy reform is the entry point to incorporate proper interventions to reduce the issue. It can be considered a paradigm shift in

improving the current policies and shifting the interventions from a reactive to a proactive approach.

1.4. Research questions

The study will provide answers to the following questions through in-depth interviews with government officials:

Main research question

How is the government of Egypt's policy working to prevent food fraud, and to what extent is it effective?

This question seeks to understand the current structure of the food fraud framework and how it works. There is not enough literature on this topic in Egypt. Therefore, this question will give us a deeper understanding of the regulations, which authorities are concerned with, and what is the mandate of each authority.

Investigative research questions

The main research question is divided into small investigative questions as follows:

What are the main challenges facing the government in controlling food fraud?

The question aims at identifying the main difficulties that face the government in mitigating food fraud. This will help us to answer whether food fraud can be adequately addressed in Egypt's policy. This will help us to address the challenges from different governmental authorities' perspectives. As a result, we can set realistic and attainable recommendations to overcome the challenges.

What are the current reforms that are being taken to reduce food fraud?

The question aims at exploring the current reforms and whether the current strategy is proactive or reactive and then compare it to the global reforms so we can predict any gaps to tackle the problem.

What is still needed to be done to reduce the food fraud issue?

The question aims at understanding the continuous improvement and discovering the gaps between policy and implementation, what has been achieved and then monitored or needs monitoring to tackle the problem, and whether Egyptian control policy provides enough means to sufficiently tackle both ‘safe’, and unsafe food fraud.

CHAPTER TWO: Background

2.1. Background: The Egyptian context

The Egyptian government is aware of the importance of implementing the food control system. A reduction in food fraud practices will not only have positive effects on the health of citizens but will also lead to a potential boom in the tourism and export sector through realizing appropriate food product competition in both local and international markets. Moreover, in light of the current economic situation Egypt is going through in 2023, with the currency devaluation and rising inflation rates, and given that during tough economic times, some consumers may be more likely to purchase cheaper and potentially lower-quality food products, which could increase the risk of foodborne illness, reducing the prevalence of diseases is expected to lead to financial savings by reducing expenditures on the health sector.

Egypt was at the forefront of countries that cared about food safety. “These protective measures are described in early Chinese and Hindu literature and in the laws of ancient Egypt, Greece, and Rome. Although the emphasis on these measures was principally related to fraudulent trade practices, many did impact food quality, particularly those measures governing food adulteration and cleanliness” (Whitehead, 1995, p. 247).

Egypt was one of the first countries to join the leading international organizations in this field, such as the Food and Agriculture Organization, the World Health Organization, and the World Trade and the International Codex Organization (WHO, 1999). Egypt has a long history of setting these regulations. For example, the law of slaughterhouses and butcher shops dates back to 1893 (Hassan, 2016). Moreover, Egypt issued the first law on Food Fraud and deception law in

1941 (Combating Fraud and Deception Law 48, 1941). Over 80 years have passed since the food fraud and deception law issuance.

Former studies showed that the Egyptian state generally faces multiple crises as regards food fraud. The International Food Policy Research Institute (IFPRI) report highlighted that Egypt's food system is suffering from a crisis resulting from the poor quality of food available to the citizens. For instance, “standards for the use of pesticides are in place, but weakly enforced. Imitation brands from Asia are easily found in the markets alongside brand name products, but farmers are not trained to use them, and unsafe pesticide levels are found regularly” (Robertson, 2016, para. 3).

IFPRIs report also highlighted that the wealthiest consumers in Egypt could afford high-quality food commodities from *Gourmet*, for instance, - an expensive supermarket chain - imported beef from Australia, even fish from dedicated high-end suppliers, or locally produced fruits and vegetables from corporate farms, whose production is intended for export – and in turn, meets international food safety standards. On the other hand, most Egyptians do not have the luxury to afford these food commodities and eat the poor-quality food available from street vendors or in small supermarkets (Robertson, 2016). Thus, the issue of food fraud gets more complicated and is felt more harshly by the poorer segments of society.

2.2.1. Food control system challenges and the urge to reform

Food safety policy covers the regulations and structures that address contamination risk in food. It ensures that there is no potential hazard, including microbiological, chemical, or physical, that may harm health at any point along the food chain, including handling, production, processing, manufacturing, packaging, storage, transport, distribution, and trade. It must be started at the farm

level and continue through the food chain to final consumption by the consumer (from farm to fork) (Robson, 2021).

Egypt's food safety challenges involved inadequate commitment, outdated food regulations, and weak law enforcement (Ibrahim & Abdel-Haleem, 2017). Until 2017, Egypt did not have a unified regulatory competent authority to supervise food safety. Responsibility for creating food safety policy is delivered through several government departments and agencies at the national, regional, and local levels (Figure 3). Furthermore, there needed to be a clear mechanism for managing food safety emergencies, traceability, recalls, and risk assessment systems. Around 17 different government agencies were responsible for regulating food safety in Egypt. These agencies include, but are not limited to, the Ministry of Health and Population, the Ministry of Agriculture, the Industrial Supervisory Agency, the Ministry of Supply, the General Organization for Supervision on Imports & Exports, the Agricultural Quarantine Agency, and the Veterinary Quarantine Agency. However, the Ministry of Health and Population carried out the main responsibility. The Ministry of Health and Population was responsible for implementing the basic laws number 281/94 and 10/1966 (FAO, 2002).

Figure 3. Institutions involved in food control in Egypt.

Source: Designed by the author based on FAO (2002).

The Ministry of Health and Population's food safety and control division was in charge of managing the implementation of national food rules. The Ministry of Supply was responsible for inspecting food at the local market for compliance with the requirements of law number 281/1994 (prevention of adulteration and fraud). The General Import and Export Control organization with

the Ministry of Health and Population and the Ministry of Agriculture were responsible for inspecting exported and imported food. The Committee of rejected imported food at the Ministry of Health and Population involved members of the different responsible ministries and other members from the research institutes and universities. It was mandated for any problems related to imported food. The Ministry of Industry and Internal Trade was responsible for issuing Egyptian standards for different food commodities (FAO, 2002; Figure 3).

Coordination and communication among the agencies in dealing with existing and emerging food safety challenges were inadequate (Ibrahim & Abdel-Haleem, 2017). Moreover, the jurisdictional overlaps between these agencies created problems in responding to foodborne hazard crises and handling routine inspections. This resulted in ineffective law enforcement and the fragmentation of regulations between different sectors. Therefore, these limitations acted as an obstacle to attaining an effective food control system (Ibrahim & Abdel-Haleem, 2017).

2.2.1.1. Outbreaks from exported food

Instances of inefficiencies in the system appeared in the form of outbreaks of exported food from Egypt. In 2011, the EU banned the import of Egyptian Fenugreek Seeds 2011. Egyptian Fenugreek Seeds was suspected to be the source of the EU E. coli O104:H4 outbreak that, according to the European Food Safety Authority wrap-up report, sickened 3,134 and killed at least 47. The confirmed cases included 778 who developed the kidney-damaging disease called hemolytic uremic syndrome (HUS) (Foley et al., 2013). However, the Minister of Agriculture denied this outbreak. “When Europe’s top food safety laboratory said it found the infected shipment of Egyptian fenugreek seeds that killed 50 people, Agriculture Minister Ayman Abu-Hadid said Egypt had nothing to do with it and instead blamed Israel” (Flynn, 2016). This resulted in imposing restrictions on Egypt by banning the import of seeds from Egypt (Tuffs, 2011).

It is crucial to emphasize that the lack of foodborne pathogens surveillance systems prevents an accurate evaluation of the burden of foodborne diseases in Egyptian foods. Foodborne pathogens surveillance systems are responsible for gathering data, detecting, tracking, and monitoring pathogens that cause foodborne diseases (Aboubakr & Goyal, 2019). This makes evaluating the food control system in Egypt a difficult task. Another outbreak happened in 2016, where Egyptian strawberry was suspected to be linked to Hepatitis A cases in the U.S. According to a statement from the Virginia Department of Health dated 19 August, "genetic testing shows the illnesses were caused by a strain of hepatitis A that has been associated with past outbreaks due to frozen strawberries from Egypt." (Enterprise, 2016).

These outbreaks that happened drew the attention of the government to the need for change. The government can integrate these siloed systems into the central food safety system. While the Bovine Spongiform Encephalopathy scandal in Europe (the biggest food scandal of the twentieth century) was the motive behind establishing the European Food Safety Authority (risk assessment agency) (Dressel, 2002), these recurrent outbreaks in Egypt also led to several institutional changes and were the motor of establishing a unified body concerned with food safety in Egypt, the National Food Safety Authority (NFSA). As a reaction to these incidents, "Egypt is giving top priority to food safety issues by establishing the National Food Safety Authority. The Food and Agriculture Organization (FAO) has been working with our development partners on sanitary and phytosanitary measures, sustainable agriculture, and good hygienic practices. We also support NFSA in preparing the capacity development plan to enhance food safety," said Hussein Gadain, FAO representative in Egypt (FAO, 2019, para. 9).

2.2.1.2. A new vision and a Framework to Reform

In January 2017, The Egyptian Parliament established the National Food Safety Authority (NFSA), which currently provides the general regulatory framework for the national food safety control system in Egypt. The primary objective of the NFSA, as stated in Article 3 of Law Number 1/2017, is to safeguard human health and safety by adhering to food safety regulations. NFSA is the authority with the aim of ensuring that all food consumed in Egypt complies with the highest standards of food safety and hygiene in order to preserve consumer health. The Prime Minister acts as the competent minister, and NFSA is an affiliate of the President of the Republic.

With its mission to "protect consumer health, by ensuring that food products consumed, distributed, marketed, or produced in Egypt meet the highest standards of food safety and hygiene. The agency is responsible for food safety regulation for domestic production, import, and export through undertaking inspection, licensing, and certification" (USDA, 2019, p. 2). The main powers of NFSA are setting mandatory food safety criteria in harmony with the international standards, inspection, control, licensing, and handling of food. It is in charge of managing inspection, licensing, and certification in order to regulate the safety of food for domestic production, import, and export. Its goal is to safeguard the health of consumers by guaranteeing that every food consumed, distributed, marketed, or manufactured in Egypt complies with the globally agreed international requirements for food safety and hygiene (NFSA, 2017).

According to Law number 1/2017, NFSA consists of the following: Board of Trustees, Board of Directors, Executive Director, and NFSA Employees. The Board of Trustees is responsible for drawing up the general food safety policies (NFSA, 2017). According to the prime minister, decision no 683 to the year 2017, regarding the formation of the board of trustees at NFSA, the board of trustees compromises the prime minister, the minister of environment, the

minister of health and population, the minister of trade and industry, the minister of tourism, the minister of supply and internal trade, the minister of agriculture and land reclamation, and two food safety experts. The board of trustee members cooperates to establish policies and regulations of NFSA (NFSA, 2017).

The executive regulations for the NFSA were released by the government on February 18, 2019. Egypt's food safety regulatory system is planned to be reformed by NFSA (NFSA Prime Minister's Decision No. 412, 2019). "We stand committed to working with all involved in food safety in Egypt to enhance our capacities by operating more efficiently across the supply chain, thereby ensuring food security in our country for our people," said Dr. Hussein Mansour, chairman of the NFSA (FAO, 2019, para. 7).

2.2.1.3. Inefficient system due to overlapping and lack of technical expertise.

According to law no. one in the year 2017, NFSA alone assumes control of all stages of food manufacturing and circulation in the Egyptian market. However, this is not the case so far. The General Organization of Export and Import Control's appeal committee collaborates to assess appeals from exporters concerning rejections and determine if additional testing is required. In contrast, NFSA does not possess its own committee. Moreover, the Ministry of Agriculture and Land Reclamation's General Organization for Veterinary Services and Central Administration of Plant Quarantine are still fulfilling their duties related to animal and plant health without any conflict with NFSA's new responsibilities. However, there is some overlap in technical functions regarding animal products, leading to confusion among traders (USDA, 2022).

NFSA relies on the laboratories of the Ministry of Health for conducting tests and gives precedence to public laboratories for sample analysis. Furthermore, NFSA utilizes the services of

both the Reference Laboratory for Safety Analysis of Food of Animal Origin and the Regional Center for Food and Feed (USDA, 2022).

The Ministry of Health continues to do its role by inspecting some food establishments in the market due to the limited staff at NFSA and human resource constraints. The incident of fraud in cheese ingredients by mixing paint with cheese in 2021 has made the overlapping between the Ministry of Health and NFSA intensely apparent. The Ministry of Health representatives in the city of Tala, Menufia, announced the withholding of a factory, which as they announced, mixes cheese with wall paint. It should be pointed out that the Central Food Control Office at the Ministry of Health in Menoufia confirmed during investigations that the smell of wall paint was released from the cheese itself and that the material used to paint the walls was found to have been blended with cheese. The Central Food Control Office then requested the arrest and imprisonment of the owner of the cheese factory and its dairy supplier (Alkhaleej Today, 2021).

This caused great controversy. After NFSA investigation and analysis, the samples that were taken were examined in two labs, one belonging to the Ministry of Industry and the other to the Ministry of Health's sanitary division. They discovered that the ingredients of the cheese are goat's milk and other ingredients used in the production of this type of cheese, known as Jameed Baladi, which is primarily produced for desert areas and their Bedouin inhabitants because it has a shelf life of up to one, two, or even three years and is not sold in cities (Alkhaleej Today, 2021; Teller report, 2021). This confirmed the absence of fraud in the ingredients of the captured cheese to the public prosecution and that there was no food fraud.

By investigation, they revealed that the food control official from the Ministry of Health hurried and reported, in the prosecution's investigations, that the cheese captured at the factory at the "Tala" center in Menoufia smelled like wall paint and that paint bags captured at the factory,

which reinforces the hypothesis of mixing paint with cheese (Teller report, 2021). The chairman of NFSA stressed that meticulous examination by trained specialists and laboratories is necessary because these issues cannot be discovered or assessed effectively with the human eye (Alkhaleej Today, 2021). This put the qualifications and technical capacities of the food control officials at the Ministry of Health into question. While food inspectors and official controls are an integral part of food control supervision and enforcement, inefficiencies in service delivery that results from inconsistencies and lack of coordination between inspectors and different official controls can expand if unaddressed.

While a direction for eliminating siloed systems and preventing the replicated building blocks was the motivation for the reform, it is clear that multiple ministries and authorities implement food control systems on the ground, then the rules and strategies for each ministry and authority in the system is not specified, which reflects a greater likelihood of mistakes being made. The cheese-painted incident offers us an opportunity to look back and consider how we could reconfigure our current food control system. What happened in the cheese-painted incident was that multiple ministries and authorities implementing the enforcement of food laws and regulations on the ground, which puts a burden on the food operator to interact with these authorities and ministries, and this can also lead to no system having all the information that managers of the system (and any other users) require. Therefore, eliminating duplicate food control systems that limit or waste time and resources through an integrated food control system would be able to manage and direct these in such a way as to maximize the outcomes that can be obtained for the available resources.

2.2.1.4. Consumers' Perception of food safety in Egypt

With the continuous increase in demand because of the demographic changes and population continuous growth and urbanization, the challenges to fighting food fraud became harder. Furthermore, consumer behavior which influences the way they choose, store, prepare, cook, and eat their food, has an impact on the safety of their food. The consumer's perception of food safety in Egypt is poor, and knowledge is insufficient even among highly educated people. For instance, a study conducted among medical students in Ain Shams, estimating attitude and self-reported practice, revealed that less than 50% of the students in this study could score correct answers for food safety questions (Boulos & Abouelezz, 2020). This means that they had poor knowledge of food safety. Taken together, these trends demonstrate there is an urgent need to develop continued education on food safety in parallel with the development of food safety regulations.

Given that food borne diseases prevention requires awareness from both the producer and the consumer, another study conducted by Elnahas et al. (2022) to measure food safety knowledge and practice at the Kasr El Ainy Family Medicine outpatient clinic highlighted that both food safety knowledge and practice are poor among the participants, which reflects lack of awareness and inadequate understanding of hygienic and safety requirements. Consumers' perception of food safety in Egypt is low not only among people who do not work in the food sector but also among food handlers. For example, a study conducted in Sohag governorate revealed that 39.2% (less than 50 %) had good knowledge of food safety (Hamed & Mohammed, 2020). This reflects inadequate compliance with food safety management systems and food safety practices.

2.2.1.5. Food fraud law and the need for reform

Some of the most prominent laws that control food in Egypt are law no 49 of 1941 on food fraud; law no 53 of 1966 on agriculture; law no 132 of 1950 on milk and milk products; Decree no 4 of 1953 on meat and meat products trade regulation; law no 10 of 1966 on food control and regulation of food circulation; and law no 1 of 2017 on establishing NFSA.

In Egypt, Food fraud is covered by Law No. 48 of 1941 and Law No.281 of 1994, amending some provisions of Law No.48 of 1941 to combat fraud and deception. These laws outline the general principles and penalties of fraud, emphasizing the sanctions of the violators.

A closer look at food fraud law shows that the food fraud law in Egypt does not rely on the internationally accepted standards, guidelines, guides, and recommendations developed by the United Nations Food and Agriculture Organization (FAO), the World Health Organization (WHO), the Codex Alimentarius Commission, the International Organization for Conservation Animal Health (OIE), International Plant Protection Convention (IPPC), International Organization for Standardization (ISO), etc. Shortcomings and inconsistencies in the current food fraud law will be discussed in the results section.

CHAPTER THREE: CONCEPTUAL FRAMEWORK

Food fraud control systems comprise interconnected core elements, enablers, and stakeholders that are working together to guard the public against adulterated food and promote the food trade. The general framework of the food fraud control system is a comprehensive framework for ensuring the absence of fraudulent and adulterant practices in the food supply chain (Figure 4).

The researcher developed a typology based on the national food control system (Whitehead et al., 1995) to understand and assess the complexity of food fraud and to identify patterns or trends within a dataset. This conceptual framework can be a useful tool for researchers to organize and analyze complex data and to identify patterns and trends that might not be apparent through other methods (Figure 4).

As per the conceptual framework, this research revolves around five main dimensions. The first element, which relates to food fraud laws and regulations, seeks to understand the current structure of the food fraud regulatory framework and how it works. The second element looks at how the food fraud control management system is implemented. In other words, the study would be looking at identifying the main difficulties that face the government in mitigating food fraud. The third element would address the inspection services. The fourth element would address the laboratory services. Finally, the last element would discuss how the governments made an effort to educate and equip the food industry and enable the general public to demand authentic food (Figure 4).

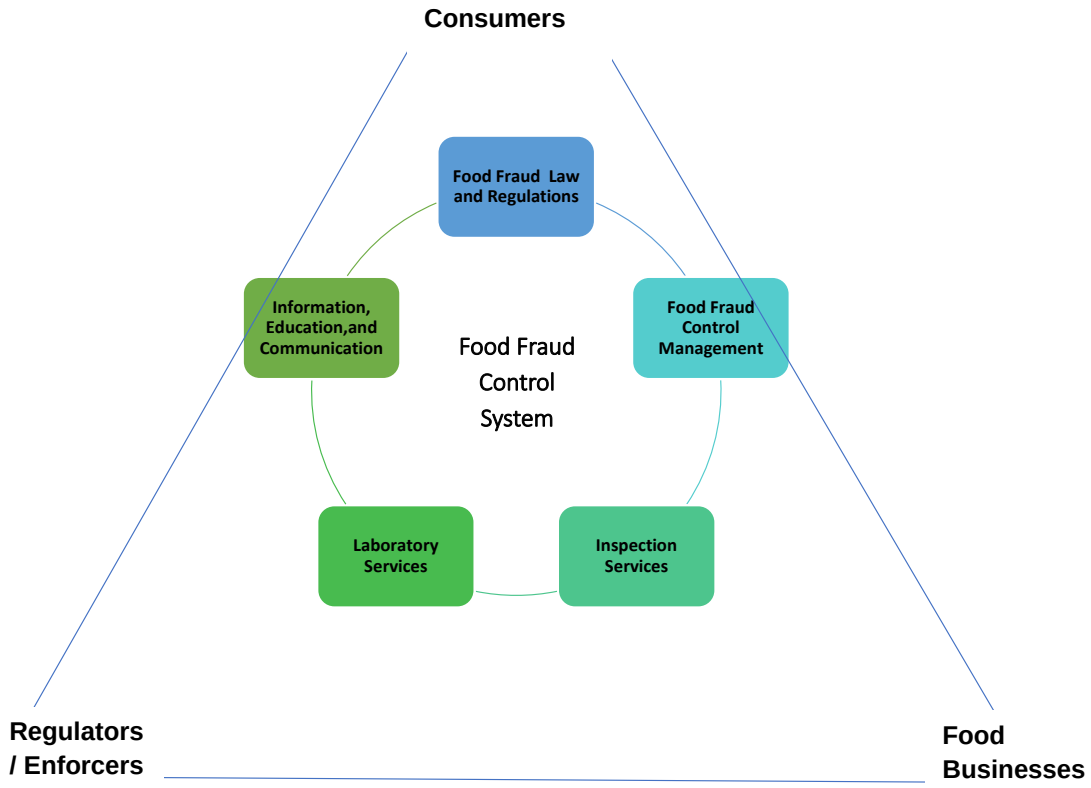

Figure 4. Conceptual framework: the general framework of food fraud control system.

Designed by the author and inspired by Whitehead et al., (1995); Spink et al. (2016 a); WHO (2021).

Regulators/ law enforcers: Consists of all divisions, offices, and organizations engaged in government food regulation. The government ensures that food companies follow all applicable rules and regulations about food safety and that the market is supplied with healthy food. Government regulators and law enforcers are in charge of monitoring, enforcing legal and regulatory requirements, and assessing the efficacy of the food businesses (Spink et al., 2016 a). According to Law number 1/2017, NFSA shall consist of the following: Board of Trustees, Board of Directors, Executive Director, and NFSA Employees. The Board of Trustees is responsible for drawing up the general food safety policies (NFSA, 2017). The Board of Trustees comprised the

prime minister, the minister of environment, the minister of health and population, the minister of trade and industry, the minister of tourism, the minister of supply and internal trade, the minister of agriculture and land reclamation, and two food safety experts. The board of trustee members cooperates to establish policies and regulations of NFSA.

Business: This group of stakeholders comprises food business operators, distributors, processors, retailers, and wholesalers. This group of stakeholders also includes food industry associations and private consultancy firms. Food business operators are ultimately accountable for guaranteeing that food will not be adulterated and that consumers obtain authentic food when it is purchased, processed, distributed, and/or sold in accordance with its intended usage (Spink et al., 2016 a).

Consumers: encompasses both individual consumers of food and consumer groups. Customers must feel confident in the authenticity of the food they purchase, and this confidence is primarily based on how they view the trustworthiness of food management systems. By seeking cheaper goods, consumers may unintentionally encourage food fraud by incentivizing adulteration. The danger of fraud can be mitigated by providing education on the benefits and risks of food safety and authenticity. Consumers should report food fraud or other deceptive practices by contacting the authorities.

Governments and industry have the most control over the food supply chain at specific exchange points. At border crossings and in regulating the point of consumer purchase, governments have the most control over the food supply chain. At these exchange points, governments can enforce regulations, inspect products, and prevent the entry of fraudulent and unsafe food products into the country or market. On the other hand, industry has the most control over the food supply chain at the ownership exchange when receiving materials and at the sale to

consumers. At these exchange points, industry can implement quality control measures, traceability systems, and other strategies to prevent food fraud (Spink et al., 2016 a).

The relationship between regulators and the food industry in preventing food fraud is complex and sometimes strained. The industry seeks protection from non-compliant or illicit products while also desiring the freedom to trade their goods. This tension has varied throughout history, often influenced by the global political climate of the time. Despite their different perspectives, the food industry and regulators share a common goal of preventing food fraud due to its potential impact on consumer health, safety, and trust in the industry. However, there may be different approaches to achieving this goal and balancing the interests of industry and regulation (Popping et al., 2022).

Governments must therefore bring together stakeholders and take the lead in establishing a clear vision, providing stakeholders with accurate information on food fraud-related issues, and implementing a set of policy instruments that encourage food business operators, professionals, and consumers to take positive actions. Governments should make a concerted effort to educate and equip the food industry and the general public to create safe food, including enabling people to demand authentic food. This procedure will result in a new method of approaching food fraud regulation and enforcement (Spink et al., 2016 a).

Food fraud law and regulations: To effectively prevent or mitigate food fraud, food laws and regulations must be updated, enforced, and proactive (containing a preventive element). To increase clarity and legal justice, they must also contain explicit definitions (Whitehead, 1995).

Food fraud control management: A food fraud control management system refers to identifying and evaluating the risks of food fraud, putting control mechanisms in place to deter and disrupt

fraudulent activity, and regularly analyzing and evaluating the efficacy of these controls are all part of food fraud control management. The core duties include monitoring system performance, facilitating continual improvement, and offering overarching policy direction. This could be done through Food Fraud Vulnerability Assessment. Food Fraud Vulnerability Assessment involves supply chain mapping and socioeconomic/behavioral/geo-political analysis. A notable way for controlling identified vulnerabilities is, for example, origin/label verification, supplier audit, and analytical testing strategy (Manning & Soon, 2019).

Inspection services: Government food regulators are in charge of monitoring, enforcing the law and regulations, and surveilling the food system. Monitoring of the food control system is primarily based on keeping track of the number of food-related businesses that are inspected, food samples that are collected, food-related complaints that are resolved, and food poisoning cases that are resolved. This is done by inspection services (Whitehead, 1995).

Laboratory services: Laboratory services refer to the analytical capability and capacity. "Within the official food control system, there must be sufficient analytical capability and capacity to determine and monitor the level of quality of the national food supply (Whitehead, 1995, P: 250)." The earlier scenario demonstrated how the official food control laboratories' equipment is manifestly inadequate and lacking in some key areas, which inhibits the completion of various analyses pertaining to food safety. However, the capacity of the laboratories has been upgraded, strengthened, and maintained after establishing NFSA (Ibrahim & Abdel-Haleem, 2017).

Information, education, and communication: Training, education, and community engagement initiatives must be combined with implementing legal requirements for effective food control. Information, education, and communication to food business operators to help them comply with

food safety regulations and prevent food fraud. Information, education, and communication to consumers to empower them to make informed choices.

Customers have the right to assume that their food is secure and correctly labeled, and the food industry has the duty to maintain consumers' confidence. To protect consumers, support the industry, and prevent the economic harm of food fraud, the government should design effective policies to avoid and detect food fraud and ensure that customers are aware of the items they are buying and food companies that prioritize food safety and integrity have the tools to protect their business from fraudulent. Thus, our research can assist in identifying the most effective policy solutions.

CHAPTER FOUR: LITERATURE REVIEW

An extensive analysis of the various internet databases of peer-reviewed books, journals, reports, studies, and publications issued by international organizations engaged in the field of food control is conducted in order to clearly grasp the current structure of the food fraud framework, identify the main difficulties that face the government in mitigating food fraud, address the strategies and tools of combating food fraud and discover the gaps between policy and implementation. The major topics and ideas that will be covered in the study are defined and explained at the beginning of the chapter. As a result, the chapter defines food fraud and provides a history of how the concept came to be from different academic, government, and international organizations' perspectives. The chapter then defines the terms and describes the many types and shapes of food fraud. After that, the chapter covers the tools to tackle food fraud in the supply chain and clarifies several related concerns. The chapter then illustrates global experiences about how other countries dealt with the problem of food fraud.

Although food fraud is a global issue affecting every country in every region of the world, which has recently received substantial public and media attention, there is not enough academic literature on it. Some notable exceptions can be found in Spink & Moyer (2011); Kulas (2014); Spink et al. (2016); Charlebois et al. (2016); Kets (2016) and Popping et al. (2022).

4.1. Food risk matrix

The food risk matrix includes four main elements: food quality, food safety, food fraud, and food defense (Figure 5). Food quality violations are unintentional. Manipulations affect product value and quality characteristics such as appearance, size, and shape. For example, when the label of food claims that this food is classified as class 1 according to the food legislations and

product specification, while it contains class 2 food. On the other hand, if the change in this product labeling was intentional, it is called food fraud. It deceives the consumer for economic gain (Spink & Moyer, 2011).

Food safety hazards refer to food that contains physical, chemical, and microbiological hazards. It unintentionally affects the consumer's public health. For instance, the egg tortilla salmonella outbreak that occurred recently in Madrid (Hedgecoe, 2023) is considered as food safety problem, and it is not food fraud. On the other hand, food fraud may cause harm to consumers' health. For instance, the addition of melamine to infants' milk in China in 2008. This incident resulted in 6 death and 300,000 infants affected (Gossner et al., 2009). This example shows how food fraud can deleteriously impact consumers' health. In contrast, the substitution of beef meat with horse meat, which happened in the UK in 2013, is considered an example of a case where food fraud does not cause harm to consumers' health, yet it deceived consumers with a label mentioning that the food contains 100% beef.

Both food fraud and food defense are intentional. Food fraud is intentional adulteration with the intention of economic gain, while food defense is intentional adulteration with the intention of terror and causing harm (Figure 5). Food defenses counteract food terrorism, a subcategory of bioterrorism, which is defined by the World Health Organization (WHO) as "an act or threat of deliberate contamination of food for human consumption with chemical, biological or radio-nuclear agents for the purpose of causing injury or death to civilian populations and/or disrupting social, eco-nomic or political stability" (WHO, 2002). An example of food defense is the strawberry needle sabotage that happened in Australia in 2018 (The Guardian, 2018). A kind of commercial terrorism with the intention to harm the business.

Food Quality	Food Fraud	Motivation Gain: Economic
Food Safety	Food Defense	Harm: Public health, Economic, Terror
Unintentional	Intentional	
Action		

Figure 5. Food risk Matrix.

Source: Adapted from Spink & Moyer (2011).

Spink & Moyer (2011), in their study “Defining the public health threat of food fraud,” focuses on food fraud as a risk that influences public health. Direct, indirect, and technological food fraud risks to public health were all highlighted in their study. These three risk types are the result of the public rather than the fraudster's intent. The term "direct food fraud risk” occurs when the consumer is exposed to immediate or imminent risk, such as when an acutely toxic or lethal contaminant is intentionally present. The term "indirect food fraud risk” occurs when the consumer is exposed to the risks in the long term, such as the accumulation of small doses of the toxin in the body that will result in causing harm in the long term. Another example is the absence of a certain vitamin from a vitamin formula, which causes harm to the consumer in the long run. The term "technical food fraud risk” is concerned with technological fraud. For instance, it occurs when the place of origin or the documentation is purposefully misrepresented (Spink & Moyer, 2011).

4.2. Tools to fight food fraud

4.2.1. Defining food fraud

This section will discuss various definitions and classifications of food fraud, including intentional and unintentional fraud, adulteration, mislabeling, and counterfeiting.

The first barrier to tackling food fraud is that there is no globally agreed definition for food fraud. Moreover, traditional food safety and defense management systems do not address food fraud (Spink & Moyer, 2011). FDA (2007) defined adulterated food as "If it bears or contains any poisonous or deleterious substance which may render it injurious to health; but in case the substance is not an added substance such food shall not be considered adulterated under this clause if the quantity of such substance in such food does not ordinarily render it injurious to health." According to this definition, the undeclared substitution of beef meat with horsemeat, which happened in the UK in 2013, is not food adulterant if the quantity of it does not cause harm or risk (even when it reduces the nutritional value of the food).

In 2009, FDA defined economically motivated adulteration (EMA) as "the fraudulent, intentional substitution or addition of a substance in a product for the purpose of increasing the apparent value of the product or reducing the cost of its production, i.e., for economic gain. EMA includes dilution of products with increased quantities of an already-present substance (e.g., increasing inactive ingredients of a drug with a resulting reduction in strength of the finished product or watering down of juice) to the extent that such dilution poses a known or possible health risk to consumers, as well as the addition or substitution of substances to mask dilution." For instance, the use of (illegal) coloring agents (for example, the addition of nitrites to meat or burgers) to make food appear to be fresher or of higher quality is an example of adulteration.

However, this definition did not mention the term food fraud, but they just provided a working definition for economically motivated adulteration.

Two years after the FDA definition, Spink and Moyler (2011) refer to food fraud as “a collective term used to encompass the deliberate and intentional substitution, addition, tampering, or misrepresentation of food, food ingredients, or food packaging; or false or misleading statements made about a product, for economic gain” (p. 158). This means that seven different types of fraud are highlighted including “substitution, addition, tampering, or misrepresentation of food, food ingredients, or food packaging; or false or misleading statements made about a product.” For instance, the misrepresentation of the country’s origin is an example of misrepresentation as a type of fraud. Another notable example of tampering is changing best-before dates (Table 1). This definition is broader than the FDA definition and is considered the basic one that sends a clear message, which may help other researchers in food science, food safety, and food law to start building up on it for a harmonized approach that can turn the tide against food fraud.

GFSI has also adopted Spink and Moyler's (2011) definition (GFSI, 2018). However, seven different categories, including dilution, concealment, substitution, mislabeling, counterfeit, gray market/theft/diversion, and unapproved enhancements, were involved in the GFSI (GFSI, 2018).

The recent WHO food safety strategy 2022 has, for the first time, mentioned food fraud with an emphasis on it as a critical issue that may harm governments, businesses, and consumers. It also used Spink et al. (2019) definition, “any suspected intentional action committed when an

FBO intentionally decides to deceive customers about the quality and/ or content of the food they are purchasing in order to gain an undue advantage, usually economic gains, for themselves."

FAO's (2021) report emphasized that the adoption of a national definition for food fraud could assist in identifying specific actions to address the issue. They also suggest that aligning with the food standards set by Codex Alimentarius could be beneficial for national food safety authorities in dealing with food fraud.

Even though food fraud received more attention in Europe after the horsemeat scandal in 2013, Wisniewski (2019) found that different officials of food control authorities in Germany have different ideas of what the terms related to food fraud mean. This means that the legal definition of the terms in the law is ambiguous. In Dutch national law or European law, there is no legally agreed definition of food fraud (Kets, 2016). In Canada, there is a gap between food fraud laws and implementation in the Canadian system (Cadieux, 2019). The author revealed that not all types of food fraud are not well defined in the current Canadian food law.

Food fraud is defined, in the NFSA Prime Minister's Decision No. 412 (2019), article 1 , as "Counterfeiting, imitation, or mixing of a specific commodity intended for sale, or acquired with the intention of trading and it is a change, modification, and distortion that occurs on that commodity and its essence or its natural composition, its weight, or its expiry period, and the aim behind this is to hinder its properties or conceal any defects that appear in the counterfeit or imitated commodity while being careful to give it the shape and appearance of another authentic commodity, but actually, it differs from it without disclosure about that in the label, in order to take advantage of the false properties and benefit with the benefits obtained and get the price difference for easy and quick earning, or it is the intentional fraud to market goods by deception."

Since food fraud may include different types of adulteration and misbranding, grey market, or even smuggling (GFSI, 2018), it is thought of as a far broader definition.

While the NFSA Prime Minister's Decision No. 412 (2019) provides a comprehensive definition of food fraud, it lacks specific penalties for offenders. Moreover, the decision does not outline the guidance on prevention measures or the procedures for investigating and enforcing the law. This lack of specificity and guidance may lead to inconsistent enforcement.

According to NFSA Law No.1 (2017), deception is defined as: "performing a procedure or an action that leads to the acceptance of something that is not authentic by considering it authentic." While NFSA Law No.1 (2017) provides a clear definition of deception, it lacks specific penalties for offenders, guidance on prevention measures, investigation procedures, and enforcement.

Food fraud types

While food fraud is an organized crime, fraud principally takes a few specific forms. It can be an addition of a foreign or inferior substance or substituting a nutrient or a high-value ingredient with a low-value ingredient (e.g., substituting high-value fish species with low-value fish species). It can be dilution where the high-value liquid ingredient is diluted with a low-value liquid (e.g., the dilution of milk with water). It can also be an unapproved enhancement, where the unknown and undeclared compound is added to the food to make its quality look superior (e.g., the addition of melamine to milk to enhance nitrogen content in diluted milk and hide the dilution). It can also be concealment, where the low-quality food ingredient is hidden (e.g., adding carbon monoxide to meat to keep the meat color red) (Lees & Morin, 2018; Table 1).

Table 1. Different types of food fraud.

Term	Definition	Example	Recognized by
Adulterate	A component of the finished product is fraudulent.	Melamine added to milk	Spink (2011) & FAO (2019)
Tamper	Legitimate products and packaging are used in a fraudulent way	Changed expiry information, product labeling.	
Over-run	Legitimate product is made in excess of production agreements	Under-reporting of production.	
Theft	A legitimate product is stolen and passed off as legitimately procured	Stolen products are co-mingled with legitimate products.	
Diversion	The sale or distribution of legitimate products outside of the intended markets	Relief food is redirected to markets where aid is not required.	
Simulation	An illegitimate product is designed to look like but not exactly copy the legitimate product	Knock-offs" of popular foods not produced with the same food safety assurances.	
Substitution	Substituting a nutrient or food substance (typically one of higher value) with another nutrient or ingredient (often one with a lower value).	Using palm oil or other vegetable oils instead of olive oil. It harms consumers because consumers do not obtain the nutritional value of the food product and may introduce harmful substances if the consumer is allergic to the inferior substituted food substance.	Lees & Morin (2018). European commission, (2021) GFSI (2018)
Dilution	Blending a liquid ingredient (solute) of high value with a liquid of lesser value.		

Unapproved enhancement	the procedure of enhancing food goods' quality characteristics by adding unidentified, unapproved, and undeclared substances to them.	
Concealment	Hiding/masking of poor grade/quality food components or products.	
Grey market	The creation, theft, and diversion of goods through illegal routes of trade.	When there are production quotas or contracts for the goods, and the commodity is purposefully produced in surplus, the sale of the surplus is unreported.
Counterfeit	A situation when intellectual property rights (IPR) have been violated. This could involve completely replicating any or all characteristics of the other product or package, such as imitating the brand name, packaging design, or manufacturing process to make money and profit commercially.	Packing low-quality olive oil as high-quality extra virgin olive oil. It can mislead consumers about the quality or authenticity of the food product.
Mislabeling	It relates to the act of writing fraudulent statements on packaging to make money and profit commercially.	A food product may be labeled as "organic" or "halal" when it does not meet the relevant standards.

Figure 6. Food Fraud Records – Fraud types (2013 - 2022).

Adapted from Elahi (2023), from FoodChain ID food fraud database.

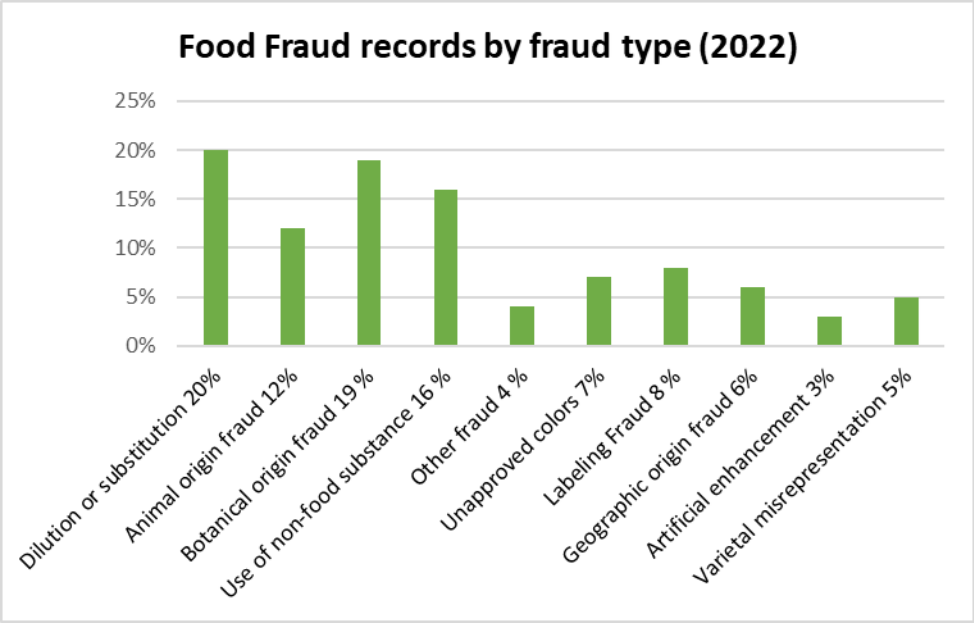

Figure 7. Food Fraud Records – Fraud types (2022).

Adapted from Elahi (2023), based on FoodChain ID food fraud database.

According to Figures (6 & 7), the common incidents of food fraud in 2022 that most frequently happen are dilution/substitution, botanical origin fraud, animal origin fraud, and use of a non-fraud substance. Dilution or substitution is the most common type of fraud sheds light on the need for regulatory agencies and industry stakeholders to focus on preventing and detecting this type of fraud, which may have serious health consequences. Furthermore, the prevalence of labeling fraud and geographic origin fraud draws attention to the importance of accurate and transparent labeling of food products, as labeling fraud is prevalent at 6% in Figure (6) and 8% in Figure (7). Labeling fraud and geographic origin fraud hinder consumers from making informed choices and avoiding potential health risks.

4.2.2. Food fraud opportunity

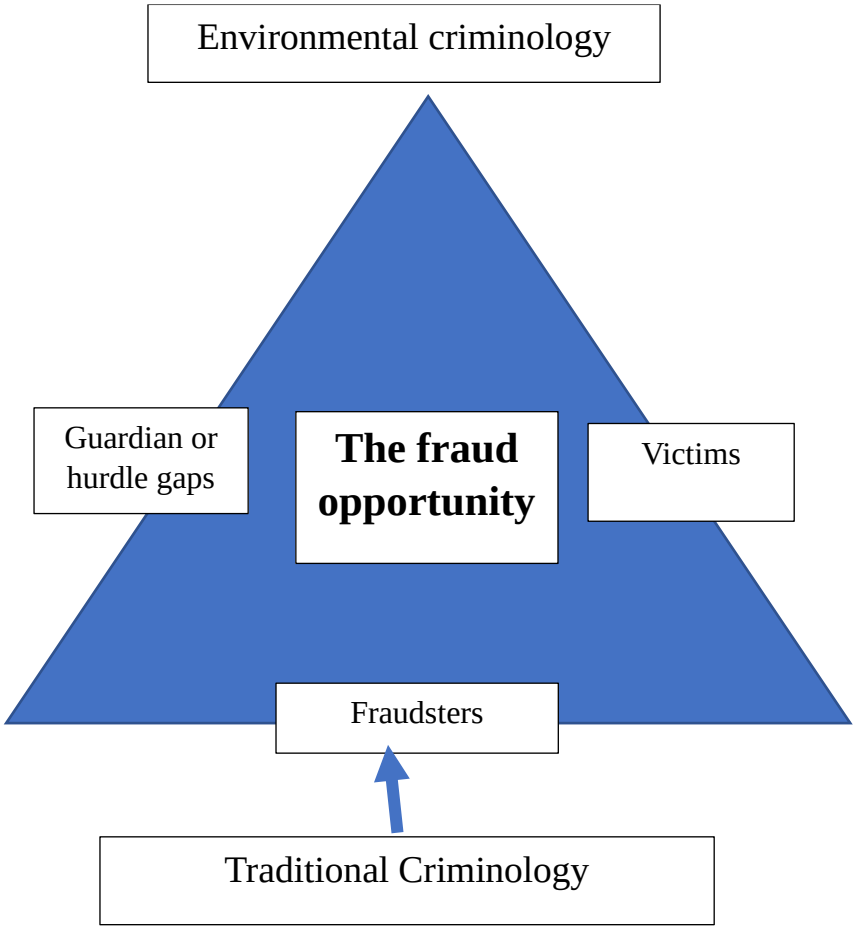

Figure 8. The crime triangle.

Source: Adapted from Spink & Moyer (2011).

Actors involved in the food supply chain who may engage in fraudulent practices include farmers, processors, distributors, and retailers. “Food fraud is committed by any actor who is intentionally involved in illegal acts for economic advantage, thus causing or facilitating illegal food to be laundered into the supply chain or for food to be fraudulently value-enhanced” (Gussow, 2020, p. 113). The fraud crime triangle consists of three main elements: fraudsters, hurdle gaps, and victims (Figure 8). Food fraud happens when fraudsters find gaps in the supply chain or regulations. Opportunities for fraud exist for every actor and every interaction within the supply chain. This means that the longer the supply chain, the more opportunities fraudsters have to commit fraud. These opportunities can vary between different sectors of the food system.

To address the expanding scope of food fraud, Spink (2019), in his paper “The current state of food fraud prevention: overview and requirements to address How to Start? and How Much is Enough?”, revealed that it is necessary to incorporate various disciplines, such as criminology, public policy, business enterprise risk management, and activity management. The proposed approach for dealing with this issue is known as the Food Fraud Implementation Method (FFIM). FFIM is a strategic approach to addressing food fraud that involves the integration of various disciplines. This approach is designed to identify and mitigate risks associated with food fraud, enhance transparency and accountability, and ensure the safety and quality of the food supply.

4.2.3. Food fraud in the supply chain

Food fraud is everyone’s responsibility. The industry and government must ensure that food is not adulterated along the supply chain (Gallagher & Thomas, 2010). For micro and small food producers, rigid supplier management is the main way to protect against food fraud in your

business (Dani, 2015). Food producers must ensure they use suppliers that can provide the necessary documentation. Moreover, audits of the supplier's facility should be considered when dealing with high-risk food such as meat and dairy (Kussaga et al., 2014).

Bindet's (2016) thesis demonstrated the intricate nature of recall actions and the interconnectedness of links within the supply chain. Retailers, in particular, are crucial clients to consider due to their significant power within the supply chain. A large cluster of retailers (47%) was found to be ignoring fraud mitigation strategies identified by the Food Fraud Vulnerability Assessment. Therefore, paying attention to retailers' fraud mitigation strategies can potentially address gaps in fraud prevention strategies and improve the overall integrity of the supply chain.

The prevalence of food crime is closely linked to the socio-economic system of "cheap capitalism". This system is characterized by a focus on low prices and high profits, often at the expense of product quality, social morality, and business ethics. "The prevalence of food crime occurs in the context of ' cheap capitalism ' which is characterized by the low price, inferior quality of products and degraded social morality and business ethics" (Cheng, 2012, p. 254). The Egyptian government has a difficult job improving food safety, starting by imposing restrictions on imported low-quality food commodities. In Egypt, remarkable efforts have been made by NFSA to control imported food. After developing a risk-based imported food control system, the National Food Safety Authority Board of Directors issued Resolution No. 6 July 2020 on the rules for regulating imported food licensing (prohibiting the import of food without obtaining a license from the authority).

An initial step towards improving the traceability of imported food. This license is considered a certificate from NFSA that the food importer is obtaining a license for imported food and fulfilling measures for food safety and quality management in accordance with the technical

requirements and rules issued by the authority. This means that the food importer complies with good practices in managing foreign food suppliers and relevant foreign food supplier conformity assessment programs. This also means the food importer can track and recall products from the market if there is a problem (NFSA, 2020). However, this is usually documented paperwork that may be fabricated and falsified. This makes food fraud opportunities in the supply chain harder to detect and, consequently, the enforcement of food fraud law harder. Therefore, the current supply chain, with its challenges of interdependencies, complexity, uncertainty, and ambiguities, does not provide today's customers with enough answers to increase confidence.

The supply chain is entirely impacted by global events, like natural disasters (COVID-19 or climate change), port and border closures (due to COVID-19, for example), and changes to the geo-political landscape (Ukrainian crisis, for example). Covid-19 has put a burden on the food supply chain. The supply chain disruption resulting from the COVID-19 pandemic has an economic, cultural, and behavioral impact on the supply chain (van Ruth, 2020). This pandemic has impacted not only operations but also crime and criminal behavior. As the supply chain was interrupted by the COVID-19 pandemic, more opportunities for fraudsters evolved due to insufficient audits and inspection, and more challenges for traceability and recalls appeared, which, in turn, means that the government’s ability to control fraudulent food practices became more complicated. Yet, former studies showed that generally, it is difficult to answer questions such as whether COVID led to more food fraud or not (van Ruth, 2020) or to measure the actual size of fraud before, during, and after the pandemic (Brooks et al., 2021).

The high, unmet demand for food resulted from the Ukrainian crisis and the complex supply chain with the inefficiencies in government control have created the incentives and opportunities that are conducive to fraud - a conducive environment for fraudsters. The Elliot

Review provides a notable instance of this difference: “Food fraud becomes food crime when it no longer involves random acts by ‘rogues’ within the food industry but becomes an organized activity by groups which knowingly set out to deceive, and or injure, those purchasing food” (HM Government 2014, p. 6). Therefore, actors needed to implement reforms to mitigate fraud and shift from crime catching to crime prevention. To mitigate fraud opportunities, a collective approach is needed to identify all suppliers in the food supply chain, certify them, and then track them (Esteki et al., 2019).

4.2.4. Traceability

According to the Decision of the Board of Directors of NFSA Decision No. 16 of 2022 regarding traceability requirements, Traceability is defined as “The ability to track and follow up food through all stages of production, processing, and distribution.” This definition is the same as the European Regulation EC 178/2002 definition of traceability. Traceability is defined by the European Regulation EC 178/2002 as “the ability to trace and follow the food, feed, and ingredients through all stages of production, processing, and distribution” (Regnicoli et al., 2009, P:1). According to Weiser et al. (2016), the traceability of all food and feed should be implemented in the Egyptian food market. Modern businesses must be able to track and trace food products by meticulously recording all the information about their movement through the supply chain.

Traceability in the food supply chain is becoming increasingly important considering the complex global supply chain. This is driven by various factors, including the need for effective methods to respond to the spread of outbreaks and food safety crises). Another reason for the importance of and the increasing demand for traceability in the modern supply chain is the verification of product origin, identity, and quality to ensure compliance with mandatory regulations and standards. Traceability will provide data for food businesses that will increase

supply chain visibility and allow management to analyze other vulnerability points in the supply chain. Food fraud incidents can expose food businesses to reputational and/or legal risk. Consumers today are becoming less forgiving when unethical and risky food is discovered (Ryan, 2015).

Every Food business operator should identify one step above and another below them. As a result, all the information will be available to the regulatory authorities upon request. For instance, when food fraud incidents occur, the authorities can trace the system back and know the vulnerabilities points more efficiently in the food supply chain from the primary production to the retailers (the root cause of the fraud). As a result, the product could be recalled or withdrawn from the market (Sarpong, 2014).

The definitions of 'tracking' and 'tracing' provided by Schwagele are important concepts in supply chain management, particularly in the context of food control. “Schwagele defined ‘tracking’ as the ability to follow the path of an item as it moves downstream through the supply chain from the beginning to the end, while ‘tracing’ is the ability to identify the origin of an item or group of items through records upstream in the supply chain” (Schwagele, 2005, p. 166). Similar definitions of tracking and tracing were found in the Decision of the Board of Directors of NFSA Decision No. 16 of 2022 regarding traceability requirements. Tracking refers to “the ability to track the path of a single unit and/or batch of the product in the supply chain as it is circulated between food establishments towards the final point of the process (points of sale).” Tracing refers to “the ability to identify the source, movement, and all information related to a specific unit or batch of a product present within the supply chain by using records related to the product in the opposite direction of the movement of the product” (Decision No. 16, 2022). Tracing is a backward process. This means that it enables the regulators, food business operators, and consumers to

identify the origin of food. This is done by creating documents and records from the first provider to the final consumer (Aung & Chang, 2014).

Traceability information is a legal requirement for food producers and retailers, and this information should allow for the tracking of food products "one step forward" (i.e., to the customer) and "one step back" (i.e., to the source of the product). However, the provision of information to consumers is often limited, and Manning and Smith (2015) found that the information provided on the packaging and in-store displays was often not sufficient to ensure the traceability and authenticity of the products.

Traceability's level of specificity is not based on a single company. However, it is based on the system’s effectiveness for tracking and tracing depending on the agreements within the group of businesses. It is a system, and systems do not operate in a vacuum. If one node lacks transparency, this will impact the entire chain (Scholten et al., 2016).

According to the Decision of the Board of Directors of NFSA Decision No. 16 of 2022 regarding traceability requirements, article 4, food business operators can conduct traceability through documents and certifications. This leads to the possibility of misleading and falsification. Therefore, it is recommended to use blockchain technology in the food supply chain to increase the visibility of food from farm to fork and from sea to plate (Lekha et al., 2021).

Preliminary results from blockchain technology demonstrate that it can increase the transparency and traceability of the food supply chain. Blockchain technology makes it difficult to change the records of a food product. As a result, it might be effective in preventing middlemen in the supply chain from modifying a food product's description, such as by mislabelling horse meat as beef, but it wouldn't stop the person who entered the first piece of data into the blockchain

from intentionally defining adulterating the food product at the beginning of the supply chain. The cost of adopting blockchain technology should be considered because operating a blockchain can be expensive, and for complete traceability, multiple companies' blockchains must cooperate (Kim & Laskowski, 2017). FAO (2021), in their report, food fraud intention, detection, and management, argue that blockchains do not provide a magic solution to address issues with traceability and food fraud in general, they can improve supply chain transparency and boost consumer confidence when used carefully and in conjunction with inspections to validate the accuracy of the original information.

4.2.5. Vulnerability assessment

To detect and assess the likelihood of fraudulent activities related to particular food products or ingredients, a proactive and organized approach called food fraud vulnerability assessment is used. A notable way for controlling identified vulnerabilities is, for example, origin/label verification, supplier audit, and analytical testing strategy (Manning & Soon, 2019).

Bindt (2016), in his study, costs and benefits of the food fraud vulnerability assessment in the Dutch food supply chain, found that the most acknowledged costs were linked to the validation and verification of mitigation tools such as vulnerability assessment and training expenses. However, the participants perceived that the certification process, the ability to intervene effectively, addressing customer complaints, and meeting customer quality audit requirements could lead to cost reduction. Furthermore, the study suggests that the implementation of fraud prevention measures may not only incur costs but also bring potential benefits. In terms of the benefits of the tools, the participants identified customer confidence, transparency, and a competitive advantage as the most significant factors.

4.2.6. Risk Communication

This section will explain the role of risk communication in addressing food fraud, including the importance of transparency, honesty, collaboration among stakeholders in the food industry, and the need for effective communication strategies to build consumer trust.

Risk communication can be defined as: “an interactive process of exchange of information and opinion among individuals, groups, and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, which express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management” (as cited in Charlebois & Summan, 2015, p. 153). Risk communication aims to provide consumers and stakeholders with an understanding of the logic behind a risk-based decision, allowing them to make an informed decision that considers the relevant facts and their interests and values (EFSA, 2017). The responsibility of the mandated authority is to ensure that risk is appropriately and timely identified and communicated to the consumers, decision-makers, and relevant local and international stakeholders to avoid negative misperceptions that may result in undesirable behavior (Charlebois & Summan, 2015).

Charlebois & Summan (2015) has developed a risk communication model for food safety regulators, which outlines communication strategies aimed at consumers and the food industry, as well as evaluation and continuous improvement processes to minimize the effects of food safety risks by influencing stakeholder behavior. This serves as the cornerstone of effective risk communication techniques, where consumers must feel confident in the authenticity of the food they purchase, and this confidence is primarily based on how they view the trustworthiness of food management systems. This means that everyone interested in food and food control (i.e., all stakeholders) should be able to learn how and why decisions were made. Also, they must be able

to contribute effectively to the process on their own. Choices must be explained, i.e., through risk communication, for individuals to understand why they are essential. Customer trust can be maintained in this way (Charlebois & Summan, 2015).

4.3. Global efforts to fight food fraud

Comparing the risk of food fraud between countries can be difficult due to comparability issues. For instance, countries with lower wages may have more production stages that increase the risk of fraud. However, comparing countries' efforts to fight food fraud can help identify effective fraud mitigation policies due to the global nature of the food supply chain (Bindt, 2016).

4.3.1. Europe

The European Commission (EC) has taken several measures to tackle food fraud through its various initiatives and agencies. As a response to the horse meat scandal and the complexity of the supply chain in a globalized world, the Directorate-General for Health and Food Safety (DG SANTE), which is a department of the European Commission, has set up a Food Fraud Unit and launched the EU Food Fraud Network, which brings together competent authorities of the Member States and Europol to share information and expertise. This network facilitates the exchange of information between EU countries to overcome cross-border fraud. This initiative is crucial in enhancing the coordination of efforts to prevent and detect food fraud across the EU and improving the effectiveness of enforcement actions. The establishment of a dedicated Food Fraud Unit within DG SANTE underscores the growing significance of addressing food fraud at the EU level and the necessity for a concerted approach to tackle this problem. Furthermore, Europol, the law enforcement agency of the European Union, plays a crucial role in addressing food fraud through its participation in the OPSON initiatives. OPSON is a program aimed at combating food fraud

and related crimes, with a recent focus on organic products (Lees & Morin, 2018; Europol, 2021; Popping et al., 2022).

One of these agencies is the European Anti-Fraud Office (OLAF), which works under the EC and is involved in preventing food fraud. To bridge science and policymaking, the EU established the Knowledge Center for Food Fraud and Quality in March 2018, which the Commission's Joint Research Centre operates to complement the EU Food Fraud Network (Lees & Morin, 2018). The Joint Research Center (JRC), the EC's science agency, is also involved in food fraud activities, and the Rapid Alerts for Safety of Food and Feed (RASFF) database is maintained by DG SANTE. Although the primary aim of the RASFF database is to prevent unsafe food and feed items from entering the EU, it also includes entries for foodstuffs that do not comply with regulated residue and contaminant specifications. The RASFF database has a "adulteration/fraud" category but lacks a detailed classification of alerts. For instance, mislabeling of allergens may be considered food fraud, while melamine is classified as a food safety incident, even though it is also a form of food fraud (Popping et al., 2022).

The Administrative Assistance and Cooperation System for Food Fraud (AAC-FF) is a system set up within the European Commission (EC) and between Member States to capture potential food fraud incidents. The AAC-FF system facilitates information sharing and cooperation, which is essential in the fight against food fraud. By working together, authorities can better prevent, detect, and respond to incidents of food fraud and ensure the safety and integrity of the food supply chain. Member States are required to report all suspicions of cross-border agri-food fraud through this portal, enabling investigations by any Member State in addition to the EC (Popping et al., 2022).

To expand information beyond authority inspections, Member States are required to set up a "whistleblower" platform, where individuals can report suspected food fraud anonymously. By empowering individuals to report suspected fraud, authorities can access valuable information that may otherwise go undetected, improving the effectiveness of enforcement actions and preventing fraudulent activity in the food supply chain. At the public level, the "Food Fraud Reporter" newsletter is published, containing information from multiple sources, including the RASFF database and incidents reported by media across the world (Popping et al., 2022).

The Food Integrity Project offers a unique experience of creating a global network of stakeholders by gathering experts from industry and academia alongside technology providers altogether to work towards one objective, which is mitigating food fraud (Lees & Morin, 2018).

4.3.2. Netherlands

In the Netherlands, the Dutch authorities take food fraud very seriously, as demonstrated by their use of police powers and intelligence-gathering techniques. To investigate cases of food fraud, the Netherlands has set up a criminal investigation unit, NVWA-IOD, which the Public Prosecution Office has authorized to use a range of tools and methods, including administrative inspections and criminal investigations. The authorities respond to all reports of food fraud, regardless of their source, whether it comes from a whistleblower, consumer, or journalist. This shows their commitment to ensuring the safety and integrity of the food supply chain. By taking a comprehensive approach to detecting and preventing food fraud, the Dutch authorities are sending a clear message that this is a serious crime that will not be tolerated (Popping et al., 2022).

Overall, food control systems should involve the supervision and control of food safety and authenticity. Although in the Netherlands, supervision and control of food are enforced by the

authority and private (third) parties, the European Parliament refuses to delegate the supervision and control of food to private (third) parties, where insufficient capacity should not make authorities rely on private (third) parties (Bondt et al., 2008).

4.3.3. Germany

The German government recognizes the importance of cooperation and information sharing among various stakeholders and authorities to combat food fraud. To this end, they have established the Nationales Referenz Zentrum für Authentizität (NRZ-Authent) as the national reference center for food authenticity. The center has a decentralized structure with different specializations in various locations across Germany. For instance, the NRZ-Authent has a meat analysis and speciation center in Bavaria and a fish analysis center in Schleswig Holstein. This approach allows the center to utilize expertise from multiple disciplines and locations, contributing to a more comprehensive strategy to detect and prevent food fraud (Popping et al., 2022).

4.3.4. United Kingdom

The UK's efforts to combat food fraud are divided between the Food Standards Agency (FSA) and the Department on the Environment Food and Rural Affairs (DEFRA). While the FSA handles operational tasks related to food fraud, DEFRA is responsible for policy matters and funding research and networking initiatives like the Food Authenticity Network (Rizzuti, 2020; Armstrong et al., 2021).

The UK government has a track record of financing research aimed at addressing food fraud, particularly in the realm of developing new analysis techniques. To combat food fraud and safeguard consumers and the food industry against criminal activities within the food supply chain, the FSA has established a specialized resource known as the National Food Crime Unit (Rizzuti, 2020).

The UK created a Food Authenticity Network (FAN) to combat food fraud in 2015, and it is managed by the UK Laboratory of the Government Chemist, with funding support from DEFRA. Joining the FAN is free and open to all interested parties. The primary objective of the network is to raise awareness of tools for detecting mislabeling and food fraud and to ensure the UK has access to expert labs for checking food authenticity. The FAN serves as a source of information and contains an archive of UK projects, reports, and methods, as well as links to external resources. Through information sharing and collaboration, the FAN promotes a more effective overall response to food fraud in the UK and contributes to a more resilient and trustworthy food system (Popping et al., 2022).

4.3.5. Scotland

In Scotland, the Scottish Food Crime & Incidents Unit (SFCIU), a division of Food Standards Scotland (FSS), leads the investigation into food crimes. In October 2022, in collaboration with the National Food Crime Unit in the UK, SFCIU released the Control Strategy 2022–2025, which was influenced by the UK's Food Crime Strategic Assessment that FSS and FSA created. This strategy uses the Detect, Disrupt, Deter, and Divert framework (Table 2), which the Scottish Government and FSS have adopted for their Serious Organized Crime strategy, to highlight the main strategic goals in the approach to combating food crime (Food Standards Scotland, 2022).

Table 2. The 4 Ds: Detect, Disrupt, Deter, and Divert framework are the strategic approach to identify, investigate, and combat food crime.

Detect	Consider opportunities for information collection and food crime detection throughout the supply chain. Analyze information, intelligence, and statistics to spot trends, patterns, and new risks in the food sector.

Disrupt	Engage in multi-agency efforts guided by data to identify, prevent, mitigate, and combat threats. Find opportunities to disrupt fraudsters' activities and share data and analytical products with partners to improve fraud evaluation. Use the current laws that the organization and its partners to fraud gaps and opportunities.
Deter	Collaborate with food businesses and stakeholders to create a hostile environment for illegal activity. Prosecution of unlawful behavior using the appropriate legal means. To spread awareness and discourage people who might engage in this behavior, keep making food crime a national issue
Divert	Explore potential collaboration opportunities with industry and food businesses to adopt preventative methods. Publicly announce consumers hazards from fraud, prosecutions, interventions, and enforcement actions. Expand the knowledge of the consequences of prosecution, including the possibility of monetary loss, economic damage, and damage to reputation.

Source: Food Standards Scotland (2022).

The Egyptian literature on food fraud is virtually non-existent, but there have been recent publications in food science journals focusing on analytical methods (tests) to detect food fraud, in particular in meat products as an expensive and highly consumed commodity in the Egyptian market. For instance, a study conducted by Hassab El-Nabi et al. (2021) documented the presence of a low level of mislabeling and a low level of species substitution in the most consumed meat cuts in the Egyptian markets. They recommended tracing meat products and enforcing strict labeling requirements. Another study to detect food fraud in meat products from popular companies (in terms of production and marketing) in the Egyptian market in Sohag used

histological methods in its analysis. This study revealed that the analyzed sample failed to meet the quality and hygienic standards, even among the high price products (Abd-Elhafeez et al., 2021). The study recommended that competent authorities should enforce tighter hygienic screening of meat products. A recent study detected food adulteration with genetically modified soybeans and maize, the meat of animal species, and ractopamine residues in different food products in the Egyptian market (Mostafa et al., 2022). Therefore, it is recommended to impose a highly tightened labeling system and routine analysis in internationally accredited laboratories.

It is clear from the literature that there hasn't been enough published qualitative research to explore the food fraud control framework in Egypt. Looking at the Egyptian context, there is a scarcity of literature on food fraud, and research is virtually non-existent, but there have been recent publications in food science journals focusing on analytical methods to detect food fraud, in particular in meat products as an expensive and highly consumed commodity in the Egyptian market but limited studies tackle the current structure of the food fraud framework and how it works. As a result, this research study aims to contribute to filling this gap by using qualitative approaches to understand to explore the current structure of the food fraud framework and how it works. The findings of this research are valuable to academics and policymakers who are interested in understanding the gaps in the implementation of the current framework and how it could be closed.

CHAPTER FIVE: METHODOLOGY

5.1. Research design

The study uses a qualitative exploratory design to explore the current structure that the government follows to deal with the food fraud problem, identify the barriers to tackling food fraud, and the new reforms that are undertaken or need to be taken to reduce the problem (Berg, 2009). The issue of food fraud in Egypt is still underrepresented in research and publications.

To obtain a comprehensive overview of this matter, reaching out to policymakers in the different competent authorities, including the National Food Safety Authority, Ministry of Supply and Internal Trade Affairs, Ministry of Health, and Ministry of Trade and Industry, is crucial to gain deeper insights of how the current regulatory framework works, its challenges, and its reforms. Therefore, a qualitative research design opens a new dimension that explores and draws a broad picture of the situation through human interaction and facilitates understanding the issue from different stakeholders' perspectives. A qualitative research design is adopted when examining an issue in depth comprehensively while concentrating on interpretations and actions (Neuman, 2006). To explore more about the issue, research questions are exploratory in design and seek to address the whats, hows, and whys that can only be determined through qualitative research techniques.

5.2. Overall research strategy

The study depends on in-depth interviews with policymakers and implementers from the competent authorities. In-depth interviews are considered a tool to collect detailed primary information about the subject matter from crucial informants (Neuman, 2006). The collected data was subjected to the data triangulation method to ensure the validity and reliability of the findings.

The interviews are designed to involve government officials and decision-makers from different competent authorities to ensure the diversity of the views included in the problem and to ensure triangulation. Their work at the different competent authorities entails their full understanding of the significant challenges the government faces and the changes made to combat food fraud.

The interview questions are previously determined around how the regulatory framework operates, the key hurdles that face the government, and the reforms to reduce food fraud. In certain cases, where more elaboration will be needed to understand the situation, more questions will be asked of the interviewee. A set of questions, which can be found in Appendix A, was used to guide the interviews.

5.3. Sampling selection

Nonprobability purposive sampling techniques are used to choose the participants of the research (Babbie, 2013). The research selects this sampling technique to be able to make specific criteria for the selection of the participants in the research. This allows us to purposively select the participants that will contribute to the research with credible information. The diversity in the positions selected will be taken into consideration. According to this selection criteria, a total number of 13 one-to-one interviews were conducted.

The interviewees are selected from authorities and ministries that have relevance to the food fraud policy-making process or implementation process. National Food Safety Authority (NFSA) is the main policy maker and implementer. The selection of the Ministry of Health, Ministry of Trade and Industry, and Ministry of Supply and Internal Trade Affairs added value to the research because, according to NFSA Law No.1 (2017), the ministers of the Ministry of Health, Ministry of Trade and Industry, and Ministry of Supply and Internal Trade Affairs are members in

the board of trustees in NFSA (policymakers). These ministries also continue to perform their jobs according to their regulations until NFSA starts functioning with the full required capacity to cover the whole country (implementers). They gave us insights into how the current reforms overcome the challenges they faced over the years.

Table 3. List of the study participants.

Code	Interviewee job	Interview Date
01	Director at NFSA	31 October 2022
02	Technical officer at the Ministry of Trade and Industry	27 Nov 2022
03	Food control department manager at the Ministry of Health	15 January 2023
04	Food inspector at the Ministry of Health	19 January 2023
05	Food inspector at the complaints department at NFSA	20 January 2023
06	Food analysis officer at the Laboratories department at NFSA	21 January 2023
07	Food inspector at the touristic food establishment department at NFSA	22 January 2023
08	Food inspector at the slaughter department at NFSA	22 January 2023
09	Food inspector at the Fisheries Department at NFSA	24 January 2023
10	Food inspector at touristic food establishments department at NFSA	27 January 2023
11	Department manager at NFSA	27 January 2023
12	Legislation officer at NFSA	13 February 2023
13	Food inspector at the Ministry of Supply and Internal Trade	15 February 2023

The job hierarchy at NFSA has not yet been fully developed, and the interviewee's titles are based on the current informal situation.

5.4. Data collection

Due to the limited literature and research on food fraud in Egypt, the study depends on the primary data collected from the semi-structured interviews. The interview duration ranged from 30 to 60 minutes for each one. The interviews were recorded using a mobile phone after the permission of the interviewee. If the interviewee did not allow recording, the researcher used written notes to document the data. All the interviews were conducted by the researcher. The interviews were conducted mainly in Arabic, and the researcher used English in some terms to avoid misunderstanding some scientific terms related to the topic.

The interview questions are divided into four main categories. The first category pertains to the participants' role in combating food fraud, the second category is about their level of knowledge by asking them to define and give examples of food fraud cases that they have witnessed in their daily work, the third category is focused on the challenges faced during implementation from their perspectives, and the fourth category covers recommendations and suggestions to combat food fraud in Egypt (Appendix A).

5.5. Data analysis

A total of 13 interviews were transcribed and then analyzed. Specifically, nine interviews each were conducted with officials from NFSA, two interviews each were conducted with officials from the Ministry of Health, one interview was conducted with officials from the Ministry of Trade, and one interview was conducted with officials from the Ministry of Supply and Internal Trade.

The analysis was completed through Microsoft Word. Since the data collected was qualitative, a coding system was used to identify meaningful links within the findings. The

research data were classified according to the identified themes in the literature (Figure 4). After interviews with government officials from various departments at NFSA, the Ministry of Health, the Ministry of Trade, and the Ministry of Supply and Internal Trade, the gathered data was categorized into themes and sections. The most relevant quotes were selected and integrated into the findings and field analysis.

5.6. Ethical considerations

The information that participants provide for this research is confidential (Babbie, 2013). Informed consent to ensure the voluntary participation of the participants was signed before collecting the data. The researcher obtained the approval of the institutional review board of the American University in Cairo before starting to collect the data. The research objectives were shared with the participants to clarify the purpose of the data collection is to complete the research.

5.7. Limitation of the study

Although the in-depth interviews aim to identify key, it is broad and not representative. Some participants were reluctant to participate in the research. Difficulty in interviewing policymakers from the Ministry of Health, Ministry of Trade and Industry, and Ministry of Supply and Internal Trade Affairs was expected. Moreover, some interviewees might hide some challenges in policy implementation due to the sensitivity of food fraud issues that may affect exports and national security.

The research questions and interviews focus on the governmental entities as the ones mandated with enforcement and oversight and exclude the NGOs, the industry, or the consumers. Further research that includes consumer perception as enabling them to demand authentic food

and the food business operators' perspectives as the ones bearing primary responsibility for the prevention and mitigation will be needed to complete the picture.

CHAPTER SIX: RESULTS AND DISCUSSION

Counterfeit (fake) food continues to be a big threat to Egypt's food sector because of its negative impact on the reputation of the food industry. Additionally, it jeopardizes the success of initiatives to increase investment, tourism, and exports in Egypt. Addressing fraud is, by definition, the most difficult food control system form because it directly addresses a personal stake benefiting from fraud behavior. Addressing fraud means overcoming the opposition of those who have a lot to lose (the violators), not just in terms of the profit they want but also in terms of the punishment that follows the discovery of the fraudster's behavior.

Since the data collected was qualitative, a coding system was used to identify meaningful links within the findings. The research data were classified according to the identified themes in the literature (Figure 4). Based on the thirteen in-depth interviews conducted with the current study’s participants, challenges that contribute to the occurrence of fraudulent and adulterant food practices and hinder the mitigation of food fraud involve, but are not limited to, the absence of a globally agreed definition, weak regulations, lack of supply chain visibility, poor communication, and difficulty in fraud detection, challenges in vulnerability assessment.

For clarity of analysis, the current challenges to mitigate food fraud in Egypt, including the absence of a globally agreed definition, weak regulations, lack of supply chain visibility, poor communication, and difficulty in fraud detection, is separated in this section under five connected elements of food fraud control systems, which are: (1) food fraud laws and regulations, (2) food fraud control management system, (3) inspection services, (4) laboratory services, and (5) Education, communication, and information (Figure 4).

6.1. Food fraud laws and regulations

6.1.1. Agreed or clear definition

Food fraud is defined, in the NFSA Prime Minister's decision No. 412 of 2019 article 1 ,as "Counterfeiting, imitation, or mixing of a specific commodity intended for sale, or acquired with the intention of trading and it is a change, modification, and distortion that occurs on that commodity and its essence or its natural composition, its weight, or its expiry period, and the aim behind this is to hinder its properties or conceal any defects that appear in the counterfeit or imitated commodity while being careful to give it the shape and appearance of another authentic commodity, but, it differs from it without disclosure about that in the label, to take advantage of the false properties and benefit with the benefits obtained and get the price difference for easy and quick earning, or it is the intentional fraud to market goods by deception." A food regulator gives an example of food fraud that he has witnessed by saying:

> "The most shocking food fraud incident that we found was a dead rat in one of the salted fish containers." (Legislation officer at NFSA, February 2023)

The previous quote by a food regulator succinctly revealed the ambiguous definition of food fraud in Egyptian food law, resulting in confusion about what is fraud and what is not fraud among the food regulators. This result highlights that little is known about food fraud definition. This is shown in the interview responses of some inspectors who are unaware of the difference between food fraud and food safety issues. According to NFSA law no. 1/ 2017, food safety is defined as: "the absence of any source of hazard in food and its environment in accordance with the stipulated rules in this law and the laws related to food safety, and the decisions issued in its implementation." This hazard includes "any physical, biological, chemical or radioactive agent

that appears in food." The presence of a dead rat in one of the salted fish containers is a potential hazard. Another food regulator commenting on a recent fraud incident that occurred with a coffee brand:

> "NFSA is not mandated by detecting the adulteration of the brand of Nescafe coffee that happened recently if it does not affect consumers' health because this is considered a food quality issue and we have to differentiate between food fraud and food quality and the brand fraud is not our responsibility." (Department manager at NFSA, January 2023)

In the above quote, the food regulator mixes food quality and food fraud. According to NFSA law no. 1/ 2017, deception is defined as: "performing a procedure or an action that leads to the acceptance of something that is not authentic by considering it authentic." According to this definition, this is considered deception. Furthermore, according to Lees & Morin (2018), this is considered counterfeit. The definition of counterfeit is a situation when intellectual property rights (IPR) have been violated. This could involve completely replicating any or all characteristics of the other product or package, such as imitating the brand name, packaging design, or manufacturing process to make money and profit commercially.

Having a good level of awareness would enable control staff to identify potential fraudulent activities, which can be challenging to detect without adequate training. "Official control staff should have a good level of awareness in order to collect fraud signals during regular controls and to distinguish between a non-compliance in general, intentional violations perpetrated through fraudulent or deceptive practices, and deceptive practices that lack an intentional element and should be trained (Winkler et al., 2023, p. 250)". As noted earlier, the inconsistencies and confusion in understanding food fraud and related terms among food regulators that resulted from the absence of an agreed or clear definition of food fraud in Egypt makes it challenging to

counteract or mitigate the issue. This, in turn, leads to the absence of regulatory guidance for the food industry to prevent or mitigate it. Developing modern guidance for the food industry for food fraud prevention and mitigation is needed to mitigate food fraud in Egypt.

6.1.2. Weak regulations

While some food regulators are unaware of the globally agreed definition and different types of food fraud, others have insights into Egyptian food fraud regulations reform by exploring the emerging root causes of food fraud. Adopting relevant, updated, harmonized, and enforceable food rules and regulations can guarantee food authenticity and prevent fraudulent food practices. A food regulator, when asked to give an example of food fraud occurring in Egypt, notes:

> "Luncheon is a popular example of fraudulent products. Fraud happens when food companies sell luncheons made of protein from a plant of origin, which is soybean, and do not declare that on its label. That is food fraud. The main issue is that Egyptian standards have various limits and must be updated. For example, food industries only write protein on luncheon label ingredients, and the Egyptian standards do not mandate them to write the type of protein, whether it is from plant origin or animal origin. So, according to the current specifications, they are not fraudulent products. However, this should be updated to inform the consumers about what they eat." (Food Inspector at touristic food establishments department at NFSA, January 2023)

The previous quote highlighted the adulteration of processed meat (e.g., luncheon), which is supposed to be meat from beef or cow, without communicating this with the consumers. Consumers in Egypt eat luncheon as an animal meat product, while it does not contain any meat. The previous quote explained that the origin of the protein in Egypt is not declared on the label because of weak, outdated, and irrelevant regulations and standards. This means that Egyptian standards unintentionally increase adulteration practices through insufficient specifications for labeling the origin of food products.

> "Another example is the pasteurized egg. Food businesses are not mandated to declare the origin of the egg, whether it comes from duck or chicken. The problem is that both eggs have the same size, but when it comes to taste, duck eggs are not acceptable to be eaten directly, and it is better to be used for baking with the addition of vanilla." (Food inspector at touristic food establishments department at NFSA, January 2023)

As noted in the previous two examples, food regulations can negatively influence or mislead consumer choice in the absence of correct information. In many cases, the current law does not provide relevant, updated, harmonized, and enforceable food rules and regulations and misleads consumers' choices.

The role of laws is to establish enforcement punishments for non-compliance, stipulate the obligations and responsibilities of the food industry and the private sector, define the function and authority of government institutions, and provide for consumer complaints mechanisms (Whitehead, 1995). According to Law 48. (1941), article 1, "Whoever deceives or attempts to deceive his contracting/trading party in any way shall be punished by imprisonment for a period not more than one year and a fine of not less than five pounds and not more than one hundred pounds, or by one of these two penalties."

Law No. 281. (1994), amending some provisions of Law 48. (1941), punishes anyone who places a prohibited substance or an amount more significant than what is permitted in food commodities traded in the markets with imprisonment for one year and a fine of about 10,000 Egyptian pounds (about 670 US dollars) or one of these two penalties. The penalty is doubled if the violation is repeated, with up to three years in prison and a fine of up to 50,000 Egyptian pounds. However, it does not differentiate between different types of food fraud and does not assess the different levels of sanctions. In response to the question of what the essential reform could be to mitigate food fraud, food regulators notes:

> “Who grants no punishment, misbehaves. Currently, there are no powerful laws or regulations that stop fraudsters. Strong punishment and tighter is the first step to fighting fraud.” (Food inspector at slaughter department at NFSA, January 2023)

> "Fraudsters are driven by greed for profit, so without a tight food fraud law and high sanctions, they will continue to commit fraud." (Food control department manager at Ministry of Health, January 2023)

In the above two quotes, food regulators emphasized that fraudsters are driven by greed for profit, and without a tight food fraud law and high sanctions, they will continue to commit fraud. This draws attention to the need for solid legal penalties to create a deterrent effect and prevent fraudsters from engaging in fraudulent activities.

> “Strict control is the solution. We cannot leave it to the ethics and religion of food business operators. Therefore, we have to put strong legislation alongside increasing consumer awareness.” (Food Inspector at fisheries department at NFSA, January 2023)

Another food regulator highlighted that while relying solely on the ethics and religion of food business operators is not enough to prevent food fraud and that stricter controls are necessary, the need for a comprehensive approach to addressing food fraud that includes strong legislation, strict control, and increasing consumer awareness is crucial.

> “There is a gap in the current legislation because the most recent food fraud law was not updated since 1994. The sanction in this law is low compared to the current time and the inflation.” (Food legislation officer at NFSA, February 2023)

Another food regulator highlighted a gap in the current food fraud legislation due to the most recent law not being updated since 1994. He further suggested that the current law's sanctions may not deter potential offenders compared to current inflation rates and economic conditions. This draws attention to the importance of reviewing the current food fraud legislation

to ensure that it effectively prevents and addresses food fraud within the current economic and social context. This also links with the other food regulators who believe that the profit generated by food fraud activities outweighs the fines that fraudsters pay when caught, as he notes:

> "The profit that fraudsters make is more than the fines that they pay if caught, so the current law encourages more fraud." (Food inspector at Ministry of Health, January 2023)

The food regulator believes that what incentive fraudsters to engage in food fraud is that the potential gains outweigh the legal risks and consequences.

All by word highlights a common view amongst food regulators that reform is needed to the law to render it relevant, and imposing high sanctions is the first step in deterring food fraud and punishing food fraudsters. According to Law No.281 of 1994, amending some provisions of Law No.48 of 1941, article 2, the sanctions on food fraud are “imprisonment for a period of not less than one year and not more than five years, and a fine of not less than ten thousand pounds and not more than thirty thousand pounds, or the equivalent value of the commodity subject of the crime, whichever is greater.” Current regulations lack powerful sanctions that motivate people to comply with legislation. As explained in the previous quotes, the current food fraud law's sanctions are low and may not be sufficient to deter potential offenders.

> “We submitted a new proposed food fraud law to the prime minister a year ago, but it is still not accredited by the parliament. This new law raises the fraud sanctions and classifies them according to the business size.” (Director at NFSA, October 2023)

The relevance, update and harmonization of food fraud laws is a critical component of any strategy to combat food fraud. He also noted that NFSA made an effort to reform the law, but it

has not been released so far. This means that NFSA is aware of the gaps in the current legal framework as one of the challenges facing the combating of food fraud in Egypt and the potential solutions to address them.

A food regulator, when asked about how they implement this outdated law to mitigate food fraud, notes:

> "We investigate the complaints, and most of the time, we advise food operators to comply. We do not want to close all the food establishments in Egypt because if we did so, from where will we get food to eat." (Food inspector at complaints department at NFSA, January 2023)

"All by word" summarizes the weak enforcement of the laws. NFSA advises/educates food operators and gives them knowledge enabling them to comply, where they are criminals and committing intentional adulteration. The above quote demonstrates that the investigation is based on a positive reinforcement approach, and the inspector avoids negative reinforcement, even when necessary. However, the approach that the authorities adopt in dealing with food fraud should be different from the approach that they follow in dealing with food safety (Winkler et al., 2023). Although food safety control is primarily based on voluntary compliance, where food business operators follow the law voluntarily because they appreciate the advantages of good behavior rather than avoid criminal consequences or other sanctions for breaking the rules, food fraud control is based on negative reinforcement, where food business operators avoid criminal consequences or other sanctions for breaking the rules. To achieve negative reinforcement, strict monitoring and enforcement are needed.

> "The company can be closed, products suspended, and if necessary, recalled." (Food analysis at laboratories department at NFSA, January 2023)

Another food regulator reported that the competent authorities respond to food fraud incidents by either recalling or suspending the product or closing the company. This reveals inconsistencies in law implementation and enforcement among food regulators.

In Egypt, Combating Fraud and Deception Law 48 (1941). The law criminalizes activities such as putting up or offering for sale or selling adulterated goods and establishes clear boundaries for acceptable practices in the food and agriculture industry. It also serves as a deterrent to fraudulent activities by outlining mild penalties, including imprisonment "for a period not exceeding two years" and fines "not less than ten pounds and not exceeding one hundred and fifty pounds." However, without effective enforcement, this law will not achieve its objectives. Effective enforcement may involve investigations into suspected cases of fraud in the food in Egypt. The law emphasizes the shared responsibility of all stakeholders, including buyers and consumers, in ensuring the integrity of the food and agriculture industry. However, if the consumer knows the truth about the food, "if the consumer is aware of the fraud or corruption of the goods," this contradicts the concept of intentional adulteration to deceive consumers (Combating Fraud and Deception Law 48, 1941). Furthermore, critics of this law are that it considers that one size fits all by not differentiating between neither different types of violations nor degrees of punishment.

Given that food fraud penalties are less than other crimes penalties, Meerza et al. (2021) economically analyzed the optimal government response to food fraud given the differences in the consumer's preferences, quality options, and the variation in food fraud detection. They concluded that strict monitoring and enforcement is an efficient solution for the public sector. For instance, in 2017, the food safety inspectors who accepted bribes to facilitate the sale of rotting meat products in both local and international markets were taken into custody by the Brazilian federal

police. In this incident, not only bureaucratic corruption but also political corruption exists because the Brazilian federal police revealed that these bribes are often channeled to political parties (Romero, 2017). Thus, the government should keep an eye on corruption because strict monitoring and enforcement in the presence of high levels of corruption will increase the opportunity of forming coalitions between fraudsters (dishonest food producers) and government officials (corrupt policy implementers).

6.2. Food fraud control management system

6.2.1. Supply chain visibility

Visibility refers to making certain data and information easily accessible to people who need it (both inside and outside the company) to validate, monitor and confirm business processes and the history of food products.

Traceability

According to the Decision of the Board of Directors of NFSA Decision No. 16 of 2022 regarding traceability requirements, Traceability is defined as "The ability to track and follow up food through all stages of production, processing, and distribution." Food regulators, when asked about the challenges to mitigating food fraud in Egypt, signify:

> "The biggest crisis is that there is no traceability in place in Egypt." (Food analysis officer at laboratories department at NFSA, January 2023)

> "Despite the fact that we are living in the digital era and the government is taking serious steps towards digital transformation, there is no digital system for traceability in Egypt. There is no system to connect distributors." (Food inspector at fisheries department at NFSA, January 2023)

> "The main issue is the complex supply chain management, so we need stronger mechanisms to ensure that traceability in the supply chain has adhered." (Technical officer at the Ministry of Trade and Industry, November 2022)

The above quote highlights the absence of a traceability system in Egypt's complex food supply chain, despite the government's efforts toward digital transformation. The interviewee notes that there is no system to connect distributors, which makes it challenging to trace the origin of food products and prevent fraudulent activities.

A common view amongst food regulators is that traceability is an essential tool to mitigate food fraud. Traceability ensures that food is tracked and traced along the supply chain. While tracing is the backward process of identifying the origin of the food, tracking is the forward process of following the food along the supply chain. According to Weiser et al. (2016), all food and feed traceability should be implemented in the Egyptian food market. Modern businesses must be able to track and trace food products by meticulously recording all the information about their movement through the supply chain.

> "Traceability regulations were just published last October. So, even good food business operators who want to make their supply chain visible did not know where to start because there were no regulations before." (Department manager at NFSA, January 2023)

A food regulator notes that food business operators interested in improving supply chain visibility may not know where to begin because they were not mandated to conduct traceability before issuing the Decision of the Board of Directors of NFSA Decision No. 16 of 2022 regarding traceability requirements. This could have a negative impact for food business operators by creating confusion and uncertainty about the best practices for ensuring transparency and accountability within their supply chains.

> “Traceability is one of the important challenges to mitigate fraud in Egypt. For example, in the US, a restaurant does traceability by taking the consumer's information, so he can track them if there is an outbreak. In Egypt, restaurants are not required to keep records of customers' contact information to facilitate contact tracing if necessary. In my opinion, the new traceability law that NFSA has released recently is a great step towards more traceability.” (Food inspector at touristic food establishments department at NFSA, January 2023)

The above quote implies that restaurants in the United States are taking proactive steps to ensure traceability in their supply chains and to protect their customers from potential harm. This approach to traceability is an example of how food establishments can take a more proactive role in addressing food fraud.

“We have to apply traceability and cover all food sectors and geographical locations in all the country, but there will still be a problem in food fraud law. If we did not update the food fraud law, then we have not done anything.” (Director at NFSA, October 2022)

A director at NFSA noted that despite the importance of implementing a robust traceability system in the food industry to prevent food fraud, simply implementing traceability measures may not be sufficient to address the problem of food fraud. Therefore, a holistic approach is needed to tackle food fraud.

Without proper traceability systems, it is difficult to identify the source of food fraud, and food businesses are less likely to be held accountable for their actions. However, some food business operators avoid traceability because it comes with more accountability and responsibility, as revealed by a food regulator when asked about challenges to traceability in his opinion, signifies:

> "The application of traceability to the food supply chain in Egypt is not easy because food business operators fear a traceability system because it will make them transparently pay taxes." (Food inspector at fisheries department at NFSA)

In the above quote, a food regulator revealed the reasons why food business operators resist the implementation of traceability at the management level. Food businesses resist implementing traceability simply because it will cost them more money. Interviews revealed that the challenges to implementing traceability involve the cost of implementation, tax avoidance, and the lack of regulations before issuing the Decision of the Board of Directors of NFSA Decision No. 16 of 2022 regarding traceability requirements. However, traceability will provide data for food businesses that will increase supply chain visibility and allow management to analyze other vulnerability points in the supply chain. Food fraud incidents can expose food businesses to reputational and/or legal risk. Consumers today are becoming less forgiving when unethical and risky food is discovered.

Verified suppliers

Supplier verification is the process of evaluating and verifying the suppliers. The following quote by food regulators succinctly illustrates that one of the challenges to preventing adulteration is supplier verification; they note:

> "I am facing multiple cases in my work where even the spices samples from the most reputable hotels fail to comply with the standards, not because they intend to adulterate it but because they fail to select the genuine supplier. As you may know, spices can be easily adulterated because they can be easily colored yellow to be sold as turmeric or black to be sold as pepper." (Food analysis officer at laboratories department at NFSA, January 2023)

A food regulator suggests that fraud sometimes occurs when businesses fail to select genuine suppliers rather than the intentional desire to deceive consumers. This highlights the

importance of supplier selection in mitigating the risk of food fraud. This also raises important questions regarding the challenges faced by businesses in selecting genuine suppliers, which is evident when asked another food regulator about challenges that face the supply chain visibility in Egypt; notes:

> "If you check the website of NFSA, you will find a list of the accredited suppliers in the whitelist of suppliers. Food businesses can go to the website and check those suppliers whomever they like to deal with. However, the number of accredited suppliers so far is not enough to request from food establishments to deal only with them." (Food inspector at touristic food establishments department at NFSA)

> "NFSA did not accredit all suppliers that can cover Egypt yet." (Department Manager at NFSA, January 2023)

A common view amongst food regulators is that the inadequate number of verified/ registered suppliers is one of the challenges to preventing food fraud. From the above quotes, the supply chain visibility and traceability are challenging to be implemented because of the inadequate number of verified/ registered suppliers, which provides more opportunities for violators. This also exemplifies the issue of traceability mentioned above.

During the interview, a food regulator working in the complaints department raised several issues about the department's approach to mitigating food fraud.

> "We cannot inspect every food in the market, but we can work smarter, not harder. In my opinion, we should track the complaints from the same governorates and check who is the main supplier of this product and inspect it so we can convert our approach from reactive to proactive. For instance, if we received more than one complaint about cheese from El Beheira governorate, then we check with the main suppliers and start focusing more inspection on them." (Food inspector at complaints department at NFSA, January 2023)

The above quote refers to systemic problems in implementing the control system. It highlighted the absence of supply chain visibility and following the reactive approach in responding to complaints or crises, which hinder the need to validate, monitor and confirm business processes and the history of food products. It is incredibly challenging to monitor every case of fraud because the amount of the food commodity being inspected is simply an inadequate portion of the total food in the market. A food regulator at the complaints department at NFSA, which is mandated with investigating food fraud, suggests a Geographical Information System (GIS)-based approach (Beni et al., 2011), which works as an early warning system regarding food fraud and improves the food fraud control management system. The GIS-based approach is a tool to help the decision-makers identify vulnerabilities and assess the risks related to food safety cases.

6.2.2. Vulnerability assessment

The GFSIs and WHO require food fraud vulnerability assessment as essential for an effective mitigation plan and for assisting competent authorities in identifying potential fraudsters. "The most important step for the food industry is to start addressing food fraud, and for auditors to start asking the basic questions on how vulnerabilities were assessed and identified, and a strong mitigation plan thought through (Spink, 2019. p: 434)." Vulnerability assessment refers to "an in-depth analysis of the circumstances that make a control system vulnerable." (Winkler et al., 2023, P: 10). Vulnerability assessment is conducted by, first, the gathering and analysis of data, which comes as the first step in the assessment. Second, the likelihood of intentional non-compliance and the related risks (chance and severity of a negative consequence) (Winkler et al., 2023). Food regulators, when asked how they use the vulnerability assessment to identify understand how to identify or anticipate potential food fraud, they note:

> “I do not know what the vulnerability assessment is.” (Food inspector at the Ministry of Health, January 2023)

> “Food establishments, including hotels and restaurants, are not mandated to assess vulnerability. We don’t ask them to prepare this document for our inspection. It is not in the checklist.” (Food inspector at touristic food establishment department at NFSA, January 2023)

The most striking result from the above quotes is that some food regulators are unfamiliar with the vulnerability assessment process, a crucial tool used in the food industry to identify and mitigate risks associated with food fraud. In contrast, others reported the absence of vulnerability assessment in the inspection checklist.

Since fraud occurs in expensive food, according to the EU and FDA, the most vulnerable products to fraud are seafood, meat, dairy, honey, spices, and some oils (Figures 1 & 2). A food regulator, when asked what the most vulnerable food in Egypt is, he signifies:

> “I do not know about the most vulnerable food for last year in Egypt, and I do not think there is a list of the food products based on their vulnerability.” (Food inspector at touristic food establishment department at NFSA, January 2023)

The above quote highlights that food regulators do not consider food fraud Vulnerability assessment in their daily inspections. While food businesses should have a list of the products with their classified vulnerability to fraud, no vulnerability assessment is required by the NFSA or the Ministry of Health inspection checklist agenda. This is a central issue in identifying potentially vulnerable food in vulnerability in the supply chains. The data about the vulnerable food list in Egypt is unavailable.

6.3. Inspection services

Competent authorities conduct inspections and audits to ensure that all aspects of the food supply chain, from production to distribution and sale in compliance with legal requirements and regulations. This includes identifying the root cause of foodborne illness outbreaks and gathering evidence that proves non-compliance with legal statutes or regulatory mandates (Whitehead, 1995).

Government food regulators are in charge of monitoring, enforcing the law and regulations, and surveilling the food system. To achieve this, food inspectors conduct routine inspections of food businesses and collect food samples to ensure the authenticity of the food and ensure they comply with food safety regulations. Fraud inspection services and investigations require different skills than daily inspections (Winkler et al., 2023). Food regulators, when asked about the challenges to mitigating food fraud in Egypt, signify:

> "Another issue is that the number of inspectors is unsuitable for the number of food businesses in Egypt. Despite NFSA branches covering the country geographically, it does not cover it when it comes to the ratio of inspector numbers to the food business number." (Food inspector at fisheries department at NFSA, January 2023)

What food regulator describes the shortage of inspectors to oversee a huge number of food businesses, which is a systemic problem in preventing food fraud, as shown in the previous quote: the limited number of inspectors considering the number of food businesses in Egypt. This suggests that inadequate resources may be allocated to food inspection, which can compromise the effectiveness of fraud prevention efforts. Furthermore, inspectors cannot conduct the effective fraud investigation that their job may entail unless they have taken appropriate training because fraud investigation needs distinct competencies compared to standard inspection procedures

(Winkler et al., 2023). Food regulators, when asked about how they investigate fraud, they highlight the following:

> "There is no specific training to detect fraud. However, most of the fraud should be detected through laboratory analysis, which is costly." (Food control department manager at Ministry of Health, January 2023)

The above quote refers to structural barriers in the provision of food fraud investigations in Egypt. Inspectors are not familiar with training to detect or investigate food fraud. "Inspectors should not be encouraged to perform fraud investigations unless they have received appropriate training and instructions" (Winkler, et al., 2023, P: 250). However, this food fraud investigation is not meant for all inspectors (Winkler, et al., 2023).

> "It is hard to detect fish fraud by inspection after cooking and adding spices. It could be detected only by laboratory analysis; likewise in the case of meat fraud." (Food inspector at fisheries department at NFSA, January 2023)

> "We cannot discover some types of fraud with a visual inspection." (Food inspector at Ministry of Health, January 2023)

Food regulators highlight another barrier to prevent food fraud in the above quotes, noting the difficulty of detecting it without laboratory analysis. This highlights that food fraud can often be more subtle and difficult to detect through visual inspection alone, especially when the fraud involves the use of sophisticated techniques to alter the composition or quality of a food product. The difficulty of detecting it without laboratory analysis relates to another serious concern about the cost of laboratory analysis and the availability of laboratory services, which will be discussed in the following section.

6.4. Laboratory services

Having sufficient analytical capacity and capability is critical for identifying potential risks and vulnerabilities in the food supply, such as food fraud or contamination, and taking appropriate measures to prevent or mitigate these risks. Analytical testing can also help ensure compliance with regulatory standards and requirements, which can help protect the health and safety of consumers. “Within the official food control system, there must be sufficient analytical capability and capacity to determine and monitor the level of quality of the national food supply (Whitehead, 1995, P: 250).” Adequate measures must be taken to ensure that the laboratory capacity is available and the necessary equipment, supplies, and trained staff are available to meet the needed technical requirements of the workload (Whitehead, 1995). A food regulator highlights the challenges in the affordability of testing in small and medium businesses; he notes:

> “If we are in a factory, they have the laboratory and can detect fraud; however, in small or medium enterprises, detecting fraud is expensive and should be confirmed in state laboratories.” (Director at NFSA, October 2023)

The above quote highlights that limited resources or capabilities to devote to food fraud prevention is one of the barriers to mitigating food fraud that faces small and medium-sized enterprises (SMEs) in detecting food fraud. This is challenging because they may lack the laboratory infrastructure and expertise to conduct sophisticated tests and analyses. This draws our attention to the impact of food fraud on SMEs and the potential strategies and practices to mitigate food fraud in SMEs. The food industry should put more robust measures into auditing and testing. Testing methods for the food industry must not be straightforward and expensive. Thus, cost-effective means of testing should be in place.

6.5. Information, Education, and Communication

6.5.1. Communication with outside agencies

Risk communication aims to give consumers and stakeholders an understanding of the logic behind a risk-based decision, allowing them to make an informed decision that considers the relevant facts and their interests and values (EFSA, 2017). In the following quotes, the food regulators highlighted the gaps in communication outside the agency.

> "There are no direct channels between NFSA and consumers. The complaints department receives food complaints from the prime minister's office and then proceeds to deal with it." (Food inspector at the complaints department at NFSA, January 2023)

The above quote highlights a potential gap in communication and collaboration between the government and consumers regarding food fraud prevention. The statement suggests that there may be limited opportunities for consumers to directly engage with the government on food fraud prevention issues, which may negatively impact the consumers' trust in the food supply chain and the government's legitimacy. Another food regulator, when asked about the mechanism of communication, he notes:

> "NFSA spread the message of the risk through social media; for instance, in the case of Indomie, they informed consumers through social media (Facebook). NFSA depends on television or some websites to reach consumers. In my opinion, NFSA should have an effective system for rapid alerting and communication, such as RASFF in Europe." (Food inspector at fisheries department at NFSA, January 2023)

The above quote highlights the potential for social media as a communication channel to enhance the spread of messages related to food safety and fraud prevention. By using social media, the government could reach a wider audience and engage with consumers more effectively than traditional communication channels such as brochures or posters. However, this

draws attention to the potential benefits and limitations of using social media to communicate food fraud risk messages. He also highlighted the need for effective system for rapid alerting and communication, such as RASFF in Europe.

> "Most of the communication depends on some brochures, which, in my opinion, are not suitable for citizens because they contain scientific expressions and information that is not easily understood by all segments of the society." (Food analysis officer at laboratory department at NFSA, January 2023)

Issues related to inappropriate public engagement were prominent in the above quote. Although appropriate public engagement increases confidence in the government, interviews demonstrated the absence of adequate public engagement mechanisms. Moreover, whenever it exists, the information communicated is either too scientific or too technical for the public to understand. Food regulators do not discuss food safety and fraud in the consumers' language. They do not keep the information understandable for all.

> "Luncheon is a popular example of fraudulent products. Fraud happens when food companies sell luncheons made of protein from a plant of origin, which is soybean, and do not declare that on its label. That is food fraud" (Food inspector at touristic food establishments department at NFSA, January 2023)

The above quotes exemplify what was mentioned earlier about inappropriate communication. It provides evidence of the absence of communicating the food facts from food producers to consumers. The correct information about food authenticity is available to producers, but consumers do not have the tools to know about food authenticity. Moreover, interviews revealed the need to build a trustful interactive relationship between food regulatory bodies and relevant stakeholders.

> "I traveled abroad, and in some countries, you can check the results of the last inspection of restaurants on Google to help you choose which restaurant you should choose. They have a high level of transparency that we do not have." (Technical officer at the Ministry of Trade and Industry, November 2022)

From the interviewee's responses, it is clear that the inspection results are not available to the public. Competent authorities do not provide advice to consumers to help them make informed choices. The interviewee highlights the potential for digital platforms such as Google to provide consumers with access to information on food safety and restaurant inspections. Using this information, consumers can make informed decisions regarding where to dine and which restaurants to avoid based on their past inspection results.

Food regulators highlighted the way they communicate incidents; they note:

> "By looking back at what happened when there was an issue with Indomie noodles. NFSA has requested the factory to recall the product. Then, the factory communicates with its buyers or distributors to recall the product until it reaches the small supermarkets." (Food inspector at touristic food establishment department at NFSA, January 2023)

The above quotes demonstrate an important finding in understanding how the Egyptian food safety authority deals with food fraud incidents. In response to this food fraud, the NFSA in Egypt took action by ordering the food plant to stop production and recall all of the Indomie it had produced during the previous few months. After there was enough information to evaluate whether this food product posed harm to human health, the initial decision to withdraw and recall was made. However, the absence of an incidence risk communication platform made it difficult to respond promptly.

Food regulators, when asked about their views on overcoming this poor risk communication, they signify:

> "The culture of the Egyptian community towards reporting fraud should be changed through increasing mechanisms to report fraud through websites and enabling them to take videos and report it." (Food Inspector at fisheries department at NFSA, January 2023)

One concern expressed regarding the importance of providing people with effective tools to report instances of fraud. By enhancing mechanisms through websites, individuals can easily report incidents and provide evidence through videos. This can lead to greater transparency and accountability and help prevent future instances of fraud. This draws attention to whether the provision of technological mechanisms to report fraud is sufficient or not. It is crucial to ensure that these mechanisms are effective and accessible to everyone, regardless of their technological skills or resources. Given that simply announcing tools for detecting and mitigating food fraud is not enough, a food regulator, when asked about how to tackle the food fraud issue, he notes:

> "The culture of the competent authorities and government should be changed because instead of hiding food fraud incidents that negatively impact our exports, they have to announce mechanisms of detecting and mitigating it." (Food control department manager at the Ministry of Health, November 2022)

Extensive interviews show that the authorities deal with food fraud issues with denial. The food regulators highlighted that competent authorities should deal with food fraud incidents transparently and openly.

6.5.2. Coordination between law enforcement agencies

During a crisis, agencies must work together and coordinate their efforts. To increase trust in regulatory authorities, statements from various information sources must be consistent (Charlebois & Summan, 2015).

> "There is a coordination problem between different ministries or departments in the public rather than the private sector. This centralization and the desire to make only my department successful results in redundancy. This led to failure." (Food inspector at fisheries department at NFSA, January 2023)

The interviewed food regulator expresses his concerns about coordinating and increasing the information flow between the departments and different ministries. He criticizes the food regulatory agencies for the miscoordination, complexity, and fragmentation, with no central accountability, which delays the response to food incidents.

Interviews suggest that coordination and increasing the flow of information between the departments between different ministries or departments are essential, particularly during crises, to enhance confidence in regulatory authorities.

> "The general administration of internal trade is in charge of controlling the internal market at the Ministry of Supply and Internal Trade, where the central administration is in charge of controlling the bakeries. When we catch a food product that has any problem, we seize it and make a record in the police department, and recently these records go to state security and become a misdemeanor. We do not know what happens after that because we do not have a problem with the food producer. We took the products that interest us. We do not have traceability. Our role stops when we get the prosecution decision on seizures." (Food inspector at the Ministry of Supply and Internal Trade, February 2023)

The interviews shed light on the separation between the food regulatory agencies and the police in catching food crime. It suggests that there may be a lack of coordination and collaboration between these two entities, which could hinder efforts to prevent and prosecute food crimes. Given that these crimes must be detected and dealt with quickly and effectively to protect public health, a food regulator asked about a food crime unit to deal with quickly and effectively; he notes:

> “Currently, there is no food crime unit at NFSA or any other agency in Egypt.” (Food legislation officer at NFSA, February 2023)

One concern expressed regarding the absence of a coordinating body, such as the food crime unit, is that it makes tracking the data about food fraud incidents difficult. Establishing a food crime unit could provide a centralized and coordinated approach to addressing issues related to food crime. Such a unit could bring food regulatory agencies, law enforcement, and other stakeholders together to share information, coordinate investigations, and develop strategies to prevent and prosecute food crimes.

CHAPTER SEVEN: CONCLUSION AND POLICY RECOMMENDATIONS

7.1. Conclusion

Based on an analysis of the data gathered, this chapter gives the study's conclusion. To address some of the gaps mentioned by the participants, it also offers some policy recommendations.

Food fraud jeopardizes the integrity of the food business and may reduce consumer confidence. The Egyptian government decided to prioritize food safety on its policy agenda by establishing NFSA. As mentioned in the previous chapters, since the food sector in Egypt is crucial for international trade, exports, and tourism, not sufficiently dealing with fraud would undermine the Egyptian position as a reliable supplier of food products internationally. Accordingly, this study's main research question is: how is the government of Egypt's policy working to prevent food fraud, and to what extent is it effective?

The findings indicate the ongoing challenges to prevent or mitigate food adulteration. First, based on the findings, it was evident from the different discussions that weak regulations and standards are one of the challenges of this issue. The current food fraud law is outdated, irrelevant, and not harmonized with international standards. It increases adulteration practices through insufficient specifications for labeling the origin of food products. Moreover, current regulations lack powerful sanctions that motivate people to comply with legislation.

Second, the system may currently face a crisis because of challenges in the food control management system. Consumers' confidence may face a crisis due to lacking supply chain visibility. Challenges to supply chain visibility involve (1) traceability barriers, which involve the cost of implementation, tax avoidance, and the lack of regulations before issuing the decision of

the board directors of NFSA decision no 16 of 2022 regarding traceability requirements, (2) the inadequate number of verified or registered suppliers, (3) the absence of the food fraud vulnerability assessment as a tool to mitigate fraud from the inspection checklists.

Third, since food regulators should have a good level of awareness in order to investigate fraud signals, the previous interviews revealed systemic barriers in the provision of fraud investigation. Inspectors do not receive specific training or instructions to detect fraud and investigate incidences of criminal activity. In addition, the insufficient number of inspectors considering the number of food businesses in Egypt hinders the deceptive practices of fraudsters in Egypt.

Fourth, much effort has been exerted to improve laboratory services. However, testing methods for the food industry must not be expensive. Thus, cost-effective means of testing should be in place.

Fifth, interviews demonstrated that competent authorities neither provide an appropriate legislative framework nor equip consumers to make informed food choices and understand food fraud practices. Furthermore, it was revealed that Egyptians do not receive public engagement from food safety authorities and regulators. In addition, there is a need for more connectivity between the food industry, consumers, and food regulators, which requires food regulators to change how they interact with their stakeholders.

Overall, it is still necessary to continue developing the food fraud control system as per the responses shared by food regulators and government officials to overcome the above-mentioned challenges and gaps in this research.

7.2. Policy Recommendations

Based on the insights of food regulators, who are current food fraud sector public sector employees, the study shows that several areas require further development to strengthen the food fraud control system with a focus on ways to improve the implementation of the pillars of this system. This section offers a set of recommendations that aim to help policymakers develop an effective food fraud control management system. An effective food fraud control management system needs a comprehensive and multi-faceted approach to combat food fraud.

Food fraud is a complex and multifaceted problem that cannot be solved by a single, one-off policy or intervention. Instead, a whole-of-system approach is needed, which involves addressing various elements of the food fraud control system, governance, and other key dimensions of the issue.

This comprehensive and multi-faceted approach to combat food fraud includes: (1) Updating and strengthening the food fraud law and regulations. (2) Govern the Food Fraud Control Management by bolstering the supply chain visibility, supporting effective traceability implementation, and food fraud vulnerability assessment (3) Promotion inspection services. (4) Expanding laboratory services. (5) Promoting education, information, and communication.

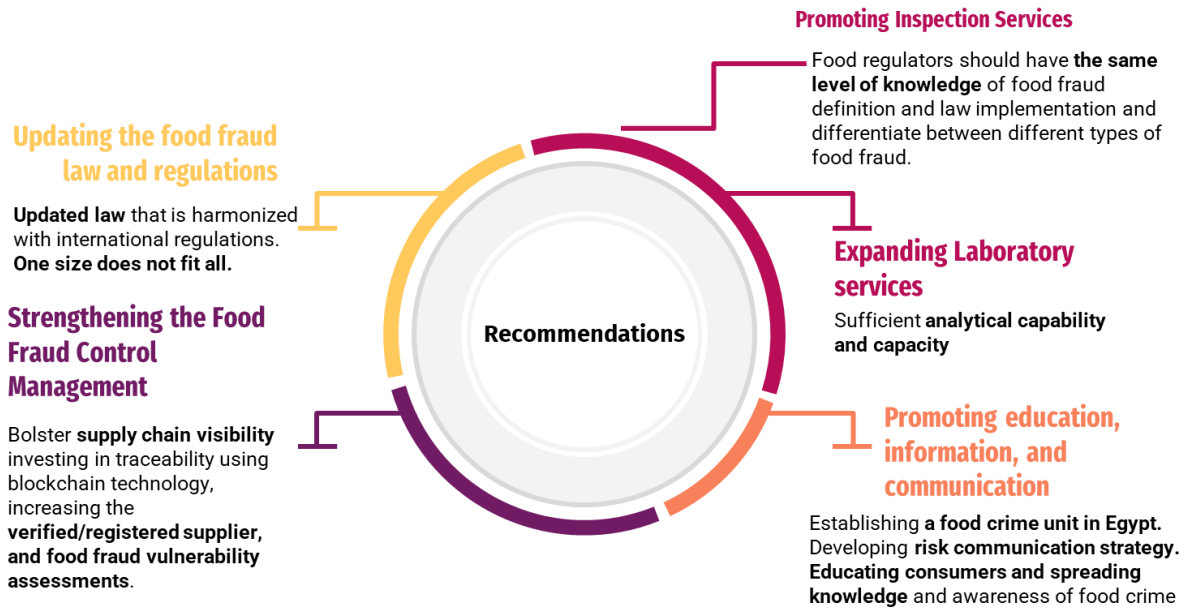

Figure 9. Comprehensive and multi-faceted approach to combat food fraud in Egypt.

Source: Author creation.

To support the food fraud policy, the research study suggests the following actions to strengthen the enabling environment in support of the food fraud policy:

(1) Updating the food fraud law and regulations.

Updated food laws should give competent food authorities the legal authority needed to incorporate preventive measures into the food fraud control system. The Egyptian government requires updated food standards that address the big difficulties involved in accomplishing food fraud mitigation goals and updated legislation.

To create an updated regulatory framework that suits national needs and complies with international standards and regulations, lessons learned about food fraud from other nations and from dialogue with stakeholders can be employed.

(2) Strengthening the Food Fraud Control Management

Strengthening food fraud control management is crucial in monitoring the supply chain. This could be done to bolster the supply chain visibility by investing in developing fraud control technologies, for instance, investing in traceability using blockchain technology, increasing the verified/registered supplier, and giving more attention to food fraud vulnerability assessments.

(3) Promoting Inspection Services

While adopting a globally agreed definition of food fraud in Egyptian regulation is needed, food regulators should also have the capacity to differentiate between different types of food fraud. A gap between food fraud awareness and knowledge was demonstrated through this research as not all food regulators showed the same level of knowledge of food fraud definition and law implementation. Therefore, it is essential to provide training and capacity-building programs to them to deter food fraud.

(4) Expanding Laboratory services

Although previous effort has been made to invest in advanced testing technologies and equipment, there is a lot that must be done to ensure that sufficient analytical capability and capacity are in place.

(5) Promoting education, information, and communication.

Today, the efforts for addressing and mitigating food fraud are dispersed. As a result, establishing a food crime unit in Egypt is recommended.

To enhance communication, developing a risk communication strategy and creating a strong interface across key stakeholders is recommended as an indicator of promoting communication, which will enable them to work together to share information, best practices, and

technologies. A "whistleblower" platform, where individuals can report suspected food fraud anonymously, is required. By empowering individuals to report suspected fraud, authorities can access valuable information that may otherwise go undetected, improving the effectiveness of enforcement actions and preventing fraudulent activity in the food supply chain.

To enhance education, launching public awareness campaigns to educate consumers and spread knowledge and awareness of food crime to promote public communication is recommended to overcome disinformation, and misinformation.

A public private partnership between government and industry can involve joint research and development efforts, information sharing, training and education programs for stakeholders, and collaborative efforts to develop and implement food fraud regulations. A public-private partnership can also help to foster a culture of transparency and trust among stakeholders, which is essential for effective food fraud prevention.

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Appendix A

Interview guidelines questions

The current regulatory framework working to prevent potential risks to public health from food fraud

- What is the role that you play to combat food fraud?
- What are the efforts that have been made to combat food fraud?
  What are you planning to do to combat food fraud?
- What are the most shocking food fraud incidents that our country has witnessed?
- How has you dealt with this shocking food fraud incidents?
- Is there a coordination body such as the food crime unit in Egypt?
- How is the food fraud included in the audit work at your organization's different inspection/departments, including the food establishment inspection and manufacturing inspection departments?
- How can you regulate and coordinate between the multi-agency/ different authorities/ organizations when it comes to combating food fraud?

The main challenges facing the government in controlling food fraud

- What are the policy and strategy issues for food fraud prevention?
- What are the gaps in the current regulatory framework for food fraud?
- How do you address traceability and transparency in the food supply chain in your organization's work?
- What are the obstacles that face traceability and transparency?

The current reforms that are taken to reduce food fraud

- What are the preventative measures that should be taken to combat food fraud?
- How did you make the industry/food establishments committed to having processes to detect, evaluate and control vulnerabilities?
- What is still needed to be done to reduce the food fraud issue?